The 6th Annual Scientific Meeting on Disaster Research 2019
International Conference on Disaster Management

PROCEEDING BOOK VOL. 1

PIT 6 Riset Kebencanaan

Social and Technological Innovation on Disaster for Industry 4.0

INDONESIA DEFENSE UNIVERSITY, BOGOR

18 - 19 JUNE 2019

BNPB

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Penanggung Jawab	:	Dr. Tri Legionosuko, S.IP., M.AP
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Kawasan IPSC, Sentul, Sukahati, Citeureup, Bogor,
Jawa Barat, Indonesia, 16810.
Telp/Fax: +62 21 296187

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PREFACE

Praise be upon the Almighty God for allowing the completion of the Proceeding of ICDM 2019 which held in the 6th Annual Scientific Meeting on Disaster Research 2019. ICDM 2019 was held at Indonesia Defense University and Indonesia Disaster Relief Training Ground (INA-DRTG) on 18 – 19 June 2019. This proceeding is a documentation of scientific work by academics, bureaucrats, practitioners, and community members who are participate in ICDM 2019.

The committee has received more than 220 manuscripts from national and international participants. After going through review process by our esteemed team of reviewers, there are 118 manuscripts to be included in a four-volume proceeding. The proceedings will be available for download on our website. The manuscripts will discuss following themes: Strengthening Local Partners to Reduce Disaster Risk; Innovation and Disruption in Disaster Management Technology; Social Engineering in Technology Application of Disaster; Early Warning System Technology, Preparedness and Society Communication; The Role of Local Wisdom as a Creative Consideration in Managing Local Disaster; The Role of National Resilience as a Consideration in Disaster Management; Innovation and Application of Disaster Management; Disaster Management in Industrial Areas; Strength of Science and Technology in Disaster Management to Reach the SDGs; and Smart and Resilience Cities.

Lastly, we are truly grateful to all parties who supports this event: keynote speakers, invited speakers, committees, moderators and reviewers, and all of the authors and participants. We hope that all participants can make the best use of this event as the best practice for managing and reducing disaster risks in the future.

Conference Chairman,

FADM Dr. M. Adnan Madjid, SH., M.Hum
Vice Dean of Faculty of National Security
Indonesia Defense University

KEYNOTE SPEECH

First of all, let us raise our most gratitude to God the Almighty, for giving us his blessing, and allowing us to finish the series of proceedings of the sixth Annual Scientific Meeting Disaster Research, the International Conference on Disaster Management (ICDM 2019).

As has been declared, that one of the purposes of the Sixth Annual Scientific Meeting Disaster Research is to implement planners to improve research culture, to provide comprehensive, holistic and systematic thinking contributions. Then, the theme of this year's meeting is: **"Social and Technological Innovation on Disaster for Industry 4.0"**

The theme is important to be raised, considering the dynamics of geopolitics and geostrategic development, and development of dynamic technology, that impact on challenges and threats which are complex, including challenges on state defense. The various threats are military threats, nonmilitary threats, and hybrid threats, which can be grouped into real threats or unreal threats. One of the real threats faced by the Indonesian is a natural disaster.

Last year, many disasters happened in Indonesia so the efforts to prepare ourselves for disasters become a very important focus. The loss of a big disaster was beyond our expectation. Our highly risk and vulnerability rate that detain us in disaster management efforts to save human life or minimize loss.

In handling disaster, it doesn't require speed only, but also accuracy. Industrial revolution 4.0 is marked by the emergence of artificial intelligent, internet of things, robotic, and 3-d. Everything will assist the implementation of disaster management in every prevention phase, emergency response, or rehabilitation and reconstruction phase.

Complete information about hazards in a region will be well analyzed by the internet of things, artificial intelligent, including drones. These may help prevention phase. At the time of emergency response, it will also accelerate victims registration in insolated areas using drones or robotic faster that they may immediately get evacuated.

On the other hand, in rehabilitation and reconstruction stages, they can accelerate housing and other building development using very quick 3-d copy to easyly return and normalized community life. By so, the 4.0 industry must be used for the efforts of disaster management, especially in transforming towards reliable next generation in disaster management.

In the social aspect, social innovation is required for creation of disaster responsible communities. The innovation on social, educational, education and training aspects to improve special awareness and community behavior in disaster and remote areas, in order to be ready to save or reduce risk from disaster or actual disaster threats. IDU as state defense campus, focus to give attention from national and defense security aspects. In Law Number 3 of 2002 on State Defense, it is stated that disasters are non-military or non-traditional threats. It is important to protect the community and the environment of extreme disasters.

In this context, this disaster is considered as a full threat of inaccuracy that will come around the distribution of vulnerable communities, communities that are low capacity against natural, non-natural or social threats. That is why, the community should be enhanced to be able to face disaster to avoid on the impact of victims and damages that are done. The sinergry in facing such disaster threats is required, so the stakeholders must be involved actively, planned, direct, and holistic as well as universal. Involving pentahelix elements which government, community, business sector, higher education and mass media. Moreover, the role of wisdom for development, for example togetherness, culture, religion, vocationality, trust, tradition, religion, experience in disaster. Such things have been appreciated by the un as a global champion for disaster risk reduction.

Therefore, in the future, in facing such threats, we are not just partially depending on the power of conventional defense, but also the power of integrated and synergic defense, in order to create a harmony relationship, communication, coordination to face and overcome the threat together. Various abilities and advantages of each stakeholder to support the power of state defense. For those interests, IDU opens the study of disaster management that include the scope of national security faculty. Expected IDU graduates can construct their planning in disaster management. They also have a Disaster Study Center and Climate Change Adaptation (PSB-API), research activities, devotion to communities and other cooperation with national disaster management agency of indonesia.

In this good opportunity, we would like to express the best gratitude to the national disaster management agency of indonesia for a very intensive cooperation to support a learning in IDU, in particular on the disaster management product, and the trust that has been given to idu as the partner of the Sixth Annual Scientific Meeting on Disaster Research International Conference on Disaster Management (ICDM) 2019. Hopefully, this proceeding may contribute to the comprehensive and holistic thoughts for disaster management in Indonesia.

Rector of Indonesia Defense University,

LG Dr. Tri Legionosuko, S.IP., M.AP

Determining Geographic Resilience Index through the Analysis of Remote Sensing Image and Digital Elevation Model

Sukendra Martha[1, 2] and Asep Edi Rosyidin[3]

[1]The National Institute of the Republic of Indonesia (Lemhannas RI), Jl. Merdeka Selatan 10, Jakarta 11010, Indonesia
[2]Defense University (Unhan), Jl. Anyar Kawasan IPSC, Sentul Bogor, Indonesia
[3)]Directorate of Topography - Indonesian Army, TNI-AD, Jl. Kalibaru Timur V, No. 47 Jakarta, Indonesia

E-mail: sukendra.martha@yahoo.co.id

Abstract. Geographic resilience is considered to be an important factor to determine national resiliences indices. To measure a national resilience is basically an integration of resilience indices of 8 (eight) aspects or *gatra* including geography. The objective of this research is to determine a geographical resilience index; through determination of slope element from remotely sensed image and Digital Elevation Model. The province of West Sulawesi is selected as a study area. For the purpose of measuring national resilience index, the slope data have never been routinely supported by Ministries and other involved Institutions. Therefore, slope element as geospatial information requires to be measured separately. Indices of geographic resilience in period of 2015-2018 were mostly indicated in the position of 'less tough' consisting values of 2.54 (2015), 2.52 (2017) 2.58 (2018) and 3.37 (2016) categorised as 'moderately tough'. The latest value was calculated from different method called as 'validation' and subject to be evaluated further. The result of this work, slope data have been derived from analysing remote sensing imagery and digital elevation model. These data are required and very useful for determining national resilience indices for the whole Indonesian territory.

1. Introduction

National resilience in the life of the nation is a prerequisite or demands that will guarantee continuity of national life. National life itself consists of various fields, aspects *(gatra),* variables and indicators with varying parameters. So diversified as between fields, aspects, variables and indicators in the national resilience can give each other strength, but at the same time can also be a factor which weaken each other [1]. Strong national resilience needs full coverage of accurate geospatial databases in the whole national territory [2]. This article focuses and limits to national resilience in West Sulawesi where is selected as a study area.
Geography is considered as a 'static' aspect needed due to the first natural determinant, and become part of 8 (eight) aspects (asta-gatra) such as: geography, demography, natural resources, ideology, politic, economy, social and culture, and defence and security. According to the National Infrstructure Advisory Council (NIAC) for practical purposes, resilience is an ability to reduce the magnitude and or duration of disruptive event. Therefore, efectivity of the

infrastructure or company resilience depends on the ability to anticipate, absorp, suit and cure fast from the event of natural and human disasters which are potentially destructive [3].

In general, Indonesia has moderately tough for national geographic index (2,71) in 2018 [4]. This value is increased 0,15 point or 5,86% from 2017 (2, 56). As shown on the map (Figure 1), all Sumatra island, Papua, many parts of Sulawesi, Java and Maluku have a moderate tough resilience index. Areas of middle Java, West Papua are in the status of 'tough' position, while nothern Kalimantan, Bangka Belitung, West and East Nusatenggara including West Sulawesi are still in the index status of low regeographic resilience.

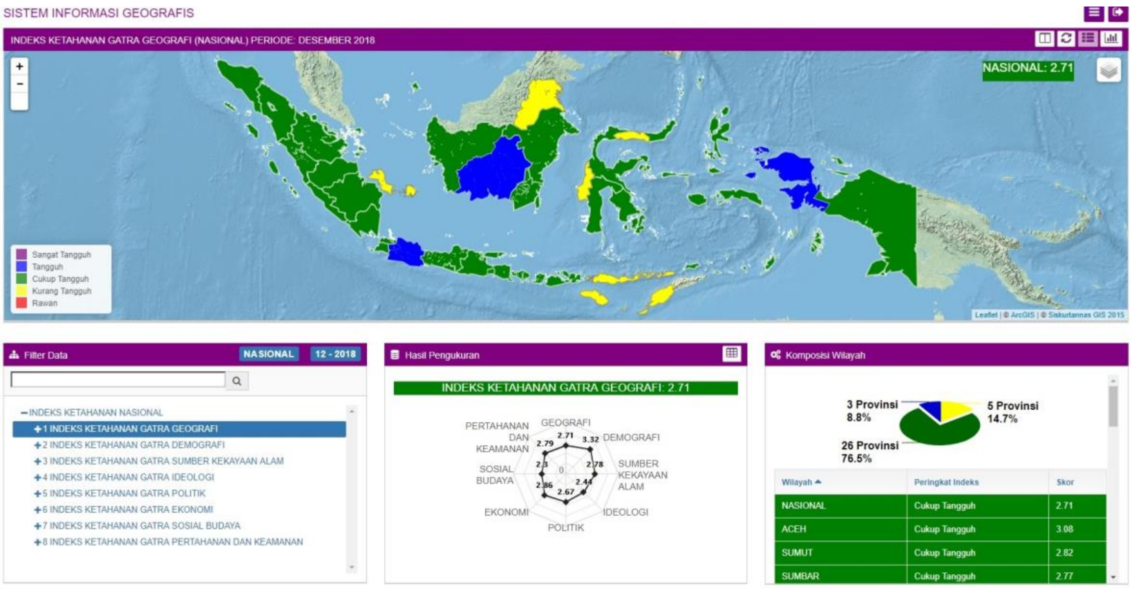


Figure 1. Map of National Geographic Resilience Index [4]

Based on Law no. 26 year 2004, the Province of West Sulawesi was established as the 33th Provinces in Indonesia. Geographically, position of this Province is located on 0°12'-3°38' South Lattidute and 118°43'15"-119°54'3" East Longitude. This province was a part of South Sulawesi province, and separated as a new Province where has boundaries in northern part with the province of Central Sulawesi, in eastern and southern part with South Sulawesi, and in the western part with Malacca Strait (see Fig. 1).

Figure 2. Administrative Map of West Sulawesi [5]

West Sulawesi province covering an area of 16787.18 sq km has a population of 1.28216 million inhabitants spread over six (6) districts (kabupaten) covering 69 sub districts (kecamatan) and 646 villages (desa). Demographically, the population density in the province was 76 inhabitants per km2 with a population growth rate of 2.01% from the year 2000-2015. The general picture of the development in West Sulawesi is an ingredient in the preparation of the Interior Strategic Studies known as Studi Strategis Dalam Negeri (SSDN) in the regular education program of the National Resilience Institute of Republic Indonesia (Lemhannas RI). SSDN in turn has made a visit to the West Sulawesi through study, meetings and discussions with the relevant agencies in the area concerned.

National resilience index of West Sulawesi province in agregated level based on the study in 2010 and 2016 increased to moderately tough. When viewed by the index experienced dynamic resistence items, namely ... from rank 13 on the study in 2010, ranking 9 in study in 2011, being ranked 12 in a study in 2014 and returned to the 9th rank. National Resilience Index (NSI) in December 2015 in West Sulawesi was 2.97 (moderately tough) above the national average of 2.67. Remote sensing data can be used for various geographical applications. Using remote sensing data, like Landsat ETM 7+ satellite imagery to analyze land use changes [6] and using Ikonos and Quick Bird for study of land cover changes [7]. As with variables, topographic or relief condition and slope affects national resilience particularly to economic, social and culture, and defense and security resiliences. For economic aspect, for instance, slope classes are important to determinate agricultural land areas.

Table 1. Slope Classification [8]

Slope Class	Values (%)	Remarks
I	0 - 8	flat
II	8 - 15	undulating
III	15 - 25	Slightly steep
IV	25 - 45	Steep
V	45 or more	Very steep

Area with class I to II (flat to undulating topography) are very good for agriculture, class III is suitable for plantation purposes, while class IV and V are important for defense and security. More area having flat to undulating topography in area, the better for the economic resilience.

For social and culture, more flat areas is favorable, and more benefial than areas with steep to very steep topography.

Based on national defence system embraces the overall total defence involving all potentials including the topography of an area. The condition of the slope would be a hindrance to the enemy, the reverse slope of the land acts as a protected firing reconnaissance and protection for the Indonesian nation. For defence purposes, it is precisely the more extreme slope (very steep) the better. Conversely, flat area that stretches along the coast will be considered more to avoid or protect the enemy infiltration. Topographic view of province of West Sulawesi, in general can be shown in Figure 3.

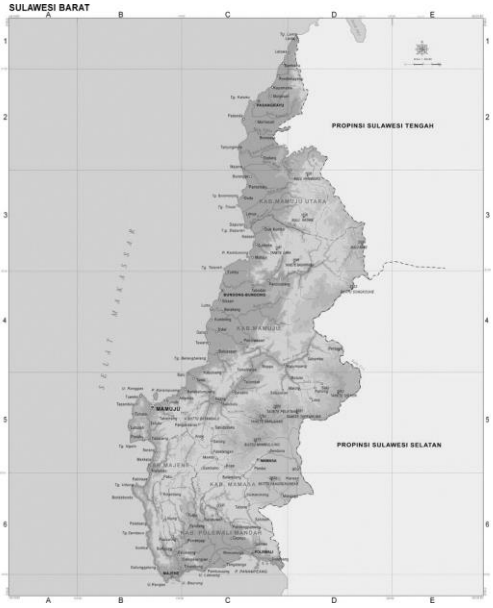


Figure 3. Topographic Map of West Sulawesi [5]

2. Research Method

This research is to determine index of geographic resilience, supported by slope data. Satellite images were analysed to support and generate slopes data. Satellite images as part of geospatial data and information can be applied for supporting a formulation of national resilience [9]. Remotely sensed image of Shuttle Radar Thematic Mapping (SRTM) and Digital Elevation Model (DEM) are applied to generate slope data of West Sulawesi.

Data used in the study include (i). Satellite image of the province of West Sulawesi, (ii). Arc-GIS Software, (iii). Map of the administrative area of the Province of West Sulawesi scale of 1: 50,000, the Provincial Bappeda Sulawesi, Mamuju, (iv). Map of Mamuju industrial distribution, scale 1: 50,000, (v). Slope classification of West Sulawesi; and (vi). Digital Elevation Model (DEM) of West Sulawesi province. In simple procedure, 6 (six) steps of the application process remote sensing and ArcGIS [10] to create map of slope classification, can be explained as follows: (1) Enable program or operate ArcGIS software from ESRI; (2) Showing DEM display as shown in Figure 4.

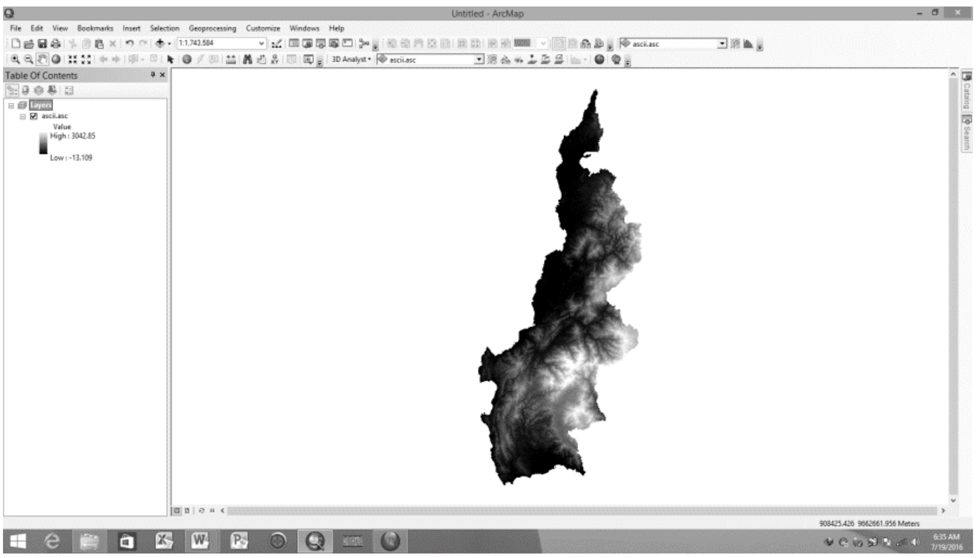


Figure 4. Display of DEM

(3). Analysis of slope can be conducted with the command of **ArcToolbox -> 3D analys Tools -> Raster Surface -> Slope** as shown in Figure 5.

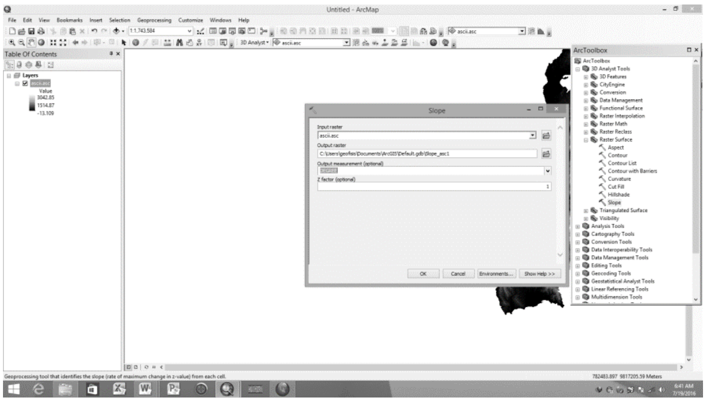


Figure 5. Command of ArcGIS for Slope Analysis

An analysis of slope can use the unit of percentage (%) or of degree (^{o}). The results of the analysis of slope, can be shown in Figure 6:

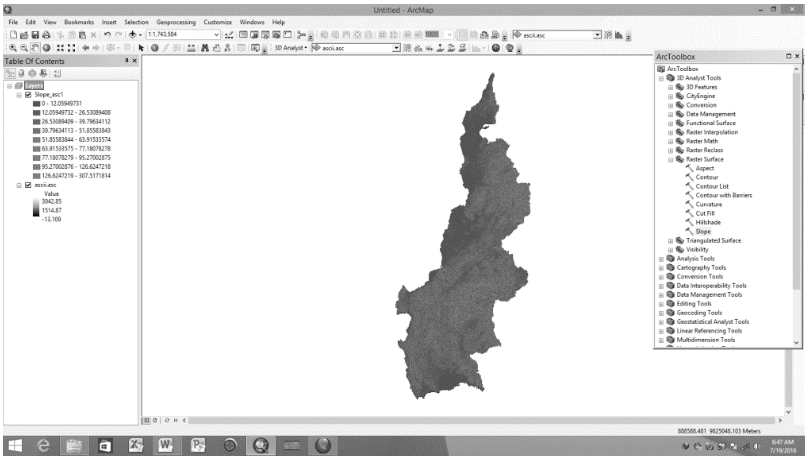


Figure 6. Display results of Slope Analysis

(4). Reclassify slopes. The result of the slope analysis has been made and then reclassified to conform with the desired requirements.

Table 2: Available and Existing Slope Classification [8]

No	Slope Classification	Interval values
1	Flat	0 - 8 %
2	Undulating	8 - 15 %
3	Slightly steep	15 – 25 %
4	Steep	25 - 45 %
5	Very steep	>45 %

To generate desired slope classes, available class as stated in Table 2 can be replaced and created in accordance with the needs (Table 3). The latest slope classification is accomodated by National Resilience Measurement Laboratory known as Laboratorium Pengukuran Ketahanan Nasional (Labkurtannas)- Lemhannas RI.

Table 3. Desired Slope Classification, accomodated by [4], [11]. [15]

No	Slope Classification	Interval values
1	Flat	<2 %
2	Very Undulating	2 – 8 %
3	Undulating	9 – 15%
4	Slightly steep	16 – 25 %
5	Steep	26 – 40 %
6	Very steep	41 – 60%
7	Extra Steep	> 60 %

To perform a reclassification of the existing slope, data reclassification can be done by opening **ArcToolbox -> Raster Reclass-> Reclassify**

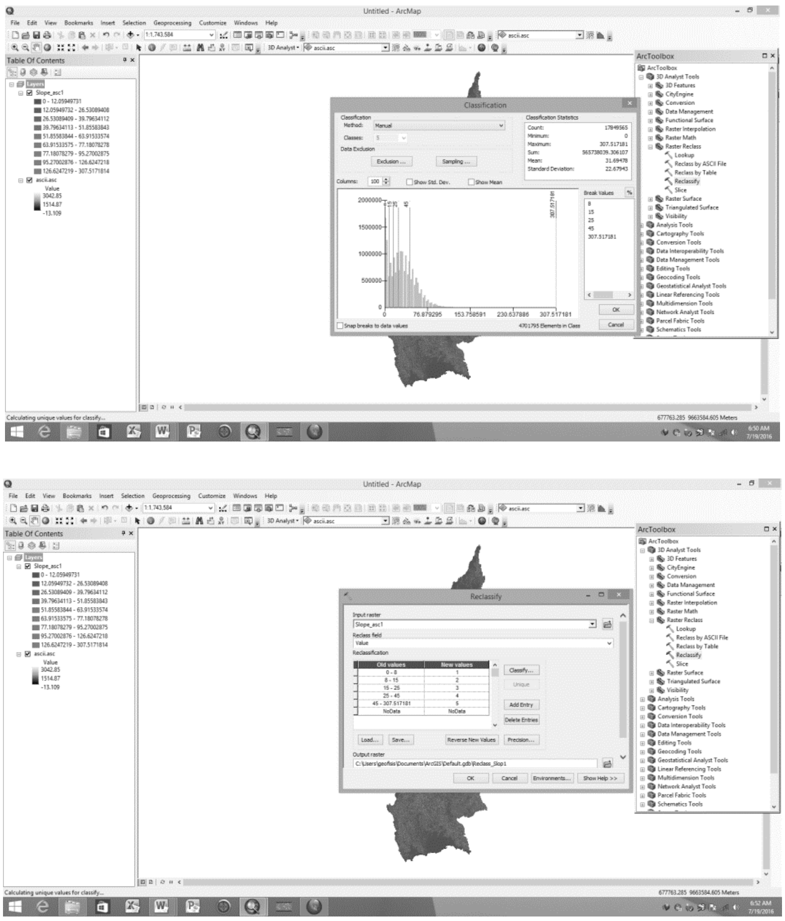


Figure 7. Processes of raster reclassification

Re-classification of slope can be done with the display as Figure 7.

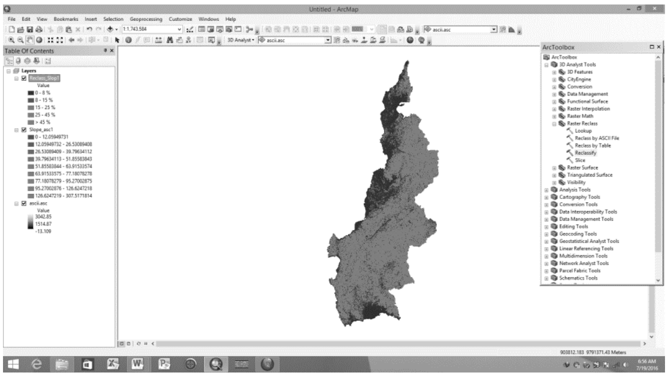


Figure 8. Result of re-classification.

(5). Changing the raster data into vector data (polygon): After reclassify then the data is converted into a vector format by opening **ArcToolbox -> Conversion Tools -> From Raster -> Raster To Polygon**

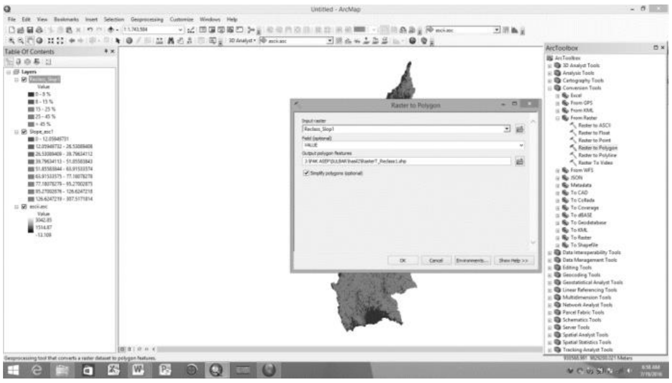


Figure 9. Changing process of conversion from raster to vector data.

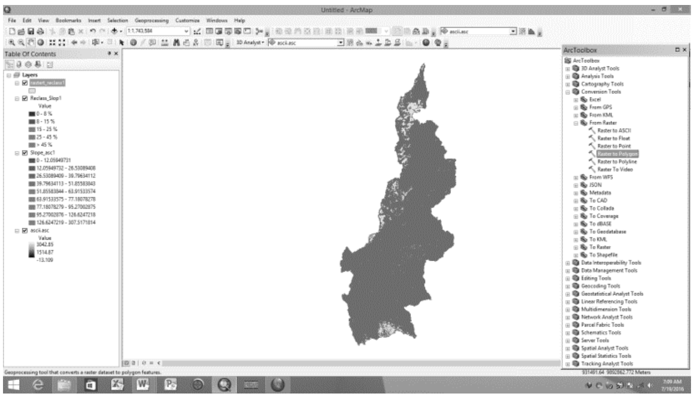


Figure 10. Result of Raster to Polygon.

(6). Phase Smoothing Polygon of slopes class

a. Removing small polygons. This phase is to remove small polygons to match the scale of the map being used. To do this stage is intended to calculate the area of each polygon and choose the first polygons vast expanses under pre-determined, for example 3 hectares, then select **ArcToolbox -> Data Management Tools -> generalization -> Eliminate**

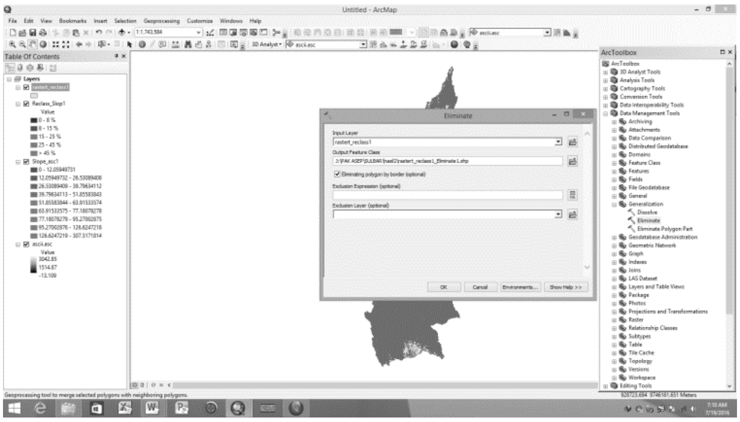


Figure 11. Process of smoothing polygon.

This must be done repeatedly until the smallest polygon has an area in accordance with a predefined.

b. Smooth the polygon (smoothing). Smooth the polygon that has a shape similar to field conditions can be done by opening the **ArcToolbox -> Cartography Tools -> generalization -> Smooth Polygon**

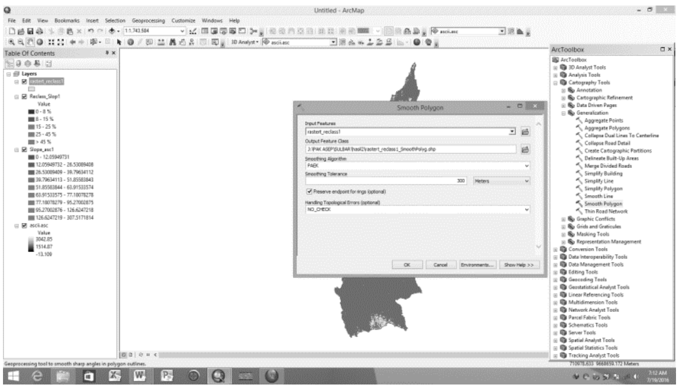


Figure 12. Process on cartographic and generalization

c. Simplify the slope grade: DISSOLVE select **ArcToolbox -> Data Management Tools -> generalization -> Dissolve**

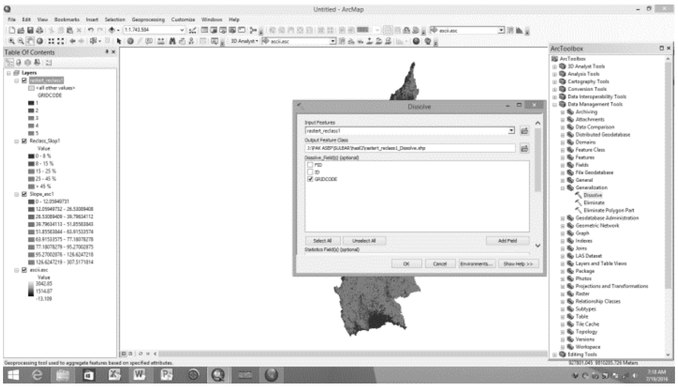


Figure 13. Process on dissolve

d. Adding captions slope class.
After class slopes formed is then necessary to add new fields to the attribute table to add information about the hose slope and slope category. After it is necessary to distinguish the color according to the category of slope of the land, and area values.

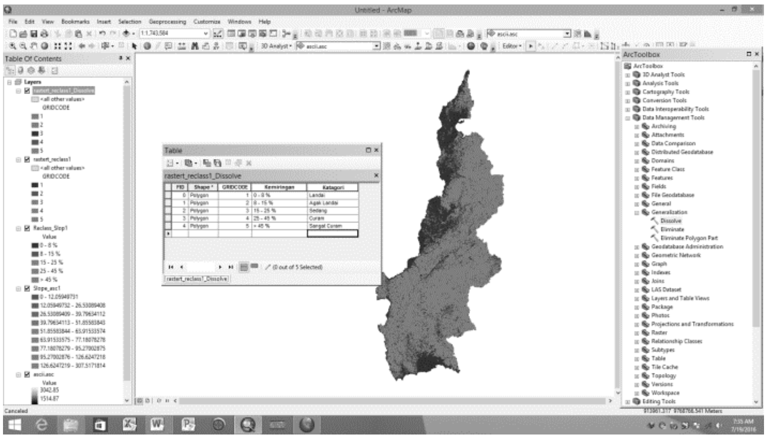


Figure 14. Display of slope class

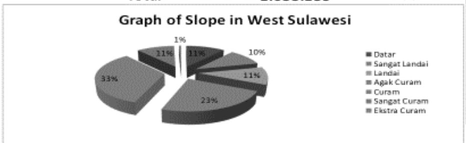
3. Results and Discussions

From the description above, the National Resilience Institute (Lemhannas RI) through Labkurtannas conducted several FGDs each year to count and monitor the national resilience for each aspect, and for national, 34 Provincial levels and even for all District or Kabupaten level in the next future. As a result of national resilience index of geography aspect (Table 5), a particular variable like slope class needs to be obtained and resulted first as seen in Table 4.

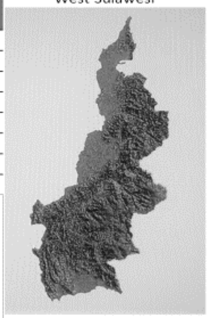
Table 4. Slope Classification: Area and Procentage of Area in West Sulawesi [12]

Slopes of West Sulawesi

No	Slope Classification	Slope Interval	Area (Ha)	Percentage of Slope Areas (%)
1	Flat	<2 %	184.895	10,95
2	Very Undulating	2 – 8 %	171.985	10,19
3	Undulating	9 – 15%	182.801	10,83
4	Slightly Steep	16 – 25 %	396.624	23,49
5	Steep	26 – 40 %	562.721	33,33
6	Very Steep	41 – 60%	179.005	10,60
7	Extra Steep	> 60 %	10.155	0,60
	Total		1.688.185	100



Province of West Sulawesi



Geography resilience index may be changed every time. It depends on values to be determined with the weighting and scoring for each variables. To compare figure of geographic resilience index, as shown on Table 5 wighting and scoring used in this case are different. Condition of geographic resilience in 2015 is based on an existing index, while in 2016 is actually a result of analysis, based on field observation and agreements among 23 persons from discussions of the Forum Group Discussion (FGD). Because of no data support for assisting measurement of national resilience index, FGD is conducted to improve the index data. This is why in the total weight in this case is only 90 (instead of 100). Only weights for two variables: 'boundaries' and 'sea-lane' remained unchanged from 2015 – 2016. All other variables are changed by seeing the real conditions in the field, discussions with local officials, community leaders, so that the weights are changed (except the last two variables), and then for the provision of the score. Because in 2016, slopes variable region is already filled (weight 15:00) and a score of 2.72.

Table 5. Comparison of Geography Resilience Index (GRI) 2015-2018 [4], [11], [13], [15]

Geography Resilience Indexes in West Sulawesi: 2015 – 2018

	2015 **2.54**		(**LESS TOUGH**)		2016 **3.37** (**MODERATELY TOUGH**)			2017 **2.56**	2018 **2.58**
No.	**Variables**	**Weight**	**Score**	**Weight x Score**	**Weight**	**Score**	**Weight x Score**	**LESS TOUGH**	
1	**Boundary**	**20.00**	**1.57**	**31.43**	**20.00**	**3.29**	**65.71**		
2	**Slope**	**-**	**-**	**-**	**15.00**	**2.72**	**40.82**		
3	**Landform**	**10.00**	**3.50**	**35.00**	**8.00**	**4.25**	**34.00**		
4	**Land Cover/ Use**	**15.00**	**3.50**	**52.50**	**12.00**	**4.36**	**52.34**		
5	**Population Density**	**9.00**	**3.67**	**33.00**	**8.00**	**4.67**	**37.33**		
6	**Climate**	**8.00**	**1.22**	**9.78**	**5.00**	**4.89**	**24.44**		
7	**Disaster Risk**	**9.00**	**3.50**	**31.50**	**14.00**	**3.00**	**42.00**		
8	**Infrastructures**	**14.00**	**1.47**	**20.59**	**13.00**	**1.94**	**25.24**		
9	**Indonesian Sea-Line (ALKI)**	**5.00**	**3.00**	**15.00**	**5.00**	**3.00**	**15.00**		
	TOTAL	**90.00**		**228.79**	**90.00**		**336.89**		

As can be seen in Table 5 above, there are nine variables in geography aspect and described in 52 indicators. Mentioning National Resilience Index or *Indeks Ketahanan Nasional* (IKN) scores and grades for geography is 3.37 *(Moderately Tough).* For 2016, there is one variable in geography aspects having less resilient like infrastructure. The reason is the percentage of land areas and oceans are quite spacious, besides lack of facilities and infrastructure of land

and sea that links between regions in the province of West Sulawesi and port infrastructure against Indonesian sea-lane adequacy ratio is also low.

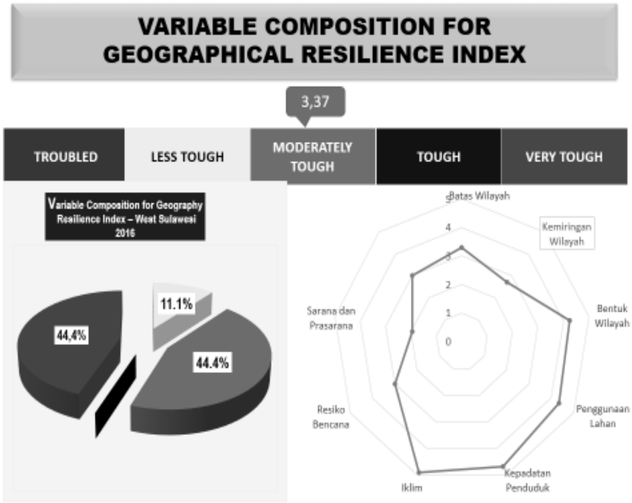


Figure 15. Composition of Variables in Geographical Resilience Index [14]

Before validating the existing data, index of national resilience in the Province of West Sulawesi in 2015 was 2.79 *(moderately tough)* (Labkurtannas, 2015); and after validation through Interior Strategic Studies (SSDN) the index has improved to 2.97 *(moderately tough)*. In the process of determining geographic resilience index, 9 (nine) variables involved are boundaries/ borders, slope, topographic/ landform, land-use/cover, population density, climate, disaster risks, infrastructure and Indonesian archipelagic sealanes (ALKI).

Tabel 6. National Resilience Index in the Province of West Sulawesi [14]

NO.	ASPECTS (Gatra)	NATIONAL RESILIENCE INDEX of WEST SULAWESI			
		LABKURTANAS 2015	Condition	SSDN 2016	Condition
1	Geography	2,54	Less Tough	3,37	Moderately Tough
2	Demography	2,87	Moderately Tough	3,61	Tough
3	Natural Resources	2,30	Less Tough	2,44	Less Tough
4	Ideology	2,28	Less Tough	2,30	Less Tough
5	Politics	3,02	Moderately Tough	3,10	Moderately Tough
6	Economy	2,71	Moderately Tough	2,93	Moderately Tough
7	Social and Culture	2,84	Moderately Tough	2,62	Moderately Tough
8	Defense and Security	3,36	Moderately Tough	2,81	Moderately Tough
	Results	**2,79**	**Moderately Tough**	**2,89**	**Moderately Tough**

Although slope factor is only a variable in measuring the index this variable is very important, particularly because of the lack of slope class numbers necessary for IKG. Then in turn it can affect the measurement of national resilience in the whole of West Sulawesi province. With the contribution of the slope data from remote sensing and DEM, National Resilience Index (NRI) can be presented as set forth in Table 6.

4. Conclusion and Recommendation

From the results and discussion, it can be concluded that: (a). National resilience index of 2,89 in West Sulawesi categorized as moderately tough, is accumulated (aggregated) figures on national resilience covering all aspects of Astagatra; and (b). The results of the final assessment of national resilience in 2015, has culminative figures of 8 aspects of Astagatra with resilience assessment indicators which are moderately tough, although geography and ideology aspects have less tough indicators.

Some recommendations can be drawn as: (a). The results of national resilience index (NRI) in West Sulawesi in 2016 compared with Labkurtannas data in 2015 was categorized as moderately tough, except for geography and ideology aspects; and (b). Slot geography with regard to the issue of boundaries between West Sulawesi and East Kalimantan and South Kalimantan in particular the ownership of islands of Balak Balakang and Lerekang Lere, so as not merely and legally solved alone but should be viewed from the aspect of politics, history and the crucial impact that will be caused. Thus it is important government's decision to solve this boundary problem comprehensively and will not become a negative impact in the future.

Many slope classifications based on sectoral purposes. These classes may confuse for geographical analysis, and other purposes. For such reason it recommends that a standard classification of slope or topographic landform needs to be determined.

The value of geographical index for West Sulawesi in 2016 as called ‘SSDN validation’ is subject to be evaluated due to the significant different value compared to the value before (2015) and after (2017, 2018).

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Analysis of Lightning Strike Density Based on Landform for Reducing The Risk of Death in Wonosobo District, Indonesia

Gagad Nur Ridho[1], Yan Abdi Rahmanu[1], Astry Zulky Permatasari[1], Emilya Nurjani[1]
[1]Department of Environmental Geography, Universitas Gadjah Mada
Jl. Kaliurang, Skip Utara, Bulaksumur, Yogyakarta 55281, Indonesia

E-mail: gagadnr@gmail.com[1], abdi.rahmanu@mail.ugm.ac.id[1], astry.zulky@gmail.com[1]
emilya.nurjani@ugm.ac.id[1]

Abstract

Lightning strikes in Wonosobo District have negative impacts on society, buildings and the environment. This research aims to (1) identify the landform characteristics, (2) identify the area that has Cloud to the Ground lightning strike density and its connection to landform characteristics, (3) analyze the risk of lightning strikes (4), recommend mitigation strategies for lightning strikes. Data used in the study includes the occurance of Cloud to Ground lightning strikes from 2015 to 2017, landform maps, land cover maps, and Digital Elevation Models (DEM). Lightning strike data was processed with kernel density on ArcGIS 10.3. The result shows that there are 3 classes of lightning strike levels with the highest grade of lightning strikes occuring in 2016. Influencial landforms are structural and volcanic landforms with a composition dominated by andesitee breccia, conglomerate, sand stone, and tuff as conductive materials that could trigger lightning strikes. The effect of elevation at 160 - 3,349 m (msl) is conducive to the formation of Cumulonimbus Clouds that could be followed with lightning. Mitigation actions that could be introduced for when lightning strikes occur are divided into indoor and outdoor actions including recognizing the appearance of the Cumulonimbus Cloud and taking shelter in closed buildings.

K*eywords*: Cloud to Ground, Landform, Lightning Strikes, Risk, Wonosobo District

1. Introduction

Indonesia is a tropical country with high rates of rainfall. Cumulonimbus clouds are considered to be the cause of many atmospheric phenomena. Cumulonimbus clouds are formed as a result of atmospheric instability and can create lightning through the heart of clouds. Cumulonimbus clouds (*Thunderclouds*) occur predominantly because Indonesia is an active convective region and thus has a very high intensity of lightning occurance. The conditions of Indonesia as a convective region affects the high intensity of thunder (Thunder Storm Days) in Indonesia. Indonesia has 200 days of thunder, compared to the United States which reaches 100 days, Brazil with 140 days and Africa with just 60 days [1]. The high frequecy of thunder days in Indonesia is what causes such high levels of damage by lightning strikes [2].

Lightning is the release of electrostatic charge accompanied by light emission and other electromagnetic radiation. Lightning occurs because of the potential difference between the two moderates. The two moderates are between clouds and earth or clouds with clouds. In normal weather conditions, the potential difference between the Earth's surface and the ionosphere is around 200,000 to 500,000 volts with current density about 2x10-12 ampere/m^2 [1]. Lightning strikes occur when the release of positive and negative electric charges contained in the cloud [3]. Lightning strikes are natural electrical phenomena in the Earth's atmosphere that cannot be prevented and reduced.

Lightning can be classified into several types. Based on the process of its occurance, it can be divided into 4 types [2][4], they are:

a. Lightning cloud to ground (Cloud to Ground / CG): the type of lightning that is most disasterous and destructive. Most of these occur as result of the release of negative charges on the lower parts of clouds to the Earth’s surface, but a positive strike is also able to occur, especially in winter (Figure 1)

b. Lightning in clouds (Intercloud / IC): the most common type of lightning occurs between opposite charge centers in the same cloud (Figure 2)

c. Lightning cloud to cloud (Cloud to Cloud / CC): This type of lightning occurs between different charge centers on different clouds. Release of charge occurs in bright air between these clouds (Figure 3)

d. Lightning Cloud to Air (CA): Usually occurs between positively charged clouds with negatively charged air. If this lightning occurs in the lower cloud, it is a combination with CG type lightning. Lightning Cloud to Air (CA) looks like fingers emerging from CG lightning (Figure 4)

FIGURE 1. CLOUD TO GROUND

FIGURE 2. INTRACLOUD

FIGURE 3. CLOUD TO CLOUD

FIGURE 4. CLOUD TO AIR

Every year in the United States, more than 300 people are struck by lightning. For 30 years, 50 people have died each year and hundreds have suffered permanent neurological and physical disabilities due to lightning strikes [5]. There are five ways that lightning strikes affects on people [5], they are:

a. Direct Strike
b. Side flash side splash
c. Ground Current
d. Conductive
e. Streamers

Lightning strikes also occur in Wonosobo District which cause negative impacts to community, buildings, and the environment. eleven people were struck by lightning while climbing Mount Prau, Wonosobo and three of them died [6]. A bolt of lightning in Wonosobo struck a couple of farmers in Kalikajar Subdistrict [6]. The aim of this research is to (1) identify landform characteristics in Wonosobo District (2) identify the area that has Cloud to the Ground lightning strikes density and its connection to landform characteristic in Wonosobo District (3) analyze the risk of lightning strikes in Wonosobo District and (4) recommend mitigation actions toward lightning strikes in Wonosobo District.

Lightning Strike Level Mapping is associated with the characteristics of the area such as landform, geology formation, land cover and elevation. Lightning Strike Level Mapping is needed to anticipate the negative impact of lightning strikes in the form of loss of property and even loss of life. Mitigation action is needed as if socialization regarding things to do when lightning occurs both indoors and outdoors. Socialization activities are expected to minimize the negative impacts caused by the lightning strike phenomenon.

2. Methodology

2.1. Study Area

This study was conducted in Wonosobo District that has 15 sub-districts. The study was conducted on April 2018 until August 2018. Wonosobo District was chosen because it has unique regional characteristics. Wonosobo District has 98,468 hectares of area and is located between 7°43'13" S to 7°04'40" S and 109°43'19" E to 110°04'40" E. Wonosobo District has hilly topography, located between 200 and 2,250 meters above mean sea level. Average temperature in Wonosobo is 14.3° - 26.5° Celsius with the average rainfall is 1713 - 4255 mm / year [7]. High rainfall is associated with the increasing of intensity of lightning strikes, especially lightning from clouds to earth or Cloud to Ground [8].

2.2 Data Collection

Data collection is done primary and secondary. The data needed in this study is on the list of tools and materials, that are:

- *Tools:*

1) Mapping Software (ArcGIS 10.3)
2) Global Positioning System (GPS)
3) Avenza Map
4) Google Earth
5) Interview Questionnaires

- *Materials:*

1) Alos Palsar Digital Elevation Model with 12.5 meters resolution of Wonosobo District (Source: Alaska Satellite Facility)
2) Landform Map of Wonosobo District (Source: Development Planning Agency at Sub-National Level of Wonosobo District)
3) Geology Map of Wonosobo District (Source: Development Planning Agency at Sub-National Level of Wonosobo District)
4) Land Cover Map of Wonosobo District in 2015 (Source: Development Planning Agency at Sub-National Level of Wonosobo District)
5) Cloud to Ground Lightning Strike Data from 2015 to 2017 in Wonosobo District (Souce: Meteorology, Climatology, and Geophysical Agency)
6) Demography Data of Wonosobo District in 2015 to 2017 (Source: Statistic Indonesia of Wonosob District)
7) Interview Results regarding community's understanding of lightning strikes impact (*random sampling*)

2.3. Data Processing

This is quantitative-qualitative research using observation and random sampling interview method. Data processing was carried out by creating lightning strike levels map, landform map, geological map, land cover map, and elevation map of Wonosobo District. Landform, land cover and geology maps were obtained from Development Planning Agency at Sub-National Level of Wonosobo District. Lightning striks levels map was made using kernel density model on ArcGIS 10.3 software. The elevation map of Wonosobo District was obtained from analysing and processing of Alos Palsar Digital Elevation Model with 12.5 meters resolution. Then Lightning strike and elevation levels were classified into three classes, namely low, moderate and high class.

Arithmetic classification method was used to classify those data because it uses the concept of arithmetic addition with the provision that the higher the level of the class, the larger the interval used and intervals classification in the values close to the minimum value can distinguish in more detail, while the values close to the maximum value will generalized [9]. The formula for calculating interval classification uses the arithmetic method as follows:

$$\boxed{Min + x + 2x + 3x + .. + nx = Max}$$

Min = Lowest value
Max = Highest Value
x = Coeffecient x

In addition to processing the secondary data, primary data processing was also carried out from community interview results and *google forms* questionnaires to find out the impact of lightning strikes. Then the collected information was used as supporting analysis of the analysis characteristics regional of lightning strike rates.

2.4. Data Analysis

Data analysis was carried out on lightning strike levels maps in 2015 to 2017, land cover map, and elevation map and interview results. Lightning strike map and elevation map were overlayed into Lightning Strike Level Maps based on the Elevation in Wonosobo District. Analysis was also carried out on the conditions of land cover and landform in Wonosobo District toward the occurrence of lightning strikes.

Analysis related to correlation between elevation, land cover, and landform with the level of lightning strikes was carried out by descriptive analysis method. Descriptive analysis method was used because it can explain the situations, facts, or issues based on existing data [10]. Descriptive analysis on maps was carried out to identify the effect of regional characteristics on the level of lightning strikes. Interview results regarding community's knowledge of negative effects of lightning strikes were used as supporting evidence that the lightning strike phenomenon also caused considerable losses such as other disasters. The results of this study were used as a basic for mitigation that can be done related to the lightning strike phenomenon which is often carried out in the rainy season in Wonosobo District. Research in the diagram in Figure 5.

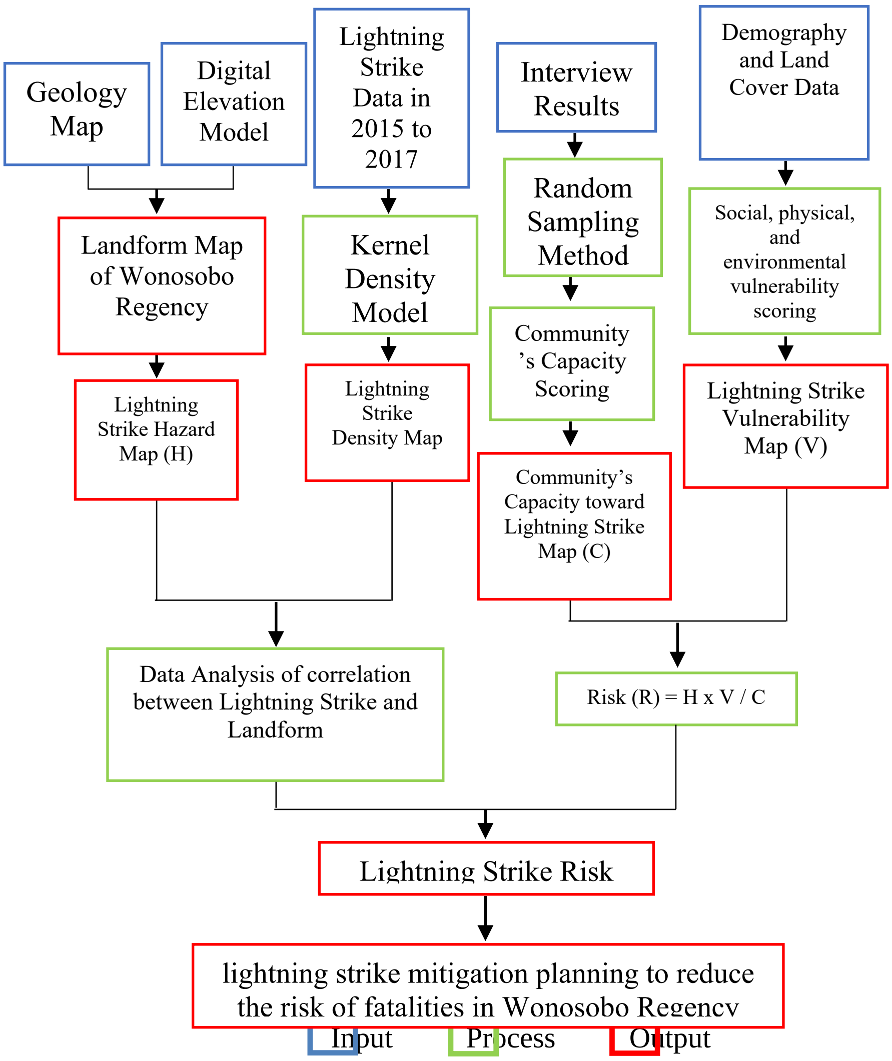
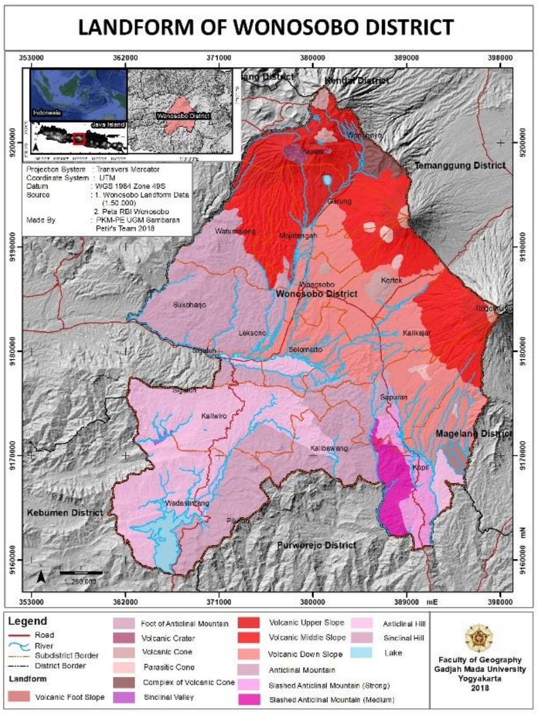


Figure 5. Diagram of The Research

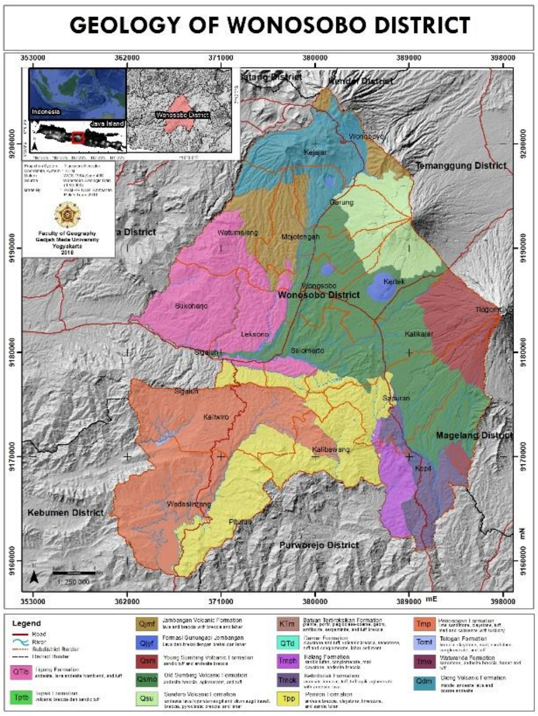
3. Result dan Discussions

3.1. Regional Characteristic

Wonosobo District has 984.68 km2 of area and is located between 7°43'13" S to 7°04'40" S and 109°43'19" E to 110°04'40" E. Wonosobo District can be divided geomorphologically into two landforms from volcanic processes in the east and north in the form of a series of Volcanoes, such as Mount Sumbing Mount Sindoro and Dieng volcanic complexes, and structuric processes in the West and South (Figure 6a). Wonosobo District is included in the physiographic lane of the Southern Serayu Mountains so that there are forms of sinklinal and anticlinal mountains and valleys [11]. The geological structure of Wonosobo District is mostly composed of sedimentary rocks formed from volcanic activity such as andesitee breccia, conglomerates, sand and tuff. (Figure 6b).



(A)



(B)

FIGURE 6. (A) LANDFORM MAP IN WONOSOBO DISTRICT AND (B) GEOLOGY MAP IN WONOSOBO DISTRICT

Land cover in Wonosobo District consists of settlement areas, buildings, shrubs, fields / moors, rice fields, plantations, forests, and reservoir (Figure 7).

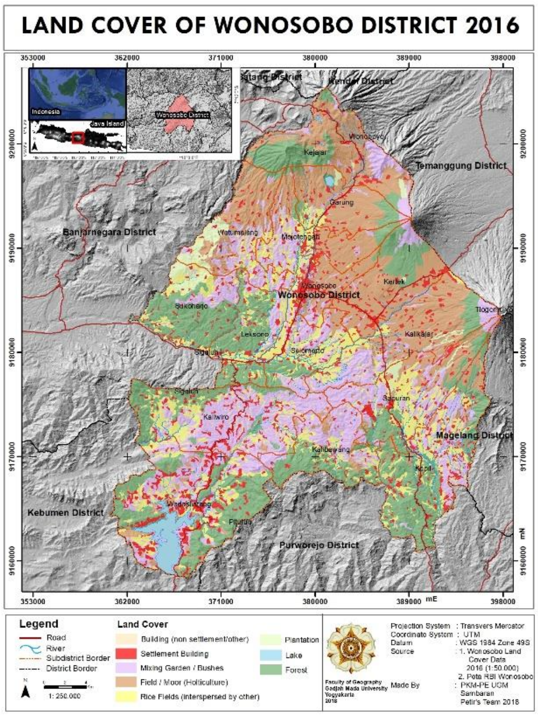
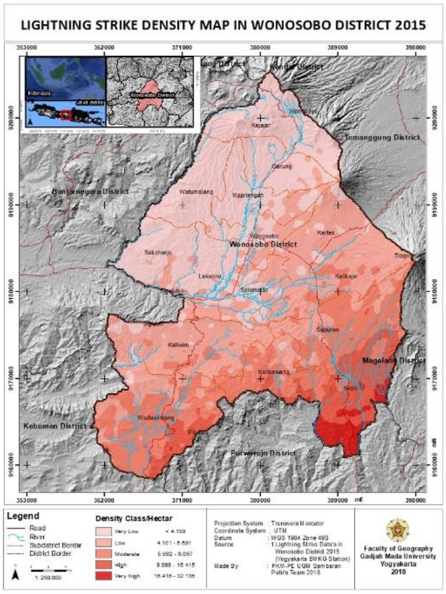


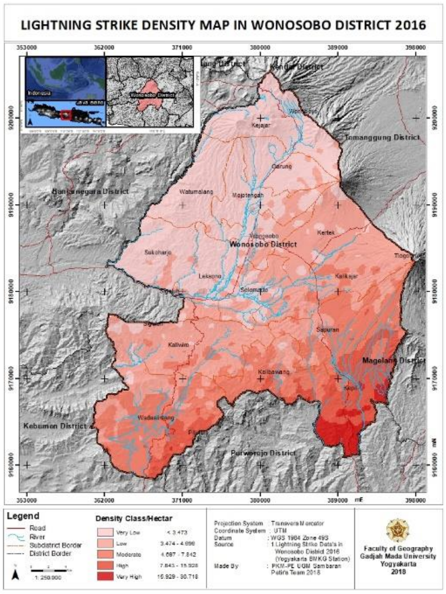
FIGURE 7. LAND COVER MAP IN WONOSOBO DISTRICT

3.2. Lightning Strike

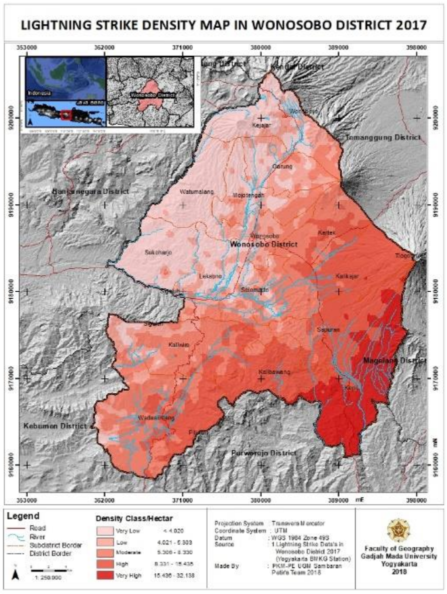
Lightning Strike Density Map in Wonosobo District shows the pattern of spatial distribution of lightning strikes from 2015 – 2017, in general has not changed. Area that has very high density of lightning strike is located in the southeastern part of Wonosobo District, Kepil and Sapuran Subdistricts and decreasing to the northwest. The highest lightning intensity occurred in 2016, which was 36,718 strikes. The lightning strike density map in Wonosobo District from 2015 - 2017 can be seen in Figure 14 to Figure 8.



(A)



(B)



(C)

FIGURE 8. (A) LIGHTNING STRIKE DENSITY MAP IN WONOSOBO DISTRICT (2015), (B) LIGHTNING STRIKE DENSITY MAP IN WONOSOBO DISTRICT (2016) AND (C) LIGHTNING STRIKE DENSITY MAP IN WONOSOBO DISTRICT (2017)

Based on the interview results, lightning strikes caused damage to some home appliances such as damaging the electricity network, causing trees to collapse and in some locations such as in Kalikajar and Kejajar Subdistricts causing deaths. According to the testimonies of several residents, the area that most frequently struck by lightning was in Sapuran Subdistrict. This is in accordance with the lightning strike density map which also shows that the southeastern Wonosobo District's area (Sapuran and Kepil Subistricts) has a high to very high lightning strike density, reaching 15,436 - 32,138 strikes / ha in 2017.

3.3. Lightning Strike and Landforms Correlation

The correlation between landforms and lightning strikes can be identified based on the morphology and material found in Wonosobo District. Based on the lightning strike density map that has been made, the density of lightning strikes is mostly found in the structural processes landforms, such as anticlinal mountains, strongly incised anticlinal mountains and moderately incised anticlinal mountains that are located in the southeastern part of Wonosobo District. High lightning strike on anticlinal mountains is influenced by topographic factors, morphology and the material contained therein.

The conditions of the various landforms in Wonosobo, especially in the southern anticlinal mountains, are associated with diverse topography. The higher the elevation of the earth's surface, the higher the frequency of lightning strikes, but it does not apply when the elevation reaches 1500 - 1800 mdpal [12]. This can be seen from the lightning strike density map in Wonosobo which shows a decrease in the density of lightning strikes from southeastern Wonosobo (Kepil District) towards the southwest (Dieng Area). When the elevation reaches above 1300 meters, the frequency of lightning strikes will decrease [13]. The relationship between landform and lightning strike density can be seen in Table 1.

Table 1. Lightning Strike Density and Landforms Characteristic Correlation in Wonosobo District

No.	Landforms	Area (ha)	Lightning Strike Density	Materials	Risk
1.	Volcanic Upper Slope	8780	Moderate	Lava Andesite, Breccia	Low
2.	Volcanic Middle Slope	13966	Moderate	Granite, Tuff, Breccia	Low
3.	Volcanic Down Slope	21654	Moderate	Lava Andesite, Breccia	Low
4.	Volcanic Foot Slope	538	High	Breccia Andesite, Tuff	Low
5.	Volcanic Cone	1547	Low	Breccia Andesite, Lava, Tuff	Low
6.	Parasitic Cone	583	Moderate	Lava, Breccia	Moderate
7.	Complex of Volcanic Cone	886	Very Low	Lava, Breccia	Very Low
8.	Volcanic Crater	360	Very Low	Lava Andesite, Andesite, Quartz	Very Low
9.	Anticlinal Mountain	22597	Moderate	Breccia Andesite, Tuff, Limestone	Low
10.	Foot of Anticlinal Mountain	151	High	Breccia Andesite, Tuff, Limestone	Moderate
11.	Slashed Anticlinal (Strong)	3050	Very High	Breccia Andesite, Tuff, Lava Andesite	Very High
12.	Slashed Anticlinal (Medium)	2364	Very High	Breccia Andesite, Tuff, Lava Andesite	Very High
13.	Anticlinal Hill	18577	Low	Breccia Andesite, Tuff, Lava	Very High

				Andesite	
14.	Sinclinal Hill	4098	Low	Andesite, Lava Andesite, Tuff	Very High
15.	Sinclinal Valley	98	Low	Andesite, Lava Andesite, Tuff	Low
16.	Lake	1168	Low	Sand Stone with limestone, Tuff, Clay Stone	Low

Anticlinal mountains in Wonosobo have morphology in the form of mountains with 20-55% slope angle, 200 - 500 m height difference of and 500 - 700 M/S/L elevation [14]. High areas such as mountains easily develop lightning Cloud to Ground (CG) caused by up process of warm air mass orographically [15]. That can trigger the growth of Cumulonimbus clouds which is the forerunner to the occurrence of lightning. Therefore, on anticlinal mountain strongly/moderately incised anticlinal mountains in Wonosobo, have high lightning strike density.

The correlation between constituent material (geology formation) and lightning strikes in Wonosobo can be identified from the rock resistivity values (Table 1). Rock resistivity values indicate the ability of a rock material to conduct electricity. The higher the resistivity value of a rock, the weaker its ability to conduct electricity. rock material based classification on its resistivity values is as follows [16]:

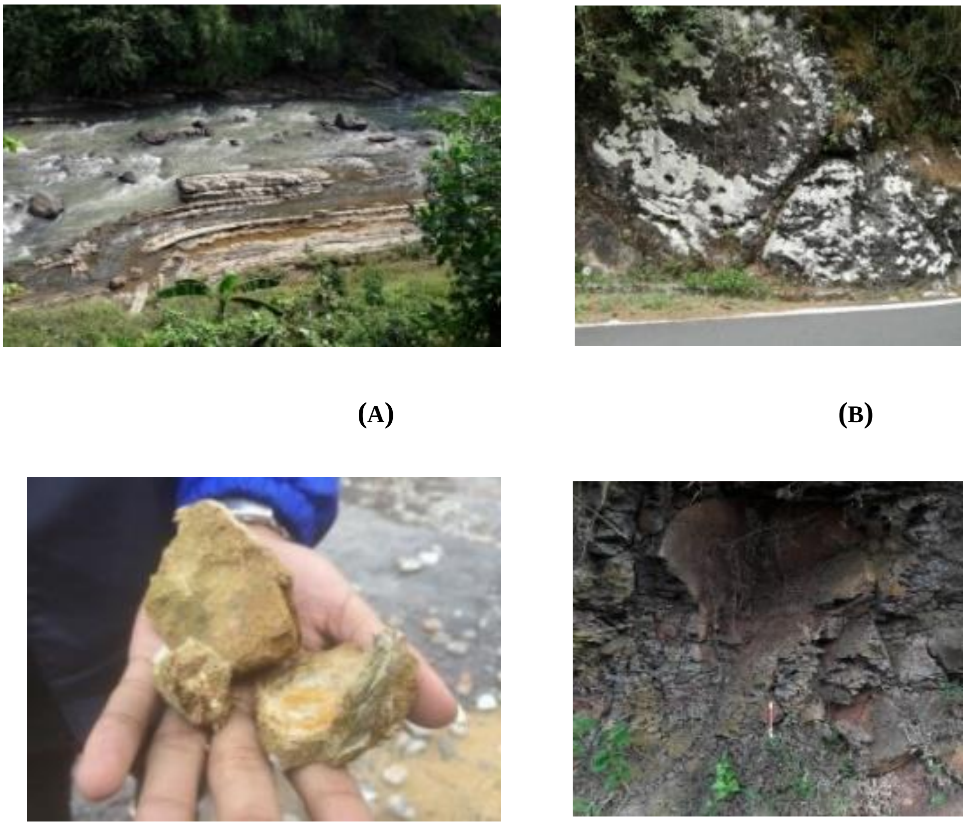
a. Good conductor (low resistivity value): 10^{-8} Ωm < p < 1 Ωm
b. Mid conductor (moderate resistivity value): 1 Ωm < p < 10^{7} Ωm
c. Insulator (high resistivity value): p > 10^{7} Ωm

The resistivity values of the breccia, lava and tuff are found in Table 2.

Table 2. The Resistivity Values of Breccia, Lava and Tuff

No.	Materials	Resistivity Value (Ωm)
1.	Breccia	75 – 200
2.	Lava	100 – $5x10^{4}$
3.	Tuff	20 – 100

According Table 2, the three dominant rock materials which are formed Wonosobo District's landform, breccia, lava, and tuff are middle conductor materials so that the ability to conduct electricity (lightning) is quite high. The distribution of rock material in Wonosobo District is shown in Figure 9.



(A) **(B)**

(C) **(D)**

FIGURE 9. (A) SAND STONE, (B) BRECCIA, (C) TUFF, AND (D) CLAY STONE

3.4. Lightning Strikes Risk

Calculation of natural disaster risk in Indonesia considers three main aspects, hazard, vulnerability (social, economic, physical and environmental) and community’s capacity for natural disasters by using the formula R = (HxV) / C, R: Risk, H: Hazard, V: Vulnerability and C: Capacity. Lightning Strikes Risk in the southeastern part of Wonosobo District in Kepil, a small part of Sapuran and Kalibawang and Wonosobo Subdistrict are very high, while in Sukoharjo, Mojotengah, Kertek, Selomerto, a past of Garung and a small part of Kalikajar Subdistrict are moderate and in Wadaslintang, Kaliwiro, Leksono, Watumalang, Garung, Kejajar, and most of Kalibawang subdistric are low. Risk of lightning strikes in Wonosobo District is shown in Figure 10.

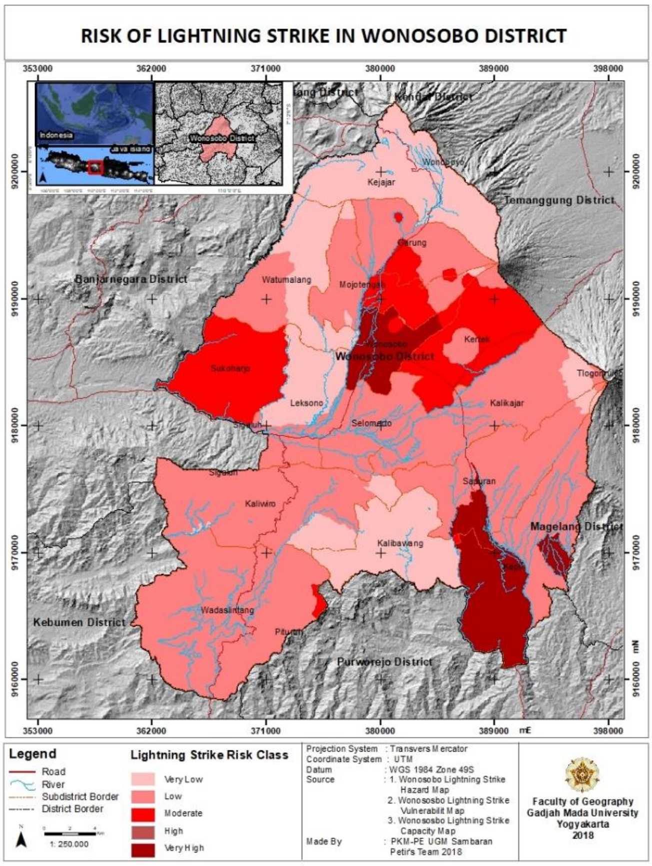


Figure 10. Risk of Lightning Strike Map in Wonosobo District

Lightning strikes risk values are due to community's capacity or community's understanding of lightning strikes in Wonosobo District. The higher of community's capacity, the lower of disaster risk. Most sub-districts in Wonosobo District show very high capacity. The interview results of 44 respondents spread across sub-districts show that the percentage of community's capacity is very high (80%), high (11%), moderate (2%), low (5%) and very low (2%).

Lightning Strike Risk values also caused by lightning strikes hazard in Wonosobo District. Areas that have high lightning strike hazards are Kepil, Kertek and Sapuran Subdistricts. This is because the level of lightning strike density is very high. The higher of lightning strikes hazard, the higher of disasters risk.

Another factor that induce of Lightning Strike Risk values is vulnerability. Vulnerability that used in lightning strikes risk analysis is social, physical and environmental vulnerability and then are overlayed / calculated as total vulnerability. Physical and social vulnerability are the most important because they have caused the greatest loss from lightning strikes. Based on the interview results with Wonosobo District's residents, 39% of the total respondents said they had experienced incidents related to lightning strikes such as power outages, damaged parts of the house and damaged electronic equipment (satellite dish, television) (Figure 11).

(A)

(B)

(C)

(D)

FIGURE 11. IMPACT OF LIGHTNING STRIKES CAUSING (A) DAMAGED HOUSE WALL, (B) DAMAGED PARABOLA, (C) DEAD OF BANANA TREE, DAN (D) LIGHTNING STRIKES OFTEN OCCUR IN HOMES LOCATED NEAR THETOWER

3.5. Mitigation Actions Against Lightning Strikes

Mitigation actions from lightning strikes danger can be done when outdoors or indoors. Some actions to prevent danger from lightning strikes while doing outdoor activities are:

a. Enter closed building or car immediately
b. Get down from high areas such as mountains and hills immediately
c. Avoid open spaces and waterbody
d. Avoid objects that can conduct electricity such as barbed wire fences, power lines, windmills, etc
e. Do not take shelter under an isolated tree and billboards [17][18]

f. Do not lie on the ground but do Lightning Safety Position in an area that is quite safe and not too close to one another person (Figure 12) [5].

FIGURE 12. LIGHTNING SAFETY POSITION

Some actions to prevent from lightning strikes danger while doing indoor activities are:

1. Stay away from telephone lines, computers and other electrical equipment
2. Avoid contact with pipes or drains, including sinks and taps
3. Stay away from windows and doors
4. Do not lie on the concrete floor and lean on the concrete wall

Another effort that can be done is to install a lightning rod in the building. Lightning rod functions to channel lightning strike energy directly to the ground thus electronic devices and other metal objects in the building will not affected.

4. Conclusion

Conclusions from this research are:

1. Wonosobo District has volcanic and structuric landforms from hills to steep mountainous morphology. Dominant materials are Breccia, Andesite Breccia, Lava and Tuff.
2. Areas that have high lightning strike densities are Kepil and Sapuran subdistrict. Many lightning strikes occur on strongly and moderately incised Anticlinal Mountains, which are caused by topographic factors and the presence of breccia as a good conductor.
3. Most of Wonosobo District has a low lightning strikes risk because the community's knowledge/capacity regarding lightning strikes is high, but there are some areas that have a very high risk such as in Kepil Subdistrict and some of Sapuran Districts because they have a high lightning strike density.
4. Mitigation actions that can be applied to reduce losses and deaths caused by lighting strikes are to put an end to outdoor activities when Cumulonimbus Clouds appear, avoid open spaces, get down from high areas such as mountains and hills immediately, and to not use telephone or other electronic equipment.

5. Suggestions

Mitigation actions should be emphasized for areas that have high lightning strike densities and farmer groups and hiking basecamps in Wonosobo District because many outdoor activities are carried out. Research on analysis of regional characteristics of lightning strikes in Wonosobo District needs further development especially from the socio-economic aspects.

Acknowledgements

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Landslide Disaster Investigation Based on Correlation of Geologic and Meteorologic Characteristics in Naringgul, Cianjur Regency, West Java, Indonesia

Mi'raj Maulana[1], Muhammad Dhika Pratama [2], Silvya Oktaviana Setia[3], Irwan Novianto Rusadi[4], Arrazi Diki Elnanda[5], dan Dicky Muslim[6]
[1, 2, 3, 4, 5]Mahasiswa Fakultas Teknik Geologi Universitas Padjadjaran, Bandung
[6]Dosen Fakultas Teknik Geologi Universitas Padjadjaran, Bandung

e-mail: mirajamulana127@gmail.com[1], muhammad16067@mail.unpad.ac.id[2], silvyaokta@gmail.com[3], irwan16001@mail.unpad.ac.id[4], arrazidiki.18@gmail.com[5], and dickgeo86@gmail.com[6]

E-mail: mirajamulana127@gmail.com

Abstract. Landslide disasters are one of the disasters that continue to occur in Indonesia, especially in West Java. Many factors that influence the occurrence of landslide disasters include; topography and rainfall. This study examines and analyzes geological and meteorological characteristics as a landslide mitigation effort in Naringgul area. Naringgul is one of the sub-districts which is administratively located in Cianjur Regency, West Java and geographically located at 7 ° 25 '19,7 "LS and 107 ° 19' 49,6" BT and 7 ° 25 '19 "LS and 107 ° 19 '51 "BT. This research area has very complex geological conditions, which are viewed from the geomorphological aspects, geological structures and stratigraphy. The geological characteristics of the study area were obtained from previous research data and field survey data conducted by the PVMBG team. Meanwhile, meteorological data is obtained from various multi satellite TRMM, Gradient wind, and Himawari. Landslides occur in the Bentang (Tmb) Formation and Jampang (Tomj) Formation and are in steep slope conditions. The saturation and softening of the soil by the flow of water at the foot of the slope causes the lower part of the slope to decrease its holding strength. Because the load continues to increase as high rainfall with a long duration causes the lower part of the slope to weaken, and the accumulation of water on rock contact causes the soil to move out of the slope with the slip plane on contact between the two materials. Thus, this research is expected to be used as a source of information for the public regarding the potential for landslides, especially in the wet month or month with high rainfall intensity, so that the community can find out the landslide mitigation in the area and is expected to increase community preparedness.

Keywords : *Rainfall, Geological Characteristics, Landslides, and Meteorology*

1. Introduction

A Disaster is an event or series that occur and caused by natural factors or non-natural factors (such as human factors) that cause human casualties, environmental damage, losing property, and create psychological impact (UUD No. 24 Tahun 2007). From that definition disaster can be divided into three categories in general, there are natural disasters, non-natural disasters, and social disasters. From those three types of disasters above, natural disaster type is mostly happening.

According to the International Strategy for Disaster Reduction (UN-ISDR-2000) natural disasters are events that are caused by nature or human activity, occur suddenly or slowly, causing casualties, property and environmental damage, this event occurs beyond the capacity of human with all its resources.

According to UUD No. 24 Tahun 2007 natural disasters can be categorized based on their causes by divided into three types, there are geological disasters, climatological disasters, and extra-terrestrial disasters. A geological disaster is an event that occurs because of geological conditions due to the interaction of various geological factors or involving geological aspects, these events result in loss of property, facilities and infrastructure damage, and also causing casualties of humans and other living things (Zakaria, 2008).

Geological disasters cannot be avoided all over the world, especially in Indonesia. This thing can happen because the geological processes and environmental conditions in Indonesia are various and dynamic both in terms of place and time (Arief. R., 2013).

Indonesia is one country that geological disasters frequently happen. According to BNPB data from 2008 to 2011, 77% of natural disasters that occurred in Indonesia were geological disasters classified as hydrometeorological disasters, such as floods, tornadoes, flash floods, and landslides.

For Indonesia, especially in West Java during the rainy season natural disasters will vulnerably happen (Arief. R., 2013).

One of the districts in West Java that has a high potential for geological disasters happen is Cianjur Regency. Some of its areas are too vulnerable to geological disasters like landslide, earthquakes, volcanic eruptions and tsunamis happen. Cianjur Regency is in the top rank of the region which has a high rate of vulnerability for landslide happen in the rainy season. Naringgul sub-district is one of the sub-district that has a high vulnerability rate for landslide happen (Zakaria, 2008). BNPB data shows that Cianjur, especially the Naringgul sub-district, has a very high potential for land movement (Table. 1).

A landslide has occurred in Naringgul District, Cianjur Regency, West Java Province, Indonesia on Sunday, December 9, 2018, at 18.30 WIB in the rainy season (Fig. 1).

2. Landslide and Rainfall

2.1. Landslide

Landslides are one of the natural disasters that frequently happen in the world (Bryant, 2005). Landslides have become one of the natural disasters which are very responsible for damage to nature, social, economic, etc. As a result of the landslide, hundreds of people died and others were injured, thus causing its own trauma for the affected human communities (international federation of red cross and red societies, 203).

Many factors that cause landslides occur, according to Dai et al. (2002) in general the causes of landslides can be grouped into 2 groups :

1. Factors that cause the soil to become weaker (topography, tectonics, geological history, weathering, etc.)
2. Dynamic factors (rainfall, earthquake, and explosion)

In addition, landslides can occur due to human activities that do not pay attention to environmental conservation rules. There are many infrastructure constructions that don’t pay attention to their weight load so that they exceed the loading capacity of the soil surface (Arief. R., 2013).

In general, landslides occur on steep slopes and make erosion rate increase. A slope where landslides happen is caused by the forces that occur inside it are not as balanced, Driving force is stronger than Resisting force (Zakaria, 2008). Failure on a slope in resisting its stability can

cause a decrease in the resisting strength of a slope which can increase with increasing water content (Zakaria, 2008). The increasing of water content in a soil material is generally caused by rain. Addition of water to the soil can cause an increase in weight on the slope (Soenarmo et al., 2008). Besides that, an increase in water content in soil material can reduce the physical or mechanical properties of the soil and reduce slope safety factors (Hirnawan & Zakaria, 1991). Besides the factor of increasing water content, landslides can occur in areas that have two different materials where there is a boundary plane between these two materials (Soenarmo et al., 2008). The occurrence of landslides in two types of material is caused by the separation between the two materials that become the slip surface. Like clay and sand, for a waterproof clay material, it will become a slip surface on the material above which absorbs water, so the material above will fall.
Some text.

2.2 Rain Factor that Causing Landslide.

Rainfall characteristics (daily rainfall, precipitation, rain intensity, and duration) have a strong relationship with the effects of landslides (Sidle and Ochiai, 2006). Many research has been done in observing rainfall under the influence of slope stability (Caine 1980, Larsen and Simon 1993, Finlay et al., 1997, Godt et al. 2006, and Cannon 1988). From the research, it shows that rainfall is one of the factors that trigger the occurrence of landslides (Kawamoto et al., 2000; Iverson, 2000; Lan et al., 2003). At the time or after the rain causing water content in the soil increase and create additional load and driving force in soil surface on the slope (Pierson, 1980; Huang and Lin, 2002; Soenarmo et al., 2008).

Indonesia, which has a tropical marine-monsoon climate, has two seasons, the wet season is known to have high average rainfall rate and the dry season (Ramage, 1968; Nakamura et al., 1994; Soenarmo, 2007). According to BMKG data (2013), Western Indonesia generally has high rainfall rate in January-February. So that in January-February western Indonesia has the potential for landslide happen in certain areas, especially in areas that have been landslides that allow the landslide to be active again. Many types of research have examined the effect of rainfall rate on slope stability (Yin et al., 2002; Guzzetti et al., 2005). So that many empirical approaches have been used to determine landslide vulnerabilities due to the influence of rainfall intensity and duration (Caine, 1980). The results of previous studies show that high rainfall intensity is a direct factor for landslide disasters (Dai et al., 2002). From the empirical approach and previous research shows that landslide events can be predicted by observing the characteristics of previous rainfall and landslides (Keefer et al., 1987). Besides that, there are some areas with certain conditions that have high landslide potential, Zakaria (2008) describes the area, there are: areas crossed by fault zones, earthquake areas, loose rock areas, strong erosion areas, hilly clay terrain areas, and hilly area with thick residual soil.

3. Methode

The data used in this study are geological condition data and climatology data of the research area at the time before the landslide happen. Geological data were obtained from field surveys conducted by the survey team from Badan Geologi, while climatological data were obtained from remote sensing TRMM satellite images from NASA and Badan Meteorologi, Klimatologi, dan Geofisika (BMKG). So that the available data can be analyzed the effect of meteorological conditions and geological conditions on landslides that occur in the research area.

3.1 Geological Characteristics of Research Areas

Cianjur regency subdistricts Naringgul particularly in the geological map included in the geological map sheet Sindang barang (Koesmono, et al., 1996) (Fig. 2). The research area is composed of two formations, namely Formations Bentang (Tmb) which closes the upper Tertiary age formations Jampang (Tomj). Formation Bentang (Tmb) composed of layered tuff sandstone lithology is good, crystal tuff and tuff pumice clays have an insert that has weathered. While Jampang Formation (Tomj) composed of lithology breccias cemented well.

Areas that landslides are generally composed of ground grained silty sand to sandy loam (Geology Agency, 2019). Residual soils or weathering of rock Bentang Formation (Tmb). This ground cover tuff sandstone layer which is above the mudstone that is and potentially as a sliding plane (Soenarmo 2008) Formation Bentang (Tmb).
The morphology of the study area has a morphology hilly with a slope between 15 ° - 45 ° or including steep slopes - steep (Van Zuidam, 1985). Landslides caused by rainfall both daily and seasonal monsoon rains are very closely related to the topography (sidle and Ochiai, 2006) and other some factors (Dai et al., 2002). On steep slopes - steep landslide is possible if there is an additional expense incurred as a result of the entry of water into the ground (Soenarmo et al., 2008). With the increasing angle of slope, it can cause rapid erosion process will more which is proportional to the weakening process of soil or rock.

3.2 *Meteorologic Condition*

In observation of meteorological conditions in the form of rain characteristics using remote sensing method of harnessing data based on NASA TRMM Multi Satellites. Remote sensing methods have been widely used in the detection and identification efforts of early symptoms and the factors that cause the occurrence of natural disasters (Kriveton et al., 2000, Buchroithner, 2002. Hugget et al. 2002. And Kaab et al. 2003) including data Multi NASA TRMM satellite.

3B43RT TRMM data is the data of precipitation with the spatial and temporal resolution is 0:25 ° and 3 hours taken from NASA in http://giovani.gsfc.nasa.gov web. Rainfall characteristics capable detected and analyzed by the TRMM satellite imagery in the tropics and sub-tropics and plays an important role to determine the mechanism of global climate change and monitoring the environmental variation (Findy R and M. Djazim S., 2011).
In addition, data in use of data gradient wind which is used to support the accumulation of carrier cloud of water vapor obtained from the web http://www.bom.gov.au

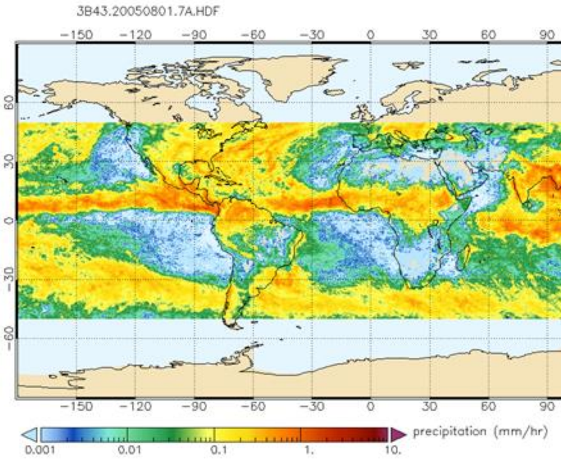

Figure 3. TRMM 3B34 Monthly Precipitation

In December 2018 shows the study area has a fairly high precipitasi is worth 0.1 to 1 mm / hr. It indicates the occurrence of rain in the area is high.

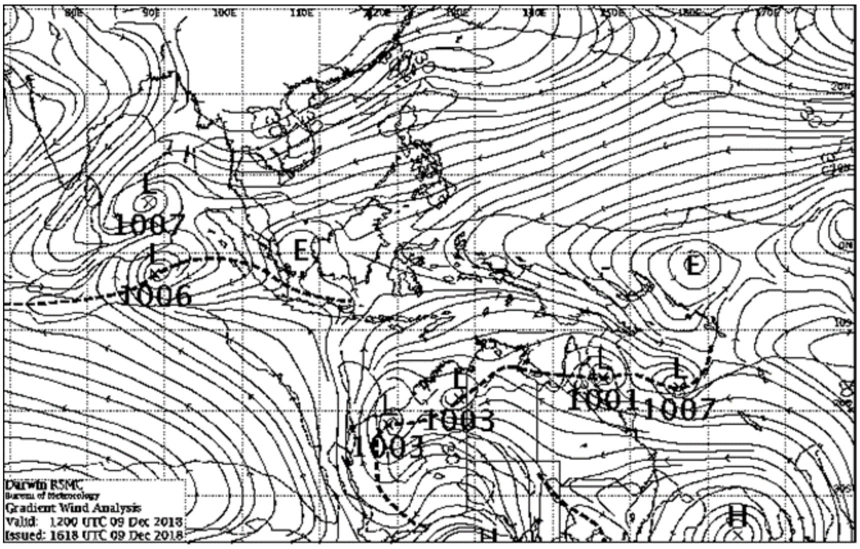

Figure 4. Gradient Wind 1200 UTC 09 Dec 2018

From the analysis of gradient wind in western Indonesia and in West, Sumatra Island are meeting place low pressure or high pressure, whereas in the study area showed no accumulation of low pressure or high pressure. Low air pressure in the West Sumatra and Indonesia the enabling happen haulage future water vapor by the air coming from the Pacific Ocean, so the area of Cianjur, West Java has the potential for high intensity rainfall due to the accumulation of clouds containing water vapor is quite high from the Pacific region , Typhoons and monsoon is one of the factors that are carrying heavy rain clouds, along the equatorial zone of the Pacific Asian continent. In addition, the cloud cover in the area of Cianjur, West Java can be seen from satellite imagery on December 9, 2018.

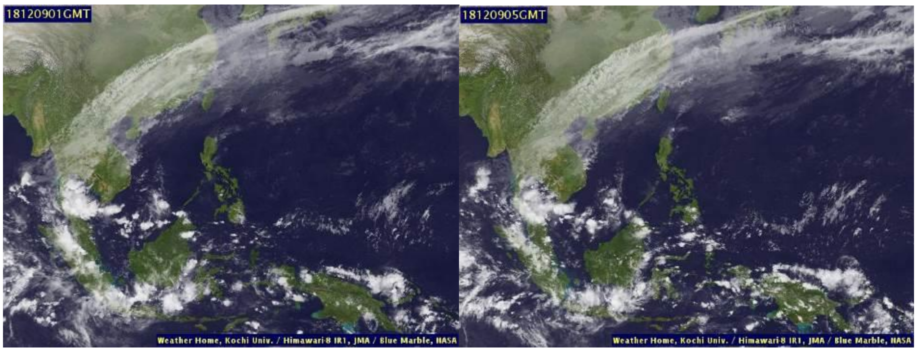

Figure 5. The set of clouds on satellite images dated December 9, 2018 a. 12 hours before the incident b. 3 hours before the incident

According to BMKG (2018) mentions that Cianjur at 069 Zoom has a peak rainy season in December with the average - average rainfall of 151 mm of rain. Based on satellite images, 12 hours and 3 hours before the incident shows the study area was covered in a thick cloud of potentially high intensity rainfall. The cloud cover research area with quite a long time for getting supply of moisture from the Pacific.

4. Discussion

The research area has a rainy season on the range in October I - June I with normal annual rainfall of 2530 - 3424 mm and has a peak rainy season in December with the average - average rainfall of 151 mm. The results of the initial analysis showed that 6 hours and 3 hours before the landslide, the study area was covered in a thick cloud containing saturated water vapor from the Pacific brought winds of high pressure to the low pressure in the western part of Indonesia. In addition, data shows TRMM precipitation western Indonesia experienced a high enough potential to experience high intensity rainfall. By the time and 6 hours to 3 hours before the landslide, the study area experiencing rainfall is above average which is about 157 mm. With rainfall as it was enough to make the area of the study experienced landslides.

High rainfall intensity above the average make up ground in the research area saturated and adding load on the slopes (Soenarmo et al., 2008). Landslides occurred on slopes of 15 ° - 45 ° (Steep-Steep) (Van Zuidam, 1985). In addition, the factors that influence that lithological rock and soil types of research areas. Ground cover has a thickness of 1-3 m with soil particle size grained silty sand to sandy loam, the soil is porous and residuals of weathering Formations Bentang (Tomb). Porous soil is above the mudstone which has a water-resistant properties, so that the boundary between the material is potentially a sliding plane (Soenarmo, 2008).

High intensity rainfall causes the porous land in the study area experiencing water saturation and increase the burden of the slopes. Due to heavy rainfall in the above - average makes the process of weakening and softening of the material at the foot of the slope more quickly, thus causing the resisting force < driving force. The duration of the rain long followed a high intensity lead to increased loading on slopes greater and style retention at the foot of the slope is getting weaker, and the underground part of which is limited by the mudstone that are watertight occur accumulation of water quickly create a boundary area advance of this material into sliding plane, thereby encouraging the porous ground material on it will be pushed out.

5. Conclusion

The landslide that occurred in the District Naringgul, Cianjur regency occurred due to rainfall was above average 157 mm, based on data from BMKG. In addition, 6 hours and 3 hours prior to the event based on satellite imagery research areas covered by the thick clouds of water vapor saturation of the Pacific.

With a long duration and high rainfall during and before the landslide enough to make the land area of research into water-saturated soil and the increasing weight of time significantly. Over time the rain long, making the material at the foot of the slope which has a slope of 15 ° - 45 ° weakening and softening rapidly, so that when the saturation of water in the soil material porous covering claystone Formation Bentang (Tomb), which is waterproof, this makes the boundary between the two materials could potentially be a sliding plane, so that the material porous water-saturated soil is pushed out over time increase soil material occur.

So the initial research results show that the landslide in Naringgul subdistrict, Cianjur regency is intimately associated with the topography, geological characteristics, and rainfall.

Please use Equation Editor or MathType to type the equations. Do not insert the equations as figures. Number the equations sequentially throughout the text.

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Attachment

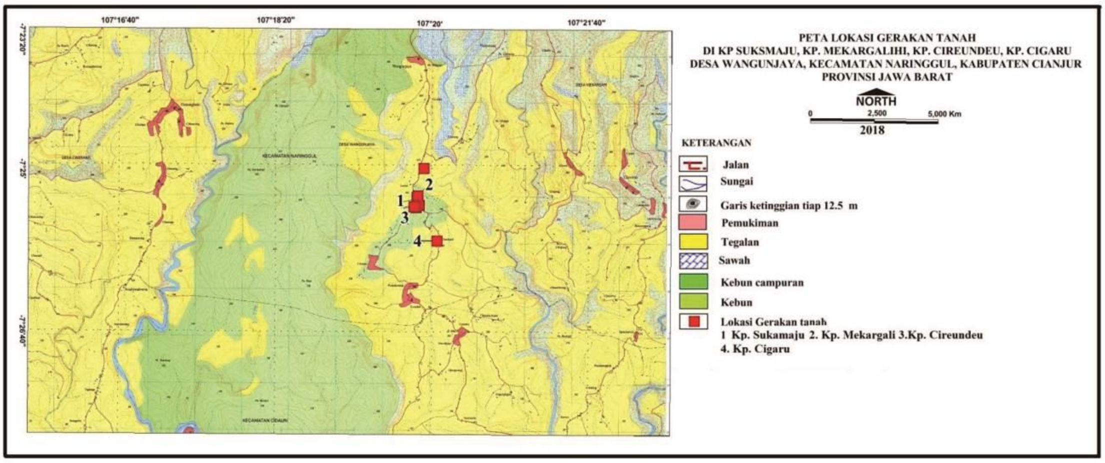

Fig. 1 Location of Landslide in Naringgul Naringgul District, Cianjur Regency, West Java Province, Indonesia

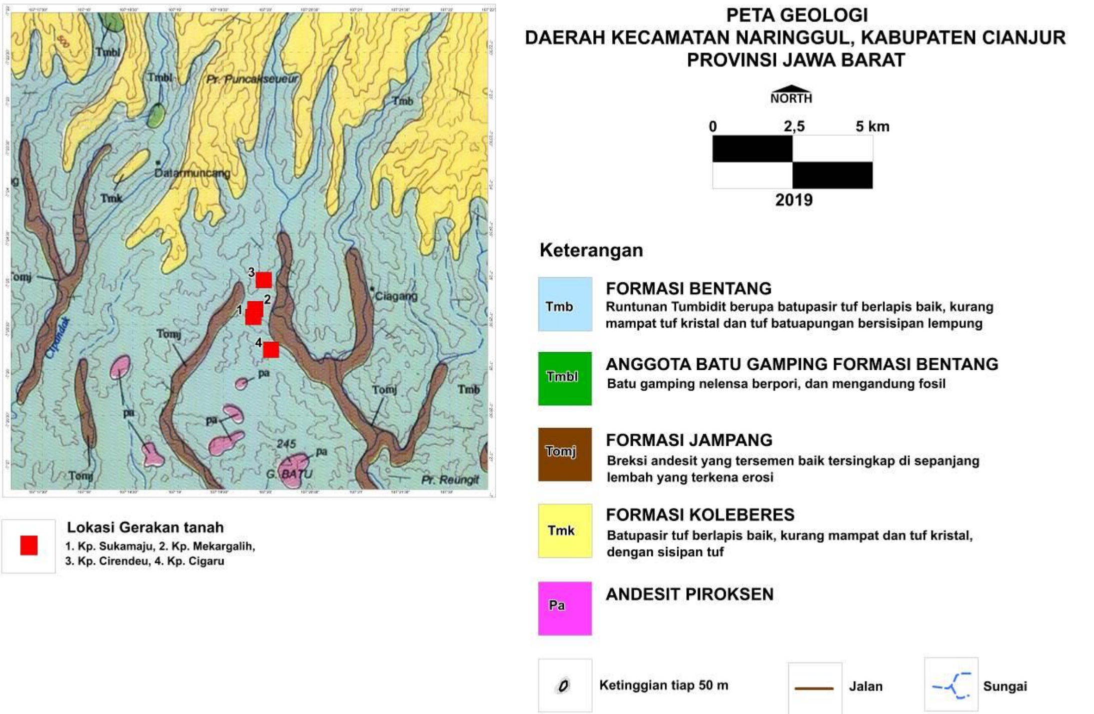

Fig. 2 Geological Map of of Landslide in Naringgul Naringgul District, Cianjur Regency, West Java Province, Indonesia (Koesmono, et al., 1996)

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The Effectiveness of Clutter Map towards the Quantitative Precipitation Estimation (QPE) on the Heavy Rain Condition in the Region of Padang (a Case Study on March 26, 2018, and September 18, 2018)

Nur Riska Lukita[1*], Agung Hari Saputra[1], Imma Redha Nugraheni[1] Abdullah Ali[2], Lalu Mantigi Wana Paksi[1]
[1]Sekolah Tinggi Meteorologi Klimatologi dan Geofisika
Jl. Perhubungan I No.5, Pd. Betung, Pd. Aren, Kota Tangerang Selatan, Banten 15221
[2]Badan Meteorology Klimatologi dan Geofisika
Jl. Angkasa I No.2 Kemayoran Jakarta Pusat, DKI Jakarta 10720
e-mail: riskalukita14@gmail.com[1*] ,agung.hs@stmkg.ac.id[2], imma.redha@stmkg.ac.id[3], alibinakhsan@gmail.com[4], rigistd@gmail.com[5]
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Abstract

Rainfall estimation with a good level of spatial accuracy and high temporality can be obtained from weather radar instruments. However, there are limitations in observing weather radar because of the blocking effect caused by ground clutter. Ground clutter is the echo of non-meteorological objects such as hills, mountains, and tall buildings that can prevent obstruction of radar waves from observing weather conditions and causing misinterpretations of rainfall estimates. The implementation of clutter map was used in this study to reduce ground clutter in the area of radar coverage. West Sumatra is a highland region with hilly topography which is considered as ground clutter. The implementation of clutter map in quantitative rainfall estimation (QPE) in cases of heavy rainfall in the field is not significant in reducing estimation errors.

Keywords: *Clutter map*, *Ground clutter*, Rainfall estimation, Weather radar.

2. Introduction

Estimates of rainfall are important because they can be used to detect potential natural disasters such as floods and landslides. In addition, information on rainfall estimates is needed for disaster management and early warning of extreme weather [1].

In Indonesia rainfall measurements are carried out using conventional tools such as rain observatory and Hellman rain gauge as well as automatic tools, namely Automatic Weather Station (AWS) and Automatic Rain Gauge (ARG) which are scattered in several observation points. Conventional rain gauges have high accuracy, however, the information collected is still in the form of points that are not evenly distributed so that the level of spatial representation is still limited [2]. One instrument that can be used to estimate the spatial distribution of accurate rainfall is through the use of weather radar [3].

Weather radar is a weather observation instrument that can provide information about the location, direction, and speed of meteorological objects such as grains in clouds. In addition, weather radar can provide information on rainfall estimates at high spatial and temporal resolutions over large areas [4].

Quantitative data based quantitative rainfall or Quantitative Precipitation Estimation (QPE) has several advantages, namely a wide area estimation coverage (100-250 km), high horizontal and vertical resolution (1-5 km horizontal resolution and vertical 0.25 - 1 , 5 km) and can produce rainfall estimation maps for large areas. Besides these advantages, weather radars have uncertainties or errors caused by many factors such as radar calibration, distance effects, variability of target volumes, variations in particle size distribution, variations in vertical profiles and diversity of Z-R equations [5].

Although it is capable of estimating rainfall, radar does not directly measure the rain. Radar estimates rainfall through the conversion of reflectivity factor values into rainfall through the reflectivity-rain rate equation (Z-R equation). Quantitative data based on radar rainfall estimates are influenced by several factors such as: (1) the area detected by radar which is limited by the surrounding area; (2) variability in rainfall at various scales; and (3) the use of radar system operating parameters. This study will focus on toporaphic factors causing complexity in determining QPE because it can reduce the effectiveness of radar observations and increase the source of bias [6].

Topographic factors can cause the presence of ground clutter and blocking area. Ground clutter is defined as the echo of a fixed object that can be in the form of buildings, trees, and hills that can affect the effectiveness of radar observations. Ground clutter can be in the form of hills, mountains, and tall buildings which can prevent obstruction of radar waves from observing weather conditions and causing misinterpretations.

The importance of recognizing the characteristics of ground clutter, especially in the location of single polarization radar observation because of the characteristics of echo-non precipitation such as ground clutter and cloud droplet clouds have very different distinctive patterns [7]. Eliminating ground clutter is a condition for the use of weather radar, both for quantitative and qualitative purposes because a large number of radar pixels are contaminated by ground clutter. A simple solution to eliminate ground clutter is to use the clutter map. Clutter map can significantly reduce ground clutter [8].

The West Sumatra region, because it is an area with a large portion of mountain and highland topography that is identified as ground clutter, thus can affect the visibility of radar observation. In this research, the clutter map effectiveness test will be conducted to see the effect on the quantitative rainfall estimation in West Sumatra.

3. Method

This research was conducted in the West Sumatra region with the selected heavy dense rain event which was on March 26, 2018, and September 18, 2018. The data used were radar and rain gauge data (AWS and ARG), and the distribution can be seen in Figure 1. The Padang weather radar location was at coordinates of 100.3051°EL and 0.7862° SL. The Padang weather radar was a C-Band, single (horizontal) type radar, the brand of Gematronic. The operational method of Padang weather radar during the research was using the volume coverage pattern (VCP) 21 which had six elevations ranging from 0.5° to 10.0°.

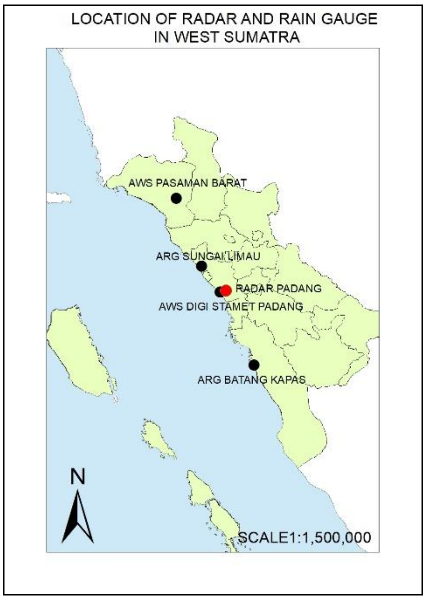


Figure 1. The location of the radar and the used rain gauge

The research was divided into two stages, namely the stage of making the clutter map, and the stage of making the QPE. The making of clutter map used the radar's raw data when the weather conditions were clear and cloudy. The data used was 143 raw data on September 18, 2018. The making of the clutter map used the assumption that at a point there was a continuous reflectivity value of 90% of the raw data used, then at that point it would be considered a ground clutter [9]. The clutter map was made at the first elevation of 0.5°, and the second elevation was 1.4°. The clutter map was only made at those elevations because the dominant ground clutter appeared at low elevations. Then the clutter map was applied to post processing to make the QPE.

The QPE was obtained from reflectivity data (Z) which was then converted to the value of rain rate (R) using the ZR equation. The ZR equation used is the ZR Marshall-Palmer equation. The most commonly used Z-R relationship was the Marshall-Palmer with a constant value A = 200 and b = 1.6, because it can be widely used for various places and conditions [10]. The Marshall-Palmer press was formulated as follows:

$$Z= 200 R^{1,6} \quad (1)$$

The rainfall data from the radar with the implementation of clutter map (filtered) and non-implementation of clutter map (unfiltered) were then verified with AWS data at four observation points, namely at Sungai Limau ARG, AWS Digi Padang Stamet, West AWS Pasaman, and Cotton Rod ARG. The fourth selection of AWS was based on data availability and the distance between AWS and the radar center. In Table 1, the location and distance between AWS and the radar center are explained. The verification of AWS rainfall data with the radar using simple statistical tests namely correlation, mean absolute error (MAE), and standard deviation.

TABLE 1
AWES AND ARG NAMES AND POSITIONS IN WEST SUMATERA

No.	*Rain gauge*	Coordinate	Distance to Radar
1	ARG Sungai Limau	0.5347° SL, 100.1075° EL	34.3 km
2	AWS Digi Stamet Padang,	0.7862° SL, 100.2871° EL	1.2 km
3	AWS Pasaman Barat	0.1211° NL, 99.8649° EL	110.78 km
4	ARG Batang Kapas.	1.4869° SL, 100.6105° EL	85.43 km

In this research, the entire process was carried out on the python-based *wradlib* software. The Python used was the version 2.7.12. Wradlib-python is an open source library for processing weather radar data, and can be used to make quantitative rainfall estimation. This software has been widely used in processing weather radar data and its applications [11]. Python-based *Wradlib* has been used for rainfall estimation from radar data, and has shown sufficient results, both in river flow estimation and flood event simulation in the Philippines [12].

4. RESULTS AND DISCUSSION

The Padang weather radar has limitations including the presence of obstacles experienced by the radar beam caused by fixed objects such as mountains and hills around the radar. The obstacles are identified as blocking, and are divided into full blocking and Partial beam blockage in which both types of obstacles cause different appearances . Full beam blocking will result in loss of data in certain azimuth/sectors depending on the magnitude, height, and distance of objects from the weather radar. Partial beam blockage is a barrier on some radar beams in a particular sector/azimuth so that the resulted sampling is not a maximum of one sampling volume. In partial beam blockage, some radar beams will be refracted by a mountain or hill known as ground clutter, causing echo from the radar contaminated with clutter ground [13].

The area of radar blocking and the distribution of AWS in West Sumatra are illustrated in Figure 1. The distribution of the dominant radar blocking is in the east of West Sumatra, which is a region that is mostly mountainous and upland. Bukit Barisan, stretching from northwest to southeast of Sumatra Island, consists of 63.8% of the Bukit Barisan Mountain Range with an altitude of 3,000 meters above sea level [14].

At the first elevation 0.5° AWS Digi Stamet Padang included in the partial blockage radar area so that the radar data at this distance will be contaminated by the echo from ground clutter. At a distance of more than 50 km, Sungai Limau ARG, West Pasaman AWS, and Cotton Rod ARG, are not contaminated by blocking because the distance is far from the radar center.

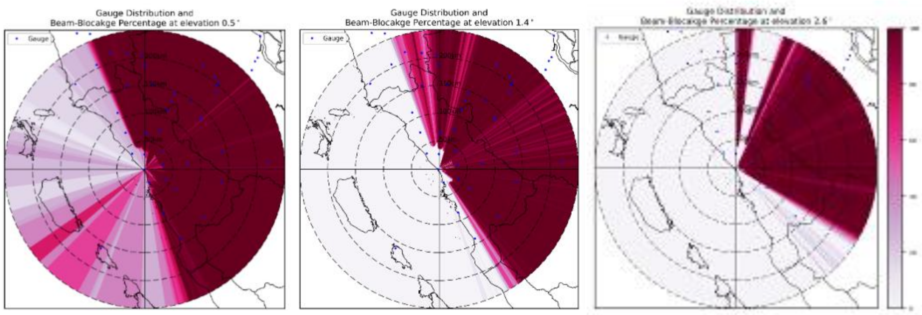


Figure 1. Blockage and distribution of rain gauge in West Sumatra

On the clutter map, fixed objects are illustrated such as a mountain or hill in the radar observation area based on the raw data used. Clutter ground is generally dominant in the highland region with hilly topography in the north-northeast and southeast region, there are mountain gutters. The distribution of ground clutter based on clutter map is dominantly following the topographic pattern on topographic maps illustrated in figure 2 (c).

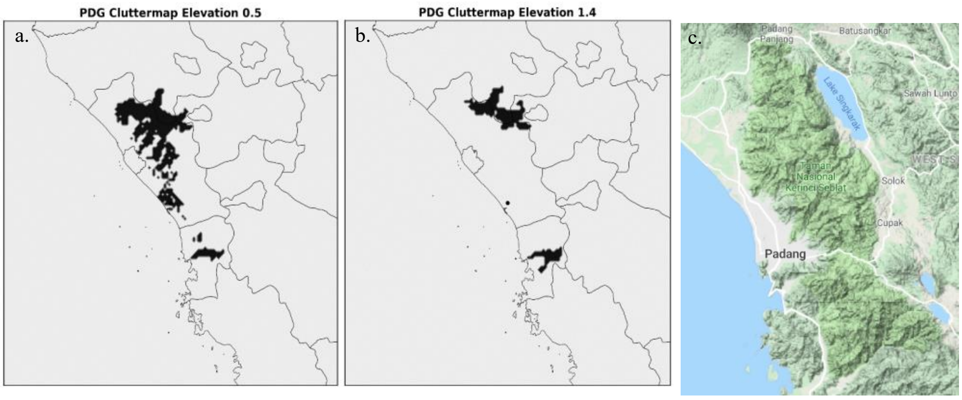
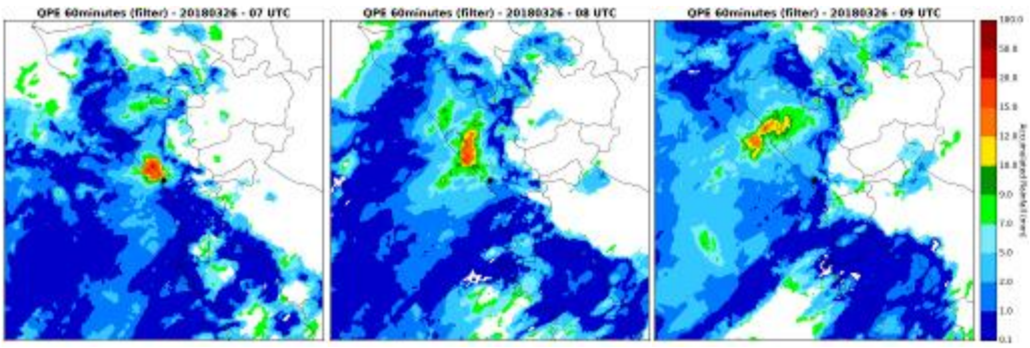


Figure 2. Clutter maps (a) and (b), Topographic Maps (c)

QPE analysis is illustrated in Figures 3 and 4, namely QPE filtered and unfiltered QPE. From the picture it can be seen that there is a change in the QPE image before and after the implementation of the clutter map. The change that can be seen is that in the area with ground clutter successfully reduced by the clutter map. Clutter implementation on QPE can reduce reflectivity intensity, however, not significantly. The difference in rainfall values between AWS, radar filtered, and unfiltered radar, is explained in Tables 2 and 3.



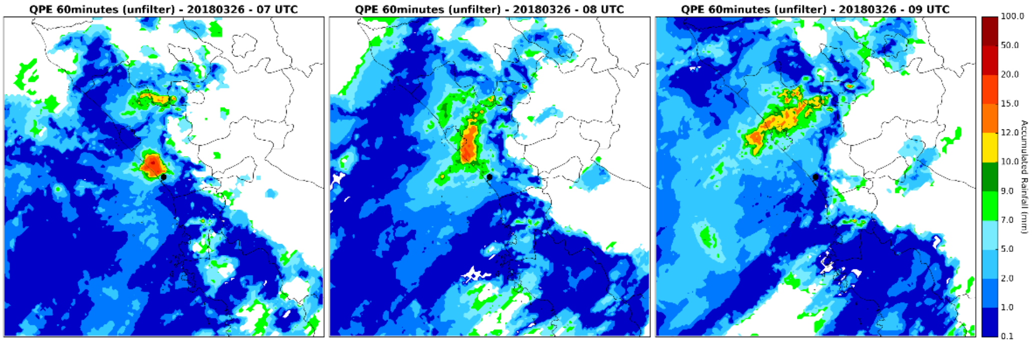


Figure 3. QPE is filtered (above) and unfiltered (below) on March 26, 2018

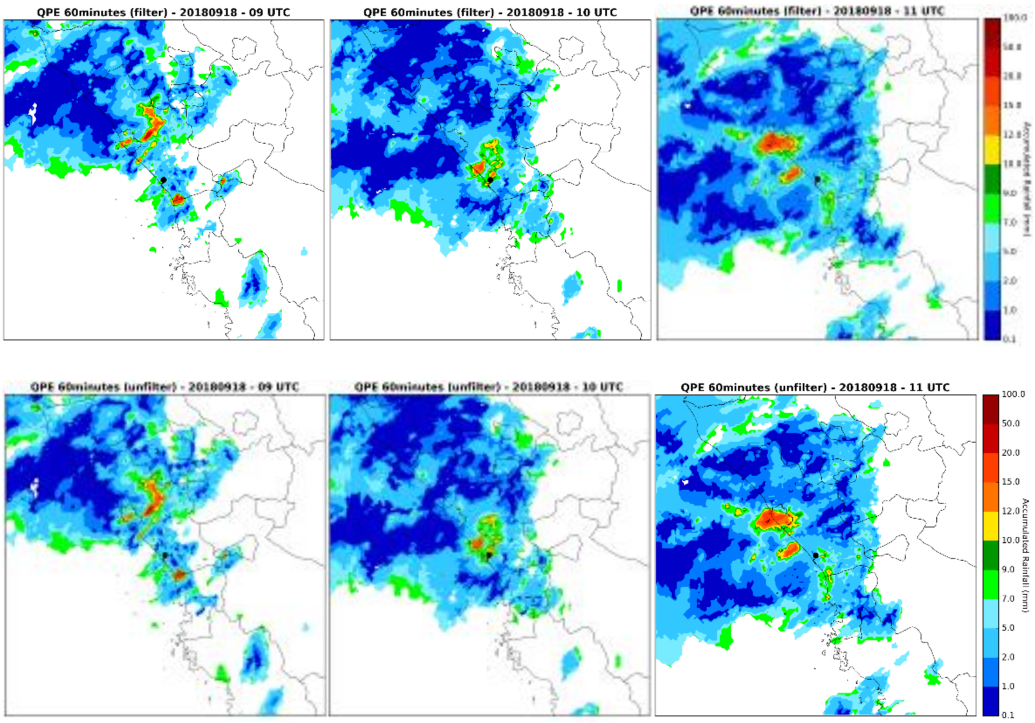


Figure. 3. QPE is filtered (above) and unfiltered (below) on September 18, 2018

TABLE 2
RADAR AND AWS RAINFALL DATA ON MARCH 26, 2018

Hour	AWS Digi Stamet Padang	Radar *Filtered*	Radar *Unfiltered*
6	8.2	1.79058	1.79058
7	23.8	6.01723	6.20075
8	23	4.9203	4.95443
9	5	0.91592	1.11733
10	1.4	0.41392	0.68779
11	7.6	0.58902	0.65797
12	0.8	0.50761	0.67225
13	2.6	0.65489	0.92254
14	0.4	4.20828	0.55295
15	0.2	6.75195	0.73862
16	0.2	5.20325	0.42685

Hour	AWS Sungai Limau	Radar *Filtered*	Radar *Unfiltered*
6	1.6	3.4164	3.4164
7	15.2	3.63424	3.63424
8	43.2	8.53254	8.53254
9	41	9.46941	9.46941
10	7	2.92901	2.92901
11	2.8	1.18203	1.18203
12	8	1.43109	1.43109
13	1.4	0.76115	0.76115
14	0.2	5.85729	5.85729
15	2	4.80045	4.80045
16	0.4	1.94852	1.94852
17	0.2	5.90722	5.90722

Hour	AWS Pasaman Barat	Radar *Filtered*	Radar *Unfiltered*
6	0.4	4.9756	4.9756
7	3.2	1.93604	1.93604
8	12.8	0.46392	0.46392
9	24.4	1.77243	1.77243
10	2.4	1.8044	1.8044
11	30	1.79464	1.79464
12	9	0.78448	0.78448
13	25.4	1.83897	1.83897
14	13.6	1.64393	1.64393
15	6.4	2.56761	2.56761
16	1.6	2.07808	2.07808

Hour	ARG Batang Kapas	Radar *Filtered*	Radar *Unfiltered*
3	1	0.47617	0.47617
4	3.2	0.43022	0.43022
5	2.4	0.27452	0.27452
6	0.8	4.19848	4.19848
7	12.4	1.7692	1.7692
8	0.4	6.6895	6.6895
9	2.2	0.85999	0.85999
10	0.4	0.38767	0.38767

TABLE 3
RADAR AND AWS RAINFALL DATA ON MARCH 26, 2018

HOUR	AWS DIGI STAMET PADANG	RADAR *FILTERED*	RADAR *UNFILTERED*
9	26.6	3.54331	3.64383
10	51	7.61397	7.95368
11	10.2	2.07391	2.14445
12	1.8	1.35089	1.5289
13	1	5.04135	0.50122

HOUR	AWS SUNGAI LIMAU	RADAR *FILTERED*	RADAR *UNFILTERED*
9	1.8	1.10987	1.10987
10	0.8	0.34968	0.34968
11	1.6	1.33464	1.33464
12	0.2	2.26024	2.26024

HOUR	AWS PASAMAN BARAT	RADAR *FILTERED*	RADAR *UNFILTERED*
6	1.2	2.97728	2.97728
7	7.6	3.13663	3.13663
8	2.2	1.9723	1.9723
9	0.2	5.11658	5.11658
10	0.4	3.44694	3.44694

HOUR	ARG BATANG KAPAS	RADAR *FILTERED*	RADAR *UNFILTERED*
10	0.6	5.90057	5.90057
11	0.6	5.86306	5.86306

TABLE 4
SUMMARY OF VERIFICATION RESULTS

Date- AWS	Correlation			MAE			Standard of Deviation		
26 March 2018	F	UF	F-UF	F	UF	F-UF	F	UF	F-UF
ARG Sungai Limau	0.73	0.73		9.02	9.02		11.10	11.10	
AWS Digi Stamet Padang	0.34	0.96	0.46	6.54	5.12	1.42	6.43	6.54	2.24
AWS Pasaman Barat	-0.35	-0.35		10.70	10.70		8.66	8.66	
ARG Batang Kapas	-0.16	-0.16		3.39	3.39		3.10	3.10	

18 September 18									
ARG Sungai Limau	-0.40	-0.40		0.87	0.87		0.67	0.67	
AWS Digi Stamet Padang	0.74	0.99	0.71	15.81	14.97	1.05	15.18	15.39	2.46
AWS Pasaman Barat	-0.32	-0.32		2.89	2.89		2.12	2.12	
ARG Batang Kapas				5.28	5.28		2.64	2.64	

The analysis of verification of the filtered and unfiltered radar data on AWS Sungai Limau with distance from the radar center of about 34 km resulted in a high correlation value of 0.73 in the case of rain on March 26, 2018, and a low correlation on September 18, 2018, with a correlation value of -0.4. Based on the clutter maps, at the AWS point there is no clutter on the clutter map, so the radar data is not corrected by the clutter map.

Based on research data, the verification analysis at AWS Digi Stamet Padang with a distance of about 1 km from the radar center, the implementation of clutter map (filtered) has a low correlation value compared to data without the implementation of clutter map (unfiltered). Radar filtered data has a bias value that tends to be larger than unfiltered data. Data filtered and unfiltered have fairly good correlation and low bias. Low bias values and correlations illustrate the clutter map performance at a distance of less than 50 km is less significant.

The verification on AWS West Pasaman with a distance of about 110 km from the radar center, detected no clutter so that it does not experience clutter reduction in QPE processing. Based on statistical tests, the correlation value of filtered and unfiltered radar has a negative correlation which means that QPE radar and AWS do not have the same trend. This is due to the limitations of bulk verification data on AWS.

Referring to the radar blocking beam data, the AWS Cotton Rods is within the partial beam blockage area at an elevation of 0.5° to 1.4° so that the radar data is only available at elevations 2.6°-10°. Limitations of the radar data cause a lack of volume of atmospheric samples obtained during observation. The radar data at higher elevations have a higher reflectivity value caused by the radar waves emitting clouds in the core and cloud tops, while the AWS data is recorded only capturing the amount of rainfall falling to the ground by less than 1 mm/hour. This causes a low correlation value and the magnitude of the deviation between the radar data and the rain gauge data. Apart from this, the limitations of the data used for the statistical test affect the results of verification.

The value of the same rainfall estimation between the filtered and unfiltered radars can be caused by the distance of AWS which is far enough from the radar center which corresponds to the working principle of the radar: the further from the radar center, the height of the scanning/beam width radar will increase. Therefore the clutter on the surface, however the distance from the radar center, is not caught by radar. Consequently, only on the AWS Digi Stamer Padang there is a difference between the filtered and unfiltered rainfall radars values because the distance is less than 10 km from the radar center.

5. Conclusion

The radar-based rainfall estimation is influenced by several factors such as ground clutter that affects the effectiveness of observations. Therefore it is important to reduce the non-precipitation (ground clutter) echo which can cause errors in the interpretation of rainfall estimation. The application of clutter map in the heavy rain events in West Sumatra was carried out with the aim of reducing ground clutter. The results showed that the clutter map with a *wradlib*-pyton-based 90% threshold was able to map the ground clutter, and reduced the deviation of the rainfall estimation from radar, however it was not significant. The *wradlib*-python-based clutter map was less significant in improving the partial beam blockage region. The limitations of radar are not only affected by ground clutter and blocking. However, there are other factors such as the relationship of ZR, beam spreading, beam refraction, and beam attenuation, so that quality control is needed for the radar data to be used. In addition, it is necessary to pay attention to the quality of data compared to rain gauges, especially in terms of equipment conditions and data continuity.

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Identification of Earthquake Hazard Zones Through Deterministic Seismic Hazard Analysis (DSHA) Method at Bandar Lampung City Based

SyamsurijalRasimeng[1,2], Putri Amalia[1], Desta Amanda Nuraini[1], Masdar Helmi[3], Tugiyono[4], Suharno[1]
[1]Department of Geophysics Engineering, University of Lampung, Indonesia
[2]Doctoral Programme of Environmental Sciences, University of Lampung, Indonesia
[3]Department of Civil Engineering, University of Lampung, Indonesia
[4]Department of Environmental Sciences, University of Lampung, Indonesia

Email: syamsurijal.rasimeng@eng.unila.ac.id

Abstract

Research on earthquake hazard zone analysis based on MASW data using deterministic methods in the Bandar Lampung which aims to determine the PGA (*Peak Ground Acceleration*) earthquake originating from the Srike-Slip Faults and the determination of soil classes based on Vs30 values. The method used is (i) identifying the earthquake source that affects the study area (ii) calculating the closest distance of the earthquake source to the study area (iii) calculating the attenuation function with Vs30 from MASW data (iv) calculating PGA *Bedrock* and *Soil*. The results of Vs30 data analysis for the city of Bandar Lampung show soil classes B, C, D to E, maximum values of land acceleration (PGA) in thelayer *bedrock* ranging from 0.0607g to 0.0752g. Meanwhile, maximum ground acceleration (PGA) inlayers *soil* ranges from 0.0637g to 0.1894g.

Keywords: *Deterministic, Vs30, PGA, Semangko Fault, Site Class.*

1. Introduction

Tectonically, the territory of Indonesia is a very complex and very active region that produces earthquakes that cause disasters. This area consists of three large tectonic plates namely Australian, Indian and Eurasian plates and nine small plates namely Burma plate, Maluku sea plate, Banda sea plate, Timor plate, Philippine plate, Caroline plate, Birdhead plate, Mauke plate and Woodlark plate (Bird , 2003). Plate with a variety of different types of movements that have shaped the earthquake zone subduction (the subduction zone) and zone transform fault (the transform fault zone) that is now a source of seismic active zone.

The geological conditions of KBL which are still influenced by the *Sumatra Fault System* (SFS) and the tectonic activity subduction *of* the Indo-Australian plate towards Eurasia are also inseparable from the earthquake shocks caused by these two geological phenomena. So that the city of Bandar Lampung, which is the center of services, trade and economy in the province of Lampung, needs to anticipate all the impacts caused by the earthquake. One of them is by determining earthquake prone zones. Based on the calculation of the effect of the fault zone on the area around the fault zone, the Semangko fault has *Peak Ground Acceleration* a fairly high (PGA) value. So that it can be expected to have a significant impact on the city of Bandar Lampung. Semangko Fault is a geological formation that stretches on the island of Sumatra from north to south, starting from Acehto Teluk Semangka in Lampung. This fault forms the Barisan Mountains, a series of highlands on the west side of the island. Semangko Fault is relatively young and most easily seen in the Sianok Canyon and Anai Valley areas near the City of Bukittinggi.

1. Methodology

2.1 Determination of coordinates The

Determination of coordinates is carried out in the city of Bandar Lampung using Google Earth software. After that calculations are carried out *latitude* and *longitude* at some points in Bandar Lampung city and 42 coordinates are obtained.

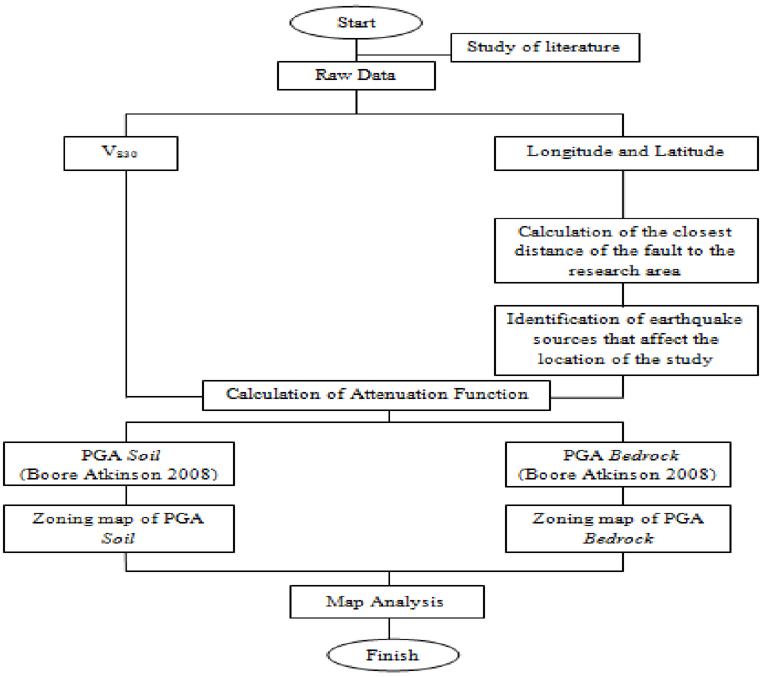
2.2 Calculation of VS30

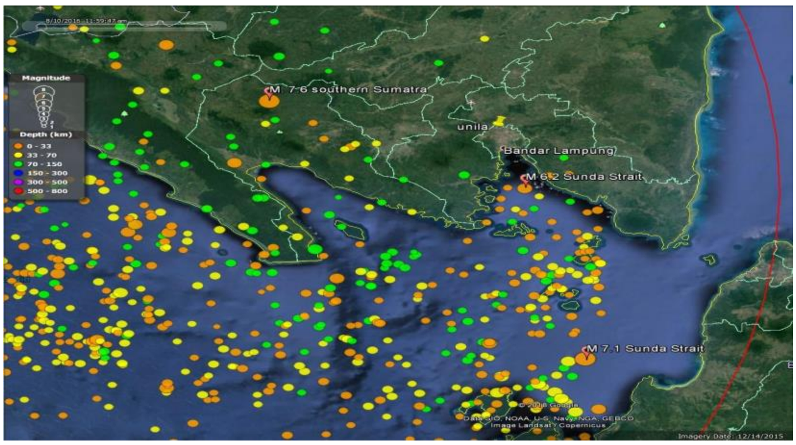
Estimates of Vs30 are obtained from *Multichannel Analysis of Surface Wave* (MASW) data in Bandar Lampung city. The estimation of Vs30 is then used to determine the soil class based on *The NEHRP site classes*.

2.3 Deterministic Seismic Hazard Analysis (DSHA)

In general, the DSHA approach method can be divided into 4 stages, namely: identifying earthquake sources that are likely to affect the observation location, determining the scenario of earthquake parameters by selecting the maximum magnitude and the closest location of the earthquake source which is expected to have an impact on the location of the observation, determine the parameters of ground motion at the observation location by using the attenuation function and determining the parameters of the largest soil movement planned to occur at the observation site. DSHA is done by determining the parameters of ground motion at the observation location using attenuation functions (Irsyam, 2010).

2. Analysis and Discussion





In this study, the location of the Lampung airport was located close to the stamps fault and the Sundanese fault. To determine the effect of the earthquake source, a PGA calculation was performed on each earthquake source for the study location. The following is the PGA value in the stamps fault and sunda fault:

Area	Magnitude	Location		The epicenter to the research location (meters)	G
Kumering Strait	6.2	5.629S	105.322E	72.109.07	0.08509996
Southern Sumatra	7.6	5.226S	104.596E	30.404,56	0.096702953
Sunda Strait	7.1	6.389S	105.480E	117,690.03	0.08509996

From the table, it can be seen that the greatest PGA value is found in semangko faults, this indicates that the stamps fault was the source of the earthquake that affected the Bandar Lampung region.

A. Determining the value of Vs30

After the earthquake source is obtained, then determine the value of Vs30. Vs30 values in the Bandar Lampung region were obtained through the *Multichannel Analysis of Surface Wave* (MASW) data in Bandar Lampung city. The value of vs30 is used to determine the classification of rocks based on the strength of earthquake vibrations due to local effects and is used for purposes in the design of earthquake resistant buildings.

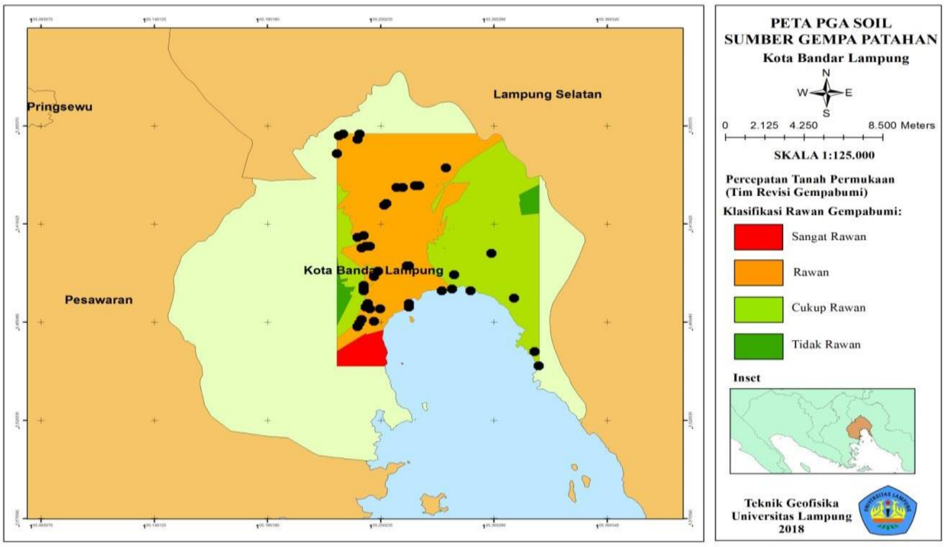
Class Land	General Description	Vs30 (m / s)
A	Rock	hard>1,500
B	Rock	750-1500
C	Land hard, very dense and soft rocks	350-750
D	Land Average	175-350
E	Land Software	<175

Table 3.1 Classification of *Site Class* based NEHRP (FEMA 302, 1997).

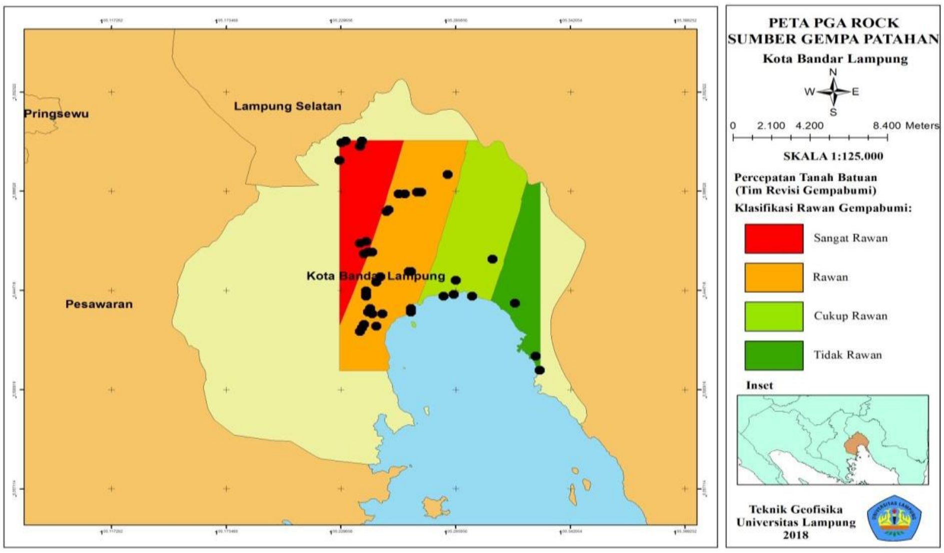
In the city of Bandar Lampung the value of Vs30 ranged from 47.3 m / s to 800 m / s, this indicates that the city of Bandar Lampung has a class of land class B, C, D and E where the soil class cannot continue seismic waves due to the type of soil in this rock is soft rock.

B. Analysis of the DSHA Method

Analysis of the potential earthquake risk in the Bandar Lampung region is done using the Deterministic Seismic Hazard Analysis (DSHA) method where the results obtained are in the form of Peak Ground Acceleration in the bedrock layer and soil layer. This PGA value is obtained from the calculation of the attenuation function.



Based on attenuation calculations using the Boore-Atkinson equation (2008) the PGA values in the bedrock layer ranged from 0.0605g-0.0755g and the PGA values for soil layers ranged from 0.06g-0.18g. From the PGA calculation by entering the value of Vs30 it can be concluded that if Vs30 is large, the resulting PGA value will be smaller and vice versa. On the zoning map of the bedrock layer, it can be seen that the PGA value of 0.073g is a very vulnerable zone located in the upper west direction. While on the zoning map in the soil layer, it can be seen that the PGA value of 0.19g is a very vulnerable zone.



4. Conclution

In Bandar Lampung City the Vs30 value produced ranges from 180 m/s to 760 m/s, this indicates that Bandar Lampung City has class C, D and E soil classifications which describe medium and hard land. The bedrock PGA values ranged from 0.060700g-0.075259g while the PGA values in soil ranged from 0.063771g-0.189448g. The deterministic method gives a picture of the relationship between the strength of the earthquake and the distance of the earthquake source. Areas that are closer to the rupture area will have a PGA value greater than the area farther away from the rupture area and the PGA value can also be affected by the type of soil.

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Lead Time Prediction Between Magnetic Anomaly and Earthquake Occurrence Using Lombok Earthquake's Magnetic Anomalies and Seismograph Data, West Nusa Tenggara

Rindi Antika Sari[1], Suaidi Ahadi,[2] M.Syirojudin,[3] Syamsurijal Rasimeng,[4]
[1,4] Geophysical Engineering, Faculty of Engineering, University of Lampung

[2,3] Meteorological Climatological and Geophysical Agency Jakarta, Indonesia
e-mail : antikasaririndi@gmail.com[1)], suaidi.ahadi@gmail.com[2)], syirojudin.bmkg@gmail.com[3)], syamsurijal.rasimeng@gmail.com[4)]

Abstract. Lombok earthquake event that indicated as the major earthquake on August 5, 2018 at 21:56 WIB, with strength of 7 Mw and 10 Km depth, has a epicenter distance 30 km away to NorthEast of East Lombok. BMKG (2018) states that this earthquake occurred due to Flores Back Arc Thrusting activities, this statement concluded as a result of earthquake source mechanism movement analysis to the shifting rocks (plates) that moving up. In an effort to mitigate earthquake disaster, BMKG try to figure out the changes in the magnetic field due to plates shifting activities that cause earthquakes by installing LEMI 018 on August 28, 2018 at Bayan field. This tool is used for measuring earth's magnetic variance data to find out the cause of the earthquake in further analysis. By using magnetic anomaly data from August to October recorded by the LEMI 018 at Bayan Station, a frequency spectrum analysis and *Z/H* ratio polarization was carried out to determine Onset time anomalies. As a result of data processing and analyzing, show that the lead time between magnetic anomalies and earthquake events using data from the earthquake seismograph of Lombok ,West Nusa Tenggara, has a minimum leadtime occurring for 173 hours and maximum leadtime occurring for 658 hours.

Keywords : Lead Time, Magnetic Anomaly, Precursor, Seismograph.

1. INTRODUCTION

Earthquake events that appear suddenly cause a lot of material losses and fatalities. Earthquakes occur because of tectonic events that always cause the earth's surface to move, such as the collision between plates and others that will cause earthquakes. The process of *stress* accumulation that occurs in rocks causes the emission of electromagnetic waves, and these emissions will result in changes in the value of measuring the magnetic data of the earth. At this time a theory has been found about earthquake precursors, earthquake precursors can be done by knowing changes in rock magnetism values in an area, with parameters from earthquake precursors including onset time, earthquake forecast zone, magnitude, and lead time.

Hattori, et al (2006), illustrate the three approach models of the mechanism of the occurrence of *ULF* wave changes in **Figure 1** by (Kamogawa, 2004). Two models explain *ULF* emissions caused by electrokinetic effects and the effects of micro-fracturing and one model explains the changes in the amplitude of electromagnetic waves seen from Power Ratio (*Z/H*) where the *H* and *Z* components greatly influence changes in the earth's magnetic field. If a significant change in conductivity occurs in the *H* component while the *Z* component is small then it is believed to originate from the atmosphere or ionosphere, but if there is a large conductivity in the *Z* component but small in the *H* component it is believed to be a result of lithosphere activity.

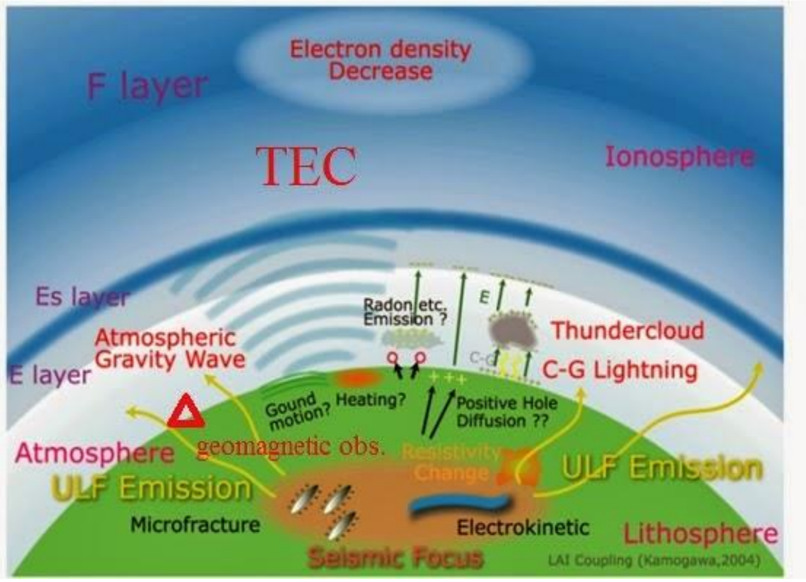


Figure 1. Three models of ULF emission anomalies related to earthquakes (Kamogawa, 2004).

The electrokinetic effect in theory, Fenoglio, et al. (1995) explains that this effect arises because rocks experience changes in pressure caused by deposits of silica in these rocks resulting in a disruption of the earth's magnetic flow.

Induction effect according to (Kovtun, 1980; Mogi, 1985) the effect of induction is the effect that arises due to the activity at the source of the earthquake (*focal zone*) which causes changes in the geo-electrical conductivity and amplitude of electromagnetic waves, non-lithospheric.

The effect of Micro-Fracturing Molchanov and Hayakawa (1995) explains that the emission of electromagnetic waves with the recorded *Ultra Low Frequency* (ULF) spectrum is assumed to experience a significant increase in the event of a fault in the rock. Therefore only the pressure induction process can meet to explain micro-fracturing observations.

This research was conducted to find out the leadtime of the earthquake, where the lead time of the earthquake is the time for estimating the occurrence of the earthquake from the time the initial anomaly appeared until the occurrence of the earthquake event. Ahadi.dkk., (2013) has conducted a 2009 earthquake earthquake precursor study related to ULF emission anomalies, namely with polarization ratios for determining the onset time and Single Station Transfer Function to determine the direction of anomalies magnetic. Lombok is one of the regions that has a high seismic history and Lombok is also an area that has high geomagnetic value because it is located between two earthquake plants namely the subduction zone and the *Flores Back Arc Thrust*. So, in this study the authors used Lombok's magnetic anomaly data which was used as an earthquake precursor. With the aim of this research is to find out the relationship between magnetic anomalies and earthquake events and determine the onset time and lead time for earthquakes

2. LITERATURE REVIEW

2.1 Research Areas

The area in this study is located in the Lombok area, West Nusa Tenggara.

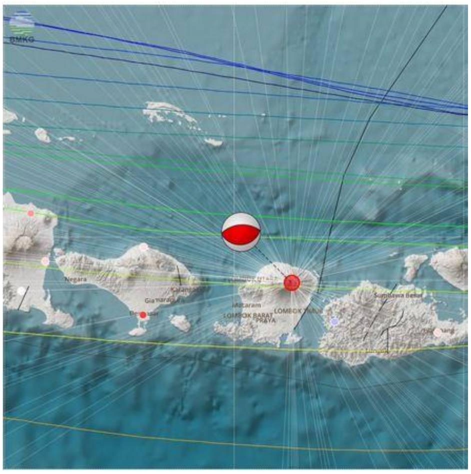


Figure 2. Map of Research Area (Bmkg, 2018)

2.2 Lombok Tectonic

Figure 3 explains that Lombok is between two earthquake generators originating from the south and north. In the south there is a subduction zone of the Indo-Australian plate that dips below the island of Lombok. Whereas from the north there is a geological structure named fault rose Flores or *Flores Back Arc Thrusting*. This fault rises Flores, the route extends from the Bali Sea to the east to the Flores Sea and is very close to Lombok Island (Daryono, 2011). With this, Lombok is said to be an earthquake-prone area, although with a hypocenter depth and varying magnitude.

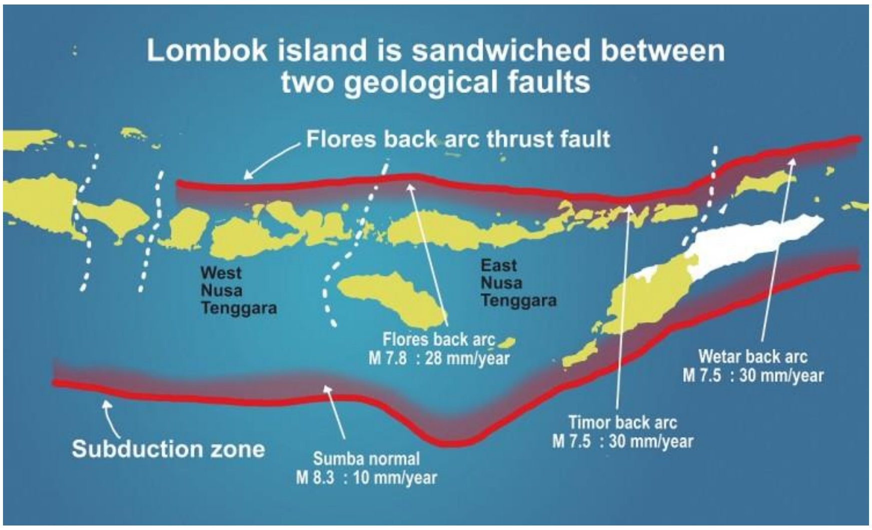


Figure 3. Subduction and Flores Zone *Back Arc Thrust* (Bmkg, 2018)

3. RESEARCH METHODS

The data used in this study is geomagnetic data from September 2018 to October 2018 which was recorded by the magnet LEMI-08 at bayan station, Lombok. And also used earthquake data that has occurred with an epicenter distance of up to 500 Km from the station.

The geomagnetic data to be analyzed are daily *H* and *Z* component data with an hourly time interval. Also used is the daily Dst Index data according to the time the anomaly appears as a validation to find out the cause of the anomaly arising from the earth's external or internal activities. Where the *H* component is believed to be more influenced by the activity of the external earth and the *Z* component is believed to be more influenced by the earth's internal activity (lithosphere).

Geomagnetic data processing as an earthquake precursor is carried out several stages, namely, conversion, correction, *Z/H* Polarization Ratio, Single Station Transfer Function (*SSTF*), determination of anomalies as earthquake precursors and validation with earthquake events that occur

3.1 Data Conversion

This conversion phase is done to change the data format to ASCII format data, this is done to facilitate reading the data

3.2 Data Correction

This correction phase is carried out daily trend correction which is useful to fill in the blank data with trend data so that complete data is obtained on each component. And the diff ploting process is performed to show the difference in data with data criteria that do not exceed ± 1. Furthermore, a bandpass filter process is carried out on each component, namely the *H* component and *Z* component frequency range 0.02-0.006 Hz, because the frequency range is believed to be more influenced by seismogenic activity.

3.3 Single Station Transfer Function (SSTF)

This method is used to convince geomagnetic interference signals originating from the earth's internal activities (lithosphere), where according to Hattori (2004) this transfer function can solve an equation from components X,Y,and Z geomagnet. This relationship is considered a linear system that has input and output. This transfer function also has information about underground electrical conductivity or commonly called CA (Counductivity Anomaly). With the equation as follows:

Linear relationship of geomagnetic variation of components X, Y, Z

$$\Delta Z\ (\omega) = A.\Delta X\ (\omega) + B.\Delta Y\ (\omega) \quad (1)$$

To determine the magnitude of constants A and B, linear inversion is used, as follows:

$$d = G\ m \quad (2)$$

Information :

d: Data matrix (value ΔZ (*ω*))

G: Kernel matrix (values ΔX (*ω*) and ΔY (*ω*))

m: Model matrix ((values A (*ω*) and B (*ω*))

$$\begin{bmatrix} \Delta Z1 \\ \Delta Z2 \\ \Delta Zn \end{bmatrix} = \begin{bmatrix} \Delta X1 & \Delta Y1 \\ \Delta X2 & \Delta Y2 \\ \Delta Xn & \Delta Yn \end{bmatrix} \begin{bmatrix} A \\ B \end{bmatrix} \quad (3)$$

Values A and B can be searched by formula

$$m = [G^T \quad G]^{-1}\ G^T d \quad (4)$$

$$\begin{bmatrix} A \\ B \end{bmatrix} = \left[\begin{bmatrix} \Delta X1 & \Delta X2 & \Delta Xn \\ \Delta X1 & \Delta Y2 & \Delta Yn \end{bmatrix} \begin{bmatrix} \Delta X1 & \Delta Y1 \\ \Delta X2 & \Delta Y2 \\ \Delta Xn & \Delta Yn \end{bmatrix} \right]^{-1} \begin{bmatrix} \Delta X1 & \Delta X2 & \Delta Xn \\ \Delta X1 & \Delta Y2 & \Delta Yn \end{bmatrix} \begin{bmatrix} \Delta Z1 \\ \Delta Z2 \\ \Delta Zn \end{bmatrix} \quad (5)$$

The magnitude of magnetic anomalies is formulated as follows

Amp (ω) = $\sqrt{A(\omega)^{\,2} + B(\omega)^{\,2}}$

And then, the magnitude of the direction of the magnet anomaly is formulated as follows

θ $= tan^{-1}(\frac{B}{A})$

Where : ΔZ = Vertical Geomagnetic Component (nT)
ΔX = Geomagnetic (nT) Horizontal Component (North - South)
ΔY = Geomagnetic (nT) Horizontal Component (East - West)
A and B = constants sought
Amp = Conductivity scale (Distance between conductivity fields)
θ = Direction of magnetic anomaly source (°)

The results of *SSTF* processing are in the form of a quadrant graph that shows the direction of the earthquake forecast zone which will then be plotted on the map with a zero position graph according to the location of the sensor at the station. Where according to Ahadi. Et al. (2014) the direction of this azimuth can be categorized as an earthquake precursor if it has a direction in the direction of the earthquake epicenter, with a tolerance limit of 25 ° with the up and down direction of the actual azimuth.

3.4 Polarization Ratio of Z/H

This method is used to determine the onset time anomaly, by analyzing standardization and daily normalization so that the daily value of component *H* and component *Z* will be obtained. Which refers to the research conducted by Prattes, et al., (2011). geomagnetic daily variation, so that it can be seen that the emission or anomalous value that arises comes from internal activities of the earth or global geomagnet. The equation used is as follows:

Prattes et al. (2011) analyzed the standardization and daily normalization with the following formula:

$$S_{HDAY}(\omega) = \frac{|SH\ (\omega)|^2}{2\pi.\Delta f} \quad (6)$$

$$S_{ZDAY}(\omega) = \frac{|SZ\ (\omega)|^2}{2\pi.\Delta f} \quad (7)$$

To get statistical analysis that is better used in daily averages:

$$S_{\Sigma\, HDAY}(\omega) = \sqrt{\frac{1}{n}\Sigma[SH\ (\omega)]^{\,2}} \quad (8)$$

$$S_{\Sigma\, ZDAY}(\omega) = \sqrt{\frac{1}{n}\Sigma[SZ\ (\omega)]^{\,2}} \quad (9)$$

And the daily values of H and Z components are obtained as follow:

$$H_{\ Day} = \frac{s\Sigma HDay - \mu\, \Sigma HMonth}{\sigma \Sigma HMonth} \quad (10)$$

$$Z_{\ Day} = \frac{s\Sigma ZDay - \mu\, \Sigma ZMonth}{\sigma \Sigma ZMonth} \quad (11)$$

For the polarization of the power ratio the following equation is used:

$$P\ Day = \frac{Z\ Day}{H\ Day} \quad (12)$$

3.5 Fast Fourier Transform

This stage is used as a process to change data from the time domain to the frequency domain. The equation used is as follows:

$$f(k) = \int_{-\infty}^{\infty} x(t)e^{-i2\pi ft}\, dx \quad (13)$$

Where *f (k)* as a function in the frequency domain, *x (t)* is a function in the time domain, *i* is an imaginary number, and *t* is time.

3.6 Determination of anomalies as earthquake precursor

The identification of the most accurate anomaly of the earthquake is known by calculating the standard deviation value using moving average geomagnetic data, and the determination of the anomaly is seen through the daily *Z* and *H* values that have passed the standard deviation.

4. RESULTS AND DISCUSSION

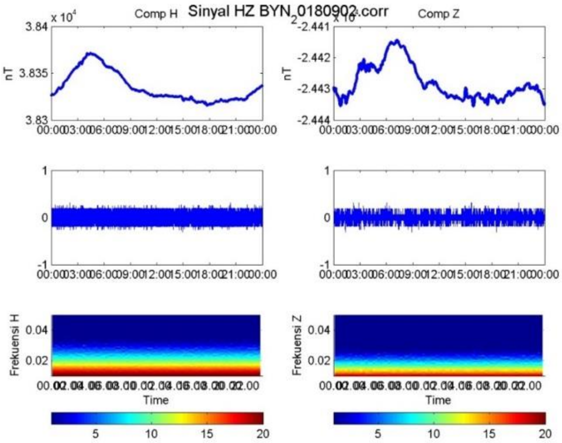
4.1 Identify anomalies as earthquake precursors

In determining anomalies as earthquake precursors it is necessary to identify with several parameters, including onset time, azimuth as earthquake forecast zone, amplitude as magnitude prediction, and leadtime. In this study 15 magnetic anomaly data were used as shown in **Table 1** which was indicated as a precursor of recorded earthquakes from Bayan station, Lombok, West Nusa Tenggara.

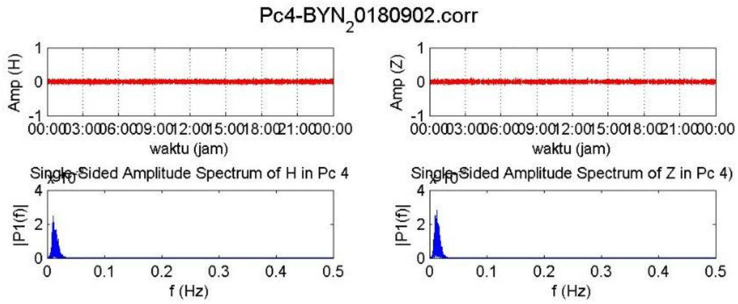
Tabel 1. Earth Magnet Anomaly as a Precursor Indicator

No.	Earth Magnet Anomaly as a Precursor Indicator				
	Date	**Time (WIB)**	**Station**	**Amplitudo**	***Azimuth***
1.	29-Agustus-108	13.00	Bayan, Lombok	2.247	314
2.	30-Agustus-2018	14.00	Bayan, Lombok	6.726	212
3.	02-September-2018	20.00	Bayan, Lombok	2.771	22
4.	03-September-2018	22.00	Bayan, Lombok	10.744	99
5.	04-September-2018	16.00	Bayan, Lombok	17.832	71
6.	05-September-2018	17.00	Bayan, Lombok	5.192	99
7.	14-September-2018	22.00	Bayan,Lombok	2.267	138
8.	19-September-2018	10.00	Bayan,Lombok	2.202	134
9.	22-September-2018	22.00	Bayan,Lombok	2.451	345
10.	23-September-2018	07.00	Bayan,Lombok	29.895	281
11.	01-Oktober-2018	02.00	Bayan,Lombok	3.668	105
12.	03-Oktober-2018	13.00	Bayan,Lombok	2.591	286
13.	04-Oktober-2018	17.00	Bayan,Lombok	2.532	314
14.	06-Oktober-2018	05.00	Bayan,Lombok	2.461	142
15.	08-Oktober-2018	20.00	Bayan,Lombok	3.355	333

The anomalious data was then analyzed for earthquake precursor parameters. The first analysis carried out was spectrum analysis, signal response, *diff* and intensity of power spectrum to ensure that the cause of the anomaly appeared as a result of global seismogenic or geomagnetic activity. According to Ahadi, et al. (2012) the *H* component is believed to be more influenced by the global or external geomagnetic activity of the earth, while the *Z* component is believed to be more influenced by the earth's internal activities**. Figure 2a** shows the signal response on *H* and *Z* components, and shows the diff ploting results and spectrograms. Seeing the data indicates that each component has a good response, does not indicate the cause of the anomaly. However, seen in **Figure 2b** shows that the intensity of power on component *Z* is greater than component *H*. By stating that the anomaly that appears on September 2, 2018 is a result of internal activities of the earth. Because component *Z* is believed to be more influenced by internal activities of the earth, while component *H* is more influenced by external activities of the earth.



(a)



(b)

Figure 2. (a) Signal Response Components *H* and *Z*. (b) Data before and after FFT and Band Pass Filter

And then azimuth analysis is used as an earthquake forecast zone using the Single Station Transfer Function (*SSTF*) method. From the results of processing using the *SSTF* method, it was found that on September 2, 2018 there were identified anomalies as earthquake precursors that occurred on September 10, 2018. With azimuth value of 22,150 ° and in the direction of the earthquake epicenter on September 10 2018 as in **Figure 3** (a) and (b).

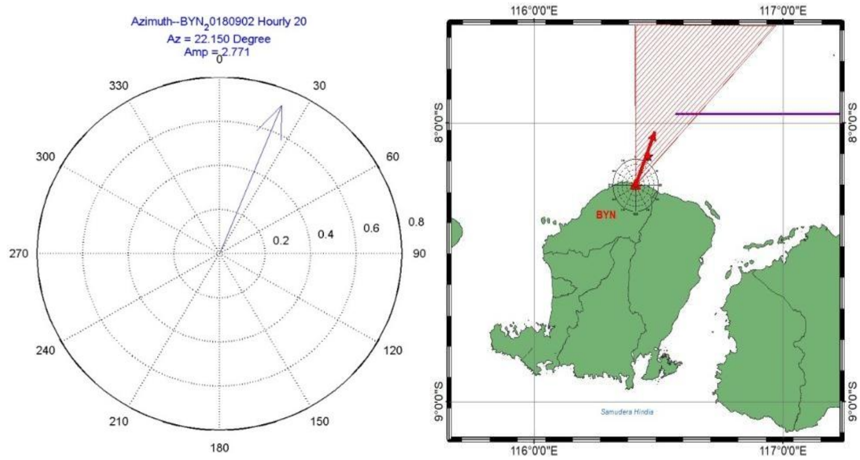


Figure 3. (a) Azimuth September 02 2018. (b) Epicenter of Earthquake September 10, 2018.

Figure 4 is the polarization of *Z/H* anomaly 02 September 2018 ratio which has been limited by standard deviation to determine the onset time anomaly and validated by the Dst index, because it refers to the research that has been done (Ibrahim, et al. 2012; Ahadi et al., 2013: 2014) Dst index is used to determine global geomagnetic activity when anomalies occur whether there are magnetic storms or not, so that it can be used to ensure that the anomalies that arise are a result of the earth's internal activities rather than global geomagnets. Data that exceeds the standard deviation is believed to be the onset time of anomalies, thus it can be seen that the onset time anomaly on 02 September 2018 is at 20.00 with an anomaly amplitude of 2,771. Looking at the daily Dst data curve on September 2, 2018, it shows a calm global geomagnetic activity, which does not indicate a geomagnetic storm. With this, it can be ascertained that the anomalies that arise are a result of the earth's internal activities.

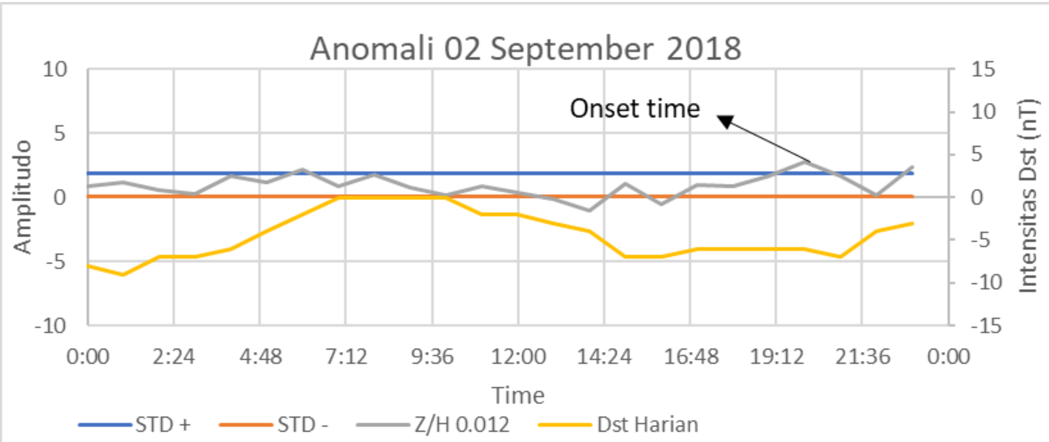


Figure 4. Polarization ratio of the Z/H September 02 2018

4.2 Determination of earthquake lead time

The lead time is the waiting time for an earthquake event, calculated from the onset time anomaly to the occurrence of an earthquake event. In determining earthquake leadtime, seismograph data from earthquake events that occur is needed. The seismograph data is then plotted with *Z/H* ratio polarization data, and daily Dst data. The maximum estimation of the earthquake lead time is 30 days from the anomaly appearing or before the earthquake event occurs. Seeing the results of ploting in **Figure 5**, it is known that the onset time anomaly is at 20:00 with an amplitude of 2,771 and the anomaly appears when the day is quiet (quiet day) does not indicate a geomagnetic storm that occurs. Validation results with earthquake seismograph data from 10 September 2018 revealed that the lead time of the anomaly appeared until the earthquake occurred for 175 Hours or for 8 days, with a blue dashed line marked as the September 10 2018 earthquake leadtime.

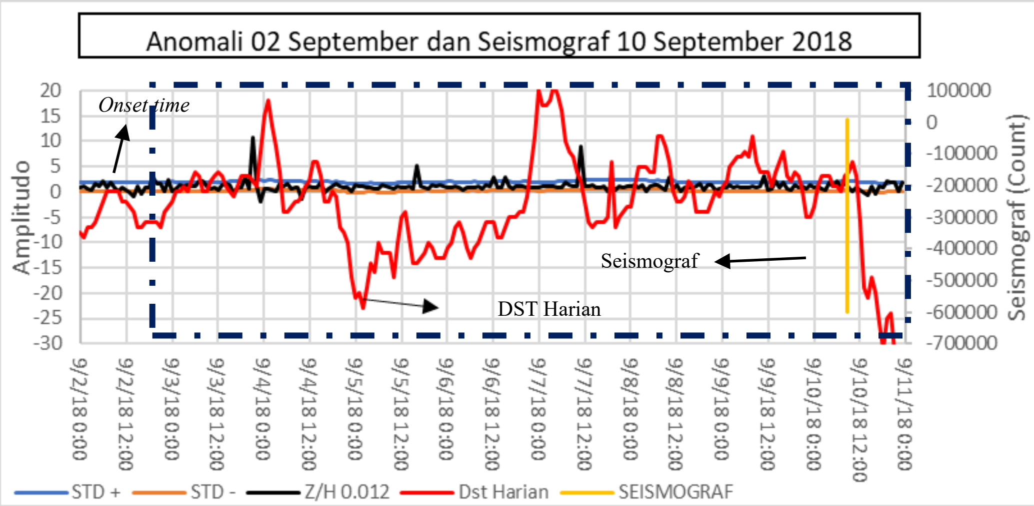
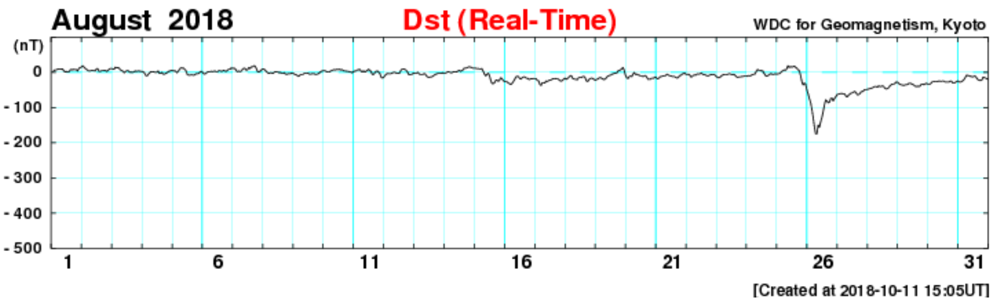


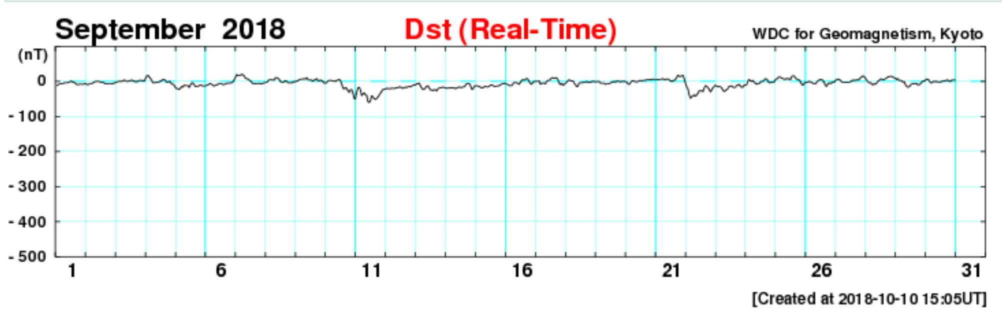
Figure 5. Earthquake lead time September 10, 2018

In this study, 8 release earthquake event data were in accordance with earthquake precursors from magnetic anomaly data in **Table I**, which had been analyzed for earthquake precursor parameters, with an earthquake epicenter distance from the station maximum 500 Km. Earthquake events that occur have magnitudes> 4 Mw. **Table 2** is 8 magnetic anomaly data and earthquake information that have been analyzed such as anomalious data September 02 2018 and earthquake information September 10 2018. With this it can be stated that the 8 anomalies that have been identified as precursors of earthquakes are a result of internal activities of the earth (lithosphere), because it is seen from the graph of the Dst index data in **Figure 6** when an anomaly appears there is no geomagnetic storm event.

Determination of the lead time of 8 earthquake events in accordance with earthquake precursors and validation of the *Z/H* ratio polarization data with sesmograph data from each earthquake event that occurred, obtained the minimum lead time and maximum results from anomalies appearing until the earthquake event occurred for 8 days and 28 days. With this, it can be stated that the 8 earthquake precursor data is right because it is seen from the lead time there is also no lead time that exceeds the limit that is for 30 days.



(a)



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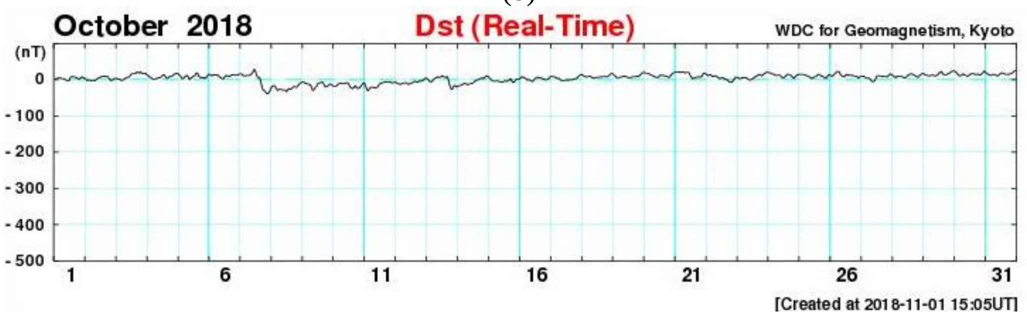

(c)

Figure 6. (a) Index Dst. in August. (b) Index Dst in September. (c) Index Dst in October

Table 2. Data on Anomalies as Precursors and Earthquake Data

No.	Date Anomalies	Amplitudo Anomalies	Earthquake Event	Lead time (Δt)	Indeks Dst	Magnitude (Mw)	Distance (Km)
1.	29 Agustus 2018	2.247	18 September 2018	474 Hour (20 day)	-20 nT	4.7	20
2.	02 September 2018	2.771	10 September 2018	175 Hour (8 day)	-6 nT	4.6	15
3.	03 September 2018	10.744	11 September 2018	173 Hour (8 day)	2 nT	5.4	17
4.	05 September 2018	5.192	23 September 2018	448 Hour (18 day)	-13 nT	4.4	41
5.	14 September 2018	2.267	12 Oktober 2018	658 Hour (28 day)	-22 nT	4.9	485
6.	23 September 2018	29.895	11 Oktober 2018	443 Hour (18 day)	-27 nT	6.4	232
7.	26 September 2018	6.757	07 Oktober 2018	261 Hour (11 day)	-4 nT	5.1	46
8.	06 Oktober 2018	2.461	16 Oktober 2018	251 Hour (10 day)	3 nT	4.9	324

5. CONCLUSION

Based on the research that has been done the following conclusions are obtained:

1. Changes in the Z / H magnetic anomaly at the time of the earthquake will be caused by lithospheric activity or movement of the earth's plates.
2. Each earthquake will be preceded by the appearance of magnetic anomalies, this can be used as an earthquake precursor. With leadtime between magnetic anomalies and earthquake terjaidnya is 173-658 hours.

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Collaborative Leadership in Search And Rescue Operations On Earthquake And Tsunami in Palu, Donggala, Central Sulawesi

Abdul Haris Achadi, Edi Purwanto
National Search and Rescue Agency
Badan Nasional Pencarian dan Pertolongan
Jl. Angkasa No.2-3, RW.10, Gunung Sahari Selatan, Kemayoran, Kota Jakarta Pusat, Jakarta 10610
Email: Habasarnas@gmail.com, edot.gk@gmail.com.

Abstract
Collaborative Leadership in Search and Rescue Operations in the Tsunami Earthquake and Disaster in Palu, Donggala, Central Sulawesi. One important factor in the successful implementation of search and rescue operations in accidents, disasters and conditions that endanger humans is the leadership factor. Collaborative leadership is deemed appropriate to be applied in emergency response / search and rescue operations. The purpose of this study was to find out what kind of leadership was appropriate at the time of the earthquake and tsunami search and rescue operation in Palu, Donggala, Central Sulawesi Province in particular and general search and rescue operations. Writing in the earthquake and Tsunami emergency response research in Palu Province is a qualitative descriptive study. Collaborative leadership leads to interdependent structures and cultures that work together to achieve more optimal benefits, work across organizational boundaries and leave a culture of independent achievement, and sectoral ego. Collaborative leadership in carrying out search and rescue operations, especially in the earthquake and tsunami disaster in Palu, Donggala in Su-lawesi Tengah, is the right solution in an effort to optimize search and rescue operations. The search and rescue coordinator should work together and strive to always maintain good relations with stakeholders not only during search and rescue operations, but also when there is no disaster. Stakeholders need to discuss various matters related to preparedness and action plans in the event of a natural disaster.

Keywords: Search and Rescue Operations, Leadership, Collaborative, Disaster, SMC.

1. Introduction

Central Sulawesi Province is located in the central part of the island of Sulawesi. The total area is 61,841.29 km2. The land area is 36.47 percent of the area of Su-lawesi Island.
The waters area of Central Sulawesi reaches 193,923.75 km2 with a total of 1,140 islands with the following boundaries:
a) The North is bordered by the Sulawesi Sea and Gorontalo Province.
b) East side bordering Maluku Province and North Maluku.

c) South side bordering South Sulawesi Province and Southeast Sulawesi Province.
d) West side bordering the Makassar Strait and West Sulawesi Province.
Administratively, until now Central Sulawesi Province consists of 12 Regencies and 1 City, namely: Banggai Regency, Banggai Islands, Banggai Laut, Buol, Donggala, Morowali, Morowali Utara, Parigi Moutong, Poso, Sigi, Tojo Una-una, Toli- toli and Palu City.
The geological structure and characteristics of Central Sulawesi are dominated by mountain ranges and highlands, starting from the regions of Buol and Tolitoli, there are rows of mountains that line into the mountain ranges in North Sulawesi Province. In the middle of the Central Sulawesi region, namely Donggala and Parigi Moutong, there is an isthmus that is flanked by the Makassar Strait and Tomini Bay, besides that most of them are hilly and mountainous areas. In the south and east, which includes the Poso, Tojo Una-una, Morowali and Banggai Regencies, there are very tight groups such as the Tokolekayu Mountains, Verbeek, Tineba, Pampangeo, Fenne.
Central Sulawesi Province is a region that has the potential for earthquakes because Sulawesi is skipped by the formation of the Pacific Ring of Fire connected from Japan, the Philippines, Maluku and Sulawesi. This formation is a series of volcanoes with more than 450 active and inactive volcanoes.
Overall the condition of Central Sulawesi Province can be described as follows:

A. Topography of Central Sulawesi

Based on the slope of the land, the plains of Central Sulawesi are detailed as follows:
1) Slope of 0-3 degrees around 11.8%;
2) Slope of 3-15 degrees around 8.9%;
3) Slope of 15-40 degrees around 19.9%;
4) Slope above 40 degrees around 59.9%.
Based on the height of the sea level, divided into:
1) The altitude of 0 m to 100 m is around 20.2%;
2) Altitude of 101 m to 500 m around 27.2%;
3) Altitude of 501 m to 1,000 m around 26.7%;
4) Altitude of 1.001 m above about 25.9%.

B. Area and distance between regencies / cities

C. Area (Km²) District / City in Central Sulawesi Province[1]

No	Districts/ City	Scale Km²	Capital city districts
1	Banggai	9.672,70	Luwuk
2	Banggai Kepulauan	2.488,79	Salakan
3	Banggai Laut	725,67	Banggai
4	Buol	4.043,57	Buol
5	Donggala	4.275,08	Donggala
6	Morowali	3.037,04	Bungku
7	Morowali Utara	10.004,28	Kolonedale
8	Parigi Moutong	5.089,91	Parigi
9	Poso	7.112,25	Poso
10	Sigi	5.196,02	Sigi Biromaru
11	Tojo Una-una	5.721,15	Ampana
12	**Toli-toli**	**4.079,77**	**Toli-toli**
13	Palu	395,06	Palu

[1] Ibid

Total Population	**2.876.689**	

Tabel 1: Area Size quoted from Regional Administration Code and Regional Data (Permendagri No.56-2015)

Distance (km) between regencies / cities and the provincial capital in Central Sulawesi:[2]

No	Districts/ City	Districts Capital	Distance to the Capital of the Province	Information
1	**2**	**3**	**4**	**5**
1.	Banggai Kepulauan	Salakan	607 + 46 mile	Road +Sea
2.	Banggai	Luwuk	607	Road
3.	Morowali	Bungku	518	Road
4.	Poso	Poso	221	Road
5.	Donggala	Donggala	34	Road
6.	Toli-toli	Toli-toli	434	Road
7.	Buol	Buol	383	Road
8.	Parigi Moutong	Parigi	84	Road
9.	Tojo Una-una	Ampana	377	Road
10.	Sigi	Sigi Biromaru	30	Road
11.	Banggai Laut	Banggai	607+ 94 mile	Road+ Sea
12.	Morowali Utara	Kolonedale	431	Road
13.	Palu	Palu	0	

Tabel 2 : Distance between districts / cities and provincial capitals in Central Sulawesi

D. Population

Based on the results of the interim data submitted by the Central Sulawesi Provincial Statistics Agency in 2016 the population of the Province of Central Sulawesi was 2,729,227 people consisting of 1,469,626 people and 1,407.0 women with an average population density of 40 square meter soul. The following are data on the population of each district / city:[3]

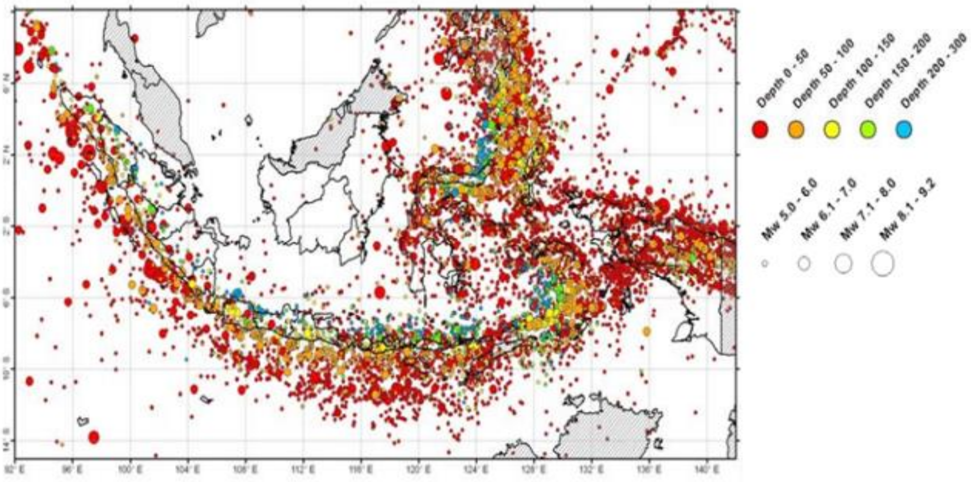
No	Districts/ City	Population		
		Man	**Woman**	**Total**
1	Banggai	180.388	174.014	354.402
2	Banggai Kepulauan	58.011	56.969	114.980
3	Banggai Laut	35.003	34.511	69.514
4	Buol	76.284	72.720	149.004
5	Donggala	150.224	143.518	293.742
6	Morowali	57.820	55.312	113.132
7	Morowali Utara	61.474	56.196	117.670
8	Parigi Moutong	234.912	222.795	457.707
9	Poso	121.974	113.593	235.567
10	Sigi	117.794	111.680	229.474

[2] Ibid
[3] Ibid

11	Tojo Una-una	75.432	72.104	147.536
12	**Toli-toli**	**115.205**	**110.670**	**225.875**
13	Palu	185.105	182.981	368.086
Total		**1,469,626**	**1,407,063**	**2,876,689**

Tabel 3 : Population of Central Sulawesi Province

The following are maps of hydrometeorological and geological disasters and disasters in Tolitoli District area based on data compiled from the National Disaster Management Agency (BNPB).[4]



Picture 1. Earthquake prone map in Indonesia

On September 28, 2018 there were earthquakes in Palu and Donggala with a power of 7.4 MG which caused a tsunami and the occurrence of liquefaction which caused many fatalities and significant damage to buildings. Thousands of fatalities and buildings that until now cannot be detected and counted with certainty the amount of damage.

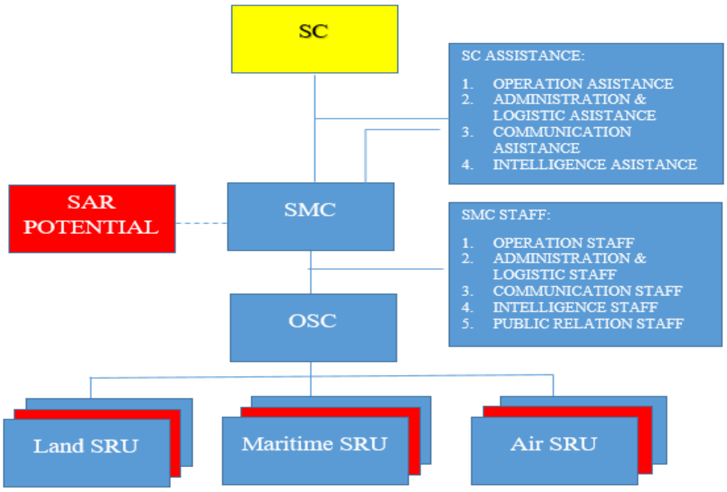
As mandated in the Preamble of the 1945 Constitution of the Republic of Indonesia that the government must protect all citizens, it is appropriate for citizens to be one of the responsibilities that must be carried out by the government in a state of safety threat especially when the community needs assistance . The National Search and Rescue Agency as a Non-Ministerial Government Institution that organizes government affairs in the field of search and rescue is always present when needed by the community.

Based on Law Number 29 of 2014 concerning Search and Rescue, the National Search and Rescue Agency (Basarnas) as a government institution which has direct responsibility to the President is authorized to be able to carry out duties in the field of search and rescue for victims of ship and aircraft accidents, transport accidents with special handling, disasters during the emergency response phase and conditions that endanger humans. Basarnas continue to optimize services to the community that require search and rescue services through various programs such as structuring and optimizing institutions, increasing the competence and professionalism of human resources, fulfilling supporting facilities and infrastructure in organizing search and rescue that are be adapted to the tasks and functions as well as current developments / needs.

The National Search and Rescue Agency (Basarnas) as the main institution given the mandate to be the executor of search and rescue operations is always ready to carry out its mission. During an emergency due to an accident or disaster, Basarnas forms an Ad Hoc organization (see figure 2) which includes the Search and Rescue Coordinator which is held by the Head of

[4] https://www.bnpb.go.id/home/potensi.html

National Search and Rescue Agency, Search and Rescue Mission Coordinator (SAR Mission Coordinator) who held by the Head of the Search and Rescue Office in the local area or other officials other than the National Search and Rescue Agency, and the On Scene Coordinator held by anyone who uses search and rescue facilities that can come from National Search and Rescue Agency, Military (TNI) / Police (POLRI), other government agencies and the private sector (Basarnas, 2018).[5]



Gambar 2. Basarnas Operational Organization Structure

The Palu Search and Rescue Office has a working area that covers the entire Central Sulawesi Province, to service the entire community for SAR services in the Central Sulawesi region, the Palu Search and Rescue Office has been supported by 2 (two) Search and Rescue Posts namely Luwuk Banggai Search and Rescue Post and Parigi Moutong Search and Rescue Post, which is an extension of the Palu Search and Rescue Office's task in serving the community in the Banggai and Parigi Moutong Regency. With a large enough area, the number of available personnel and limited infrastructure certainly results in SAR services not yet maximized and evenly distributed. For very remote areas such as Toli-toli District, it cannot be served quickly, this is due to the time taken by land to get to the destination approximately 12 hours.

As of December 31, 2017 there have been 53 people in the Search and Rescue Office of Palu, consisting of 4 structural officials, 8 administrative and financial officers, 1 communication officer, 5 crew members, 35 team rescuer. Due to the limited human resources in the Office of Search and Rescue in Palu, rescuers in addition to carrying out their main tasks also assist in carrying out other required tasks.

The purpose of this study is to find out what kind of leadership style was appropriate to use during the earthquake and tsunami search and rescue operations in Central Sulawesi Province in particular as well as search and rescue operations in the event of an accident in general. The study focused more on the various questions:

1. How to handle search and rescue operations in the earthquake and tsunami in Central Sulawesi?
2. How was the leadership during the search and rescue operation in the earthquake and tsunami in the province of Central Sulawesi?

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[5] http://basarnas.go.id/pengendalian-operasi

As understood together that in the implementation of natural disaster management there are three aspects carried out by the Ministries / Agencies, related Regional Governments, namely at the time of pre-disaster, during emergency response and post-disaster. In accordance with Law Number 29 of 2014 article 29 paragraph (1) it is stated that the National Search and Rescue Agency coordinates and is responsible for the Implementation of Search and Rescue Operations. Paragraph (2) during the emergency response as Article 14 letter c the Search and Rescue Mission Coordinator is operationally responsible to the National Search and Rescue Agency and administratively to the Search and Rescue Coordinator and coordinates with the agency that organizes government affairs in the field of disaster management.

However, the reality in the field during the search and rescue operations of the earthquake and tsunami disaster in Central Sulawesi, Palu and Donggala, the Head of the Palu Search and Rescue Office as the SMC or the leader of search and defense operations still found it difficult to coordinate and empower the Search and Rescue according to operational standards and procedures (SOP) due to the existence of sectoral egos. There is still an SRU that moves without coordinating with the SMC and reports to the SMC.

SRU's movement was scattered without SMC's knowledge, this made Search and Rescue operations unable to be carried out as expected. Therefore, to be able to carry out a good, effective and efficient search and rescue operation, appropriate leadership is needed that can unite all the related elements (Search and Rescue potential).

Referring to some of these problems, we hope that this research will produce an implementation concept of leadership in search and rescue operations, which can unite and integrate all elements and potential of Search and Rescue, so that the main goal is to save victims and minimize disaster victims based by a sense of humanity. This research is also expected to be useful for the government of Indonesia and also other countries, SAR activists such as NGOs, electronic media, private sector, academics and others.

2. Metodologhy

Writing in the Leadership Study on Earthquake Emergency Response and the Tsunami in Palu Province is a qualitative descriptive study. The data is taken in two ways, namely by interviewing stakeholders, Palu Search and Rescue Office Staff, SAR Potential (TNI, POLRI, Palu Local Government, SAR Activists, Potential SAR Societies) and also from journalists, print and electronic media . In addition to interviews, observations were also made on the location of the earthquake, liquefaction and tsunami in Central Sulawesi Province, Palu and data on search and rescue operations.

The study was conducted and began on Thursday, March 14, 2019 until March 16, 2019, while the field data collection took place from March 14, 2019 to March 28, 2019.

3. Results and Discussion

September 28, 2018 at 17.02 WIB, the Palu Search and Rescue Office received information and detect the occurrence of the Earthquake and Tsunami Disasters in Palu and Donggala, Central Sulawesi. The affected areas due to the Earthquake and Tsunami are located in several locations, which is Donggala, Palu City, Petobo, Balaroa, Sigi, Mamboro, Biromaru and several other regions.

In addition to the Palu Search and Rescue Office carrying out Search and Rescue operations against the Earthquake and Tsunami Disasters in the Central Sulawesi region, the National Search and Rescue Agency also mobilized several Search and Rescue Offices in Sulawesi and Kalimantan as well as the Basarnas Special Group (BSG) from the Head Office in addition to strengthening personnel.

A. Search and Rescue Operation

After getting information about the earthquake and tsunami that occurred in the Central Sulawesi Province, SRU Rescue Office of Search and Rescue of Palu moved towards the location affected by the earthquake and tsunami, and coordinated with the Military (TNI), Police (Polri), Local Government officials and other Potential Search and Rescue Potentials to provide search and rescue assistance.

No	Day to-/ date	alive	Dead
1.	1 / 28 Sep 2018	7 people	8 people
2.	2 / 29 Sep 2018	45 people	229 people
3.	3 / 30 sep 2018	15 people	35 people
4.	4 / 1 Okt 2018	55 people	290 people
5.	5 / 2 Okt 2018	31 people	39 people
6.	6 / 3 Okt 2018	-	68 people
7.	7 / 4 Okt 2018	-	110 people
8.	8 / 5 Okt 2018	-	81 people
9.	9 / 6 Okt 2018	-	110 people
1(	10 / 7 Okt 2018	-	38 people

Tabel 3. Number of disaster victims [6]

Search and rescue services for the people of Central Sulawesi Province are still felt to be not optimally implemented, because there are still a number of areas in the Central Sulawesi region that are very far from the radius of the Palu Search and Rescue Office and Search and Rescue Post, as well as the number of rescuers. still very limited.

The search and rescue operations on the earthquake and tsunami disaster in Palu, Donggala, and several affected areas have provided many valuable lessons especially for the Palu Search and Rescue Office, as well as potential SAR such as: Government of the Central Sulawesi Province, elements of the TNI, POLRI, Indonesian Red Cross (PMI), SAR activists and journalists. The implementation of search and rescue operations for disaster victims has been carried out as optimally as possible by the Palu Search and Rescue Office, coordinating with the Regional Government (Local Emergency Management Agency/BPBD) as well as SAR authorities such as: TNI, POLRI, PMI, and SAR potentials. However, due to the large number of victims and the location of the damage that was caused by earthquakes, tsunamis and liquefaction, it was quite severe and spread in several areas of Palu and Donggala, the search and rescue operations could not be carried out in accordance with the Operational Standards and Procedures adopted by the National Agency Search and Rescue.

At the time of the search and rescue operation for the earthquake and tsunami in Central Sula, Palu and Donggala the potential for SAR could not be fully coordinated properly, there were still many who were not under the control of the SMC, moved without coordination with the SMC and did not report to SMC for the performance of SAR operations every day. There are several SAR posts led by several potential SAR units but have not yet coordinated with the SMC. Head of the Palu Search and Rescue Office, controls the potential of SAR located at the Palu Search and Rescue Office posts, while those in several post do not coordinate with SMC regularly until operations at certain locations have many SAR potentials, but at locations that others are very short on resources / potential SAR. This could cause problems in the field because at the same time there were several SRUs moving to one SAR operation location but reporting to several SAR operations, so the casualties data was invalid because it was not in one command.

The earthquake and tsunami in Palu and Donggala not only caused a problem of casualties but also extended to social and criminal problems, namely by looting property in several shops and also in people's homes. The period has also been able to enter a restricted area for public such as an airport that should be sterile from an unauthorized community. However, due to the lack of security officers because airport employees and security officers have tried to save themselves and their families, uncontrolled residents have entered a vital area and taken important items at the airport area.

[6] Operasi SAR. “Data Korban Bencana Palu”. Kantor SAR Palu. Palu. Indonesia. 2019

In the event of an earthquake, local government agencies are generally quiet from the start because each employee and resident tries to save himself and his family. Panic has engulfed the community members and apparatus so that it can directly influence the conduct of search and rescue operations, because besides having to be tasked with saving victims, they must also seek and save family members.

When the conditions of service to the community are paralyzed due to the impact of natural disasters, leadership is needed to overcome various problems that arise both in terms of security, search and rescue, provision of clothing and food, housing and basic needs. Therefore implementative leadership is expected to be able to overcome various problems that exist in the field for each cluster in disaster management. Therefore, in search and rescue operations collaborative leadership is also needed to be able to unite the vision and mission of various SAR elements / potentials, so that a harmonious, effective and efficient cooperation can be established and in the end search and rescue operations can be more save the victim.

B. Some things that need to be done during pre-disaster

In Government Regulation Number 21 of 2017 concerning the Development of Search and Rescue Potential, it is explained that the government is responsible for being able to provide guidance on search and rescue potential. The target of search and rescue coaching is aimed at each person and agency / organization that has the potential for Search and Rescue. Guidance on search and rescue potential can be done through guidance and counseling. In addition to conducting guidance and counseling, it could be also conduct coordination with search and rescue potential. The coordination is carried out through organizing a search and rescue potential coordination forum with the aim of providing information, synchronizing and evaluating the development of search and rescue potential that can be carried out at the central and regional levels.

In addition to the above, the National Search and Rescue Agency also organizes dissemination. Dissemination is carried out through face-to-face meetings, socialization and workshops such as SAR Goes to School. The implementation of education and technical training is carried out to provide competencies in the field of search and rescue as well as the implementation of joint training with everyone and / or agencies or organizations that have the potential for search and rescue.

The exercise, aimed at testing and improving the competencies already possessed by Potential Search and Rescue, tests and enhances preparedness of potential search and rescue, tests and improves coordination with potential SAR tests and SAR procedures.

Noting the handling of the earthquake and tsunami disasters in Central Sulawesi, it was seen that collaboration and collaboration in the implementation of search and rescue operations still needed to be improved. The researcher found that at the time of the disaster, stakeholders, or parties involved in handling natural disasters, had not yet conducted a coordination forum for handling natural disasters and made simulations of natural disasters.

The coordination forum for handling natural disasters involves many parties such as the Local Emergency Management Agency (BPBD) in Province/District/City, National Search and Rescue Agency, TNI, POLRI, Social Service, Fire Department, PMI and various related agencies. This forum can discuss various matters related to the duties and authorities of the parties in the event of a natural disaster.

The active role of stakeholders in the field of handling natural disasters is very important especially during pre-disaster. Formulate a joint agreement on disaster management and create Standard Operational and Procedure (SOP) for search and rescue operations, making contingency plans a very appropriate step. This would need to be held and continued to be increased by the Central Sulawesi Regional Government by involving stakeholders in natural disaster management.

Another important thing that must be done by all parties involved in Central Sulawesi in disaster management is to make a simulation or disaster prevention exercise. This simulation applies Operational Standards and Procedures that have been made and agreed upon by all stakeholders. In the simulation you will know who did what and how to deal with things that were not in accordance with the Operational Standards and Procedures.

C. Leadership in Search and Rescue Operations

Archer and Cameron pay attention now that we are in an *interconnected world* and they argue that the success of the organization lies in their ability to cooperate with other organizations. They explained that existing organizations tended to focus on internal potential within the organization, but put aside other potentials.

Wall and Hedlund (2016) propose a collaborative and decentralized paradigm for improving search and rescue performance. Wall explained that the involvement of local communities plays a significant role in response time because it excels in sensitivity, speed and efficiency (Wall and Hedlund, 2016). It was proven at the time of the 1999 earthquake in Turkey's Marmara that killed more than 17,000 people: Local people became the first in saving neighbors and relatives, while the state and other official institutions at the beginning of the earthquake could not provide or coordinate humanitarian assistance. The survey showed 34 percent of the victims interviewed said that they received most of the assistance immediately after the earthquake from family members and neighbors, and through their own efforts, only 10.3 percent mentioned assistance from state authorities (Jalali, 2002); Tsunamis in Indonesia and Sri Lanka in 2004: Survey results show the dominant influence of communities and local communities in rescue assistance such as rescue, provision of food, water, clothing and burial of bodies. In Sri Lanka and Thailand, almost all life-saving and rescue activities in the first one-two days after the tsunami were by local residents (Fritz Institute, 2005; Telford, 2006; Scheper 2006); Earthquake in Port-au-Prince Haiti in 2010: Providing informal assistance such as sending money from family members in other countries (Versluis, 2014); Earthquake in Kathmandu in April 2015: Local people became the first in saving family members and neighbors from collapsed buildings, establishing temporary tents for those who lost their homes, providing food for victims; distribution of aid packages, and online fund collectors (Devkota, 2016).

United Nations Office for Disaster Risk Reduction (UNDRR or UNISDR) through the Hyogo 2005 framework and the replacement of the Sendai 2015 framework, responds to the real role of the community in minimizing the number of victims of disaster by outlining the actions and efforts deemed necessary by many community actors to reduce disaster risks and losses. It is emphasized that actors across sectors and levels must hold fast to organizing in ways that are networked, collaborative and decentralized.

The collaborative paradigm of decentralization has the advantage of being flexible, able to adapt and able to mobilize diverse resources so that it is able to face the complexity and uncertainty surrounding disasters. Collaborative "flat" structures are believed to be better equipped to deal with disasters than rigid hierarchies with top-down command and control strategies (Bingham 2008). The power of collaboration also goes beyond the disaster response phase because most of the activities before and after a disaster depend on the extent to which various actors are involved in collaboration even before the disaster strikes (McEntire 2007).

The challenge of implementing the collaborative paradigm of decentralization is the ability of actors involved in disaster management to collaborate across sectors and levels of government not as high as desired. The Indonesian government was among those who received attention in disaster management by UNISDR in its final report in 2014, in order to improve coordination between ministries; comprehensive linking between the central government and local communities. This challenge must be resolved so that the collaborative potential of decentralization can be applied to improve Basarnas operations management.

As God's creatures, humans are obliged to help each other, help fellow human beings who need help regardless basically ethnicity, religion, race, rank, class or institution, so that the conduct of humanitarian search and support operations should override sectoral, political egos and imaging.

This research will actualize decentralized collaborative leadership in search and help to improve the performance of Basarnas. Formulate leadership in mobilizing spontaneous responses of voluntary groups and individuals from inside and outside the affected community before formal organizations can mobilize. So that it becomes an important resource and capacity for emergency response response time which is the key to Basarnas performance.

Collaborative leadership in the implementation of search operations and special assistance in the earthquake and tsunami disaster in Palu, Donggala in Central Sulawesi, is the right solution in an effort to improve search and rescue services. Collaborative leadership is a source of increasingly vital competitive advantage in search and rescue that is highly networked, team-based and partnership oriented. In the future leaders related to tasks and functions in the field of search and rescue need training on collaborative leadership. Leaders at this time must think strategically in the global context, be good at analyzing various circumstances, think that search and rescue operations are cross-ministerial missions and institutions and local governments as well as the private sector, and are good at making wise decisions.

The leader of search and rescue operations should use the power of influence rather than the position authority to be able to involve and coordinate people and organizations, can focus on teamwork and maintain momentum. This is of course very much influenced by how it can create a trust, giving respect to the team, accepting various aspirations, good and right proposals in order to contribute to the achievement of optimal search and defense operations.

The collaborative leadership approach does not completely erase or negate command, command and control style leadership. But nowadays there has been a lot of research and application of collaborative leadership that has been quite successful and successful with collaborative leadership, which works with various teams both from internal and outside organizations, supporting each other and working to achieve goals.

Therefore the search and rescue operations coordinator is required to be able to harmonize strategies, coordinate operations, manage teams, can synergize all potential search and Rescie from the TNI, POLRI, Ministries / Institutions, Regional Governments, State-owned enterprises and the private sector to become a solid team.

The involvement of various community groups and Ministries / Institutions as well as the TNI / POLRI called Potential for Search and Rescue makes the Basarnas highly skilled in search and rescue missions in all fields. At the same time it shows that the conduct of search and rescue is cross-disciplinary and complex cross-disciplinary activities that require the combined efforts of several actors with special human and technical resources.

The Search and Rescue Mission Coordinator in carrying out his responsibilities can distribute according to tasks and functions using a flatter hierarchical structure, matrix structure, and more general cross-functional teams. The Search and Rescue Mission Coordinator should be able to work with the team that is woven not only during search and rescue operations but also when there is no disaster. Discussing various matters related to preparedness and action plans in the event of a disaster is an appropriate method that can be carried out by elements of the community responsible for search and rescue.

In addition to the core competencies that must be possessed by someone who conducts search and rescue operations, it also requires the ability to build networks and trust which can harmonize various interests and sectoral egos and maintain the integrity of the team.

Collaborative leadership leads to interdependent structures and cultures that work together to achieve more optimal benefits, work across organizational boundaries and leave a culture of independent achievement, and sectoral ego. Shifting the leadership culture from an "I" -based orientation leads to "our" orientation to achieve optimal results based on developing commitments, collaborating and utilizing collective intelligence.

Based on this, collaborative leadership capacity in search and rescue operations is needed especially in terms of coordination, high quality conversations and clear, open and directed communication.

Today's leaders need to develop repertoire skills and have a new mindset for success in an increasingly fast-paced, chaotic and highly competitive environment. Through collaborative leadership, we are intended to carry out a collective capability process to deliver results across organizational boundaries when ordinary control mechanisms do not exist.

Collaborative leadership does not completely replace leadership with the command and control systems in an organization. Flat hierarchy, structured matrices and cross-functional teams are increasingly developing simultaneously, this means that leaders must work with people who do not have official authority. Collaborative dreams are rooted in "leadership from the inside out". Although leading collaboratively means minimal attention to individual power or appreciation and more attention to innovation and mutual achievement, leaders must stay upright and lead themselves to collaborate effectively or create a more cooperative culture.

According to Ciulla, leadership is not someone's personal position, but it is a complex link in shaping morals among people, based on trust, obligation, commitment, emotions and shared vision. Leaders must think more strategically, given the impact of their decisions and relationships inside and outside the organization. Every leader has the potential to create a workplace (organization) that serves the interests of the best followers and constituencies. To do this, leaders must identify and be willing to take the actions needed to move forward for others and to achieve organizational goals.

4. Conclution

Search and rescue operations due to the earthquake and tsunami natural disasters and liquefaction in Palu, Donggala, Central Sulawesi have been carried out by involving stakeholders such as the Provincial and District / City Disaster Management Agency, Office of Search and Rescue, Palu, TNI, POLRI , PMI, state-owned enterprises, NGOs and SAR potential and SAR activists.

The search and rescue operation on earthquakes in Palu and Donggala, Central Sulawesi with a strength of 7.4 MG which caused tsunamis and liquefaction was a search and rescue operation that was quite heavy and not easy for the joint SAR team. Earthquakes, tsunamis and liquefaction caused a lot of casualties and significant damage to buildings. The number of fatalities died and survived with the condition of severe and minor injuries scattered in several regions in a row, desperately in need of rescue, but due to the limited number of search and rescue workers, many infrastructure and facilities damaged by the disaster, the implementation of search and rescue can not be implemented optimally. The handling of injured victims also has problems, because the capacity of hospitals, as well as limited medical personnel is not proportional to the number of people who are victims.

The unpreparedness of stakeholders in the response to natural disasters as well as the community involved has also added to its own problems. This can be seen in the event of an earthquake, tsunami and liquefaction in Palu and Donggala, Central Java, many officials or employees in government agencies, and security officers are not on duty, due to saving themselves and their families or due to rasak office building.

Other social problems arise because the public is anxious, looting occurs in the shops or houses left by the owner. In addition to this, the airport space and public facilities that should be as sterile as the general public that have no interest have been entered into by the community as well as taking existing items. There was chaos and panic among the people in various places.

In times of security and social stability, chaos and search and rescue operations are also facing problems. The Coordinator of the Search and Rescue Mission (SMC) has gotten some SAR potential / SRU, not all of which are incorporated into one SMC control. There were several SRUs who moved each without communicating and coordinating with the SMC. The communication was carried out during briefings and debriefings to discuss preparations, developments, as well as problems and the best solutions in search and rescue operations. In addition to the above, during the search and rescue operations there were still several search and rescue posts that carried out search and rescue operations in Central Sulawesi coordinated not by the SMC from the National Search and Rescue Agency. So, the deployment of resources that have not matched the needs in the field. There is a search / rescue operation area that is lacking /

lacks assistance, but on the other hand there is a large accumulation of search and search potential.

Because not all Field Coordinators (OSCs) are under the coordination of the SMC and the number of SRUs moves without coordination in a search and rescue organization, it can lead to inaccuracies in calculating the number of victims found.

From a number of findings regarding the conduct of search and rescue operations in earthquakes, tsunamis and liquefaction in Palu, Donggala, Central Sulawesi, the researchers presented several suggestions, as follows::

A. *In natural disaster management*
   All stakeholders should perform their duties and functions according to the regulatory requirements set forth in the invitation warrants, based on predefined clusters that are pre-disaster, emergency response and post-disaster, so there is no duplication of functions and work based on the SOPs that have been created.
B. *Handling natural disaster management involves many stakeholders*
   So it is necessary to understand understanding, cooperation and good relationship among stakeholders. Every cluster in disaster reporting has been established, in accordance with the provisions of the bill, with clear accountability, so that it can serve as a competence, task and function.
C. *Especially in emergency response clusters*
   The search and rescue operation for earthquakes and tsunamis and the operation of information in Central Sulawesi, have not been carried out optimally and some problems are still found. In accordance with Law Number 29 of 2014 concerning Search and Rescue, the National Search and Rescue Agency is mandated to be able to hold a search for and rescue with accidents, disasters and conditions that endanger humans. National Search and Rescue Agency has the authority to mobilize and control Search and Rescue Potential in carrying out search and rescue operations.
D. *To perform good search and rescue operations*
   Competence is needed in coordinating all potential so that it can run well and effectively. Collaborative leadership in conducting search and rescue operations is most appropriate for coordinating various potential stakeholders. Collaborative leadership leads to interdependent structures and cultures that work together to achieve more optimal benefits, work across organizational boundaries and leave a culture of independent achievement, and sectoral ego leads to a leadership culture of an "I" based orientation towards "us" orientation to achieve optimal results based on commitment, to help fellow creatures of God Almighty based on human values.
E. *Colaboratif leadership*
   It is a source of increasingly vital competitive advantage in search and rescue that is highly networked, team-based and partnership oriented. Search and rescue coordinators should often work with teams and people who do not have formal authority. Good relations can be established not only during search and rescue operations but also when there is no disaster. Discussing various matters related to preparedness and action plans in the event of a disaster is an appropriate way to be carried out by community elements responsible for search and rescue.
F. *Active role of stakeholders*
   In the field of handling natural disasters it is very important especially during pre-disaster. Formulate a joint agreement on disaster management and create Operational and Procedure Standards (SOP) for search and rescue operations, and make contingency plans a very appropriate step that must be taken by the government concerned.

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The Role of Local Wisdom in Disaster Risk Reduction

Deny Hidayati[#]

[#] Research Centre for Population, the Indonesian Institute of Sciences (P2K – LIPI), Gatot Subroto Street No.10, Jakarta, 12190, Indonesia
E-mail: gatsu.lt10@yahoo.com

Abstract

Living in a country at high risk to natural disasters, most Indonesia population faces a high potential to disaster exposure therefore they have to prepare to reduce these calamity risks. Local wisdom as a social capital of the Indonesian community serves as guidelines to deal with the vulnerability and uncertainty condition. This paper discusses the role of local wisdom in disaster risk reduction with special case studies of flood in rural Jambi and earthquakes in Bantul, Yogyakarta. This paper uses empirical evidence based on qualitative method from my research results under Human Ecology and LIPI research activities. Data is also gathered through secondary sources that largely rely on desk reviews of relevant books, papers, and other research results. This paper shows that local wisdom plays important roles in disaster risk reduction, both before and after disasters occur, that varies among the communities and disaster types. The community in rural low-lying areas of Jambi has applied mitigation and preparedness activities to cope with and adapt to the regular floods. While the Javanese community in Bantul use their local wisdom in facing post-earthquake condition, particularly in raising their efforts to find relief and recover from the impact of disaster.

1. Introduction

Local wisdom is a social capital of community to meet their need in the form of traditional knowledge, norm, rules and skills that has been passed through generations [1, 2, 3 and 4]. The community's wisdom and experiences according to [5 and 6] are integrated with the system of beliefs and togetherness. It is expressed as community traditions resulted from interaction between the community with nature and the environment around them for a long time. The wisdom contains socio-cultural order to achieve balanced and harmonious relations between the socio-economic life and the preservation of natural resources in the surrounding areas. Local wisdom therefore served as guidelines in the community attitudes and actions to fulfil their daily needs.

The community also applies on its local wisdom when facing uncertainty and risk conditions. It plays an important role in increasing community efforts to cope with, adapt to, find relief and recover from the impact of disaster. This occurs in Indonesia where most communities live in geographically and geologically vulnerable areas, and according to [7] all provinces have been identified as disaster risk hotspot areas [8]. The community in some disaster prone areas utilize their local knowledge and skill to cope with and adapted to natural hazards. They are aware of the riskiness and develop strategies to live with the environment using the knowledge from their ancestors and experiences.

Rural communities in Jambi whose regions located in lowland and peat swamp areas are frequently flooded, especially during the rainy season. Their experiences in facing flood made them perceive this disaster as *'air naik'* or a natural phenomenon. What is being learned is their capacity to live with uncertainty and disaster risk. They increase their capacity by retaining additional knowledge and skill through a cyclical process. Experiences, direct and indirect, dealing with floods has an impact on the process of increasing preparedness in anticipating future disasters and motivates them to reduce the flood risk. [9 and 10].

Indonesia also prone to earthquake and this disaster frequently occurs in most parts of the country, including in Yogyakarta and Central Java in 2006. The Javanese in the District of Bantul faced the greatest problems, particularly when the government and other donor have not yet reached the earthquake locations. For their survival, the Bantul Javanese utilized their local wisdom that loads with the value of togetherness, worked hand in hand in handling this devastated disaster. [11].

2. Objectives and Method

This paper focuses on the role of local wisdom in disaster risk reduction in Indonesia with special case studies of flood in rural Jambi and earthquakes in Bantul, Yogyakarta. It discusses forms of local wisdom at all disaster stages, before the disaster with a focus on mitigation and preparedness of households and community in facing regular flood in rural Jambi, and after the disaster, especially how the Javanese community survive and rise from the devastated earthquake in Bantul.

This paper is based on empirical evidence from regular floods in rural Jambi and the 2006 Bantul earthquake. The evidence is collected from Human Ecology, Research Center for Population, with its research on Community Resilience in Facing Environmental Changes and Disasters (Flooding and Haze) in Jambi in 2015-2019, and from LIPI research on the Javanese Survival Strategy in Facing the 2006 Bantul Earthquake in 2011.

These two researches are based on the qualitative method, using focus group discussions (FGDs) with community representative such as disaster victims, farmers, women, and youth groups; open interviews with key informants, such as with formal and non-formal leaders, representatives of disaster victims (floods in Jambi and earthquakes in Bantul), including farmers, women, youth groups, and local community organizations. These researches also conducted workshops with government institution officials in Jambi dan Bantul, and field observation in these locations.

In addition, this paper also applies the secondary data collection that largely relies on desk reviews of relevant books, documents, papers, and other references. The review is conducted to gain more understanding of relevant concepts and theories, such as local wisdom, mitigation, preparedness, social learning and their link to this topic.

This paper relies on research results in rural Jambi and Bantul locations. In Jambi, the study focused on Seponjen Village in the District of Muaro Jambi. This village is geographically located in the lowlands and some are peat swamps. This location is very vulnerable to flooding, especially during the rainy season and lately it also happens in the dry season when heavy rains occur for several days. Flooding occurs 2-3 times for 3-6 months per year. Floods affect the community's lives and disrupt their livelihoods. [9].

Bantul District in Yogyakarta is geologically located in area that prone to earthquakes. A devastated earthquake occurred in Yogyakarta with the 6.7 on the Richter scale earthquake on May 27, 2006. The earthquake had significant socio economic impact, killing about 5,716 people, mostly in the District of Bantul. This disaster led to huge property damage, disrupting economic, educational and social activities and systems. This big disaster damaged about 236,024 houses and lost around 66,000 people's jobs. [12].

3. Results and Discussion

This paper that discusses the community wisdom at all stages of the disasters reveals that the forms of community wisdom varies between before and after a disaster. A form of wisdom before disaster focused on community mitigation and preparedness activities. This wisdom is carried out by the community in rural low-lying area of Jambi, especially in Seponjen Village. While the wisdom of the community after the disaster is described by the Javanese who experienced a devastated earthquake in Bantul.

3.1. The Form of Local Wisdom Before the Disaster

Jambi village community whose area has become a flood customer since a long time perceives flooding as a natural phenomenon that occurs during the rainy season. The community in Seponjen Village that located in the lowlands and peat swamps which are flowed by the Kumpeh River consider flooding not as a disaster. They have a local term of flooding, namely 'water rises' or *'air naik'*. When the water rises, the community members have adapted to this phenomenon, therefore they react wisely so that they can still run their daily life and many of them state that 'flood brings out blessings' or '*anugerah*' such as an economic opportunity.

- *Disaster Mitigation*

Mitigation is efforts, structural and non-structural, to reduce vulnerability and risk of flooding. This paper identifies two important structural mitigation efforts of community wisdom in Seponjen Village to reduce vulnerability and risk of flooding. These efforts include the development of pillar houses and water transportation equipment. The construction of pillar houses uses wood and boards sources from the forest around the community. The pillar houses are wide spread throughout the Jambi area, including Seponjen Village. This traditional house is 'native' in Jambi that has been carried out for a long time since the ancestors. [10].

The main purpose of making a house with a pole is for the security and comfort of the community members. They are safe from flooding that regularly occurs, 2-3 times for 3-6 months per year in the rainy season, especially houses that are located on low lands and along rivers. In addition, pillar houses are also aimed to safe them from other disturbances, such as wild animals. Home safety from wild animals is very important because the community settlements are around the forest.

Another important flood mitigation is the development of water transportation facilities, particularly using canoes or boats. They made and prepared canoes or boats made of wood and boards taken from the forest surroung their settlement. The use of water transportation has been going on for a long time, especially the river transportation which is spread almost all over Jambi, including in Seponjen Village.

Canoes or boats became the main means of transportation in Jambi, especially before the construction of roads and the development of land transportation in this province. However, the operation of water transportation is currently experiencing a significant decline. The boat or canoe however is still a means of transportation which is very important when the flood that lasts long enough.

In addition to structural mitigation, the native (Melayu) community of Jambi also has also developed non structural mitigation, particularly through increasing knowledge and skill such as flood early warning, safe house and evacuation place, swimming and rowing skills. The community's direct experiences assist their beliefs, attitudes and actions about whether and how they have to face floods and lower the risks. These experiences are encouraging their thinking and talking, increasing awareness and knowledge, assisting individuals understand the consequences of a disaster, and raising preparedness (see the following explanation).

- *Disaster Preparedness*

The local wisdom related to preparedness for flood in Jambi is explained through the community preparation before the flood enter to their village and houses. With the preparedness the community members can still carry out their socio-economic activities when flooded. This paper classifies the community preparedness into three parts, namely: preparation for evacuation, water transportation equipment, and fulfillment of basic needs, especially food. [10].

The community has plans and preparations for evacuation during floods. They make *amben-amben* which is a safe place of wood and boards that are made of poles so that it is relatively high in the house or known as ‘a house in the house’. *Amben-amben* is places with multi functions, including:

- to save important documents and valuable goods (land certificate, children’s school report cards, TV, Sterio set) and other basic need (medicines)
- to put equipment for daily vital needs, such as clothes, mattresses as beds, cooking utensils and meals.
- to perform daily vital activities, such as resting, sleeping, cooking and eating.

Amben-amben are built when there is a flood, before water enters the house, and disassembled when the water is dry. The community based on their traditional knowledge and experiences understands the flood early warning, so that they know when the water come to their village and houses. This ambient materials are then stored at home, because the materials which are relatively good can be resilient and reused in the next flood season.

The community has also prepared water transportation equipment before the floods inundate their area. They prepare boats, canoes and paddlers/oars and put them near the house so they can be used at any time when needed during the flood. Almost all households, especially those located in low-lying areas, own and prepare boats/canoes. This tool is very vital for those who live in settlements and the surrounding areas are flooded for quite long time, 3-6 months per year. The canoes/boats becomes a means of transportation to agricultural lands and residential settlements, and to other places that are needed by the community, such as to schools, village health cares and shops.

The community members also prepare food to anticipate floods. Rice as the staple food is obtained from the *sawah* that harvested before flooding. The community who were mostly farmers planted rice after the flood water dried up and harvested before the flood water struck again in Seponjen Village. Some Seponjen villagers also plant field rice (padi ladang) in the dry season. So when a flood the farmer already has rice supplies, and because the flood event last a long time, some community members are forced to buy rice. Some farmers, especially those in relatively high paddy fields and gardens can still grow vegetables which are relatively resistant to flooding. Most of the community members buy rice imported from outside this village, including the City of Jambi. The ability of the community to buy rice is mainly sourced from the result of fish catchments along the Kumpeh River which flow through this village and the surrounding flooded areas. Fish production during the flood season is quite high, indicated by the production sold not only in this village but also to Jambi and Palembang Cities. The high fish production even correlates with the length of the flood, the longer the flood, the bigger and the higher fish production.

3.2. Strategy in Handling Post Disaster

The role of local wisdom is also important in raising community efforts to find relief and recover from the impact of disaster. Knowledge, values and action can develop in harmony to enhance individual or community's capacity to reduce disaster risk and enhance its resilience. This paper identifies three forms of local wisdom that existed when devastating earthquake occurred in Bantul, Yogyakarta, in 2006. These include community mutual aid, community leaders and institutions, and sharing role by gender.

- *Community Mutual Aid*

The Javanese in the District of Bantul, Yogyakarta, applied community mutual aid as a local wisdom for their survival and reducing the risk of further disaster impacts. This mutual aid consisted of two types i.e. community self-help *(tolong menolong*, personal gain), mutual-help/cooperation *(gotong royong*, community gain*)*.

*Tolong menolo*ng and *gotong royong* are the custom of Indonesian society [15 and 16]. *Tolong menolong* is usually carried out between community members for individual needs which are intended for curtained purposes, such as the construction of waterways to houses and construction of houses. Whereas *gotong royong* is an activity done by the community together to meet the common (public) needs that are voluntary in nature.

The Javanese spirit of *tolong menolong* and *gotong royong* made them strong and caring among neighbors. These indicated the fervor within a community members, their values of harmony and togetherness. These key elements facilitated the effectiveness of the recovery efforts during the emergency and reconstruction phases. [17].

With technical assistance from professionals, the Javanese worked together (*bergotong royong)* to rebuild the ruined houses during the reconstruction phase. The earthquake impacted severe infrastructure damage in this district with the total of destroyed house was about 236,024 [12]. Their involvement in mutual cooperation led to the effective process of building houses in this disaster area. This mutual cooperation was actually been started at the earlier time of earthquake – they quickly built temporary shelters using available materials around them, including ruins of houses that can still be used, tarpaulin and zinc roofs and mats [11].

- *The Important Role of Local Leaders and Institutions*

The roles of local leaders and institutions are importance in supporting the community survival and reducing further disaster risk [17]. The roles vary among disaster locations, some significant and others still lacking. A good lesson learnt about this topic comes from the role of local leaders and institutions in handling post- earthquake in Bantul. The major role of local institutions, both formal (neighborhood/RT, hamlet/RW and village/*Desa*) and informal (kinship and *paguyuban*) especially occurred during the first three days after the earthquake and in the emergency phase. [11].

This paper informs the local leaders and institutions in Bantul played a significant role in mobilizing the Javanese to meet their basic needs. They also assisted the community to distribute disaster aid according to disaster victims who needed more help. This role was based on the local wisdom that still practices throughout the district and endorsed by the leadership of the Head of Bantul District (*Bupati*) and the Sultanate of Yogyakarta (*Sultan*).

This role can be seen from distribution of food aid and tents at the grassroots levels. The hamlet/RW head provided assistance to the community in managing food and tent distribution. In Potrobayan Hamlet, for example, the food aid was divided into three parts based on the number of household compounds/neighborhoods/RT. If, for instant, they received 50 boxes of noodles, so each RT would receive ten boxes and twenty more noodle boxes would stay in the hamlet command post until this post received more noodle boxes from other donors that could be divided for the three RT. The food distribution was still applied even though the food stock was limited. For example, when RT only received 5 cans of milk for infants and it was inadequate for all infants if it was distributed in cans. So, the community poured the milk into glasses with the total the same as the total of infants (such as 20 infants). So 5 milk cans were divided into 20 glasses and each infant would receive one glass of milk. This strategy was effective particularly to reduce conflict of distribution among disaster victims. [11].

Experiences from previous disasters in many locations in Indonesia showed that provision of basic needs was urgent for the disaster victims because they face difficulty in providing for their basic needs, especially before the arrival of relief from governments and other donors. This is usually due to transportation obstacles and a less suitable type and amount of aid. Another important problem is related to unbalance aid distribution among disaster locations and victims, often abundance in a few locations and vice versa, lack in other locations, particularly in far distant and isolated areas and inappropriate target groups/persons. These problems often lead to horizontal conflicts among disaster victims, therefore should be managed in order to reduce further risk.

- *The Importance of Sharing Roles by Gender*

Another important lesson learnt from Bantul earthquake is that the Javanese shared their role according to gender and prioritized assistance to earthquake victims who were more in need, especially during the event and emergency phase. The shared role was automatically carried out by men's group (men and youth) and women's group (women and teenage daughters). The role was based on men and women domain. Domain of men was related to activities that require 'energy', 'muscle' and 'courage', such as the rescue and evacuation of the victims. These activities were immediately conducted after the earthquake. [18].

Domain of women was based on domestic activities that require thoroughness and diligence. It is related to daily life activities, such as preparing cooked food and distributing it to the earthquake survivors. Women also participated to rescue and search activities, but focused only on their family salvation, children and family members. In some activities women and men worked together, especially community leaders and youth, actively participated in collecting and distributing food aid.

Gender roles and relations influence the capacity of women and men to respond to disaster although place women at greater risk than men. Understanding gender dynamics and involving women within the framework of disaster risk reduction therefore are critical factors, particularly for developing effective disaster risk reduction. This indicates one of the most important gender roles, not only on the family scale but also on a much larger scale in disaster policies and programs.

4. Closing

This paper shows that local wisdom plays important roles in disaster risk reduction that varies among the communities and disaster types. It is indicated by the mitigation and preparedness activities of the community in facing regular flood in rural low-lying areas of Jambi. Meanwhile, the Javanese in Bantul apply their local wisdom as a strategy in dealing with and recovering from the devastated earthquake impact.

The rural Jambi's community has adapted to regular flood occurring in their location so that when the flood arrives they can still do their daily life and livelihood activities. They build pillar houses, provide water transportation equipment (boats/canoes and peddler), and increase their knowledge and skill as mitigation activities. They set up their preparedness through preparation of safe places (*amben-amben*) in the houses and provide household basic need (food). Their canoes/boats as main water transportation equipment are also ready every time they want to go to agricultural lands, shopping or taking children to school.

In addition, the Bantul's community experience in handling earthquake disaster has become a good lesson learned for disaster management in Indonesia. The spirit of *tolong menolong* and *gotong royong*, the important role of local leaders and institutions, and share role by gender are they key elements for the effectiveness of the recovery efforts.

This paper highlights that the existence of local wisdom in disaster risk reduction needs to be paid serious attention. The community tradition to prepare and mitigate disaster risk, and to provide mutual aid and share role by gender to find relief and recover from disaster impact should continuously been applied. This is especially in condition where the role of local wisdom in preserving balance and harmony between the communities and their surrounding environment and solidarity and mutual assistance of community members faces many challenges and has experience a shift. A serious attention should also be given to increase the care and capacity of community throughout Indonesia to reduce the disaster risks that tend to increase over time in most parts of Indonesia.

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Designing Flood Early Warning System Based on IoT as Flood Mitigation Awareness

Agus Tri Sutanto, Naufal Ananda, Wandes Gumamven
School of Meteorology Climatology and Geophysics (STMKG), Perhubungan 1 Street No. 5, Pondok Betung, South-Tangerang 15221, Indonesia

E-mail: agustri2004@yahoo.com [1)], naufal.ananda17@gmail.com [2)], gumamven@gmail-.com[3)]

Abstract. Indonesia is a country that has extreme weather with high rainfall intensity and many regions are prone to hydrometeorological disasters, one of which is flooding. Floods are disasters that can cause detrimental effects such as fatalities, environmental damage, property losses, hamper transportation routes, and cause the instability in the economy of the community. Therefore, to reduce the impact of the disaster, a flood early warning system is needed. The purpose of this study is to design an Internet of Thing (IoT) based flood early warning system using the parameters of water level and rainfall intensity through Short Message Service (SMS) information, Blynk application and Website. The research method includes literature study, design, and testing of the system. This system consists of a power supply system, a reed switch sensor, a JSN-SR04T sensor, a SIM900A communication module, data storage with micro SD, and a GPRS communication system to transmit data to Cloud Server as well as warnings via SMS and buzzer. The JSN-SR04T sensor is an ultrasonic sensor for calculating water level. Reed switch sensors as magnetic sensors functions to calculate the intensity of rainfall. ATMega328 microcontroller as an acquisition and processing of data generated by sensors. The reed switch sensor has a resolution of 0.2 mm and produces an error value of 0.1% after comparison of three set points. JSN-SR04T sensor produces a correction value of 0.5 after comparison of four set points. The test results show that the system is able to provide sensor observation data every 3 minutes in real time through the Blynk and Website applications and sends disaster preparedness information via SMS and turning on the buzzer according to the level of disaster conditions.

1. Introduction

The great potential of hydrometeorological disasters in Indonesia can occur geographically, geologically, hydrologically and demographically. The emergence of this disaster can occur suddenly or unpredictably and can be observed with a slow and predictable process. Hydrometeorological disasters can have devastating effects on the economic, social and environmental fields in both short and long term.

Indonesia is a country that has two seasons throughout the year, dry season and rainy season. During the dry season, the rain will still fall occasionally because Indonesia is located in the equator. This position enables the occurrence of large amounts of evaporation, plus the fact that the oceans in Indonesia are wider than the land. One of the hydrometeorological disasters often associated with the intensity of rainfall is flooding. Almost every rainy season flood comes with a variety of impacts. Apart from the high intensity of rainfall, river overflowing is also a cause of floods in Indonesia

The high frequency of flooding in Indonesia is oftenly in January and February, for example, in DKI Jakarta which has more than 500 mm rainfall intensity [1]. 99 percent of disasters in Indonesia are hydro-meteorological disasters caused by weather and surface flow [2].
Badan Nasional Penanggulangan Bencana (BNPB) noted that during 2017 there were 777 floods, making it the most frequent disasters compared to the others.

The flood phenomenon is a difficult problem to solve in Indonesia because there is still a lack of a water level monitoring system or flood early warning and the slow delivery of early warning information. In today's modern era, a system is needed to overcome flood problems with a easily designed tool that is easy to operate and convey information quickly. The author argues that the concept of Internet of Things is a very good breakthrough in the era of revolution 4.0, where integrated tools can provide useful information, especially overcoming current flood problems.

The impact caused by floods is very detrimental to human life and the environment such as fatalities, environmental damage, property losses, hampering transportation routes, and making the economy of the community unstable. For example, floods in Indonesia in 2017 caused 135 people to lose their lives, 91 people injured, more than 2.3 million people suffered and evacuated, and thousands of homes damaged [3].

Seeing the number of victims and losses arising from the flood, it is important for us to do disaster preparedness. The Republic of Indonesia Law Number 24 of 2007 about Disaster Management mentions several natural disasters, one of which is flooding. In order to implement the Law, it is necessary to bring attention from various layers of society and the government. The dangerous effects of floods and the development of information technology are growing, therefore a flood early warning system is needed to improve disaster preparedness and disaster mitigation.

2. Research Methodology

The methods of this sesearch are the study of literature, system design and system testing based on quantitative analysis. In the early stages of this study, the authors studied literature related to flooding, flood early warning systems, Internet Of Things, JSN-SR04T sensors, reed switch, Atmega328 microcontrollers, SIM900 modules, Cloud Server, buzzers, RTCDS1307 modules, microSD, power supply systems, database design, web display, Blynk application display and information via SMS. The system's design consists of the system's block diagrams, flow diagrams, and sequences.

2.1. Block Diagram

The system's block diagram is an overview of the whole. The block diagram is useful to produce a system that can work and function as desired. This system has a diagram block as shown in Figure 1:

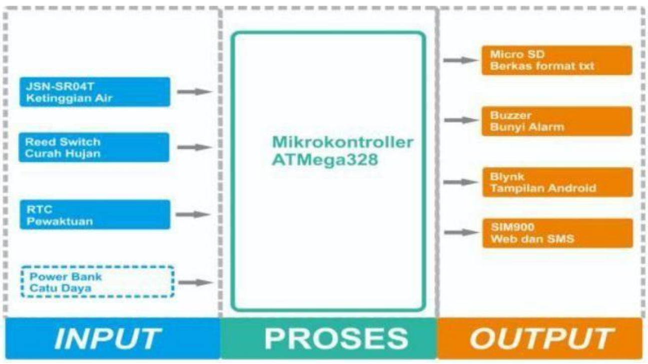

Figure 1. Diagram Blok Based Flood Early Warning System

The input consists of the JSN-SR04T ultrasonic sensor, the Reed Switch rainfall sensor, the RTC DS1307 as a time marker, and the power supply as a supplier in the form of solar panels or power banks with a capacity of 1000 mAH so that it can do 24 hours of observation with high stability. The process of measurement and data acquisition is carried out by the Arduino ATMega 328 microcontroller. The output of the system is in the form of data stored on a Micro SD Card. Warning information is passed through the SIM900 module and delivered based on SMS, Website, Blynk application, and buzzer as a siren simulation if the sensor parameters are in the Warning Status.

2.2. System Schematic Series

The system schematic series of the flood early warning is shown in Figure 2. All components of the system are connected directly to the Arduino ATMega 328 through the ports available on the microcontroller. The wiring path design of the flood early warning system is made using the open source Fritzing application.

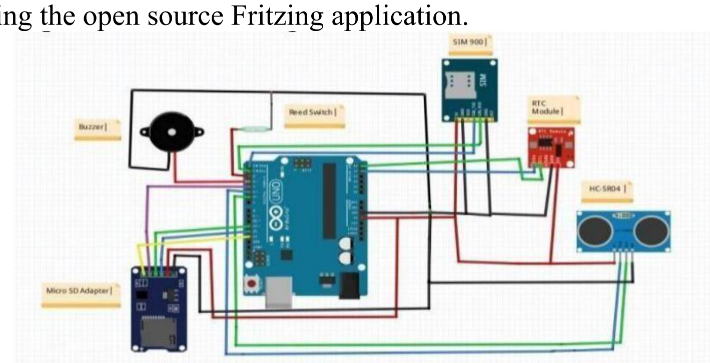

Figure 2. System Schematic Circuit

The JSN-SR04T sensor module that functions to measures the water level and RTC module as a time marker are connected to the SDA and SCL ports on the microcontroller. The Buzzer module as a siren simulation is connected to a digital pin. The tipping bucket sensor has 2 output pins connected to the digital pin and ground.

The microcontroller will process the value of rainfall parameters and the water level produced by each sensor. Each data generated by the sensor will be stored on a Micro SD Card module which will give a warning through SMS (Send Message Service), Website, Blynk application, and buzzer sound if a sensor measurement parameter exceeds the threshold.

The SIM900 module will send an alert via SMS to the user for the Warning and Watch conditions. The contentsof the SMS are the status, the intensity of rainfall, and distance of the water sensor. The buzzer will go off when the condition shows Warning. The website will provide information on the intensity of rainfall and the distance of the water surface to JSNSR04T in real time every 5 minutes.

2.3. System Flow Chart

The software used to program the design of the flood early warning system is Arduino IDE with the basis of C language. This study uses software installed on Windows-based PCs / Laptops. The making of data acquisition systems required programming design stages which are presented in the form of flow diagrams. Overall programming is shown in Figure 3.

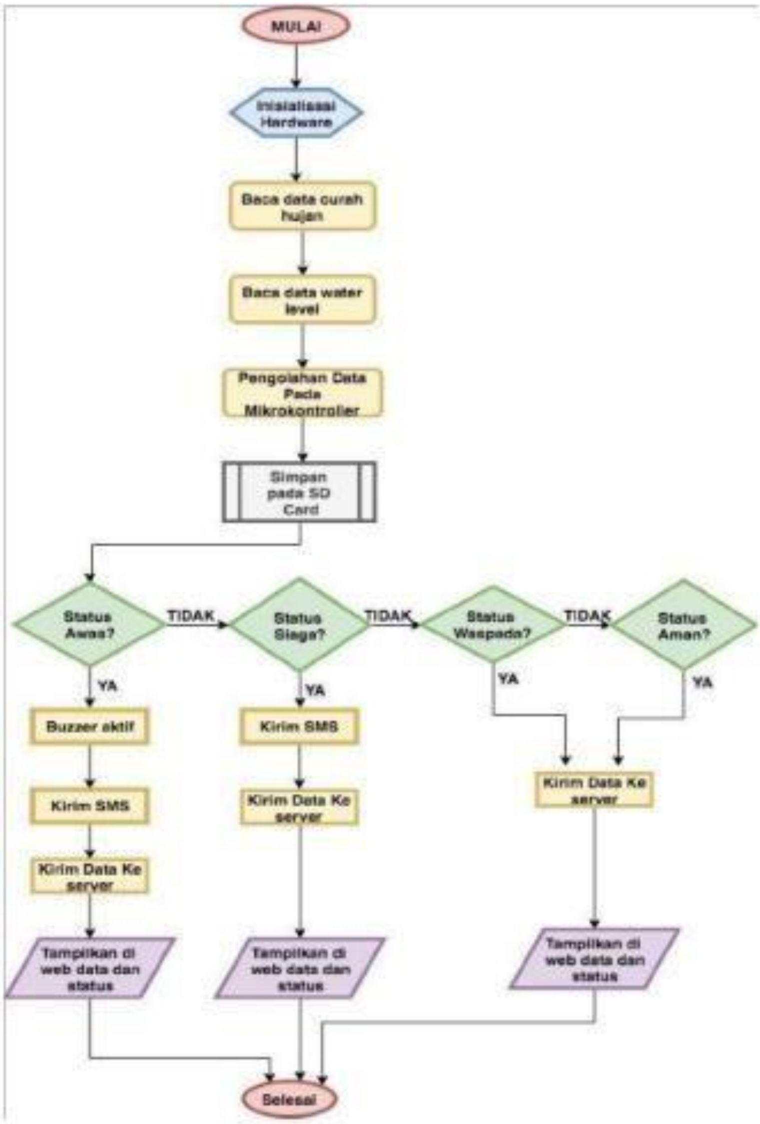

Figure 3. Overall System Programming Flowchart

The flow chart in Figure 3 explains the flow of microcontroller programming in designing the flood early warning system, the descriptions are:

1. Starting is the first step in activating the system.
2. The program performs hardware initialization, namely the reed switch sensor, JSN-SR04T sensor, RTC, Microcontroller, ATMega328, SIM900 Module, and SD card module.
3. The microcontroller reads the output data from the reed switch sensor.
4. The microcontroller reads the output data from the JSN-SR04T sensor.
5. Microcontroller processes data output from the sensor.
6. Data stored in SD Card via SD Card Adapter module.
7. If the measurement data at the threshold value shows “Warning”, the buzzer will be active and the system will send SMS information to the user.

8. Data processed by the microcontroller is sent to the server using the SIM900A module, the server receives the data and displays it on the Blynk web and application.
9. If the measurement data at the threshold value shows “Watch”, then the system will send an SMS to the user and will send data to the server and display data on the Blynk web and application.
10. If the measurement data at the threshold value shows “Advisory” and “Safe”, the system will only display data on the Blynk web and application.
11. Data that has been sent to the server will be saved, then displayed and send the early warning status on the web.
12. In processing of threshold data, the researcher uses the if function.
13. Finished.

Output data from each sensor is acquired in the microcontroller into digital data which is stored in the MicroSD, and sensor data sent to the observer via SMS, Blynk application and Website. In addition, buzzer as a siren simulation will be active if the data has entered a predetermined level of conditions. This conditioning is classified into 4 levels of conditions;

1. Safe status is fulfilled if sensor measurements show:
   a. The JSN-SR04T sensor measures the distance between the water surface and the sensor resulting in a close distance of ≥150 cm and the reed switch sensor measures the intensity of rainfall in light rain conditions (<5 mm).
   b. The JSN-SR04T sensor measures the distance between the surface of the water and the sensor resulting in a long distance of ≥150 cm and the reed switch sensor measures the intensity of rainfall under moderate rain conditions (≥5 mm and ≤10 mm).
2. Advisory status is fulfilled if sensor measurements show:
   a. The JSN-SR04T sensor measures the distance between the water surface and the sensor resulting in a long distance of ≥150 cm and the reed switch sensor measures the intensity of rainfall in heavy rain conditions (> 10 mm).
   b. The JSN-SR04T sensor measures the distance between the water surface and the sensor resulting in a moderate distance of ≥81 cm and ≤149 cm, then the reed switch sensor measures the intensity of rainfall in light rain conditions (<5 mm).
3. Standby status is fulfilled if sensor measurements show:
   a. The JSN-SR04T sensor measures the distance between the water surface and the sensor resulting in a moderate distance of ≥81 cm and ≤149 cm, and the reed switch sensor measures the intensity of rainfall in moderate rain conditions (≥5 mm and ≤10 mm).
   b. The JSN-SR04T sensor measures the distance between the water surface and the sensor resulting in a medium distance of ≥81 cm and ≤149 cm, then the reed switch sensor measures the intensity of rainfall in heavy rain conditions (> 10 mm).
4. Warning status is fulfilled if sensor measurements show:
   a. The JSN-SR04T sensor measures the distance between the water surface and the sensor resulting in a short distance of ≤80 cm and the reed switch sensor measures the intensity of rainfall in light rain conditions (<5 mm).
   b. The JSN-SR04T sensor measures the distance between the water surface and the sensor resulting in a short distance of ≤80 cm and the reed switch sensor t measures the intensity of rainfall under moderate rain conditions (≥5 mm and ≤10 mm).
   c. The JSN-SR04T sensor measures the distance between the water surface and the sensor resulting in a short distance of ≤80 cm and the reed switch sensor measures the intensity of rainfall in heavy rain conditions (> 10 mm).

3. Results and Discussion

3.1. JSN-SR04 Sensor Test

The JSN-SR04 ultrasonic sensor testing was conducted on Thursday, April 3, 2019, in the Bintaro Kodam Swimming Pool with a comparative media using the "ONI" meter with a range of up to 5 meters. The set point used is 50 cm, 100 cm, 150 cm and 200 cm.

Figure 4. Comparison of the JSN-SR04 Ultrasonic Sensor

Figure 4 shows the process of comparing ultrasonic sensors to actual distances. In each set point of measurement, five data is taken from the sensor reading. The following are the results of measurements from the JSN-SR04 ultrasonic sensor.

Table 1. Comparative Results of the JSN-SR04 Ultrasonic Sensor

Set Point	Meters (cm)	Sensor (cm)	Correction	Standard Deviation
50	50	50	0	0,447213595
	50	50	0	
	50	49	1	
	50	50	0	
	50	50	0	
Average		49,8	0,2	
100	100	100	0	0,447213595
	100	100	0	
	100	100	0	
	100	99	1	
	100	100	0	
Average		99,8	0,2	
150	150	150	0	0,447213595
	150	150	0	
	150	151	1	
	150	150	0	
	150	150	0	
Average		150,2	0,2	
200	200	200	0	0,547722558
	200	200	0	

	200	199	1	
	200	200	0	
	200	199	1	
Average		199,6	0,4	

The comparison results of the ultrasonic sensors with the comparator in table 1 show that at each set point, the measurement produces the correction value and standard deviation as follows:

- The 50 cm set point produces a correction value of 0.2 cm and standard deviation of 0.447213595 cm.
- The 100 cm set point produces a correction value of 0.2 cm and standard deviation of 0.447213595cm.
- The 150 cm set point produces a correction value of 0.2 cm and standard deviation of 0.447213595cm.
- The 200 cm set point produces a correction value of 0.4 cm and standard deviation of 0.547722558 cm.

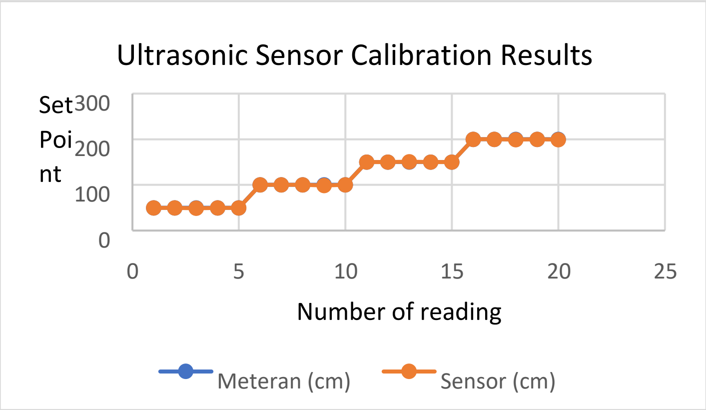

Figure 5. JSN-SR04 Graph of Ultrasonic Sensor Calibration

Based on the data from the ultrasonic sensor comparison above, it shows that the JSNSR04 type ultrasonic sensor produces almost the same correction value from each set point. The farther the set point of measurement, the higher the correction value ultrasonic sensor produces.

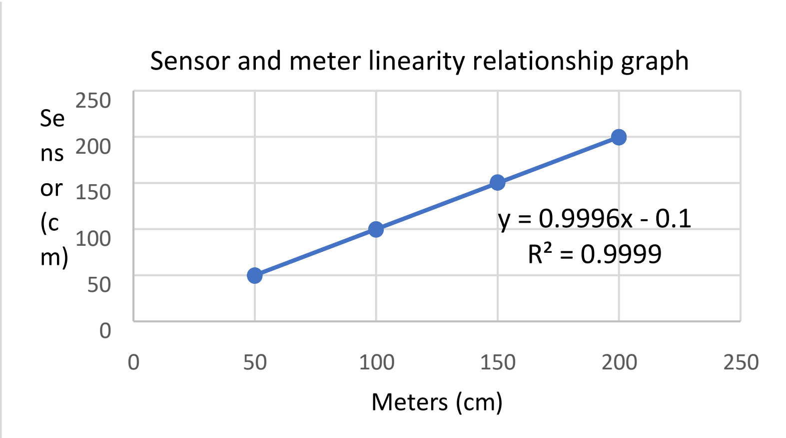

Figure 6. Sensor and meter linearity relationship graph

Figure 6 shows the linearity relationship between sensor and meter readings. The equation obtained from the linearity relationship is 0.9996x - 0.1. The linearity relationship between sensor and meter readings shows a strong correlation of 0.999.

3.2. Testing The Reed Switch Sensors

Testing is carried out with a rainfall prototype with a Pyrex measuring device (with a 5% correction) compared to an ARG (Automatic Rain Gauge). Samples of data on the amount of water used were 157 ml with 25 tips, 314 ml with 50 tips, and 471 ml with 75 tips. The result obtained is a correction with error value of 0.1% (Table 2). This shows that the rainfall prototype can be used as an alternative in measuring the intensity of rainfall at a Meteorological station.

Figure 7. Testing of Reed Switch Sensors

Table 2. Rainfall testing data

intake ml)	unt of Tip (tip)	r Value (%)	outtake ml)
57	25	0.1	57
	25		
	25		
14	50	0.1	14
	50		
	50		
71	75	0.1	71
	75		
	75		

3.3. Communication Testing
3.3.1. SMS Testing

SMS-based communication testing were carried out after all devices are fully installed. SMSsending is active when the Flood Early Warning System Design receives certain triggers that can meet the specified threshold value. SIM900A will send SMS if the condition is at the level of Warning and Watch. Additional hardware for testing the SMS communication system is a prepaid sim card. Communication system testing was carried out by connecting the sensor to the Ardunio ATMega 328 microcontroller which is connected to the SIM900A module.

Figure 8. SMS display from the System to Users

Figure 8 is an SMS image display sent by the tool, based on the simulation results of moving the JSN-SR04T sensor and sensor tipping bucket with the output of Warning and Watch conditions. The SMS sent contains the status, rainfall intensity, and sensor output of the JSNSR04T. Communication testing succeeded with about 10 seconds after sensor data retrieval.

3.3.2. Interface Testing

The data logger sends the data that has been processed by the microcontroller using the GSM SIM900A module to the Blynk web server and application. Data transmission from the data logger is carried out or executed simultaneously. Communication data transmission uses GPRS to get to the web server and Blynk android application.

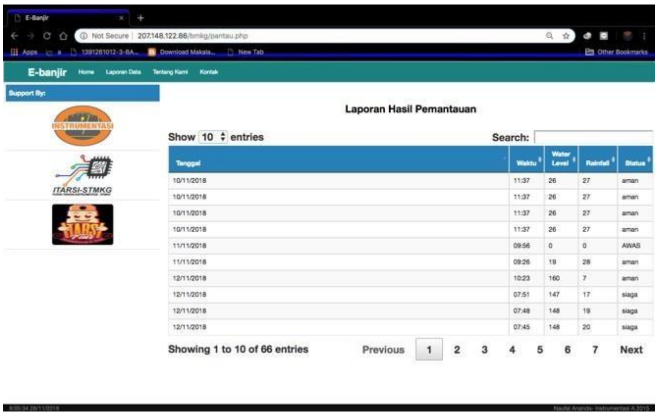

Figure 9. Display of data on the Website

Figure 10. Display of data on Blynk

Figures 9 and 10 are IoT-based monitoring interface displays where the system can send data properly. The data are consist of Water level, rainfall and condition status. The data will continue to be updated every 3 minutes and will be stored on the server's database.

4. Conclusions

Conclusions from the design of IoT-based flood early warning system to increase flood mitigation:

1. The prototype of the Internet Of Things (IoT) based flood early warning system has been successfully created and is able to measure parameters of water level, rainfall intensity, and status of conditions automatically and in real-time.
2. The cause of flood is the high intensity of rainfall in an area and overflow of river water.
3. Information on observational data on flood early warning system parameters can be displayed on the Blynk website and application online and real-time, making it easier for people to monitor and increase disaster preparedness.
4. Warning information in the form of SMS is sent by the system to the public when the status has entered the level of Warning and Watch.
5. The prototype of the flood early warning system can work and respond well in conducting a series of tests with the results:
   a. The self-designed Reed switch sensors are similar to the Automatic Rain Gauge (ARG) that can produce a correction value of 0.1% for each amount of water and different tips.
   b. The JSN-SR04T sensor that can detect water levels can produce a correlation value of 0.999 and the largest correction value of 0.55.
6. Observation information is updated every 3 minutes on the Blynk web and application. SMS alerts are delivered within 10 seconds.

Acknowledgments

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Relationship of Meteorological Drought with El Nino and Its Correlation with Physical Condition of the Land in Kebumen District

Nurul Chamidah Masruroh[1], Tito Latif Indra[2], dan Kuswantoro[3]

[1]Student Departement of Geography. Faculty of Mathematics and Natural Science , Universitas Indonesia, Campus UI Depok, 16424, Indonesia

[2,3]Lecturer Departement of Geography. Faculty of Mathematics and Natural Science , Universitas Indonesia, Campus UI Depok, 16424, Indonesia

E-mail: nurul.chamidah41@ui.ac.id

Abstract

Kebumen Regency is the second worst drought region of Central Java in 2015. Based on the value of the Southern Oscillation Index (SOI) in 2015 El Nino phenomena resulted in reduced rainfall in Indonesia,like Kebumen Regency. This study aims to analyze the El Nino relationship with meteorological drought in Kebumen Regency and its relation to the physical condition of the Kebumen Regency. The data is used the SOI derived from Australian Bureau of Meteorology and the monthly rainfall data obtained from 30 rainfall observation stations in Kebumen Regency. Metodologyis used quantitative analysis of linear regression and the Standardized Preciptation Index (SPI) formula. Temporal spatial analysis is also used to explain the pattern of drought in Kebumen Regency. The results isthe pattern of drought in March is related to altitude, the patterns of drought in April and August are related to wind direction, and the pattern of drought in May is related to the direction of the slope.El Nino represented by the SOI value has a positive relationship to the drought represented by SPI. The strongest correlation value is 0.60 at Tersobo and the lowest is 0.42 at Ayah Station. The drought pattern that was formed in Kebumen Regency in 2015 was related to the physical condition of the region.

Keyword :Kebumen Regency, Drought,*Southern Oscillation Index* (SOI), *Standardized Preciptation Index* (SPI)

1. Introduction

The decline rainfall during El Nino can result drought. Drought is a period abnormal dry weather in long term cause serious imbalances between water supply and demand (Zhang, Li, Singh, & Bai, 2012). These events can have other negative impacts. Especially El Nino events can recur in a range of 2 to 7 years with an average incidence once in 4 years (Sarachik and Cane, 2010). This is the urgency of this research so that it can predict and anticipate the negative impacts of El Nino.

Drought has a lot of negative impacts such as disruption of the forecast of the end of the dry season and the beginning of the rainy season which can have a direct impact on agriculture and can result in crop failure. The longer dry day series can reduce groundwater reserves in an area. Decreased groundwater reserves in an area can result in a shortage of clean water as happened in Kebumen. Reporting from Media Indonesia (2015), drought in 2015 hit 94 villages in the district Kebumen who has difficulty getting water b clean. In 2005, Kebumen Regency experienced a drought which resulted in damage to around 10,838 hectares of rice plantations spread throughout the sub-district (Kompas, 2005). In 2008, Koran Indonesia (2008) stated that Kebumen Regency experienced a back drought caused by a decrease in water resources discharge from the Lukulo River, Kalibanda River and Telomoyo River, resulting in people having difficulties in clean water and around 2000 hectares of agriculture experiencing drought and crop failure. Based on these impacts, further handling is needed in responding to the effects of drought as an effort to anticipate or mitigate drought.

Drought is difficult to define because of the various kinds of disciplines that are affected by drought. Drought can be identified by the value of SPI (*Standardized Precipitation Index*). The SPI value is based on monthly rainfall data at certain rain stations, so that spatial analysis can be carried out by comparing the SPI values from other rain stations. SPI is an index based on standardized probability of recording certain amounts of rainfall. Negative indices show drought and positive indices indicate wet conditions. SPI is calculated for several time scales, ranging from one month to 72 months (Australian Bureau of Meteorology, 2012), to find out various timescale of drought, both short and long term.

2. Study Area

Kebumen District is astronomically located at $7^0 27'$-$7^0 50'$ South Latitude and $109^0 22'$-$109^0 50'$ East Longitude. Kebumen Regency is located on the southwest coast of Central Java Province. The boundaries of the Kebumen Regency are the south is the Indian Ocean, the West are Cilacap Regency and Banyumas Regency, the north are Banjarnegara Regency and Wonosobo Regency, and on the east bordering Purworejo Regency. Kebumen Regency has an area of 133,141 hectares or 1,331.41 km^2. Administratively, Kebumen Regency consists of 6 sub-districts.

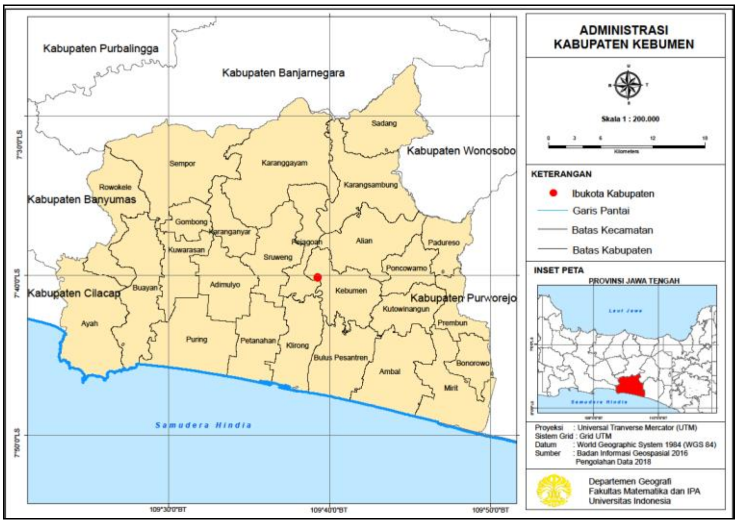

Figure 1. Kebumen District Administrative Map

3. Data and Methods

3.1 Data

This study used primary data and secondary data. Primary data collect by field surveys. The field survey aims to verify and document the field. Verification was carried out by visiting drought-affected villages according to the data from the Kebumen Regional Disaster Management Agency. Secondary data like administration data, Southern Oscillation Index (SOI) 1986-2017, rainfall in 1986-2017, elevation data, direction of slope, and wind direction. Each of these data is obtained from related agencies such as the BAPPEDA of Kebumen Regency, the Australian Bureau of Meteorology, the Kebumen District Public Works and Spatial Planning Office, the Geospatial Information Agency (BIG), and the Kebumen District Disaster Management Agency.

3.2 Methods

This study analyzes the El Nino Relationship with Meteorological Drought and its Relation to the Physical Condition of Regions in Kebumen Regency with the research variables of the Southern Oscillation Index (SOI), rainfall, and physical conditions such as altitude, direction of slope, and direction wind. The value of the Southern Oscillation Index (SOI) used is the monthly SOI value in 1986-2017. The rainfall data used is rainfall during the period 1986-2017 from 30 rainfall measuring stations spread across Kebumen Regency. Rainfall data at each rainfall measuring station is processed to determine the drought using the Standardized Precipitation Index (SPI) method. The results of the drought of each station were then interpolated using the Spline method, in order to obtain the spatial pattern of Kebumen drought. The monthly drought rate was correlated with the monthly SOI value using the Pearson Product Moment (PPM). So that the results of the relationship between El Nino events and the level of meteorological drought are strong. In addition, the interpolation of SPI values was reviewed compared to the physical condition of the area so that it can be seen how the physical condition of the area is related to the region's drought pattern (Figure 1).

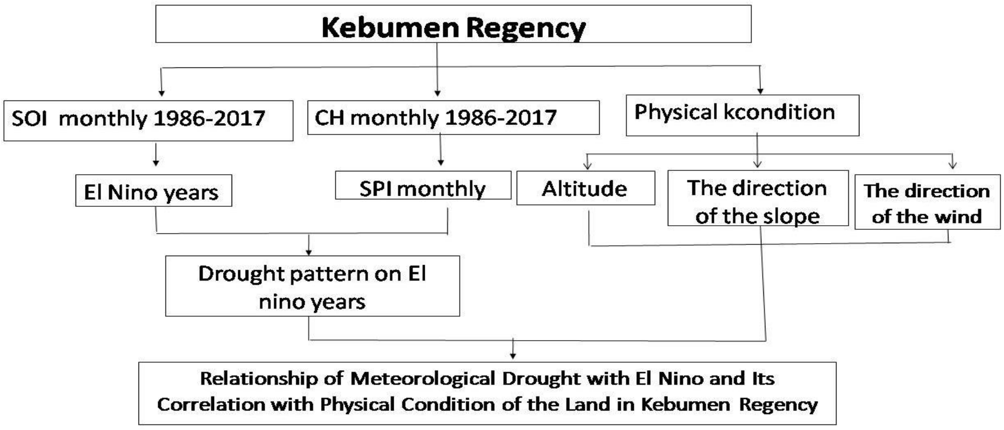

Figure 2. Research Thinking Flow

4. Results

4.1 Spatial Pattern of Drought Level of Kebumen Regency

Based on the calculation results, the SPI value is at least -9.61 in August 1988 because the amount of rainfall from year to year is below 1 mm. The maximum value of SPI was 4.52 in March 1986. This indicates the influence of a strong El Nino event in 1987. In 2015 El Elino phenomena also occurred and caused drought. Drought in 2015 varied from the index -4.95 to 3.46. The drought with the index of -4.95 occurred in August which was included in the very dry category. The index of 3.46 or the level of very wet drought that occurred in December.

In August almost all of Kebumen Regency experienced a very dry drought of 113,949 ha or 85.5%. There are two parts of the Kebumen Regency which experienced a less significant drought, namely the west and southeast. Even this month there are very wet conditions even though it is only 448 ha or 0.3% and is only located on the coast of Mirit District. In addition there are also wet conditions with an area of 936 ha and a rather wet condition with an area of 1,373 ha found in some Mirit and Buluspesantren Districts. The dry conditions with an area of 5,789 ha 4.3%, rather dry conditions with an area of 3,434 ha or 2.6% and normal conditions of 7,198 ha or 5.4% located in the western and southeastern part of Kebumen Regency.

In December the condition of the Kebumen Regency was also wet. The more east the condition gets wet. There are three conditions in this December, namely normal conditions covering an area of 91,613 ha or 68.80%, rather wet with an area of 39,185 ha, and wet conditions of 2,323 ha which are only distributed in the eastern part of Kebumen District, Padureso District (Figure 3).

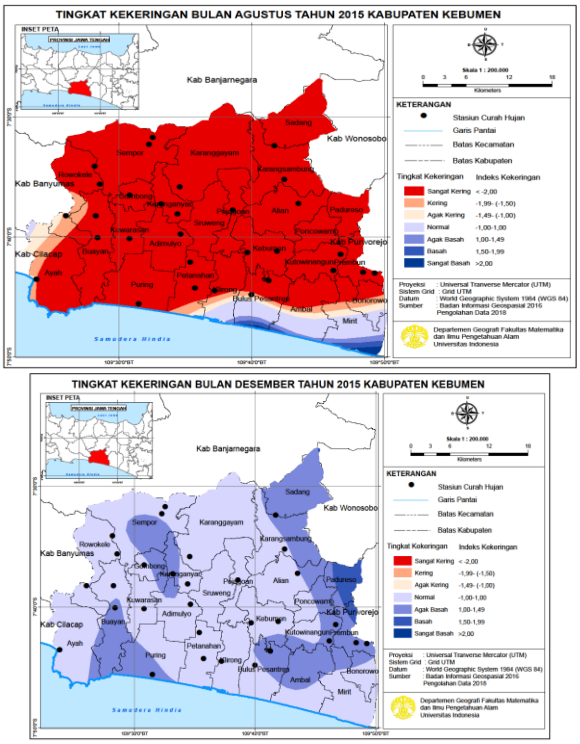

Figure 3. Drought Rate Map for August 2015 (left) and Desember 2015 Kebumen Regency (right)

4.2 Relationship between Drought Level and Regional Physical Condition

Based on the results of the SPI calculation, the drought index value in Kebumen Regency in 2015 varied. The drought pattern that is formed also varies. Many factors influence the pattern, one of which is the rain-forming factor. This is because the pattern of drought is formed from the value of SPI which bases its calculation on rainfall. The several factors that form the rainfall include height, the direction of the slope, and the direction of the wind.

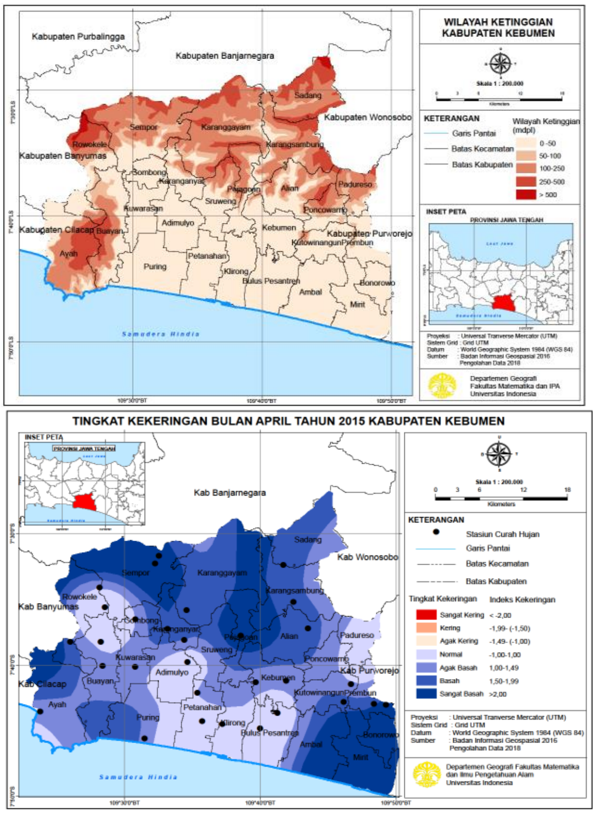

Figure 4. Map of the Altitude Area (left) and Drought Rate Map of Kebumen Regency April 2015 (right)

The height of Kebumen Regency is between 0-997.5 masl. The more north the higher the area (Figure 4), so the more north will get wet. This proposition applies to the spatial pattern of droughts in April 2015 in Kebumen District. In that month, the more north the condition gets wetter, such as Sempor and Karanggayam Subdistricts that experience wet conditions while the coast of Kebumen Regency is included in normal conditions which means the SPI value is lower. The area most associated with El Nino events is an area of 100-500 meters above sea level.

The direction of the wind and the direction of the slope affect the fall of rain The slope facing the direction of the wind will get more rain than the slope that turns towards the direction of the wind. The direction of the arrival of the wind in Kebumen Regency consists of two, namely the west monsoon wind and the east monsoon wind.

The east monsoon winds blow from east/ southeast to west/ northwest. The east monsoon winds occur in Kebumen District from April to August. If the pattern of drought in April to August is seen, the pattern of drought is in accordance with the pattern of drought in the Kebumen Regency region in August 2015. In August the southeast such as the District of Mirit and Ambal are wet. However, the other parts of Kebumen Regency are in very dry conditions.

Different from the direction of the wind during the eastern monsoon, during the western monsoon, the wind blows from the west / northwest direction to the east / southeast. West monsoon carries more water vapor than during the eastern monsoon. But as the wind blows, the moisture content gets to the east more and less so the rainfall is getting smaller. Therefore the value of SPI is also getting to the east, the smaller. This is in accordance with the pattern of drought in the Kebumen Regency region in March 2015. The western part of the district, such as Rowokele, Kuwarasan, and Adimulyo, has high SPI values. In addition, the value of SPI in the eastern part is even lower and dry in Sadang District.

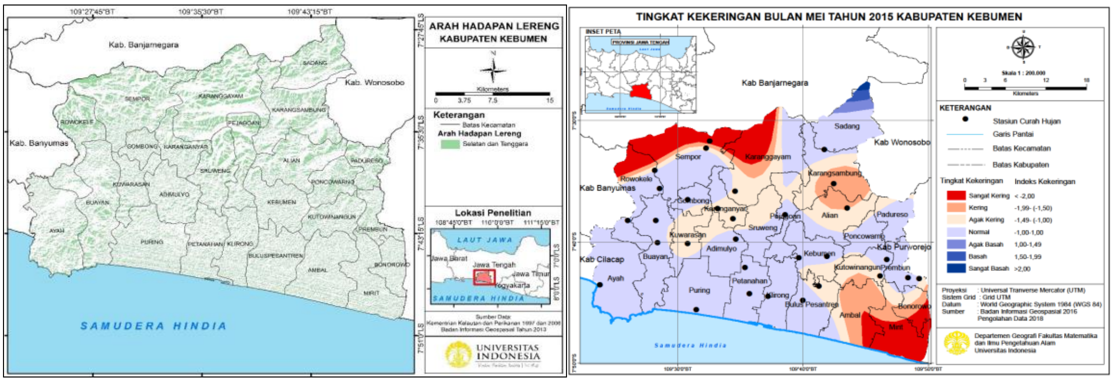

Figure 5. Map Direction of the slope (left) and Drought Rate Map for May 2015 Kebumen Regency (right)

Direction of the slope in the direction of Kebumen Regency as shown in Figure 5. The direction of the slope in the direction of Kebumen Regency which is related to the El Nino incident is to the South. Therefore, in the dry season such as in the southeastern part of May it still receives rainwater from the eastern monsoon winds. However, on the slopes facing the wind experiencing drought like what happened in Sempor and Karanggayam. Although the two sub-districts are located in an altitude of > 500 meters above sea level.

4.3 Relationship between El Nino Drought Events

The results of the calculation of the El Ninoyang relationship represented by the SOI value with the SPI drought index using simple linear regression are the correlation (multiple R) SOI values with SPI in Kebumen Regency in the range of 0.41 to 0.60 which is included in the category it relates to moderate to strong. Therefore, in general El Nino is associated with Drought in Kebumen Regency with an average correlation of 0.51 (strong correlation).

The largest correlation value between El Nino and drought is 0.60 at the Tersobo Rainfall Station which is at an altitude of 0-50 masl, 3-7% slope and with a slope facing South. The lowest correlation value is located in the Father Rainfall Station which is located at an altitude of 0-50 masl, 0-2% slope and with a north facing slope or in a rain shadow area. The simple regression results produce R^2 values 0.1 to 0.3.

5 Conclusion

In general, the drought index value in Kebumen Regency in 2015 varied so that it does not show a regular pattern spatially. The spatial pattern of drought in April follows the pattern of regional heights. The spatial pattern of drought that follows the wind direction and is a pattern of drought in March and August. The spatial pattern of drought that corresponds to the direction of the slope is a pattern of drought in May 2015. The area of drought associated with El Nino events is an area with an altitude of 100-500 masl, with the direction of the slope to the South, and in accordance with the direction of the west wind.

The El Nino relationship represented by the SOI value with drought in Kebumen Regency, represented by the SPI value, is positive with an average correlation of 0.51 (strong correlation). The biggest correlation value is 0.60 at the Tersobo Rainfall Station which is at an altitude of 0-50 masl, 3-7% slope and with a slope facing South. The lowest correlation value is located in the Father's Rainfall Station which is at an altitude of 0-50 masl, 0-2% slope and with a north facing slope or in a rain shadow area. Correlation of SOI values under normal conditions with drought is 0.05 or not related. Spatially the comparison of El Nino conditions with normal conditions, the drought that is more severe when El Nino.

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InAWARE: an early warning and decision support tool for Indonesia

1.1.1. **Victoria C. Leat[1], Cassie Stelow[2,], Dian Oktiari[3]**

[1]Pacific Disaster Center, The Hive, 46/9 Soi Sukhumvit 49, Bangkok, 10110, Thailand
[2]Pacific Disaster Center, 1305 N Holopono St # 2, Kihei, Hawaii, HI 96753,
[3]Badan Nasional Penanggulangan Bencana, Graha BNPB, Jalan Pramuka Kav. 38, Jakarta

E-mail: vleat@pdc.org

Abstract. InAWARE, Indonesia All-hazards Warning, Analysis, and Risk Evaluation overcomes the information challenges faced by Disaster Management professionals. The system was aimed to allow Disaster Management professional to obtain timely information through incorporating international best-practice methodologies and technologies for data acquisition, hazard modelling, risk and vulnerability assessment, mapping, visualization and communications into one comprehensive system.

Background

Indonesia's population of more than 260 million people is exposed to a wide variety of hazards including flood, earthquake, tsunami, volcano, forest fire, drought, landslide, and tropical cyclones [1]. The Government of Indonesia (GoI) and the international donor community have greatly increased efforts over the past decade to strengthen the capacity of national and provincial/municipal disaster management agencies, as well as communities to prepare for, and respond to, natural hazards [2]. Despite these significant advancements, decision makers, disaster managers, and the general public lacked timely ways to contribute to, and access, comprehensive and accurate near real-time hazard information [3] with supporting population, infrastructure, and response resources in a user-friendly, accessible format.

Addressing a Need

With an understanding of this capacity gap, in 2011, PDC and the Hawaii National Guard (HING) initiated engagement with BNPB as part of the U.S. National Guard Bureau "State Partnership Program" (SPP). The activity began by exploring interoperability between PDC's DisasterAWARE® platform and Indonesia's internally-developed Disaster Management creeds, *Kesiapsiagaan* and *Pengurangan Risiko Bencana*. As BNPB staff and leadership learned more about the full capabilities of DisasterAWARE, they expressed interest in having a customized, national version for Indonesia, similar to platforms developed by PDC for Thailand and Vietnam. This resulted in a formal request by BNPB for the development and deployment of InAWARE, a customized version of DisasterAWARE for Indonesia's disaster management community.

DisasterAWARE, developed by PDC over the last 20 years, is an early warning and decision support system (EW DSS) which provides disaster monitoring and early warning decision support capabilities for disaster management professionals. The web-based system contains baseline data, as well as automatically ingested and processed real-time data on hazards, environmental conditions, hazard-and-consequence model outputs, and operational status of critical infrastructure, as shown in Figure 1. Decision makers receive early warning alerts delivered via email or to their mobile devices by reliable, up-to-the-minute alert services. Subscribers to the Smart Alert service can elect to receive notifications according to hazard type, severity, and geographic region. Hazard data are put into context for responders in an easy-to-use, but sophisticated geospatial information environment providing easy and efficient sharing of analyses and situational reports through a simple process, supported (where appropriate) by a mobile application interface, thereby enriching the knowledge base for all stakeholders.

Figure 1. *Hazards in Indonesia are actively monitored InAWARE, providing alerts to its users within BNPB and BNPB.*

Following BNPB's request for a customized version of DisasterAWARE, through the generous support of USAID OFDA, PDC provided technical assistance to deploy InAWARE in BNPB in 2014. The deployment of InAWARE involved significant customization of the platform to meet the specific needs of the Indonesian disaster management community. A key component of this customization is the "Dynamic Data Processing and Publication" (D2P2) engine which has been configured for InAWARE to automate a number of key national and international data sets that are pertinent to disaster management in Indonesia. These include Indonesia's BMKG recent earthquake and MODIS active fire data, as well as weather observations (wind, clouds, visibility, and temperature) from Badan Meteorologi, Klimatologi dan Geofisika (BMKG). Table 1 lists some of the key incident data integrated into InAWARE. D2P2 rules govern hazard severity categorization and, when conditions are met, hazards are automatically created within the system, and on-screen, email, SMS, and Telegram app notifications are provided for users.

Table 1. Key incident data integrated into InAWARE

Incident Data	*Information Source*	Description	*Geographic Extent*
Earthquake	Badan Meteorologi, Klimatologi dan Geofisika (BMKG)	Continuous monitoring of new earthquake bulletins	Indonesia
Active Hotspots - MODIS	NASA Fire Information for Resource Management System (FIRMS)	Daily observations available within 3 hours of satellite overpass. 1, 2, and 7 day reporting.	Southeast Asia
Active Hotspots – NOAA 18	ASEAN Specialised Meteorological Centre (ASMC)	Daily Observations	Indonesia
Weather Observations	Badan Meteorologi, Klimatologi dan Geofisika (BMKG)	Over 100 sites providing meteorological observations related to wind, clouds, visibility, and temperature	Indonesia
SADEWA	Indonesia National Institute of Aeronautics and Space (LAPAN)	Satellite Disaster Early Warning System with meteorological observations for heavy rainfall events.	Southeast Asia
Historic Hazards	BNPB / Data Dan Informasi Bencana Indonesia (DIBI)	Historic hazards and losses	Indonesia
Hazard Risk Zones	BNPB	Exposure to natural hazards	Indonesia

To further enhance the available data within InAWARE, PDC partnered with a number of organizations who are also leveraging technology to support disaster management. These include the Australia-Indonesia Facility for Disaster Reduction (AIFDR) and DMInnovation to implement a scenario-based disaster impact assessment tool, InaSAFE; the Humanitarian OpenStreetMap (OSM) Team (HOT) to map and incorporate millions of disaster-relevant features in Indonesia within OSM with the help of HOT-trained local community organizations and individuals; and Yayasan Peta Bencana (YPB), which leverages OSM and social media crowdsourcing to allow citizens to report flooding in their neighborhoods, contributing to understanding of the circumstances and severity (where, when, how much) and the response options of BPBD.

InaSAFE

InaSAFE is a decision support tool designed to enhance the abilities of disaster managers to prepare for disasters and to reduce the impact of those disasters on the local population and infrastructure. InaSAFE uses innovative science and crowdsourced data (OpenStreetMap, OSM) to create realistic disaster and hazard impact scenarios for better planning, preparedness, and response. It provides a simple but rigorous way to combine data from communities, local governments, and scientists to help assess the possible impact of future disaster events on communities, assets, and infrastructure.

InaSAFE was originally developed by the Indonesian Government (through BNPB), the Australian Government (through the Australia-Indonesia Facility for Disaster Reduction, AIFDR), and The World Bank (through the Global Facility for Disaster Reduction and Recovery, GFDRR). Its development began in 2010, and it was officially launched in October 2012 at the Fifth Asian Ministerial Conference for Disaster Risk Reduction in Yogyakarta. In

2012, InaSAFE was released as a QGIS (a free and open source Geographic Information System (GIS)) plugin, leveraging the spatial tools available in an existing GIS.

Version 2.0 was launched in March 2014 to coincide with the opening of the Indonesia Disaster Relief Training Ground (Ina-DRTG) in Sentul, and InaSAFE 3.2 was released in September 2015. The latest version – 4.0 – was released in March 2017 which included a complete overhaul of the InaSAFE code base, a new reporting system, experimental support of infographics, and the ability to produce rich data outputs instead of the simple HTML reports previously available. InaSAFE has been socialized to representatives from all BPBDs. Over 300 Indonesian disaster managers from seven provinces have received InaSAFE training. It is a Free and Open Source Software (FOSS) project, published under the GPL V3 license and may be freely downloaded, shared and modified. The InaSAFE plugin has been downloaded more than 25,452 times worldwide (as of August 2015). The success of InaSAFE in Indonesia can be attributed to a number of factors. It has been developed iteratively with a specific target audience in mind, it is free and easy to use, and it supports the implementation of government policy.

Humanitarian OpenStreetMap (OSM) Team (HOT)

Humanitarian OpenStreetMap Team (HOT) acts as a bridge between foundations, development agencies, NGOs, humanitarian organizations, and the OpenStreetMap[7] Community. HOT works both remotely and physically in countries to assist in the collection of geographic and other map data, usage of that data, and training others in OpenStreetMap. For the past five years, HOT Indonesia has partnered with DMInnovation (formerly AIFDR), The World Bank, and their partners Kartoza and BNPB to focus on disaster risk reduction. During that time, the HOT team has demonstrated that a cadre of citizen mappers can make useful contributions to the management of natural hazards in their communities. The resulting data are currently used in InAWARE, PetaJakarta.id, and InaSAFE for DRR activities, including disaster preparedness, mitigation, and response.

This successful model has been applied in DKI Jakarta, Surabaya, and Semarang in 2016 and 2017 under the InAWARE project, providing needed data to support expanded use of InAWARE, InaSAFE, and CogniCity/"Peta" in these locations. To extend the accessibility of HOT's mapping tools, the team is now developing eLearning to support wide-scale mapping across Indonesia.

Yayasan Peta Bencana

During the 2014–2015 monsoon season, PetaJakarta.id was launched using the CogniCity open source software (CogniCity OSS) as a collaboration among the SMART Infrastructure Facility, the Jakarta Emergency Management Agency (BPBD DKI Jakarta), and Twitter Inc. The group worked with experts in academia, industry, and government to design, develop, and deploy the CongniCIty system in Jakarta. CogniCity is an open source, community-led platform to collect and disseminate information about flooding and critical water infrastructure in Jakarta. It works by crowdsourcing and combining information from multiple sources including Twitter, Detik.com (Indonesian news platform), QLUE (a software used by SmartCity Jakarta), and DIMS (a proprietary Fijitsu-owned Disaster Information Management System with an open API), among other application programming interface (API) data feeds. It uses administrative boundaries collected by HOT to aggregate hazard data from these sources, essentially enabling the production of near real-time hazard severity maps. In turn, the CogniCity software also pulls in data from PetaJakarta.id and various authoritative sources used by BPBD DKI Jakarta in a decision-support matrix for their response actions.

[7] OpenStreetMap (OSM) is a web wiki project to create a free and open map of the entire world, built largely by volunteers and professionals surveying with GPS, digitizing aerial imagery, and collecting and liberating existing public sources of data.

Under the InAWARE program, MIT Urban Risk Lab further enhanced CogniCity, to mature its Risk Evaluation Matrix (REM), and to automate the integration of multiple geospatial and non-geospatial sources via application programming interfaces (API) into a user-oriented dashboard. These developments have allowed additional secondary applications (via a dynamic output API), especially InAWARE and InaSAFE, to access the same hazard information and perform related evaluations, analyses, and alerting. The enhanced CogniCity REM engine has been deployed in the BPBD office in DKI Jakarta and Semarang, building upon the foundational data work being performed by HOT and supporting expanded use of InAWARE and InaSAFE in these regions/cities and their BPBD offices. Additionally, the CogniCity tool has been expanded to cover the entire Indonesian region, allowing for crowd-sourced hazard reporting across the country. Further, the Yayasan Peta Bencana team are now developing reporting "cards" for other hazard types, including wildfire, earthquake, and volcanic eruption.

Collectively, these efforts—all initiated separately, but oriented towards the same overall disaster risk reduction objectives—have successfully demonstrated how information and tools can be successfully applied in Indonesia at separate levels of administration ranging from national, to provincial, to municipal, and community-based.

Technical work has also been undertaken to synchronize the InAWARE system with the ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management (AHA Centre)'s customized version of DisasterAWARE, Disaster Monitoring and Response System (DMRS). Hazard and information product synchronization allows the AHA Centre to monitor hazard events in Indonesia, and more quickly provide support and assistance in the event of a large hazard.

Impact

Since its deployment in 2014, InAWARE has been enthusiastically embraced and supported by BNPB leadership and is now being used operationally at a national level, and in selected BPBD offices. During number of large disaster events including the two tsunami events in 2018, InAWARE was used at both a national and provincial-level to share information and coordinate responses. Additionally, the system has been used extensively by BNPB to keep the public informed and updated on hazard events, either through the use of the system to conduct press briefings, or via their social media accounts. Since the deployment of InAWARE, PDC and BNPB's cadre of InAWARE trainers (created under project activities) have provided in-person training to almost 1000 BNPB and BPBD staff in numerous locations across the country, as well as to NGO and UN stakeholders who utilize the system. Additionally, InAWARE system administration training has been provided to key BNPB technical staff to ensure sustainability of the system following the completion of the project. Further, steps have been taken in support of institutionalization of the use of InAWARE, with a Concept of Operations (CONOPS) and Standard Operating Procedures (SOPs) developed. These documents guide the use of InAWARE within Indonesia, ensuring the most effective and impactful utilization of the system within the local context. An InAWARE use policy document has also been drafted, providing BNPB and BPBD staff with the necessary authorization to use the system for their regular duties.

Looking Forward

Under additional funding from USAID, PDC has initiated work on a new regional DisasterAWARE program, designed to improved hazard monitoring, early-warning, and disaster management decision making outcomes throughout the ASEAN region. Within Indonesia, this will expand InAWARE user training, both instructor-led and eLearning, as well as provide additional system administration training. PDC will also assist BNPB and BPBDs offices with the development and implementation of InAWARE response SOPs to high-risk provinces and districts, supported by InAWARE usage policies within BNPB and other stakeholder ministries/agencies. The successes of PDC's project partners will also be leveraged, expanding YPB tools and HOT methodologies to allow citizen reporting of hazards across the country, as well as facilitating mapping by BPBDs and local communities.

Further data development is also planned. One significant data enhancement will be generated through PDC's parallel Indonesian activity, the National Disaster Preparedness Baseline Assessment (NDPBA). This project creates a sustainable system for accessing, understanding, updating, and applying critical risk information in decision making. The NDPBA provides the necessary tools, scientific data, and evidence-based practices to effectively reduce disaster risk—informing decisions at the national, subnational, and local level. Similar NDPBA projects have been successfully conducted across Central and South America and Vietnam. Throughout the year-long NDPBA process, stakeholders work together to conduct extensive data gathering, including risk and vulnerability information, socio-economic conditions, hazard exposure, and existing disaster management capabilities. The NDPBA also examines critical infrastructure, population, and housing data to provide increased situational awareness during all phases of disaster management to all stakeholders. Throughout the NDPBA Indonesia project, data and information gathered during the assessment will feed into InAWARE to enhance capabilities and enable evidence-based decision-making using the system.

Conclusion

Indonesia is embracing technology to support the country's national and provincial disaster management efforts. InAWARE has become an enduring feature of both BNPB's national EOC, and a number of BPBD provincial EOCs across Indonesia. This powerful early warning and decision support tool has already supported numerous disaster events, providing both decision-makers with up-to-date hazard information and facilitating provincial-national and national-regional cooperation. As capacity has developed, sustainability has become key to the success of the InAWARE system. PDC and BNPB are now developing a transitional and sustainment plan designed to guide the effective transition of InAWARE to a fully BNPB owned, operated, administrated, and maintained system to support improved disaster outcomes for Indonesian citizens both now and in the future.

Acknowledgements

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Study of Generalized Pareto Distribution to Flood Disaster Mitigation in Bandar Lampung

Achmad Raflie Pahlevi[1,2], Warsono[1] and Khorin Nisa[1]

1. [1]Faculty of Mathematics and Natural Sciences, University of Lampung
2. [2]Indonesia Agency for Meteorology Climatology and Geophysiscs (BMKG)

E-mail: achmad.raflie@bmkg.go.id

Abstract. Extreme rainfall is a hydro-meteorological event that most often causes disasters such as floods and landslides in Bandar Lampung. This makes the importance of using rainfall probability distribution to explain the potential of extreme rainfall events in Bandar Lampung. In this study, rainfall data were modelled using generalized Pareto distribution. The generalized Pareto distribution is known to be effective in explaining extreme event data and is suitable for data that involves time-dependent parameters to account for temporal changes in the frequency of distribution. The data used in this study are the intensities of daily rainfall from the Maritime Station of Meteorology, Climatology and Geophysics Agency (Indonesian: Badan Meteorologi, Klimatologi, dan Geofisika, abbreviated BMKG) in Panjang - Bandar Lampung in the period 1999-2018. The results showed that the generalized Pareto distribution was very suitable in describing the intensity of rainfall in Bandar Lampung and could be used for flood disaster mitigation.
Keyword: Extreme rainfall, generalized Pareto distribution, flood disaster mitigation

Introduction

Extreme rain event is one of the most extreme weather events in hydrometeorology, it get more attention because of its large impact on social economy and human life. This makes the importance of using rainfall probability distribution to explain the potential of extreme rainfall events in Bandar Lampung [1]. Estimating a probability distribution model that fits for the intensity of daily rainfall and wind speed has long been an interesting research topic in hydrology and meteorology.

The use of extreme value distributions in hydrometeorology was first introduced by Jenkinson in 1955 [2]. Probability models have been applied successfully in many physical phenomena such as wind speed, rainfall, and air quality [3]. Normal, lognormal, Pearson, log-Pearson, exponential, Gumbel, generalized extreme value, Weibull, and generalized Pareto distribution are the most frequently used in hydrometeorology [4].

Generalized Pareto (GP) distribution was first introduced by Pickands in 1975 [5] and it becomes a stable distribution when its values above the threshold. The use of GP distribution have been applied many times in extreme value analysis of meteorological variables, such as rainfall [6], wind speed [7], and drought [8]. The probability density function (PDF) of GP distribution is as follows,

$$f(x) = \frac{1}{\sigma}\left(1 + \xi \frac{x-\mu}{\sigma}\right)^{-\frac{1}{\xi}-1}, \xi \neq 0 \tag{1}$$

And cumulative distribution function (CDF) of GP is

$$F(x) = 1 - \left(1 + \xi \frac{x-\mu}{\sigma}\right)^{-\frac{1}{\xi}}, \xi \neq 0 \qquad (2)$$

x in this paper is defined as the intensity of daily rainfall, ξ is shape parameter, σ is scale parameter, and μ is location parameter.

The purpose of this study is to show that GP distribution is the best fit distribution to describe the intensity of daily rainfall in Bandar Lampung. The use of GP distribution models in the probability of extreme rain events can be applied to flood disaster mitigation in Bandar Lampung.

Methodology

The data used in this study are daily rainfall intensity for 21 years from 1999 – 2018 obtained from Lampung Maritime Meteorological Station of BMKG in Bandar Lampung. The rainfall data are divided into four different seasons, that are the rainy season (December, January and February), transition season I (March, April and May), dry season (June, July and August), and transition season II (September, October and November).

Parameter estimation for GP distribution is done using the maximum likelihood estimation (MLE) method. MLE has been widely used, because it produces an efficient and consistent estimator. The estimation of GP-2 parameter distribution parameters with MLE was first carried out by Grimshaw (1993) [9] and continued being used by Coles [10], Chaouche [11], and Husler [12]. The MLE solution for θ is obtained by maximizing the likelihood function L, i.e. :

$$\frac{d \log L}{d\theta} = 0 \qquad (3)$$

To show that the GP distribution model is the best fit distribution model, the GP distribution model is compared to other distributions namely generalized extreme value (GEV) and Weibull. Distribution model of rainfall data is then verified by goodness of fit tests, here we use the Kolmogrov-Smirnov (KS) and Anderson-Darling (AD) tests. The smallest value shows the best distribution. With N is the amount of data, the KS test statistic is given by

$$D = \max_{1\le i\le n}\left(F(x_i) - \frac{i-1}{N}, \frac{i}{N} - F(x_i)\right) \qquad (4)$$

and AD test statistic is given by

$$A^2 = -N - S \qquad (5)$$

where

$$S = \sum_{i=1}^{n} \frac{(2i-1)}{N}\left[\ln F(x_i) + \ln\left(1 - F(x_{N+1-i})\right)\right] \qquad (6)$$

The probability for the intensity of daily rainfall which is classified as extreme and passing a threshold value is explained as follows,

$$P(X > x) = 1 - P(X < x) = 1 - \int_{-\infty}^{x} f(x)dx \qquad (7)$$

Result and Discussion

Intensity of daily rainfall frequency data in Figure 1 shows that the information on intensity of rainfall data is positively skewed. It strengthens the reason for using extreme value distribution (such as GP, GEV, and Weibull). It shows that intensity of daily rainfall data the highest frequency of rainfall occurs in the rainy season, then transition 1 and transition 2, and the lowest frequency of rainfall during the dry season.

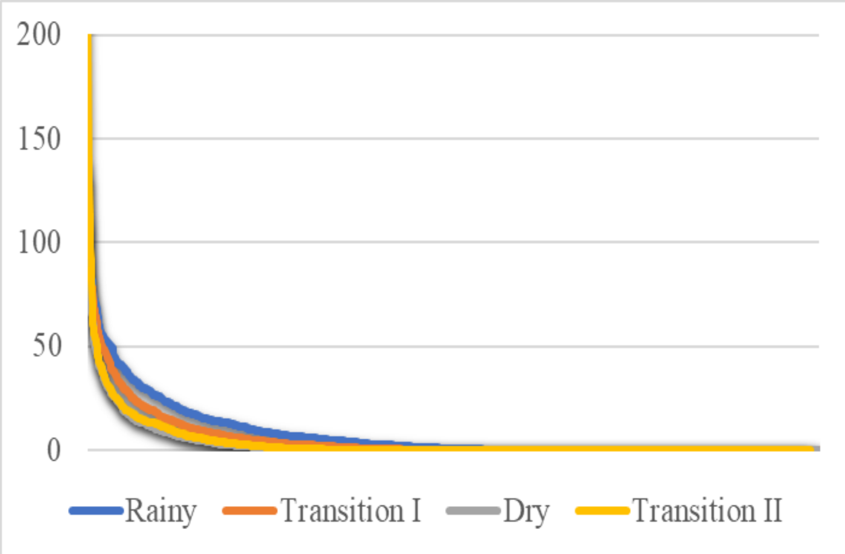

Figure 1. Graph of daily rainfall intensity data frequency

The data are summarized in Table 1 giving the minimum, maximum, median, mean, standard deviation, skewness and kurtosis. The summary in the table shows that even the highest rainfall frequency in the rainy season, the intensity of daily maximum rainfall in rainy is actually the lowest. The maximum of daily rainfall intensity occurs in transition II with rainfall intensity reach 204.9 mm. On transition II, larger value of skewness and kurtosis showed that the distribution of data was stretched to positively skewed, while lower value of skewness and kurtosis that data distribution is more integrated. It shows that during rainy season the data is more integrated while in the transition II season the data is more stretched to positively skewed.

Table 1. Summarized data of daily rainfall intensity

	Min	Max	Median	Mean	Standard Deviation	Skewness	Kurtosis
Rainy	0	108.1	1	7.7814	14.5761	2.9336	13.2558
Transition I	0	130	0	5.3451	13.0916	4.3556	27.9305
Dry	0	137.2	0	3.2385	9.7559	5.3222	42.2808
Transition II	0	204.9	0	3.8118	11.9812	7.1529	79.1506

3.1. Goodness of Fit Test

In an attempt to prove that GP distribution is the best probability model distribution to describe daily rainfall data in Bandar Lampung, the goodness of fit test is carried out using KS and AD tests. The results of the KS and AD tests are shown in Table 2. Based on Table 2, GP distribution is the best distribution, because it has the lowest test statistic value. GP distribution shows very good compatibility for the rainy season and decreases when entering the dry season.

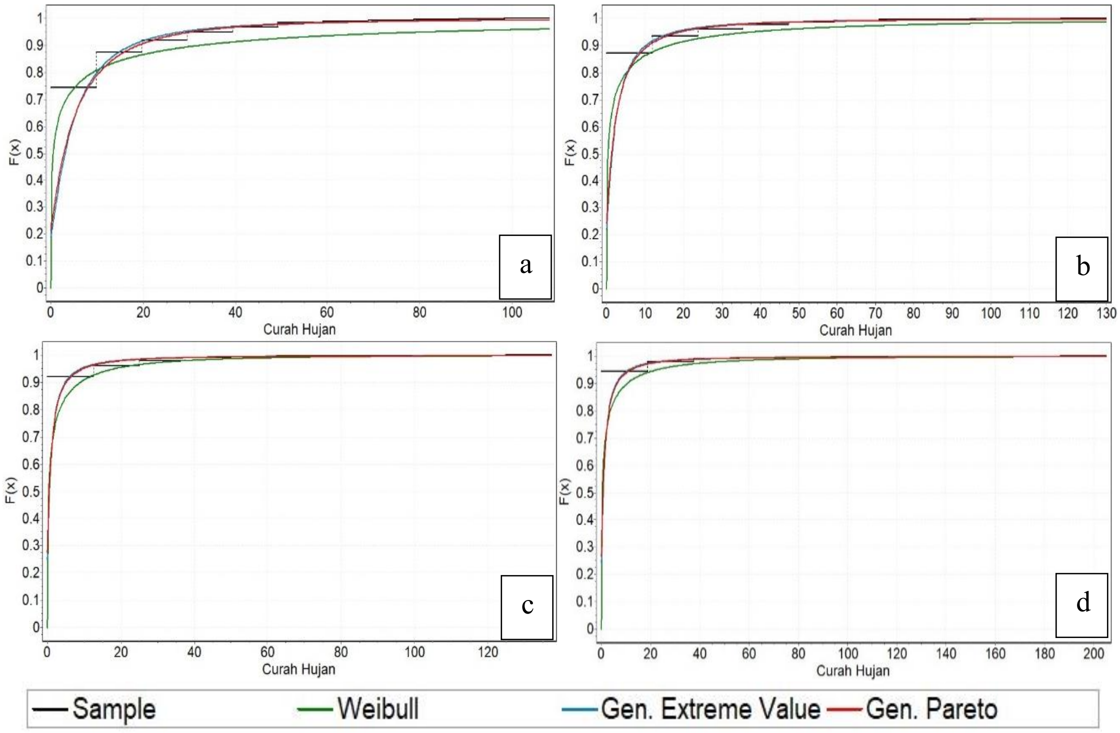

Figure 2. Graph showing the cumulative distribution function of the fitted distribution in a) rainy, b) transition II, c) dry, and d) transition II

The cumulative distribution function (CFD) graph of the three distributions is shown in Figure 2. The graph shows how the GP, GEV and weibull distributions fit the data. In Figure 2, it can be seen that the GP distribution is the best distribution because it is closest distribution to the CDF of daily rainfall intensity data.

3.2. Probability of daily rainfall intensity

Tabel 2. Goodness of fit statistics

Distribution	Rainy		Transition II		Dry		Transition II	
	Kolmogorov - Smirnov	Anderson - Darling	Kolmogorov - Smirnov	Anderson - Darling	Kolmogorov - Smirnov	Anderson - Darling	Kolmogorov - Smirnov	Anderson - Darling
Generalized Pareto	0.21282	112.52	0.2901	178.83	0.40964	314.59	0.37153	263.37
Generalized Extreme Value	0.22574	132.76	0.31495	201.41	0.43474	347.59	0.39644	291.77
Weibull	0.4145	1117.2	0.53257	1580.1	0.68371	2272.6	0.63728	2017

GP distribution more suitable than other distributions for daily rainfall intensity data in Bandar Lampung. The probability calculation will use CDF from the GP distribution. The parameters of the GP distribution are shown in Table 3.

Table 3. Parameter of GP distribution

	ξ	σ	μ
Rainy	0.46673	4.8671	-1.2323
Transition I	0.6373	2.185	-0.66375
Dry	0.75616	0.85725	-0.31068
Transition II	0.73615	1.0992	-0.38128

Based on Table 3, the CDF of rainy season,

$$F(x) = 1 - \left(1 + 0.46673\,\frac{x + 1.2323}{4.8671}\right)^{-0.46673} \qquad (8.a)$$

CDF of transition I season,

$$F(x) = 1 - \left(1 + 0.6373\,\frac{x + 0.66375}{2.185}\right)^{-0.6373} \qquad (8.b)$$

CDF of dry season,

$$F(x) = 1 - \left(1 + 0.75616\,\frac{x + 0.31068}{0.85725}\right)^{-0.75616} \qquad (8.c)$$

CDF of transition II season,

$$F(x) = 1 - \left(1 + 0.73615\,\frac{x + 0.38128}{1.0992}\right)^{-0.73615} \qquad (8.d)$$

and x is intensity of daily rainfall data.

Table 4s. Probability of daily rainfall intensity (in percentage)

x	> 0	≥ 25	≥ 50	≥ 100
Rainy	79	6.8	2.2	0.6
Transition I	76	3.5	1.3	0.4
Dry	73	1.5	0.6	0.2
Transition II	73	2	0.8	0.3

By using CDF parameters from Table 3 and equation (8.a) - (8.d), the probability of daily rainfall intensity data is obtained in Table 4. During the rainy season, the probability of rain with an intensity above 100 mm or very heavy rainfall intensity is,

$$P(X_{rainy} > 100) = 1 - P(X_{rainy} \leq 100) = 1 - 0.994 = 0.006$$
$$P(X_{rainy} > 100) = 0.6\%$$

when transition I season,

$$P(X_{transition\,II} > 100) = 1 - P(X_{transition\,I} \leq 100) = 1 - 0.996 = 0.004$$
$$P(X_{transition\,I} > 100) = 0.4\%$$

when dry season,

$$P(X_{dry} > 100) = 1 - P(X_{dry} \leq 100) = 1 - 0.998 = 0.002$$
$$PX_{dry} = 0.2\%$$

when transition II season,

$$P(X_{transition\,II} > 100) = 1 - P(X_{transition\,II} \leq 100) = 1 - 0.997 = 0.003$$
$$P(X_{transition\,II} > 100) = 0.3\%$$

So that, the frequency of very heavy rainfall from the biggest to the lowest in a row, is the rainy season (0.6%), transition period I (0.4%), dry season (0.2%), and transition II (0.3%).

Conclusion

In this paper, we have shown that the intensity of daily rainfall data is positively skewed. Based on goodness of fit tests, GP distribution is the best fit distribution to describe daily rainfall intensity data. The frequency of daily rainfall intensity that more than 100 mm or very heavy rainfall in a row, is the rainy season (0.6%), transition I (0.4%), dry season (0.2%), and transition II (0.3%).

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Community Groups Role in DRR through Community Education: The Strength, Challenges, and Recommendation

Wahyu Setyawan Minarto

Jl.Tebet Timur dalam XI/26, Jakarta 201820, Indonesia

E-mail: ws.minarto@yahoo.co.id

Abstract. As like many other world issues that the society is facing, Disaster Risk Reduction (DRR) issues also require wider collaboration across different sectors so as to initiate discussions and awareness for disaster preparedness to lower the impact and victim from disaster. The needs of DRR information in Indonesia is enlivened by the rise of Community Groups performing community education. Community Groups fills the gaps that cannot be fulfilled by Government Authority/ Agency/Bodies or from well-known NGOs. Author acknowledges several non-profit Community Groups are emerging in Indonesia to deliver non-formal education/community education focusing on the DRR. As self-initiated, self-funded, non-governmental institutions, these groups struggle with issues which could threaten their existence. Research carried out by surveying 11 Community Groups in Indonesia. The survey found out that there are several strength and weakness of this movement and author to give suggestions for improvement.

Introduction

Living in Indonesia means living with beautiful scenery supported with tremendous biodiversity with hundreds of tribes spread in an archipelago consist of more than 17.000 islands. Indonesia's geographical location makes it one of the countries with abundant natural resources and a huge population. This great condition also comes with all the challenges of natural disasters. The people of the 4th highest population in the world[13] have to live co-existed and in harmony with natural disasters in daily lives.

BNPB (National Disaster Management Authority) recorded that there was 2.372 disasters in Indonesia in 2017 with a total 20.764 in the period of 2003- 2017 which give Indonesia famous label as 'disaster laboratory'. In the ASEAN region Indonesia is a trusted study center with the existence of AHA Center (The ASEAN Coordinating Centre for Humanitarian Assistance on disaster management): an inter-governmental organization which aims to facilitate cooperation and coordination among ASEAN Member States and with the United Nations and international organizations for disaster management and emergency response in ASEAN region [11].

In Indonesia Disaster Risk Reduction (DRR) education is already embedded in the formal education which reflected in the school curricula and programs.

Avianto Amri (2015) notes that the Government of Indonesia has made substantial gains in the integration of DRR into the school curricula and is committed to scale-up teachers' training on DRR

education and school preparedness (BNPB, 2014; UNISDR, 2015).
However these effort needs to be strengthened because education about Disaster Risk Reduction is still not adequately sufficient in the community, rural areas, families and common community.
The information shared by the government related bodies and formal institutions still felt far and has not reached families and children. There is a vacuum and the breakdown of information from formal institutions as if these institutions only carry out tasks without measuring the social impact of their work in society. Filling in the gaps, Communities Groups conducting DRR community education has risen in Indonesia.
Community Groups have members or contributors from various backgrounds, 88.9% are coming from employees or professionals.
Due to technology advances not limited to boundaries so it is common even though they are based in Indonesia but they also have members in abroad and they can also reach and collaborate with other groups across the world, which will leverage their existence.

1. Literature Review

1.1. Community Education and Community Groups
Community Groups is a type of group or organization that is created and operates for a specific purpose or to provide a specific service in a community for the public benefit of the members of the community. The specific service amongst others is to perform community education.
While Community Learning Aotearoa/New Zealand(CLANZ) explained that: 'The term community education is used to describe those education activities for adults that give opportunities for social and personal development without usually being directed by a set curriculum. Activities take place through institutions as well as through a variety of community groups. Non-formal learning (on the other hand) is the process by which ideally community education takes place. It is characterized by a blurring of roles of learner and tutor (facilitator) and learner control of the process and content. It most commonly takes place outside of institutional control because of its flexible, developmental and ad hoc nature.' (CLANZ Information Paper, November 1989, pp3-4)[6]
The He Tangata Report of 1987 specified that: 'The essential element which distinguishes non-formal from formal education is that non-formal groups control their own learning independently of imposed curricula, of outside professionals or of institutions'.
This Community Groups characteristics are voluntary; non-profit oriented; community member participation; self-fund (come from crowdfunding or personal funds), even though sometimes they get funding from sponsors or private sector and collaborative.

2. Research Methodology

The research method is issuing a survey of 32 questions to 10 respondents of currently existing Community Group in Indonesia that are focusing on Non-formal DRR education or Community Group that have conducted at least one event related to DRR.

Table 1. Survey’s Respondents

Name	Year of establishment	Base
Ibu-ibu Kota Hujan	2018	Bogor
Compress	2006	Jakarta

Indonesian Youth on DRR (IYDRR)	2016	Jakarta
Kejora	2015	Jakarta
Keselamatan Keluarga	2017	Jakarta
Kidzsmile	2009	Jakarta
Pahlawan Bencana	2016	Bandung
SafeKids Indonesia	2015	Jakarta
Star Side	2017	Jakarta
U-Inspire	2018	Jakarta
Yayasan Kausa Reseliensi Indonesia (YKRI)	2015	Jakarta

3. Survey Result

3.1. Roles of Community Groups

Community Groups plays several roles in DRR such as a **source of information**. (1) As a **messenge**r: conveying the original message from Authorized Bodies such as BNPB or BMKG (Meteorological, Climatological, and Geophysical Agency) and passing them to the society by modern means such as social media and chatting application. (2) **Creating own information** which can be done by gathering , and compiling information from trusted sources (such as BNPB, BMKG, AHA Centre) and reformatting it to more friendly and simpler format such as infographics, comics, children books, short video clips, Instagram posts in order to deliver the message to families and children. Community Groups can also act promptly in making information and FAQ about a recent disaster.

Community Groups can also act as **Capacity Builder** for their own (1) **internal** improvement such as trainings and workshops for their contributor and facilitator. This can be done in real classes of virtual classes such as Google Class, YouTube Tutorial, WhatsApp Group. And obviously Groups also conduct the education for (2) **external** audience. Parents, teachers and children are most of the targets of these Groups. Survey indicated that 7 out of 10 are targeting children and 8 of them also targeting adults. Offline events such as workshops for teachers, earthquake simulation at schools, seminar for parents, game and play roles for children. Groups also acts as **Consultant**, for example, to implement safe school system or setting the evacuation route and emergency assembly points.

Due to the extensive networking Community Groups also effortlessly make collaborative works with other groups or institutions as **Collaborator**.

And a few of the groups also **Directly involved** in post disaster recovery programs such as support trauma healing for children victims by storytelling, playing games.

Table 2. Community Group’s Role in DRR

Roles	Details	Type of Activity
Source of information	Direct Messenger	Re-posting news or information from Authorized Bodies
	Composing Own Material	Collecting & compiling information and re-create to new format
Capacity Builder	For External	Workshop, awareness

		Visit to schools
		Earthquake simulation
		Online Classes
	For Internal	Training for contributors & members
		Online Classes
Consultant	Profit Oriented	School Safety System Emergency System
	Non-Profit Oriented	Expert for regulation
Collaborator	With other Community Group	Hold community events
	With Authorized Bodies	Seminars, FGD
Post-disaster support	To support and directly involved in a post disaster	Trauma Healing
		Emergency Shelter
		Story telling for children

Figure 1. Example School Visit

3.2. Community Groups Strength

Based on the data collected from the survey, it is concluded that the Non-formal Community Groups for DRR Education has advantages and challenges.

3.2.1. Trustworthy

This can be gained because the founders or their contributors and members are part of the community as well. They can be your family, friends, relatives or neighbours that you can effortlessly trust. The relatively narrow gap of a socio-economic level also becomes a positive factor so there is a sense of togetherness and a feeling of "I can experience what you experience."

This quick bonding will bridge the communication gap during a workshop or awareness session so that the information will be delivered quicker.

The survey indicates that 55.6% of the Groups already gain trust from the society while the rest still think that they begin receiving positive acceptance from the society.

3.2.2. Utilizing Popular and Family Friendly Communication

All respondents agree that using friendly informal communication is the strength of their movement.

Communication carried out by Community Groups is informal and moderately dependent on social media. Busy people have less time to read long and complicated reports or news.

Information is provided with infographics that are placed on social media and easily distributed, for example through chat applications (WhatsApp or Line).
People are to some extent reluctant to send “direct massages” to Authorized Bodies in thinking that they might get a complicated and impractical answer. So one is more convenient to ask and consult with the Groups and expect a direct and prompt reply.

Online communication can cross the nation and formal boundaries. And it is proven could be easily viral. An experience from one Community Groups is that education content can reach Indonesian society abroad such as New Zealand, UK, and Kuwait through chat applications in the matter of minutes, although it originally shared in Indonesia.
Community Groups use the common communication style that families and children could easily understand the content. And children friendly means of communication is also used such as storytelling, fairy tales, songs, infographics, children books, animations which makes the information easier to absorb.

Figure 3. Example of infographic : Duck, cover & hold

Figure 4. Example of infographic : preparing of emergency bag

The online event is also an effective way for Community Groups to deliver their message. An initiative such as online chat group discussion and distance learning by online chat is proven to be effective because the audience is specific and can reach more than 200 participants in one discussion.
Instagram is being the most popular social media because all respondents using it. They are all also using WhatsApp as a chat platform to engage with the contributors and share information.
Some of the respondents also using mixed with YouTube (77.8%), Facebook (66.7%), Twitter (44.4%), also Line, Slack & Trello.
While Television was the least option (only 1 out of 10), half of the respondents are still using printed media (newspaper & magazine).

3.2.3. High Flexibility
The venues for events such as workshops could be conducted in living rooms at homes, school’s classes, community centres, apartments, even in worship place such as a mosque.
This flexibility also enables Community Group to initiate a collaborative event with other Community Group or other members of the society or give awareness to the local RT-RW for DRR socialization.
Community Groups frequently requested a fee if they are invited to an event. However the amount of fee requested is negotiable and flexible, even often they hold a non-profit or fundraising event. For example one Community Group was teaching fire safety to a children in community of fire victim in North Jakarta.

3.2.4. Convenient of communication

People could easily find Community Groups activities by looking into the timeline of their social media posts. For more engagement people also can follow the social media or subscribe to newsletters or online video channel.

Reaching them is also more convenient than contacting formal institutions which sometimes require more complex bureaucracy. People can contact them via email, call, online application chat or call and sometimes there is no strict regulation to prevent people in direct contact with the Community Groups top level (team leader, founder) in person. One can contact Community Groups outside normal working hours and also during weekends and holidays. This is a service which an Authorized Body seldom provides.

3.3. Community Groups Challenges

3.3.1. Insecure revenue income

The survey result indicating 85.7% of the Groups confirmed that financial support is the biggest problem. An active Community Groups requires funding to support the programs. The funding will accommodate the daily operational cost (transportation, salary, printing material, communication), cost of an event (workshop, gathering, seminar), Group identity (T-shirt, business card), promotional (banner, flyer). Community Groups usually self-funded their movement. This could be gained by crowdfunding from group members; fund by founder or initiator (71.4% of the respondent); a donation from other member society; fee from the workshop attendees and a portion from the private sector such as sponsorship (42.9%) or grant from a foundation. This kind of fund source is unstable and unreliable that it can disturb their activity.

71.4% of the groups sometimes received payment from the invitee and the rest, 28.6% are not receiving payment.

3.3.2. Lack of Professional Management

As the activities become more complicated and more frequent Community Group require better planning and coordination. The organization needs to be managed more professionally such as having an organizational structure with clearly defined roles and responsibility for each position. A Key Performance Indicator (KPI) should be established and the achievement should be well documented, measured and reviewed. Any gap should be rectified. 14.3% respondents agree to this statement.

3.3.3. Competencies

Most members are a regular person or professional workers having the basic competency of DRR. Some Groups member has the background of being DRR activist or humanitarian volunteer, safety professionals, medical professional or researcher in DRR field. A few pioneer members such as the founder have enough knowledge to start the movement.

But fair amounts of the member do not have the advanced competency in DRR.

4. Recommendations

Having these advantages and disadvantages Community Groups faces several challenges such as (1) To gain more trust; (2) Enhance the capability of contributors; (3) Stable funding and (4) Impacts measurement

4.1. Gain more trust from the community

The trust achieved from the society shall be maintained and developed by Community Groups. Community Groups are challenged to a more creative approach to build a sustainable engagement and connection with the members and the follower

As Community Group develop and gain more trust, it shall upgrade the skills and competencies in DRR. This could be achieved by enrolling in government competency for example certification from BNSP. Groups could invite a DRR expert to give in-house training and even better to attract the expert to become a member of the Community Group.
Community Groups have to hold their events more frequently to get more exposure to society. Groups should have annual event planning and published it to the society. Creative online activities also need to be taken more consideration as an effective option.

4.1. Competencies
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Community Groups have to hold their events more frequently to get more exposure to society. Groups should have annual event planning and published it to the society. Creative online activities also need to be taken more consideration as an effective option.

4.2. Enhance the capability of contributors
Community Groups have to able to perform and gain exposure at the national level and proactive to introduce themselves to formal institutions. They should be present in DRR related events and activities. To be able to be in the loop of the DRR community is very important.
Physical involvement such as actively taking part in disaster relieve program is also an effective move. Being part of society with the benefit of simple communication is the advantages of these Community Groups. Community Groups with sufficient human resources of experts in DRR can perform internal development program whilst the other groups with lack of such resources can collaborate with other groups or bodies to hold an in-house classes.

4.3. Financial stability and management
An organization, either as a non-profit or profit-oriented entity, it needs a stable source of funding as a guarantee of continued and sustainable growth and development.
Funds originated from self-funding, which is the main source of 66.7% respondents, is very unstable and can threaten the smooth running of their programs and eventually their survival. Therefore Community Groups shall find the best way to generate revenue stream and maintain positive balance.
Some options to choose are:
1. Revenue generated from events. As 75% of the respondents' role is as capacity builders, Community Groups are accustoming to hold an event such as DRR awareness for family. They can charge the attendees for this kind of event.
2. Consultations fee. 75% of respondents have the ability to be a consultant. They can charge the client for a fair amount of fee.
3. Brand and product endorsement, company sponsorships or paid promotion in the social media. As Community Groups also gain popularity, by massive followers, in the social media, they can also be endorsed and sponsored by a brand or company.
This is a viable option for Community Groups but they should take extra cautions in selecting the proper brand. Because brand is eventually a profit oriented entity having a profitable means. Community Groups must set a strict requirement and have a list of non-approved type of product. They have to filter which brand or product suits and in line with their mission.
Example given for Community Groups that related to children, it is impossible to find the common target market with a cigarette brand.

4. Grant. Author suggested that Community Groups can search for foundation that give grants to social movement.
5. Donation. This revenue can be generated by donation from inside the group such as from member or contributors, or the donators can come from outside the organization.
6. Company's Corporate Social Responsibility (CSR) program. There are many companies that have funding for CSR to give.
7. Souvenir and merchandise sales. Community Groups can sell products that are closely related to the DRR. Products can be sold such as giant board game of "Snake and Ladder" about DRR, First Aid Bag, Fire extinguisher & Fire blanket, books & children stories about DRR and many more. Moreover with the online shop, it is should be even more convenient to trade merchandises.
Community Groups are expected to be creative in finding a stable review stream. To achieve that they also has to have financial management systems.
One of the tools that could be considered is using the Business Model Canvas by Osterwalder & Pigneur (2010). Annisa R. Qastharin [12] in her paper has suggested a modified BMC for Social Enterprise, which Author can be applied for Community Groups as well.

4.4. Social Impact Measurement
All efforts done by Community Groups should produce a positive social impact. And the social impact should be measured and monitored. The energy and resources devoted must be taken into account. By measuring the impact then Community Groups will have the opportunity to get a clear picture of their effort and could make a road map to reach the goals.

5. Summary and Path Forward

This study is an attempt to establish an understanding of DRR community education done by Community Groups in Indonesia, to take a clear picture of their roles.
This early guideline is expected to be able to support the capability of the positive trend of DRR community education conducted by Community Groups.
Several discussions regarding this study:
1. Societies, families, and children are more bound to trust Community Groups due to their benefit such as no flexibility, understandable way of communication and easiness of contact.
2. Community Groups needs to upgrade the capacity and capability in order to gain more support and trust by the community.
3. Funding may one of the urgent factor Community Groups need to address in order to maintain the momentum going and more sustain programs. In the other hand, Community Groups has to be careful of the source of funding taken from the private sectors (brand or company) to keep the independency.

This study is in very early stage and requires further investigations and research for improvement. The paths forward for this study are:
1. Expand the networking and increase the respondent number by search and investigate other DRR related Community Groups in Indonesia and probably across the regional (ASEAN)
2. Further collective continuous efforts are required between Community Groups, government and academic community to establish a standard or at the very least guideline / best practice guide in the role of Community Groups in DRR. The established standard or best practice guide is expected to be able to help accelerate the education of DRR in Indonesia.

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Pemetaan Cepat Untuk Identifikasi Wilayah Terdampak Bencana (Studi Kasus: Sulawesi Tengah, Banten, Dan Sentani)

Nurul Sri Rahatiningtyas[1) 2) 3) 4)]
[1)] Departemen Geografi Fakultas Matematika dan Ilmu Pengetahuan Alam
[2)]Pusat Penelitian Geografi Terapan Fakultas Matematika dan Ilmu Pengetahuan Alam
[3)]Pusat Riset dan Respons Bencana
Universitas Indonesia
[4)]U-Inspire Indonesia

e-mail: nurul.sr@ui.ac.id

Abstrak

Pemetaan cepat merupakan kegiatan pengumpulan, pengolahan, dan visualisasi data geospasial secara cepat sehingga kebutuhan informasi terhadap suatu peristiwa dapat dipenuhi sesuai dengan standar yang berlaku. Informasi yang dihasilkan dari kegiatan ini, dapat digunakan dalam pengelolaan bencana baik pada tahap pra-bencana, saat-bencana, maupun pasca-bencana. Artikel ini akan menjelaskan mengenai proses dan hasil pemetaan cepat dengan studi kasus bencana gempa, tsunami, dan likuifaksi di Sulawesi Tengah; bencana tsunami di Banten; dan bencana banjir bandang di Sentani. Kegiatan pemetaan cepat ini terdiri atas kegiatan pemetaan yang dilakukan di studio untuk menyiapkan peta dasar, lalu dilanjutkan dengan kegiatan pengumpulan data di lapangan, dan diakhiri dengan pengolahan dan visualisasi akhir kembali di studio. Informasi spasial yang dihasilkan diantaranya adalah bangunan yang rusak; jalan yang rusak; dan lokasi pengungsi berikut kebutuhannya. Hasil dari pemetaan cepat ini kemudian digunakan untuk mengidentifikasi berapa jumlah bangunan, jumlah jalan yang rusak, dan kebutuhan masyarakat di lokasi bencana. Selanjutnya digunakan untuk menentukan jumlah dan jenis logistik yang diperlukan; jalur penyaluran logistik; dan rekomendasi penempatan huntara di lokasi bencana. Hasil tersebut kemudian digunakan oleh Tim Universitas Indonesia (UI) dalam kegiatan UI Peduli di ketiga lokasi bencana tersebut. Pemetaan cepat memerlukan koordinasi yang baik dengan berbagai pihak agar hasilnya dapat digunakan sesuai dengan tujuannya. Kondisi lokasi bencana yang dinamis dan dampak bencana yang berbeda antara bencana yang satu dengan yang lain, menjadi tantangan dalam pelaksanaan pemetaan cepat dan membutuhkan modifikasi metode pemetaan yang dapat dipertanggungjawabkan namun mudah dilaksanakan di lapangan.

Kata Kunci: Pemetaan Cepat, Wilayah terdampak Bencana, Pemetaan Partisipatif, Bencana Alam

Pendahuluan

Badan Informasi Geospasial (BIG) melalui Peraturan Kepala Badan Informasi Geospasial No.8 Tahun 2015 mendefinisikan Pemetaan Cepat merupakan kegiatan pengumpulan, pengolahan, dan visualisasi data geospasial secara cepat sehingga kebutuhan informasi terhadap sesuatu peristiwa dapat dipenuhi sesuai standar yang berlaku. Informasi yang dihasilkan dari kegiatan Pemetaan Cepat dapat dijadikan kerangka kerja (*frame work*) untuk mendukung kebijakan dalam pengelolaan bencana (*initial disaster management*), pada semua tahapan yaitu pra-bencana, saat-bencana, dan pasca-bencana [1].

Kegiatan Pemetaan Cepat di bidang kebencanaan sangat penting dilakukan antara lain untuk [1]:

a) membantu Tim BNPB menyediakan informasi geospasial dasar (Peta Rupabumi) digital dan hardcopy.
b) membantu Tim SAR (search and rescue) dan semua pihak yang melakukan penyelamatan (immediate response) agar terpandu secara sistematis dengan penyediaan informasi geospasial yang relevan oleh Tim Pemetaan Cepat.
c) melakukan pemetaan secara cepat pos-pos evakuasi dan pengungsian untuk dapat digunakan dalam distribusi bantuan secara tepat, efektif dan efisien.
d) melakukan pemetaan segala jenis kerusakan dan akibat yang ditimbulkan oleh adanya bencana, sehingga dapat membantu dalam prediksi kerugian akibat bencana.
e) mendukung berbagai dokumen perencanaan bidang kebencanaan seperti: rencana kontinjensi, rencana operasi darurat, dan rencana rehabilitasi-rekonstruksi.

Indonesia sudah dikenal sebagai negara yang memiliki jenis bencana yang lengkap. Baik bencana alam, bencana nonalam, maupun bencana sosial. Catatan dari Badan Nasional Penanggulangan Bencana (BNPB) mengatakan bahwa selama Bulan Januari hingga Maret 2019 telah terjadi 1.107 kejadian bencaan yang menyebabkan 375 orang meninggal dan hilang, 1.340 orang luka-luka, 850.772 orang mengungsi dan terdampak, 17.521 unit rumah rusak (3.235 rusak berat, 2.955 rusak sedang, 11.331 rusak ringan), dan 531 fasilitas umum rusak. Lebih dari 98% bencana yang terjadi merupakan bencana hidrometeorologi. Bulan Maret ini bencana kebakaran hutan dan lahan cukup banyak dilaporkan terjadi di Riau dan beberapa wilayah lainnya di Sumatera. Bencana yang paling banyak menyebabkan korban jiwa pada bulan Maret ini adalah banjir dan tanah longsor di Jayapura [2].

Pada hari Jumat tanggal 28 September 2018, Gempa bumi dan tsunami telah melanda Propinsi Sulawesi Tengah. Gempa berkekuatan 5,9 Skala Richter (SR) pertama kali dirasakan penduduk di Kabupaten Donggala. Selanjutnya gempa datang susul menyusul dengan kekuatan terbesar 7,4 SR, yang disertai tsunami, melanda bukan saja Kabupaten Donggala tetapi juga Kota Palu dan Kabupaten Mamuju. Dan juga menimbulkan perisitiwa likuifaksi di Kabupaten Sigi. Peristiwa ini menyebabkan setidaknya lebih 4.340 Jiwa meninggal dunia & hilang [5].

Hari sabtu tanggal 23 Desember 2018, Gunung Anak Krakatau yang berada di Selat Sunda meletus dan menghasilkan material yang longsor masuk ke perairan disekitarnya. Hal ini menimbulkan tsunami terjadi di pesisir barat Propinsi Banten dan pesisir selatan Propinsi Lampung. Wilayah pesisir barat Propinsi Banten yang merupakan kawasan wisata, pada saat itu sedang padat dipenuhi wisatawan menyambut natal dan tahun baru. Peristiwa ini menyebabkan setidaknya 437 jiwa meninggal dunia [6].

Pada hari Sabtu tanggal 16 Maret 2019, terjadi banjir bandang di Sentani Propinsi Papua. Kejadian ini diawali dengan curah hujan yang ekstrim (248,5 mm) selama 7 jam yang kemudian menyebabkan longsor di kawasan pegunungan Cycloop. Informasi dari BNPB mengatakan bahwa adanya longsor karena proses alami di wilayah timur sentani dan membentuk bendung alami yang jebol ketika hujan ekstrim. Kejadian ini menyebabkan 112 orang meninggal dunia, 82 orang belum ditemukan, 917 orang luka, 2.085 KK/8.008 orang mengungsi, dan 33.161 KK terdampak [2].

Berdasarkan tiga kejadian bencana tersebut, tim pemetaan dari Departemen Geografi FMIPA Universitas Indonesia yang tergabung dengan Tim UI Peduli melakukan pemetaan cepat wilayah terdampak bencana. Artikel ini akan menjelaskan mengenai proses dan hasil kegiatan pemetaan cepat di tiga wilayah bencana yaitu Kota Palu dan Kabupaten Donggala Propinsi Sulawesi Tengah; Kabupaten Pandeglang Propinsi Banten; dan Distrik Sentani dan Distrik Waibu di Kabupaten Jayapura Propinsi Papua. Kegiatan pemetaan cepat ini bertujuan untuk mengidentifikasi wilayah terdampak bencana dan selanjutnya digunakan dalam proses penyaluran logistik dan rekomendasi lokasi pembangunan hunian sementara.

Tahapan Pemetaan Cepat

Pemetaan cepat kali ini dilakukan untuk mengidentifikasi wilayah terdampak bencana di lokasi dan dengan jenis bencana yang berbeda. Adapun jenis bencana dan wilayah yang terdampaknya adalah sebagai berikut:

a. Gempa, tsunami, dan likuifaksi di Kota Palu, Kabupaten Donggala, dan Kabupaten Sigi Propinsi Sulawesi Tengah.
b. Letusan Gunung Anak Krakatau yang menyebabkan tsunami di Kabupaten Pandeglang Propinsi Banten.
c. Banjir bandang di Distrik Sentani dan Distrik Waibu di Kabupaten Jayapura Propinsi Papua.

Tahapan pemetaan cepat yang dilakukan terdiri atas tiga tahap yaitu tahap persiapan peta kerja; tahap pengumpulan data di lapangan; dan tahap mengolahan data dan visualisasi akhir. Tahap Persiapan peta kerja, pengolahan data hasil lapangan, dan visualisasi akhir dilakukan di studio di Gedung Departemen Geografi FMIPA UI. Sedangkan pengumpulan data lapangan dilakukan di ketiga lokasi bencana. Informasi mengenai setiap tahap tersebut dapat dilihat pada tabel 1.

Tabel 1 Tahapan Kegiatan Pemetaan Cepat

Kegiatan	Gempa dan Tsunami di Propinsi Sulawesi Tengah	Tsunami di Kabupaten Pandeglang Propinsi Banten.	Banjir Bandang di Kabupaten Jayapura Propinsi Papua
Data dasar yang digunakan	BIG, BNPB, Openstreetmap	BIG, BNPB, Openstreetmap	BIG, BNPB, BPS, Openstreetmap
Mapathon oleh Mahasiswa Geografi UI	√	√	X
Penyusunan Peta Kerja	√	√	√
Kegiatan Lapangan	2018	2018	2019
Penggunaan Data Sekunder	√	√	√
Identifikasi Kerusakan Bangunan dan Jalan	√	√	√
Identifikasi posko pengungsian	√	√	√
Rekomendasi Lokasi Penyaluran Bantuan	√	√	√
Rekomendasi Jalur Penyaluran Bantuan	√	√	√

Identifikasi Lokasi Dampak Multibencana	√	X	X
Identifikasi Lokasi Huntara	√	X	X

Sumber: Pengolahan Data, 2019

Kegiatan pemetaan cepat diawali dengan tahap mempersiapkan peta kerja. Adapun kegiatan pada tahap ini terdiri atas:

a. *Mempersiapkan data dasar*.
   Peta dasar yang digunakan adalah peta dasar dari Badang Informasi Geospasial yang di download melalui http://tanahair.indonesia.go.id. Sedangkan untuk data spasial bangunan dan jalan menggunakan data dari openstreetmap. Data Openstreetmap yang digunakan dalam kegiatan ini, diperoleh melalui kegiatan pemetaan partisipatif yang dilakukan dengan bekerjasama dengan Openstreetmap Indonesia. Untuk data Openstreetmap Sulawesi Tengah dan Pandeglang Banten, kegiatan pemetaan partisipatif (*mapathon*) dilakukan oleh mahasiswa Geografi UI. Sedangkan untuk data Sentani, kegiatan pemetaan partisipatif dilakukan relawan dari luar Geografi UI.

b. Inputing Point of Interest (PoI).
   Data titik *PoI* yang dimaksud disini adalah titik fasilitas umum yang kemungkinan digunakan sebagai tempat pengungsian, misalnya sekolah, tempat ibadah, kantor pemerintahan, dan fasilitas kesehatan. Data ini diperoleh dari Badan Informasi Geospasial dan Google Earth.

c. *Layout* peta kerja.
   Setelah data dasar dan PoI sudah siap dan lengkap. Maka tahap selanjutnya adalah proses layout untuk menghasilkan peta kerja. Peta kerja tersebut kemudian akan digunakan pada saat mengumpulan data di lapangan.

Tahap kedua dari kegiatan pemetaan cepat ini adalah pengumpulan data di lapangan. Adapun kegiatan pada tahap ini terdiri atas:

a. Identifikasi kondisi bangunan dan jalan.
   Berdasarkan peta kerja yang sudah disiapkan sebelumnya yang terdiri atas polygon bangunan, jaringan jalan dan PoI, maka kegiatan selanjutnya mengidentifikasi secara visual kondisi bangunan dan jalan di wilaya bencana. Identifikasi kondisi bangunan dan jalan dilakukan berdasarkan standard kerusakan yang dikeluarkan oleh BNPB. Kegiatan ini dilengkapi dengan GPS dan formulir isian untuk mempermudah pencatatan data.

b. *Survei posko pengungsian dan kebutuhannya*.
   Tim relawan juga melakukan pengumpulan data titik posko dan kebutuhan para pengungsi di setiap posko. Kegiatan ini dilakukan melalui wawancara dan pencatatan langsung di posko pengungsian. Kegiatan ini dilengkapi dengan GPS, kuesioner, dan formulir isian untuk mempermudah pencatatan data.

c. *Dokumentasi dan plotting*.
   Setiap kali dilakukan proses pengumpulan data, maka kegiatan yang penting dilakukan adalah dokumentasi dan plotting. Dokumentasi dan *plotting* dilakukan terhadap objek yang dikumpulkan datanya, misalnya bangunan yang rusak parah, rusak sedang, dan rusak ringan; jaringan jalan yang rusak parah, rusak sedang, dan rusak ringan; dan kondisi posko pengungsian. Kegiatan ini dilengkapi dengan GPS dan kamera Digital/HP untuk mempermudah pengumpulan data.

Tim relawan yang turun di tiga lokasi bencana tersebut, memiliki jumlah yang berbeda. Tim relawan Propinsi Sulawesi Tengah berjumlah 12 orang dan dibagi ke dalam 3 tim. Setiap tim secara bergantian berada di lapangan selama sekitar 4-5 hari. Tim ini bekerja di wilayah Kabutapen Donggala dan Kota Palu Propinsi Sulawesi Tengah. Untuk di Pandeglang Banten, tim relawan berjumlah 6 orang dan dibagi ke dalam 3 tim. Setiap tim secara paralel melakukan pemetaan di Kecamatan Sumur Kabupaten Pandeglang Propinsi Banten selama 3 hari. Sedangkan tim relawan yang turun ke Sentani Papua berjumlah 2 orang dan melakukan pemetaan selama 3 hari di Distrik Sentani dan Distrik Waibu Kabupaten Jayapura Propinsi Papua.

Tahap ketiga atau terakhir dari kegiatan pemetaan cepat ini adalah tahap mengolahan data dan visualisasi akhir. Adapun kegiatan pada tahap ini terdiri atas:

a. *Pengolahan data.*
   Data yang diolah pada tahap ini merupakan data yang diperoleh dari lapangan. Pengolahan data bisa dimulai sejak tim relawan masih ada di lapangan apabila kondisi memungkinkan, misalnya terkait keberadaan sinyal dan listrik yang memungkinkan tim relawan mengirimkan data hasil survei ke studio. Jika memungkinkan maka data mulai diolah pada saat tim relawan sudah kembali dari lapangan. Pengolahan data lapangan terdiri atas inputing data hasil dokumentasi, plotting, dan wawancara. Proses inputing data tersebut bertujuan melengkapi informasi bangunan, jalan, posko pengungsian, dan PoI lain yang sudah ada sebelumnya.

b. *Visualisasi akhir.*
   Setelah proses inputing data selesai, maka selanjutnya adalah proses visualisasi akhir dalam hal ini kegiatan layout peta hasil. Proses ini akan disesuaikan dengan kebutuhan peta hasil yang diharapkan Misalnya Peta Kerusakan Bangunan; Peta Kerusakaan Jalan; Peta Posko Pengungsian dan Kebutuhannya; dan Peta Jalur Penyaluran Logistik Bantuan.

Tahap ini dilakukan maksimal 7 hari setelah tim relawan pulang dari lapangan.

Identifikasi Wilayah Terdampak

Pemetaan cepat yang dilakukan bertujuan untuk mengidentifikasi wilayah terdampak di tiga lokasi dan jenis bencana yang berbeda. Kegiatan ini dilakukan beberapa hari setelah bencana terjadi, yaitu:

a) Bencana gempa bumi, tsunami, dan likuifaksi yang terjadi di Kota Palu, Kabupaten Donggala, dan Kabupaten Sigi pada hari Jumat tanggal 28 September 2018.
b) Meletusnya Gunung Anak Krakatau yang mengakibatkan tsunami di wilayah pesisir barat Propinsi Banten terjadi pada hari Sabtu tanggal 23 Desember 2018.
c) Banjir bandang yang terjadi di Kabupaten Jayapura Propinsi Papua pada hari Sabtu tanggal 16 Maret 2019.

Pada hari Jumat tanggal 28 September 2018 telah terjadi Bencana gempa bumi, tsunami, dan likuifaksi yang terjadi di Kota Palu, Kabupaten Donggala, dan Kabupaten Sigi. Kejadian ini kemudian dilanjutkan dengan pemetaan cepat wilayah terdampak bencana. Kegiatan pemetaan cepat diawali dengan Mapathon dengan bekerjasama dengan Openstreetmap dan dilaksanakan pada hari Senin-Rabu, 1-3 Oktober 2018. Peserta dari kegiatan ini sebanyak 29 orang yang merupakan mahasiswa Departemen Geografi FMIPA UI. Mapathon kali ini berhasil mendigit sebanyak 5.122 bangunan yang berada di wilayah Kota Palu, Kabupaten Donggala, dan Kabupaten Sigi. Kegiatan tim relawan di lapangan dimulai tanggal 4 Oktober 2018 hingga 26 Oktober 2018 di Kabupaten Donggala dan Kota Palu.

Data yang digunakan untuk kasus ini, selain data openstreetmap, data lainnya berasal dari Citra Sentinel Asia dan data hasil *groundchecking* serta data pemodelan genangan dan inundasi yang disadur dari website Inarisk BNPB yang terintegrasi dengan GIS Service ArcGIS. Kemudian terdapat juga data – data administrasi dan data Rupa Bumi lainnya yang dijadikan untuk membuat peta dasar dan peta kerja. Data dari Open Stree Map (OSM) berupa data dijitasi hasil bangunan yang telah dikerjakan oleh tim Geografi bersama OSM pada kegiatan Mapathon. Data ini digunakan untuk melihat klasifikasi kerusakan bangunan di lapangan. Data dari Sentinel Asia berupa data citra Kota Palu dan Kabupaten Donggala setelah terjadi bencana. Citra ini di overlay dengan data bangunan yang telah di dijitasi untuk melihat bangunan mana yang terkena dampak hingga hancur. Selanjutnya ada data dari Inarisk BNPB yang digunakan sebagai acuan data hasil verifikasi lapang. Hasil pemodelan BNPB dioverlay dengan hasil temuan lapang untuk melihat keakuratan data yang didapat. Dalam pembuatan peta juga menggunakan data – data Rupabumi sebagai peta dasar. Data Rupabumi tersebut didapat dari data Rupabumi Badan Informasi Geospasial (BIG) [3].

Peta yang dihasilkan dari kegiatan ini terdiri atas tiga jenis, yaitu Peta Wilayah Terdampak, Peta Multibencana, dan Peta Kesesusian Wilayah Hunian Sementara. Peta wilayah terdampak merupakan sebuah peta yang dihasilkan dari pengolahan data lapangan yang dilakukan oleh tim 1, 2 dan 3 selama berada di Kota Palu dan Kabupaten Donggala. Peta terdampak ini berisikan informasi tingkat kerusakan bangunan akibat bencana. Tingkat kerusakan tersebut diklasifikasikan ke dalam 3 kelas, yaitu:

a) Kelas 1 : Rusak Ringan (retak kecil, ambruk bagian pagar, rusak hanya plafon).
b) Kelas 2 : Rusak Sedang (rumah ambruk hanya sebagian, rumah terbelah tapi dapat diperbaiki, bagian depan rusak tapi bagian belakang dapat dihuni, masih layak huni dengan perbaikan).
c) Kelas 3 : Rusak Berat (rumah ambruk, miring, tidak ada atap, tidak layak huni, tidak dapat diperbaiki).

Dari hasil digitasi bangunan terdampak dan verifikasi lapang didapatkan total bangunan rusak terdampak tsunami di Kota Palu adalah 4.143 dengan klasifikasi 634 bangunan rusak ringan, 758 bangunan rusak, dan 2751 rusak berat. Untuk Kabupaten Donggala rumah yang terdampak gempa adalah sebesar 5985 bangunan [3].

Peta terdampak Multibencana adalah suatu peta yang berisikan gambaran wilayah terdampak bencana yang terjadi di Palu, Donggala, dan Sigi. Pada peta ini ditunjukan wilayah mana saja yang terdampak gempa; gempa dan tsunami; serta gempa dan likuifaksi. Dengan adanya peta ini orang bisa tahu apabila ada wilayah yang terdampak maka bencana apa yang terjadi disana. Peta ini dibuat dengan dijitasi dan delineasi wilayah terdampak hasil survey lapang dan data hasil pemodelan BNPB [3].

Peta Kesesuaian Wilayah Huntara adalah suatu peta yang dibuat untuk melihat wilayah yang cocok dijadikan lokasi hunian sementara penduduk yang rumahnya hancur. Peta ini dibuat dari hasil temuan lapang pada saat survei dan *groundchecking*. Wilayah kesesuaian huntara yang dibuat oleh Tim Geografi ini bertujuan untuk memberikan sedikit gambaran dan masukan bagi pemerintah ataupun stakeholder terkait dalam membangun suatu hunian sementara bagi masyarakat yang terkena dampak gempa dan tsunami. Hal demikian juga berkaitan dengan situasi bencana saat ini yang sudah masuk fase pemulihan. Variabel yang dijadikan indikator untuk penetapan wilayah huntara ini antara lain adalah data rumah rusak; jumlag penduduk; sumber air; jalan; kemiringan lereng; penggunaan tanah; dan jarak dari fasilitas kesehatan. Desa yang dijadikan contoh adalah Desa Lende dan Desa Lende Tovea. Kedua desa tersebut dipilih karena berada di Kecamatan Sirenja Kabupaten Donggala dan dekat dengan episentrum gempa. Kemudian apabila dilihat dari kerusakan, jumlah bangunan yang terdampak di kedua desa ini berjumlah 563 bangunan dengan rincian 398 rumah rusak parah, 150 bangunan rusak sedang dan 15 bangunan rusak ringan. Menurut penuturan Kepala Desa Lende Tovea, jumlah Kepala Keluarga yang terdampak rumahnya rusak berjumlah lebih kurang 185 KK. Berdasarkan variabel dan indikator yang ada, didapatlah 5 wilayah yang bisa dijadikan lokasi huntara. Wilayah huntara yang paling luas adalah wilayah hintara di Desa Lende Tovea yang memiliki luas lebih kurang 7,3 Ha. Lokasi tersebut memiliki jarak lebih kurang 50 meter dari jalan, 300 meter dari sungai terdekat serta dekat dengan Poskesdes. Lokasi tersebut juga memiliki medan yang datar, sehingga bisa dijadikan lokasi Huntara [3].

Pada hari Sabtu tanggal 23 Desember 2018 terjadi peristiwa meletusnya Gunung Anak Krakatau yang mengakibatkan tsunami di wilayah pesisir barat Propinsi Banten dan pesisir selatan Propinsi Banten. Sehubungan dengan peristiwa ini, Departemen Geografi FMIPA UI kembali mengadakan kegiatan Pemetaan Cepat Wilayah Terdampak Bencana. Kegiatan ini diawali dengan kegiatan Mapathon bekerjasama dengan Openstreetmap pada Tanggal 26-28 Desember 2018. Peserta dari kegiatan ini adalah 12 orang yang merupakan mahasiswa Departemen Geografi FMIPA UI. Mapathon kali ini berhasil mendigit sebanyak 10.107 bangunan yang berada di wilayah Pesisir Barat Propinsi Banten dan Pesisir Selatan Proponsi Lampung. Tim relawan dari Departemen Geografi FMIPA UI melakukan kegiatan di lapangan pada tanggal 3-5 Januari 2019. Kegiatan lapangan untuk tim pemetaan dilakukan di Desa Cigorondong, Kertajaya, Kertamukti, Sumberjaya, Tamanjaya, Tunggaljaya, dan Ujungjaya Kecamatan Sumur Kabupaten Pandeglang Propinsi Banten.

Tabel 2 Tingkat Kerusakan Bangunan di Kecamatan Sumur Kabupaten Pandeglang Propinsi Banten (Bangunan)

Nama Desa	Rusak Berat	Rusak Sedang	Rusak Ringan	Tidak Rusak
Cigorongdong	102	0	37	465
Kertajaya	38	0	14	820
Kertamukti	23	13	52	856
Sumberjaya	266	147	18	674
Tamanjaya	28	26	53	639
Tunggaljaya	7	3	1	857
Ujungjaya	2	0	1	719

Sumber: Survei Lapang, 2019

Tabel 3 Tingkat Kerusakan Jalan di Kecamatan Sumur Kabupaten Pandeglang Propinsi Banten (Meter)

Nama Desa	Rusak Berat	Rusak Sedang	Rusak Ringan	Kondisi Baik
Cigorongdong	6731,73	12400,3	0	0
Kertajaya	5482	7204,19	0	0
Kertamukti	3917,49	6837,31	0	0
Sumberjaya	3510,19	4642,37	765,4	0
Tamanjaya	4501,74	4515,07	0	0
Tunggaljaya	887,662	8631,25	8510,94	0
Ujungjaya	3460,53	7325,23	0	0

Sumber: Survei Lapang, 2019

Kegiatan ini menghasilkan peta tingkat kerusakan bangunan dan jalan akibat tsunami Selat Sunda pada desa-desa yang disebutkan sebelumnya. Data yang digunakan untuk menyusun peta ini adalah Peta Rupa Bumi dari BIG (2018), Openstreetmap (2019), Survei Lapang (2019), dan Perhitungan Zona Inindasi dari Geosains FMIPA UI (2019). Tingkat kerusakan bangunan dibagi ke dalam 4 kelas yaitu rusak berat, rusak sedang, rusak ringan, dan tidak rusak. Sedangkan tingkat kerusakan jalan dibagi kedalam 4 kelas yaitu rusak berat, rusak sedang, rusak ringan, dan kondisi baik. Tingkat kerusakan bangunan dan jalan yang diperoleh dapat dilihat pada tabel 2 dan 3.

Pada hari Sabtu tanggal 16 Maret 2019, terjadi Banjir bandang di Kabupaten Jayapura

Propinsi Papua. Sehubungan dengan kejadian tersebut, maka pada tanggal 18 Maret 2019, Openstreetmap kembali mengadakan kegiatan pemetaan partisipatif untuk wilayah Sentani dan sekitarnya. Kegiatan ini dapat selesai mendigit seluruh bangunan yang ada di wilayah tersebut kurang dari 1 hari. Setelah data dasar tersedia, maka tim pemetaan dari Departemen Geografi FMIPA UI mulai mempersiapkan peta kerja. Peta kerja dipersiapakan untuk orientasi medan di lapangan. Peta dibuat dengan skala 1:10.000 yang memuat informasi spasial hingga detail permukiman visible untuk diamati. Basemap yang digunakan bersumber dari Openstreetmap yang berupa objek jaringan jalan dan bangunan. Tim relawan kemudian melakukan kegiatan pemetaan pada tanggal 22-26 Maret 2019 [4].

Proses pemetaan cepat kali ini, Tim Relawan dari Departemen Geografi FMIPA UI juga bekerjasama dengan tim pemetaan dari BIG dan BNPB yang telah terlebih dahulu tiba di lokasi bencana. Menurut identifikasi yang dilakukan oleh Badan Informasi Geospasial (BIG) dan Badan Nasional Penanggulangan Bencana (BNPB), Desa Hinekombe merupakan desa paling terdampak dikarenakan letaknya yang sangat dekat dengan pegunungan Cycloop. Data dari Badan Meteorologi Klimatologi dan Geofisika (BMKG) menyatakan bahwa Hujan ekstrem yang terjadi selama 8 jam dengan di wilayah Sentani mengakibatkan debit air dari puncak gunung mengalir sangat deras hingga menyebabkan kerusakan pada permukiman di Desa Hinekombe dan sekitarnya di wilayah bagian selatan pegunungan. Dari hasil interpretasi foto udara yang diambil dengan drone oleh BNPB dan BIG, terlihat bahwa lumpur dari aliran banjir terbawa dan mengendap di wilayah permukiman. Telah diidentifikasi bahwa Desa Hinekombe merupakan desa paling terdampak bencana banjir bandang [4].

Berdasarkan hasil yang didapat oleh tim BIG dan BNPB, maka kegiatan survei lapang yang dilakukan oleh tim relawan Geografi UI dilakukan di tiga wilayah, yaitu:

1. Desa Hinekombe - Distrik Sentani, Kabupaten Jayapura
2. Desa Doyo Baru - Distrik Waibu, Kabupaten Jayapura
3. Desa Dobonsolo, Kehiran, dan Ifale - Distrik Sentani, Kabupaten Jayapura

Desa Hinekombe merupakan desa paling terdampak bencana banjir bandang. Bagian utara Jalan Raya Kemiri yang merupakan wilayah kaki gunung mengalami kerusakan parah akibat bebatuan yang ikut bersama aliran banjir bandang menghantam rumah-rumah dan sarana infrastruktur seperti tiang-tiang listrik dan telekomunikasi. Air yang turun dari gunung hasil dari banjir bandang juga membentuk aliran sungai temporer dan membawa material endapan. Sementara itu, di bagian selatan Jalan Raya Kemiri, wilayah terdampak dipengaruhi oleh luapan sungai di sepanjang dataran aluvial (banjir). Luapan air sungai mebawa batang-batang pohon dan material endapan di sepanjang jalan dan rumah-rumah warga yang terkena dampak [4].

Desa Doyo Baru merupakan wilayah dengan kerusakan terparah ke-dua setelah Desa Hinekombe. Permasalahan utama yang dialami oleh warga yang menempati desa tersebut adalah terhambatnya akses terhadap air bersih di beberapa titik lokasi yang disebabkan oleh terganggunya pengairan PDAM dari pusat. Air tanah yang digunakan pun ikut tercemar oleh endapan banjir sehingga tidak dapat dimanfaatkan. Permasalahan lainnya yang timbul adalah aktivitas ekonomi yang terhalang akibat rusaknya bangunan-bangunan perdagangan seperti pertokoan di sepanjang Jalan Raya Doyo Baru [4].

Dari hasil survey lapang, Desa Dobonsolo, Kehiran, dan Ifale, yang berada di bagian selatan Desa Hinekombe mengalami dampak paling ringan dari banjir bandang tersebut. Di Desa Dobonsolo dan Kehiran, wilayah terdampak hanya terdapat di sekitar dataran sungai yang menyebabkan oleh luapan air sungai, namun tidak mengaibatkan kerusakan pada rumah-rumah warga. Sementara itu, di Desa Ifale, wilayah terdampak dipengaruhi oleh luapan Danau Sentani yang merendam rumah-rumah warga dengan kedalaman sekitar 50 – 100cm (batas betis orang dewasa). Namun demikian, dampak banjir tersebut juga menghambat aktivitas masyarakat serta akses terhadap pangan dan air bersih [4].

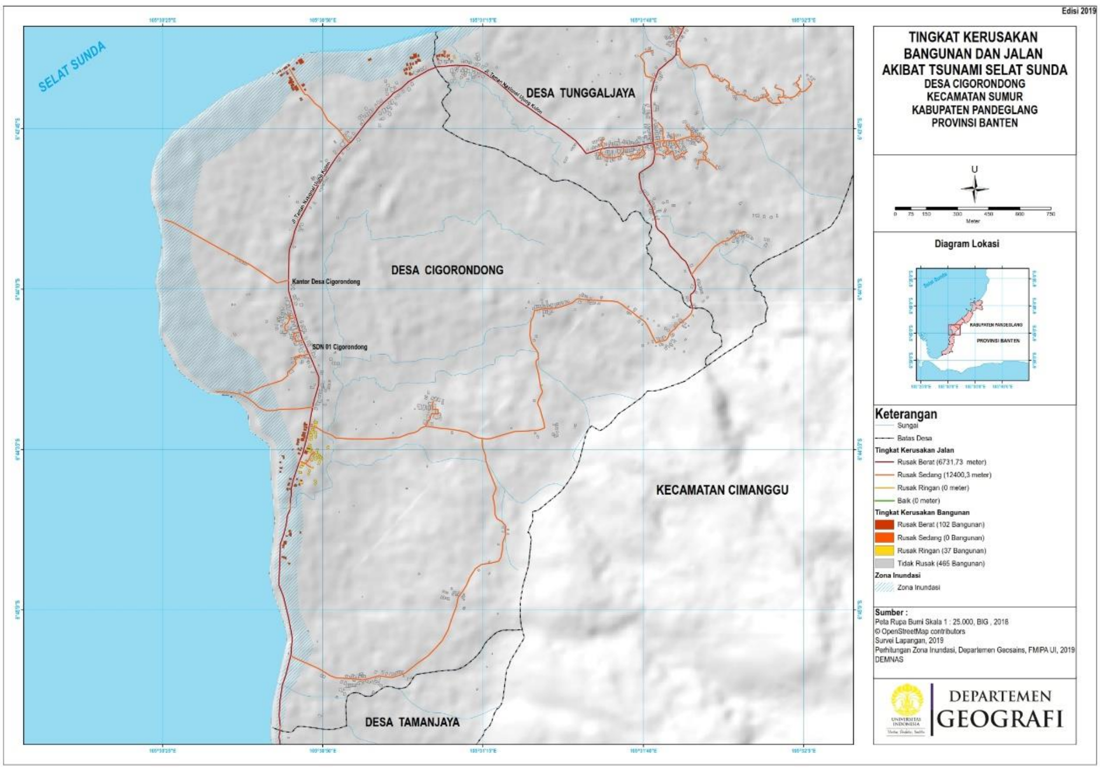
Berdasarkan data hasil koordinasi dengan divisi tanggap darurat BNPB di Posko Utama

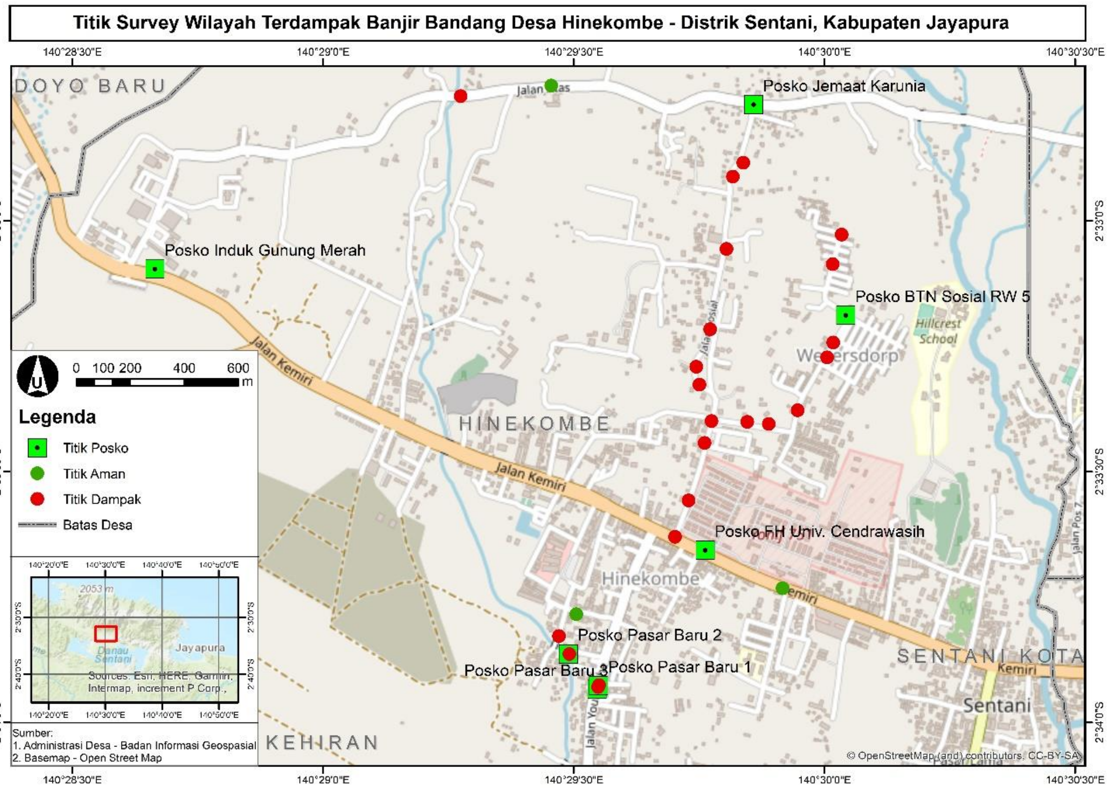
Gunung Merah – Sentani, dilaporkan hingga per tanggal 24 Maret 2019 terdapat sekitar 350 rumah, 3 jembatan, 8 unit drainase, 4 jalan utama, 2 gereja, 1 masjid, 8 sekolah, 104 ruko, dan satu unit pasar mengalami rusak berat. Tim dari Departemen Geografi Universitas Indonesia berhasil memetakan sekitar 65 titik survei termasuk 10 titik lokasi posko bencana dan 55 titik survei yang menunjukkan lokasi-lokasi kerusakan akibat bencana banjir bandang. Hasil survei dan pemetaan yang telah dilakukan menjadi dasar dalam menyalurkan bantuan logistik, tenaga medis, dan kesehatan dari Tim UI Peduli [4].

Kesimpulan

a) Kegiatan Pemetaan Cepat membutuhkan metode yang tim yang solid karena harus dilakukan dengan cepat agar hasilnya dapat dimanfaatkan secara optimal.
b) Kemandirian tim relawan secara finansial menjadi penting untuk menjaga kualitas dan kuantitas hasil pemetaan yang sama di setiap lokasi bencana.
c) Hasil survei dan pemetaan yang telah dilakukan menjadi dasar dalam menyalurkan bantuan logistik, tenaga medis, dan kesehatan dari Tim UI Peduli. Dan juga digunakan sebagai masukkan dalam penentuan lokasi huntara yang akan dibangun oleh Tim Iluni UI.

Lampiran





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Elaboration of Structural and Non-Structural Mitigation as A New Paradigm To Reduce Flood Disaster Risk in Manado City

Rizki Kirana Yuniartanti[1], Hani Fatimah Azzahra[2], Budi Santosa[3]
[1]Regional and Urban Planning Expert, Ministry of Land Affairs and Spatial Planning/National Land Agency
[2]Geographic Information System (GIS) Expert, Ministry of Land Affairs and Spatial Planning/National Land Agency
[3] Chief of New Area Development (Disaster Prone and Climate Change) Sub Directorate, Ministry of Land Affairs and Spatial Planning/National Land Agency

e-mail: rizki.kirana@gmail.com[1], hani.fatimah@sci.ui.ac.id[2], big.bee.budi@gmail.com[3]

Abstrak

Hydro-meteorological disaster is one of kind of disaster that currently being a threat in Indonesia, particularly the flash flood which caused losses in large numbers. Manado as flood prone area for its location is in a basin surrounded by 8 watersheds, where Tondano as the biggest watershed in it. Another 7 watersheds are Bailang, Kima, Malalayang, Sario, Kalasey, and Maasing.

The earlier flash flood that occurred in Manado cannot be denied as Tondano's upstream is non-functioning where Manado City, Tondano City Minahasa Regency, and North Minahasa Regency administratively part of Tondano Watershed. So the disaster risk reduction was considering conservation as non-structural mitigation. Elaboration of structural mitigation such as reservoir and Flood Retarding Basin (FRB) can be developed an integrated flood management concept.

Keywords: Flood, Structural Mitigation, Nonstructural Mitigation

Introduction

Because of its location is in Ring of Fire [8], Indonesia is a disaster prone-areas. In other hands, Indonesia has prosperous in natural resources. In general, natural disaster in Indonesia is caused by geology [11] and hydrometeorology [9].

Globally, hydrometeorology disaster such as flood was increasing in years, also in Indonesia [6]. The flood was affected by hydrology, meteorology, and climatology [5]. Normal to high rainfall scale take place in Indonesia. In 2016, rainfall was below normal in East Indonesia [2].

Historically, flood in Manado always happens every year. Because its location is in downstream of Tondano Watershed as a basin for all river flow from upstream. The Tondano upstream was experiencing environmental degradation as much as downstream experienced. The change of the land use pattern is of great significance to cope with sustainable development, remember Manado as a city that provides housing for people around. The earlier flash flood that is occurred in Manado cannot be denied as Tondano's upstream is non-functioning to take care of Manado, Minahasa, and North Minahasa where administratively part of Tondano Watershed. So the disaster risk reduction was considering conservation as non-structural mitigation. Elaboration of structural mitigation an integrated flood management concept.

Goal

This study aims to examine the effectiveness of structural and non-structural elaboration in Tondano, Sario, and Tikala Watershed to reduce runoff severity.

Objectives

1) Runoff severity overview on Tondano and Sario Watershed's land use
2) Runoff assessment prediction tren in North Minahasa, Minahasa, Manado, and Tomohon
3) Structural mitigation develops in Tondano watershed
4) The scenario of runoff assessment (Tondano, Sario, and Tikala Watershed) by conservation and structural mitigation
5) The implication of conservation application on spatial pattern and development of structural mitigation against runoff reduction in Manado

Discussion

A. Overview of runoff severity according to land use in Tondano Watershed, Sario Watershed, and Manado City

Runoff severity according to land use is resulted from overlaying runoff data and land use data. Runoff data based on The Ministry of Environment and Forestry (2018), while land use data based on Geospatial Information Agency (2015). Classification of runoff severity consists of low, normal, high, and extreme. The widest area of extreme runoff occurs in Wildwood (25,60%), shrubs (22,57%), and paddy field (7,76%).

Land use of Tondano watershed and Sario Watershed that includes high and extreme runoff should have endeavored rehabilitation and conservation. There are many programs of rehabilitation and conservation as an effort to restore land use quality. Conservation and rehabilitation should be prioritized in Wildwood to restore its function as a recharge area. In other hands, rehabilitation and conservation in plantation and paddy field area have to consider its role as food crops field. The programs necessitate balance between preserve of land use quality and increase the economic value of food crops product. Agroforestry is one concept that is used to collaborate with plants rooted and food crops that prevent degradation land use.

Runoff severity map based on The Ministry of Environment and Forestry (2018) is also overlayed by Manado land use map. Classification of runoff severity consists of normal, high, and extreme. The widest area of extreme runoff occurs in plantation (5,35%), housing (0,20%), and unoccupied land (0,04%).

Extreme severity occurs in 3,3% of grand total Manado area and high severity occurs in 26,80% of grand total Manado's area. Normal runoff also occurs in 68,10% of grand total

Manado area (Figure 1). Runoff severity can be reduced through preserve land use quality. The programs must be adapted to urban characteristics of Manado city. The program that appropriate is increasing the number of vegetation canopy, urban forest, green open space, and blue open space, particularly in the housing area. Agroforestry is also implemented in plantation and unoccupied land that part of rehabilitation and conservation in Manado City.

B. Runoff Prediction Tren Assessment of Minahasa Regency, North Minahasa Regency, and Manado City Within Tondano Watershed dan Sario Watershed

Urban flood management and water resource management are integrated and holistic from upstream to downstream [10]. Watershed planning considers all aspects of spatial utilization and watershed typology, namely river body and riparian area. One river one plan is an approach that is used to watershed planning [4]. The concept integrate and summarize of physical and governance aspects to improve the quality and quantity of river bodies and riparian areas. Based on law No. 24 of 2007 about disaster management, spatial planning includes pra disaster stage that implemented through spatial pattern plan consider disaster mitigation aspect. In this part will be discussed runoff prediction tren assessment and correlation in spatial pattern plan in regency or city that located in Tondano Watershed and Sario Watershed.

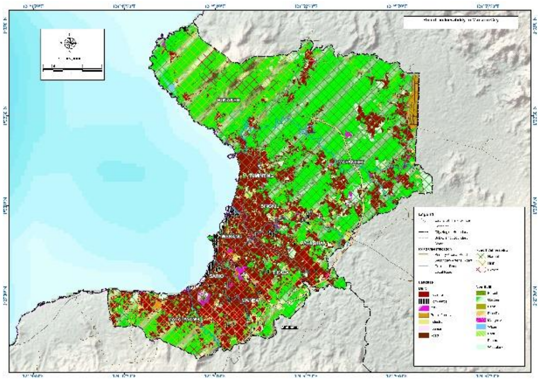

Figure 1 Runoff Severity Map According to Land use in Manado City

B.1 Minahasa Regency

Runoff debit based on existing land use is 431,22 m^3/second, while runoff debit based on spatial pattern plan that refers to Spatial Planning Policy of Minahasa Regency 2014-2034 is 434,48 m3/second. If comparing based on spatial planning is compared to existing land use, runoff debit is not significantly increased in spatial planning. It indicates that spatial pattern plan does not occur conversion significantly.

The recommendation result of the spatial pattern plan is that the runoff coefficient will decrease through conservation is 352.16 m^3 / second. This also decreases the runoff severity in Minahasa Regency because the runoff debit assessment based on recommendation is lower than the debit runoff assessment based on the 2014-2034 Spatial Planning Policy of Minahasa Regency. The reduction rate of runoff achieves 82.32 m^3/ second.

B.2 North Minahasa Regency

Runoff debit based on existing land use is 100,13 m^3/second, while runoff debit based on spatial pattern plan that refers to Spatial Planning Policy of North Minahasa Regency 2014-2034 is 106,44 m^3/second. It indicates that occur increasing runoff based on spatial pattern plan, approximately of 6.31 m^3/second. However, increasing is not significantly.

The recommendation result of the spatial pattern plan is that the runoff coefficient will decrease through conservation is 85.27 m^3 / second. This recommendation will decrease runoff severity significantly in North Minahasa Regency because the runoff debit based on assessment is lower than the debit runoff assessment based on Spatial Planning Policy of North Minahasa Regency 2014-2034. The reduction rate of runoff achieves 21.17 m^3/ second.

B.3 Manado City

Runoff prediction considers existing land use and spatial pattern plan (source: Spatial Planning Policy of Manado City 2014-2034 and Spatial Planning Policy Revision of Manado City 2018). Recommendation Result of the spatial pattern plan that assesses flood debit (Q) based on decreasing runoff coefficient is effected increasing recharge area ability of spatial pattern plan. One of runoff prediction assessment is implemented in residential pattern plan. Runoff coefficient of residential area is 0.6, afterward decreasing runoff coefficient being 0.5 that effect decreasing of flood debit. Improving the quality and quantity of open space in a residential area is a consequence for decreasing runoff coefficient.

Runoff debit based on existing land use (source: planning, research, and development agency of Manado City) is 320.29 m^3/second, while runoff debit based on existing land use (source: Geospatial Information Agency is 311.09 m^3/second. This research compares existing land use data from two sources to identify runoff debit, but the difference is not significanty.

Runoff debit based on spatial pattern plan that refers to Spatial Planning Policy of Manado City 2014-2034 is 386.85 m^3/second, while runoff debit based on Spatial Planning Policy Revision of Manado City 2018 is 442.77 m^3/second. This assessment results that runoff debit based on Spatial Planning Policy Revision of Manado City 2018 is higher than runoff debit based on Spatial Planning Policy of Manado City 2014-2034. It indicates that occurs reducing recharge area in the future. It indicates that occurs reducing recharge area in the future.

Runoff debit assessment based on both of existing land use and spatial pattern plan that indicates will increase runoff debit in the future, should implement to elaborate structural mitigation and non-structural mitigation. Structural mitigation is the program that is planned by the Ministry of Public Works and Housing and Manado City Government.

The recommendation result of the spatial pattern plan is that the runoff coefficient will decrease through conservation is 356 m3/second (Figure 2). This recommendation will not decrease runoff significantly because runoff debit only reduces 30.85 m^3/second of runoff debit based on Spatial Planning Policy of Manado City 2014-2034 and only reduces 86.7 m^3/second of runoff debit based on Spatial Planning Policy Revision of Manado City 2018.

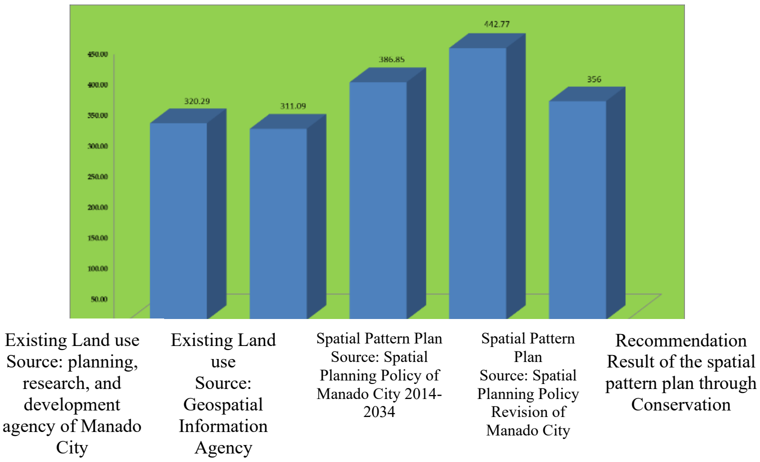

Figure 2 Runoff Prediction Tren Assessment of Manado City

B.4 Tomohon City

Runoff prediction considers existing land use is 7.42 m^3/second, while runoff debit based on spatial pattern plan that refers to Spatial Planning Policy of Tomohon City 2014-2034 is 6.36 m^3/second. It indicates that the spatial utilization of Tomohon City is appropriate to spatial planning policy. However, existing land use needs to arrangement in order to suitable to spatial pattern plan.

The recommendation results of the spatial pattern plan through conservation that runoff debit decrease achieves 5.10 m^3/second. This recommendation is significantly to reduce runoff severity in Tomohon City because the runoff debit based on recommendation is lower than the debit runoff debit based on Spatial Planning Policy of Tomohon City 2014-2034.

C. Plan of Developing Structure Mitigation in Tondano Watershed

The Ministry of Public Works and housing collaborate Japan International Cooperation Agency (JICA) carry out Comprehensive Flood Management Study in Manado City and Tondano River Basin in 2016 that one of the results is developing structural mitigation in Tondano Watershed to reduce flood disaster risk. In this research, structure mitigation plan is variable to formulate scenario of reducing runoff severity through conservation and structural mitigation.

Structural mitigations consist of the dam, Flood Retarding Basin (FRB). There are three dams that will be built, namely Tikala I Dam, Tikala II Dam, and Kuwil Dam. Tikala I Dam and Tikala II Dam are located in Minahasa Regency, while Kuwil Dam is located in North Minahasa Regency. Those are will be built outside Manado City, so it needs to synchronize of spatial planning policy in these three regions.

Structure mitigation will be built in the existing area is paddy field. The overlay process of structure mitigation location and spatial pattern plan based on Spatial Planning Policy Minahasa City 2014-2034 results that Tikala I Dam and Tikala II Dam is located in a plantation. Furthermore, the overlay process of structure mitigation location and forest delineation (source: The Ministry of Environmental and Forestry) results that those are located in unoccupied land. The conclusion is the area that will be built structure mitigation in the outside protected area and inside the non-built area.

D. Scenario of Runoff Assessment (Tondano Watershed, Sario Watershed, and Tikala Sub Watershed) Through Conservation and Structure Mitigation

The scenario of runoff assessment in Tondano Watershed through conservation and structure mitigation result will decrease runoff achieve 64.43%, while reducing runoff in Tikala Sub Watershed achieve 62.87%. It is caused the plan of developing Dam, FRB, and Kuwil Dam. There are no developing structure mitigation in Sario Watershed, so reducing runoff debit through only conservation, in the amount of 22.37%. The following are assessments of reducing runoff debit in Tondano Watershed, Sario Watershed, Tikala Sub Watershed: 1). The Reducing runoff debit in Sario Watershed through conservation is 22.37% of existing land use runoff, 2). The reducing runoff debit in Tikala Sub Watershed through conservation and structure mitigation is 62.87% of existing land use runoff, 3). The reducing runoff debit in Tondano Watershed through conservation and structure mitigation is 64.43% of existing land use runoff

E. Impliaction of conservation applied in pattern planning and structural mitigation development to runoff debit reduction

Flood mitigation can through elaborate on structural and non-structural mitigation[1]. Based on runoff calculation scenario, elaboration of conservation and structural mitigation can reduce runoff significantly in Manado City (Figure 3). If when the flood occurred in 2014 was > 3m high, then by conservation apply the area of the flood of 3 m high is around 1-2 m high. The area of flood-affected is decreasing if applying conservation and structural mitigation compared with only applying conservation. The area of above 3 m high flood affected is decreasing significantly on 53,5 Ha (Table 1) by applying conservation and structural mitigation.

TABLE 1

RUNOFF CALCULATION ON EXIXTING LANDUSE 2015 AND SPATIAL PATTERN BY APPLYING CONSERVATION AND STRUCTURAL MITIGATION

Watershed Name	LIMPASAN		APPLICATION OF CONSSERVATION AND STRUCTURAL MITIGATION (M^3/S)	RUNOFF REDUCTION (M^3/S)	PERCENTAGE OF RUNOFF REDUCTION (%)
	EXISTING LANDUSE 2015 (M^3/S)	CONSERVATION RECOMMENDATION (M^3/S)			
Sario Watershed	98.32	76.33	76.33	22.00	22.37
Tikala Sub Watershed	229.25	199.13	85.13	144.12	62.87
Tondano Watershed	582.98	489.56	207.38	375.60	64.43

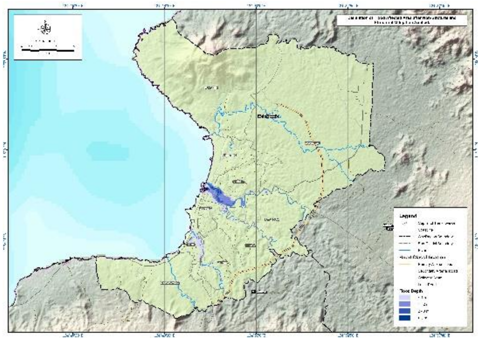

Figure 3 Deliniation of flood inundation after applying conservation and structural mitigation in Manado City

The reduce of runoff severity is the value of runoff flow on existing land use which is already implemented conservation and structural mitigation. Therefore, DAM or reservoir upstream of a watershed can reduce the area and high flood affected. The area of flood inundation if applying conservation and structural mitigation is a smaller value than without conservation. The reduction is reaching 72,46% in Tikala SubWatershed, 73,67% in Tondano Watershed, and 22,48% in Sario Watershed. There is no reduction of runoff debit in Sario Watershed because of no structural mitigation planning in Sario watershed.

Conclussion

Disaster risk reduction of flood needs integrated management between stakeholder in regions, can not be separated by administrative boundaries. This matter because of the upstream and downstream linkage between up, center, and down which part of the watershed. The Manado's problem has to consider all surrounding area of Manado City that is part of Tondano and Sario watershed. Therefore, flood reducing would be more effective if considering the whole part of the watershed. Based on runoff calculation scenario, it has been proved that elaboration of conservation and structural mitigation can reduce flood risk significantly. Moreover, elaboration of conservation and structural mitigation due to if only applying conservation or only non-structural mitigation, the benefits will be taking a long time. But if only structural mitigation can change the landscape and nothing will do the conservation and rehabilitation to maintain environmental sustainability. So that elaboration of conservation and structural mitigation will be more effective to reduce and to conserve also rehabilitate the land's sustainability.

This study can be followed up by adding stakeholder mapping and cooperation mechanism between governments. This cooperation concept can be done through Payment Environmental Services that is allocated by not only national governments but also province governments. After that, the province government manages the budget in term of incentive that given to region or city government to do kind of land conservation and rehabilitation.

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Community Resilience in Dealing with Flood and Haze in Jambi Province, Indonesia

Ali Yansyah Abdurrahim[1], Deny Hidayati[1], Intan Adhi Perdana Putri[1], Ari Purwanto Sarwo Prasodjo[1], and Herry Yogaswara[1]

[1]Research Center for Population, Indonesian Institute of Sciences, Jakarta 12710, Indonesia

E-mail: aliyansyah.lipi@gmail.com; aliy002@lipi.go.id

Abstract. Floods and haze are the two dominant types of disasters that often occur in Jambi Province, Indonesia. Rural communities exposed directly to the two disasters have made every effort to deal with these calamities. This paper aims to analyze the resilience of communities in rural areas of Jambi Province in the face of floods and haze caused by land and forest fires. It is based on the research that had been conducted over four years (2015-2018) with qualitative methods FGD, in-depth interviews, and field observation activities and quantitative methods (survey questionnaires for 200 households in 2016). This research showed levels of community resilience varied according to disaster types. For floods with slow onset characteristics, rural communities have adequate capacity to deal with this disaster with the resilience level at the stage of adaptation. However, for haze caused by forest fires, the level of resilience that can be achieved by the community is quite low. Based on these lessons learned together with the modification of relevant theories and frameworks, researchers offer a model of community resilience to disasters that can be used by various parties to analyze community resilience and alternative solutions that can be taken, particularly the provision of policy/program support.

Introduction

Flood and haze are the two most frequently disaster event in Jambi Province, Indonesia. Over the last decade, the disaster event was increased eight times [1]. A massive land use change as a consequence of rapid development in Jambi Province the occurrence of the two disasters event. Cockburn et al (1999) mention that the change of land use generates the disruptive of the ecosystem and aggravate the disaster event. Apip *et al* [3] illustrated using land use map 1990, 1997, 2005, 2015 showed that a significant change of primary forest. It is estimated the loss of primary forest is about 76,522 ha per annum. Apip *et al*. [3] forecast in 2045 only National Park (Bukit Tiga Puluh, Bukit Dua Belas & Berbak) are the primary forest will remain. Disaster event in Jambi Province certainly disrupts the development plan and economic activity. The economic loss in Jambi Province in April 2017, approximately reach 113.8 billion rupiahs just from infrastructure. On the other hand, the economic loss of haze caused by a great forest fire event in 2015 was about 11.8 trillion rupiahs [4]

The increase of disaster's frequency and magnitude in Jambi Province affect the community daily life and livelihood [5]. They found that the flood event that strikes every year in Jambi Province, has a slight effect on their daily life. The community already have an adaptation in order to deal with the flood, they prepared a boat for transportation during the flood, also prepared a number of wooden boards to build up "a stage" when the water level reaches into their house. Meanwhile, they did not prepare anything for haze event. This is because haze does not happen every year and lack of information in facing the event. Flood and haze affect the community livelihood in Jambi Province. In facing the flood, for instance, the community changing their planting period after the third flood occurred. While for haze event they did not have any "plan in terms of their livelihood although they plantation productivity is decreasing significantly. The Jambi's community behavior toward disaster leads to community resilience. Driver+ [6] definition on community resilience is "The sustained ability of a community to utilize available resources to respond to, withstand, recover from and adapt to adverse situations".

Strengthening the community's resilience is prioritize by Sendai Framework for Disaster Risk Reduction 2015-2030. Some scholars [7] [8][9][10][11] mention that the concept of community resilience has become important for portraying and assessing the ability of people to anticipate, absorb, accommodate or recover of disturbance in a timely and efficient manner. The need for the community to have this ability is because when disaster strike, the position of governments and aid organization are not perpetually to help the communities straightaway [7]. Several models, framework, and tools for assessing community resilience to the disaster have been developed over the world [12]. However, on how measuring resilience, there is no agreement exist currently (Winderl, 2014). Therefore, this paper attempt to develop the community resilience model for flood and haze event particularly in Jambi Province. The community resilience model in this paper constructed based on four years of research (2015-2018) of the human ecology research group, Research Center for Population, Indonesian Institute of Sciences. The research location is in Mekar Sari Village and Seponjen Village of Muaro Jambi Regency. The two villages represent the community that commonly lived in Jambi Province. Mekar Sari Village population majority is transmigrant from Java, while Seponjen Village representing an area inhibited by native Jambi People.

2. Objective and method

This paper aims to analyze the resilience of communities in the Jambi Province countryside in the face of floods and haze caused by forest fires. In addition, researchers also offer a model of community resilience to disasters that can be used to analyze disasters and also a choice of solutions that can be taken, including the provision of policy/program support by the government and others. Resilience is a key element in the Sendai Framework, especially goal number three which reads "Strengthening resilience through increasing preparedness, response and recovery" [14] This community resilience model was built based on the frameworks of the previous community resilience frameworks/model compiled by scholars and trusted international institutions as well as the synthesis of research conducted by the Human Ecology Research Group, Research Center for Population in 2015-2018.

The entire 2015-2018 research series was carried out with qualitative methods, except in 2015 which was also supported by a quantitative survey method. The qualitative method used is field observation; focus group discussion (FGDs) community members: farmers and / or fishers, women, youth groups; open interviews with key informants, such as formal and non-formal leaders; and several representatives of farmers and / or fishermen, women's groups, and youth groups; and workshops with government institutions at the provincial, district and village levels. Meanwhile, for the quantitative method, researchers used a questionnaire survey (structured questionnaire) for 200 respondent households randomly selected.

This paper also uses a variety of secondary data related to research topics, including data, concepts, and theories. Secondary data collection and review are focused on aspects of community, resilience, risk, vulnerability, capacity, and preparedness and mitigation/adaptation related to disasters.

3. Community response and resilience to flood

This study reveals that the households and community in the study locations have adequate capacity to respond to regular flood as indicated by their preparedness and mitigation/adaptation activities. This condition informs their resilience at the level of adaptation. This level applies to daily life activities and livelihood sustainability, even tough for the main job (agriculture) is still at the absorption stage.

Flooding is a disaster that often occurs, even routines occur 2-3 times for 3-6 months each year in Mekarsari and Seponjen Villages, the District of Muaro Jambi, the Province of Jambi. The routine of flood events in these areas has shaped the households and community perception to term flooding as ‘rising water' or ‘air naik’ and perceive it as a natural phenomenon, not a disaster. Many households and community members express that ‘flood brings blessings’ or ‘anugrah’ because it can be an economic opportunity. When the flood lasts long, they can catch fish in flood waters. However, households and community members that are mostly farmers state that when floods their agricultural activities and production are disrupted.

Preparedness and mitigation/adaptation are very important efforts for the households and communities in facing flood. Preparedness is plans and/or actions taken to reduce flood impacts on their daily lives and livelihoods. While mitigation/adaptation is efforts to reduce vulnerability and risk of flooding. The efforts are carried out through structural activities, such as the development of physic, facilities, and infrastructure (houses, dikes, and canal waterways) and through non-structural activities, such as community access to information, knowledge, and awareness toward the flood.

3.1. Daily life

Routines in dealing with flooding have become a very important and effective source of learning for households and communities in the study locations to increase their preparedness and mitigation/adaptation. The households and the community members are capable of facing these regular flood that comes 2-3 times a year. They know what and how to prepare and do to deal with floods. Although their access to information is quite limited, with a local understanding of early warning, they find out when water arrives in the village and enters the house. Preparation begun before the water inundates the house so that when the flood water arrived, they can still live their daily lives, avoid or to be able to minimize the impact of the disaster.

3.1.1. The Households and community preparedness.

This study identifies several types of preparation made by households and community in Mekarsari dan Seponjen Villages. They include to set up "amben-amben" (safe place in the house), prepare water transportation facilities (canoe/boat and rowing), move motorbike to a safer place, and provide their basic needs, particularly food.

Figure 1. |*Amben-amben* (safe places in the house)

- *Set up amben-amben: safe place in the house*

Before the flood water enters the house, all households whose houses are usually submerged in water have set up amben-amben or safe places in the house (see Figure 1). Amben-amben serves as safe evacuation places for flood water. They are used to carry out household activities in fulfilling their vital needs, such as cooking, eating, and sleeping. The households also put cooking utensils, food, bedding, clothes, and other basic necessities (important documents and medicines) on the amben-amben. They also put their valuable goods, such as TV, Radio/Stereo in this safer place. Considering its function as a home, many households and community members that give the term amben as ‘a house in a house’. Amben will be dismantled after the water is dry and the wood and boards are stored so that it can be used again in the coming flood.

- *Preparing water transportation equipment*

Most households and community members in the study locations have prepared canoes and paddles or boats with the engine (Figure 2). They need canoe/boat as a means of transportation so they are not isolated due to flooding. The water transportation is very important for all household and community members so that they can carry out daily activities, including to schools (for the school children), conduct economic activities (such as to agricultural lands and plantations, and trades), buy family basic needs and other social activities. Canoes and/or boards and paddlers then are stored in the dry season and ready to be reused when the next flood.

Figure 2. Water transportation

Figure 3. The safe place for motorbikes

- *Keep the motorbikes in a safe place*

For vehicle safety, especially motorbikes, many households move their vehicles to a higher and safer place from flooding (Figure 3). In Mekarsari Village, many motorbikes are placed on relatively high-lying bridges. Even though the vehicle was placed in an open place, according to the local informants the place was safe not only from the threat of flooding but also theft. Unlike in cities where there is a lot of theft, this village is very safe from the crime.

- *Independence' in providing basic needs*

The adequate preparedness of households and community in Mekarsari and Seponjen Villages in facing frequent flood is also indicated by their capacity in providing basic needs, especially staple food. Even though their economic activities were severely disrupted during the floods, they were still able to meet the needs of foods from alternative jobs, the savings of money, the remaining rice harvested before the flood, and some owed in the small shops (warung).

The independence of households and community members in facing floods can also be reflected by 'the absence' of disaster aid for residents in these villages. According to some informants, they reject the disaster aid from the local government, because the aid is only enough for some villagers. The main reason for refusal is to avoid conflict because help is not for all villagers who experience flooding.

3.1.2. Mitigation.
This study informs that the households and community members have adequate mitigation/adaptation in dealing with frequent floods in Mekarsari dan Seponjen Villages. Their mitigation capacity is relatively high in physical and environmental aspects as illustrated by the development of pillar/stairs houses and water transportation equipment (canoes/boats).

- *Build a pillared house*

The households and community in Seponjen Village have built pillar houses for a long time since their grandparents used to be. This village has long been a flood customer, especially during the rainy season. It is located in the lowlands which are flowed by Kumpeh River and some of the areas are in the form of peat swamps. Their grand-grandparents with their local knowledge and wisdom constructed pillar houses using woods and boards taken from the surrounding forest. The wood-studded house is a traditional home of native (Melayu) Jambi people, including the community in Seponjen Village. The construction of pillar houses aims to maintain security in order to avoid flood water and disturbances from wild animals.

While in the Mekarsari Village, the houses here were once half-stage houses built by the government through the transmigration program. This village was once the location of a food crop transmigration in 1986 where each of household transmigrants (from West, Central, and East Java) acquired a house and agricultural lands for food and tree crops. At first, all houses have the same shape and size, but over time and the economic development of transmigrants, most or even almost all houses have been repaired or demolished with varying sizes and materials. Most of the houses are still in the form of pillar houses made of wood/boards.

- *Improve swimming and rowing skill*

Non-structural forms of mitigation/adaptation which are also very important for the household and community members in Mekarsari and Seponjen Villages are swimming and rowing skill. This study informs unsatisfactory results because less than half of the household members in the Mekarsari Village can swim. This is related to the background of transmigrants in the area of origin (Java) who do not have access to swim. Some of them started to learn swim after moving to this village, while others are still afraid to swim, even though they live in the flood-prone area. In Seponjen Village, the total numbers of household and community members who can swim are much higher than in the Mekarsari Village. As native people, the Seponjen villagers are used to swim because this village is diverted by the Kumpeh River throughout the year. While rowing skills belong to almost all household and community members in both villages because of the vital water transportation needs during the floods. Transmigrants initially learned to row from native people surrounding their locations. Like swimming, they did not have these skills before moving to Mekarsari Village.

3.2. Sustainable Livelihood

Adaptation from economic aspects is very important, considering that flooding occurs 2-3 times in quite a long time 3-6 month per year in all study locations. This study shows that the sustainability of household and community livelihood was still maintained even though the flood inundated most of these areas. This condition is indicated by the availability of agricultural products even though production and income have dropped significantly, and the existence of alternative jobs during the flood.

3.2.1. The availability of declining agricultural products.

Although preparedness and mitigation of households and community in Mekarsari and Seponjen Villages are quite good in daily lives, they are still less able to mitigate/adapt flooding in order to achieve livelihood sustainability. This is especially for their main job in the agricultural sector.

When floods, agricultural and plantation activities experience significant disruption. Most farmers cannot grow food crops (rice, *palawija,* and vegetables) because agricultural land is submerged in flood water. The water cannot flow quickly due to the lack of large sluice gates on the embankments around the village. Adaptation efforts that they carry out is still limited, such as the arrangement of planting times and types of plants throughout the year. They grow rice after the flood water dry so that it can be harvested before the next flood comes. In addition to rice, they also grow corn, beans, and vegetables.

Flooding also disrupts farmer’s activities in their smallholder plantations, especially oil palm and rubber. Even though they can still take rubber and oil palm products, but the production drops significantly by about 60 percent. Income from garden produce, although small, is still an important source of income to provide basic household daily needs. In order to survive, they must be economical and can manage household expenses.

3.2.2. Alternative jobs.

Another important factor to maintain the sustainability of household and community livelihoods in Mekarsari and Seponjen Villages is through job diversification, such as becoming seasonal fishermen, a laborer in oil palm plantations or agricultural activities surrounding these villages or *ojek* drivers (motorcycle taxis). These alternative jobs vary between these two villages, fishermen are dominated in Seponjen Village, while labor workers in Mekarsari.

Farmers use flood water as an 'economic opportunity' to catch fish. The fishery has become an important alternative job and income in all study locations, especially in Seponjen Village. Most of households and community in the Seponjen Village have become seasonal fishermen. Residents in this village perceive flooding like a natural event that gives them gifts or '*berkah'*. Flooding is used as a source of income from fishing. They catch fish using fishing gears, such as nets, fishing rods (*jaring*), fish traps (*bubu*) called *menteban* made of bamboo or *tamila* from a wire. Some households also make fish cage *(karamba)* as places to accommodate fish. Most fish are sold fresh within and around the village, Jambi City, and if the floods are long enough fish production, fish production is high, so it can be sold to the City of Palembang. A small portion of fish is processed into salted fish and some are sold and the rest are stored for their own consumption in the dry season. Only some of Seponjen Villagers become *ojek* drivers and labor workers.

In Mekarsari Village, alternative household chores during floods are more diverse than in the Village of Seponjen. The type of works that many households do is those construction workers or farm laborer in oil palm plantations that are not flooded outside the village. Some also work in transportation services as *ojek* drivers using their own motorbikes. In this village, only a proportion of households catch fish using similar fishing gears with the Seponjen fishermen. Fewer households catching fish here are associated with their background, which is mostly transmigrants from Java who are not used to water activities.

This study reveals that households and communities have adequate capacity to achieve livelihood sustainability. The resilience is at the adaptation level although its resilience in agricultural activities still at absorption level. This condition is caused by their limited agricultural knowledge and skills to adapt to flooding, mainly due to their limited access to relevant information. Their knowledge and skills are dominated by local knowledge based on a lesson learned from grandparents and their own experiences. Transmigrants who mostly came from Java (Central, East, and West Java) when their first come they adapt their lives and livelihoods to a new location by learning from transmigration officials and native people surrounding their location. While information about environmental changes and flood and how to adapt to this natural phenomena from outsiders, such as government, NGOs and other stakeholders is still limited.

3.3. The Role of community.

The role of the community in dealing with floods is illustrated through the involvement of community members in social activities and disaster risk reduction in Mekarsari and Seponjen Villages. This study informs that the community role varies between daily lives activities and livelihood sustainability.

In daily lives, most community members sufficiently involve in social activities both in Mekarsari and Seponjen Villages. This condition is indicated by their participation in self-help or *tolong menolong* (such as wedding parties, grief, and build houses), and cooperation work or *gotong royong* activities (arrange and repair shipyards and waterways). This involvement is very potential as human capital and social investment in dealing with and anticipating disasters in both locations.

This local wisdom is less implemented in flood risk reduction because villagers in all locations have been independent and able to do their own preparedness. All community members are busy preparing their own household need since they know what to do and how to do it. *Tolong menolong* is limited to community members who have special events, like parties, by making their way home so that their guests don't get wet, and households whose members are elderly or disable.

Unlike daily lives, *tolong menolong* and *gotong royong* activities have been carried out by the community members for livelihood sustainability, especially related to agricultural activities. The community members whose adjacent fields help each other to repair the mounds that are damaged by the flood. They also conduct *gotong royong* to repair damaged waterways and drains before starting to plant rice and other food crops in the fields.

4. Community response and resilience to haze

In contrast to flooding, the knowledge of the community about how to deal with haze due to forest fires is still very limited. Although they have been used to haze for a long time when processing land with fuel, due to the haze caused by forest fires they cannot do anything. According to them, the basic difference is that the haze that emerges from combustion for processing land can be controlled. It is different from the haze caused by forest fires which are very thick, massive, and cannot be controlled, causing disasters.

Transfer of knowledge and skills from outside parties, including the government, private sectors, and NGOs is still very minimal. Most of them have come to the village to provide counseling, but even then the time is very limited (just one day on average) so the material is not complete. The information provided is only limited to how to prevent and extinguish forest fires, not yet discussing how to respond to the haze that has already come to the village. As a result, the community cannot do anything, as well as community members. Some of them are only able to do copings, such as using a mask or upper respiratory tract cover with handkerchiefs, scarves, and headscarves. Some of them, especially vulnerable groups, especially the elderly, toddlers, and babies are forced to be evacuated to relatively (impermeable) concrete houses from the haze. Their board houses which were built as a form of adaptation and mitigation of flooding turned out to provide a gap for the haze to enter.

For the sustainability of their livelihood, haze is considered very detrimental. Because the haze is so thick that it disturbs their vision and breathing, they cannot do agricultural and plantation activities, including harvesting the produce. As well as preventing them from working on land and gardens, haze also causes significant production of rice, secondary crops, vegetables, and palm oil. Some of them claimed to have dropped between 40-60 percent. Similar to agricultural activities, livestock activities also experience interference. In addition to the direct impact of their livestock, they are also hampered in the activities of shepherding and taking grass for animal feed.

It is different when floods that still have alternative income opportunities from fishing or working as construction workers and motorcycle taxi drivers, both in their villages and outside the village, when the haze arrives they cannot do it. All alternative work is carried out in open spaces exposed to direct haze.

5. Conditions of recent policy and program support: the role of government in increasing community resilience

This study states that the role of the government, both central and local governments, is still limited in reducing the flood risk, especially related to agricultural activities and production. The government built dikes around Mekarsari Village, but according to local sources, the sluice on the embankment was too small, so that when the flood flooded the water could not immediately be released. Other activities carried out limited to the socialization of disaster management to the community and the realization of the program from the central government to form a community preparedness organization in Mekarsari and Seponjen Villages.

The socialization was conducted after the 2015 haze disaster, focusing on information and efforts to reduce disaster risk. The information, however, was still limited, may be related to flooding that regularly occurs in Jambi, so that it is no longer the center of government attention considering that the floods can still be handled by the community.

The government establish community organizations, such as *Destana* (Resilient Village Disaster) was initiated by BNPB, KSB (Village of Disaster Preparedness) by the Ministry of Social Affairs, MPA (Community who care about Fire) by the Ministry of Forestry and Environment, KTPA (Fire Care of Farmer's group) by the Ministry of Agriculture. The main purpose of these community organizations is to increase the community preparedness and its role in disaster management. However, these organizations have not been effective. The community organizations that were set up at the end of the socialization activities have not been able to function because they have not yet completed the requirements. The necessity facilities, such as social barns for KSB, were not yet available. In addition, the ineffectiveness of these organizations was also due to the lack of community understanding and awareness about the importance of reducing disaster risk.

Whereas the lesson learned from this study shows the importance of supporting policies and programs related to community livelihood sustainability. Although the community livelihood can still be maintained with fishery activities and alternative jobs in Mekarsari and Seponjen Villages, agricultural policy and programs are needed to increase their resilience. The support that can be carried out is through the implementation of protection and assistance to farmers, such as in the form of farmer insurance.

This study highlights the limited role of actors in increasing the capacity of households and the community to achieve the highest level of their resilience (transformation) towards flooding. This indicates enhancing the capacity of actors, both community and local government, is very important and crucially needed. Socialization and guidance activities for the households and the community need to be continued with material that is tailored to their needs, particularly related to agricultural activities as the main job of the households and community in all study locations and rural Jambi.

For haze context, as highlighted in the previous section, community resilience to haze has not yet been established. The government has actually made an effort to socialize, but the number of community members who received socialization is still very limited. In addition, limited information material on efforts to prevent and extinguish the fires of forest fires has not explained how to deal with and reduce the effects of haze caused by forest fires. In fact, when a haze disaster is happening, the impact of this haze is very large. Almost all daily activities and livelihood activities are paralyzed.

New formal institutions formed by the government at the village level, such as the Community Care for Fire (MPA) formed by the Ministry of Environment and Forestry and the Fire Care Farmers Group (KTPA) by the Ministry of Agriculture did not function effectively. In addition to the lack of intensive information and mentoring from the government, the lack of clarity in rules and strict division of labor in both institutions caused overlapping functions which eventually became counterproductive.

3.5. Building a model of community resilience in the face of flood and haze disasters

Based on the discussion above, researchers try to build a model of community resilience in the face of flood and haze disasters. A model framework based on the framework of models DRLA-Tulane University [14] Berkes and Ross [9] UNDP [15] FAO [16], Winderl T/UNDP [17], USAID [18] Driver+ [6] Cutter et.al. [19] shows a cyclic process of how communities respond to disasters and build resilience to disasters (see Figure 1).

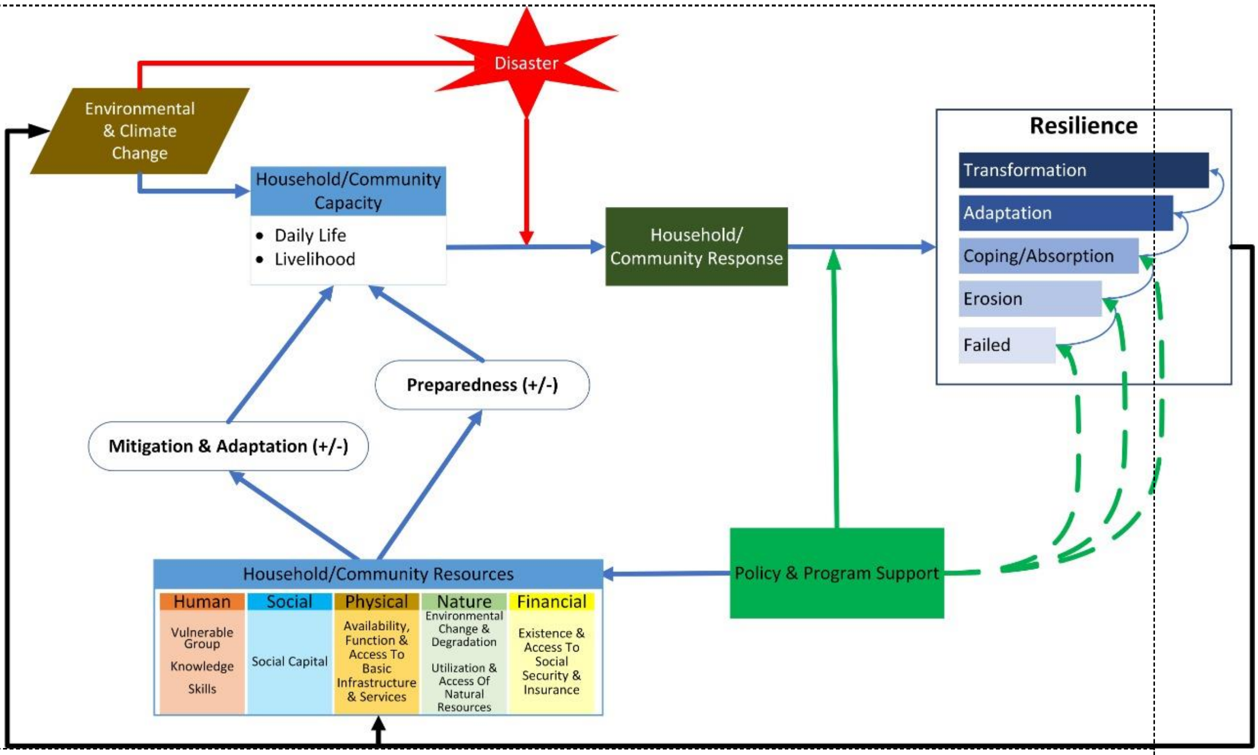

Figure 3. Model of community resilience in dealing with flood and haze

Source: modified from DRLA-Tulane University [14] Berkes and Ross [9] UNDP [15] FAO [16] Winderl T/UNDP [17], USAID [18] Driver+ [6] Cutter et.al. [19]

In this model, researchers understand resilience as a multilevel outcome adjusting to the capacity of the community and community members. The researcher divides it into five levels, namely 1) transformation (quickly recovering with much better conditions), 2) adaptation (quickly recovering with slightly better conditions), 3) coping/absorption (can recover and return to previous conditions), 4) erosion (worse and harder to return to the previous condition), and 5) failing (much worse and unable to return to the previous condition).

The level of resilience that will be achieved by the community and community members is strongly influenced by the capacity of the resources that are owned and/or accessible. These various resources are grouped into five groups, namely human (a) resources, (b) social resources, (c) physical resources, (d) natural resources, and (4) financial resources. In addition, the support of policies and programs, both those coming from the government and NGOs and the private sector also affect the level of resilience. This support can be given to increase resource capacity or can be directly given to communities or community members with low levels of resilience (failure, erosion, coping/ absorption) in order to shift to a better level of resilience. Furthermore, the level of resilience that has been built results in preparedness and mitigation and adaptation in the face of disasters.

The application of this model in the context of flooding, for example, shows that the resources that must be considered are (a) human resources (vulnerable groups, local knowledge, and skills); (b) social resources (please help, mutual cooperation, and trust in local leaders); (c) physical resources (lack of functioning of dykes and some houses submerged in water); (d) natural resources (land, rice fields and gardens submerged in water, and agricultural production is disrupted); and (e) financial resources (loans / loans, unavailability of formal social security networks). For policy and program support, the most needed by the community is insurance and agricultural assistance for all types of plants as well as repairs and management of water dikes. In addition, it is also important to optimize formal institutions that have been formed by the government and collaborate with private sectors and NGOs, such as the Disaster Awareness Group (KSB), the Fire Care Farmers Group (KTPA), and the Community of Fire Care (MPA). Then, the level of resilience that has been achieved at this level of adaptation and transformation determines the form of mitigation and adaptation, such as (1) building a pillar house and boat as a means of transportation (daily life); and (2) regulating the time & type of plants, having alternative jobs (sustainability livelihood). On the other hand, preparedness built is a place of refuge in the house (amben), water transportation, and independence in fulfilling food needs.

On the other hand, the application of this model in the context of haze disasters, the biggest difference with the context of haze disasters is the lack of adequate information and knowledge (human resources), a sense of responsibility for forest fires due to their limited access to forest resources , flood adaptive stage board houses actually make physical resources more vulnerable, all agricultural, plantation, livestock, and fisheries activities are disrupted (natural resources), and there are no formal social safety nets. The type of policy and program support needed is relatively the same as the flooding context, but what is different is the substance that needs to be emphasized in the haze. Low capacity which only results in a degree of failed resilience, erosion and coping/absorption causes limited mitigation and adaptation. Even for their daily lives, they have not been able to provide safe houses for haze, and for the continuity of blows, there is no alternative job that is safe from the haze. Even so, for preparedness. They are only able to use makeshift masks so that their daily life activities can still run, even in very disturbed conditions.

4. Conclusions

This study showed that the community resilience towards disasters in rural areas of Jambi Province varied according to the type of disasters. For floods whose character appears slowly and lasts for a relatively long time, the level of resilience is at the stage of adaptation. The level of resilience will increase at the transformative level if the community receive livelihood protection from the government. The protection is particularly related to their main job, agriculture such as in the form of farmer insuranceUnlike floods, haze disaster that caused by land and forest fires, the highest level of community resilience was only at the coping/absorptive level, while many were still at the stage of erosion and even fail.

The high level of community resilience in facing floods in the rural areas of Jambi Province is significantly contributed by their capacity to exchange valuable knowledge and skills among transmigrant community members (Javanese and Sundanese) with members of the indigenous population (Jambi Melayu tribe) in ensuring continuity daily life and sustainable livelihood. This process is a manifestation of the intercultural adaptation process that is proven to provide benefits for all communities in this province. Conversely, the community lack of knowledge and skills towards haze were mainly due to the lack of information and empowerment from the government and relevant stakeholders about how to deal with this disaster. This condition causes low levels of community resilience in all study locations.

The community adaptation to floods and cope with haze in rural areas of Jambi provides meaningful lessons to develop a model of community resilience in dealing with disaster. The model that is also modified from various theories and relevant frameworks focuses on the importance role of the community in facing disasters, particularly their capacity in mitigation/adaptation and preparedness activities based on their resources (human, social, physical, natural, financial), and the government in delivering support through appropriate policies and programs in order to increase resilience level of the community.

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Earthquake Readiness and Preparedness at Early Age

Cornelia Dede Yoshima Nekada[1),]Thomas Aquino Erjinyuare Amigo[2)]
[1)]Departement of Emergency and Critical Care Nursing of Respati University of Yogyakarta
[2)] Department of Community Nursing of Respati University of Yogyakarta
e-mail: cornelia.nekada@gmail.com[1)], erjin.respati2009@gmail.com[2)]

Abstract
Indonesia is located in a disaster prone area. Various disasters occurred in Indonesia in 2018 namely flood, landslide, earthquake, volcano eruption, and even tsunami. Those disasters are abrupt, destructive, and damaging. The loss caused by the disasters includes not only lives but also wealth. One of the most common disasters in Indonesia is earthquake. Earthquake is the shaking of the surface of the earth due to the sudden release of energy in the earth that creates seismic waves [1][3] [8][19-20]. It can also be caused by the movements of the earth's crust (earth's plates) [10][15]. Earthquake can occur anytime, at working hours or school hours, and at that time children can be the victims with the largest number of all. The purpose of this action research is that the children can expand their knowledge and adapt themselves with the ways to rescue themselves when earthquake occurs. The methods employed is health education by showing cartoon movies, music and movement activity, short interviews, observations, and self-rescue simulation. The data of the interview observation show the change of the kindergarten students' knowledge in coping with the earthquake from 50% ability in giving simple answers to the questions at the beginning of the activities to 100% ability in giving detailed answers at the end of the activities.
Keywords: Simulation, Evacuation, Earthquake, Earth

1. Introduction

Yogyakarta province has high potential of earthquake both from tectonic activity and volcanic activity. The earthquake on 27 May in 2006 killed thousands people [19-20]. Based on its history, the earthquake in Yogyakarta is not only caused by tectonic activity but also volcanic activity [3][7]. Yogyakarta has an active volcano, which is Mount Merapi that still erupts until now and leads to volcanic earthquake for the people of Yogyakarta [11]. The volcanic eruption occurred in 2010 at the end of October and the great eruption on 5 November in 2010 also killed a great number of people [11][14]. The impacts of the earthquake include the loss of family, houses, wealth and psychological problems including sadness, desperation, depression, and confusion [7][9]. The fright during the earthquake makes the self-rescue effort not optimally conducted. All levels of society need to be proactive in coping with the disaster situation, in this case earthquake [10][19]. One of the efforts to improve the active role of the society in coping with the earthquake is by giving health education. Health education can be given by simulation or practice method, so that it will be more interesting for the participants [13][16-17]. The evacuation process of the earthquake self-rescue belongs to the fifth stage in the knowledge level, which is application [16-17].

Based on the interview result to the headmaster of Indryasana Kindergarten, it is stated that the kindergarten students have never got any education about evacuation process when the earthquake occurs. The students need to know this since earthquake may occur at school time when they are at school and when they are not with their family. The second reason is that Yogyakarta Province is an earthquake prone area both from tectonic activity and volcanic activity of Mount Merapi. Indryasana Kindergarten is located in Babadan, Wedomartani, Ngemplak, Sleman and it is in the same regency as the Mount Merapi. Simulation and practice that are given to the kindergarten students aim at improving the skills and adeptness of the students to face the earthquake that might occur without knowing when it will.

Nurses have the role to provide health promotion for all of the society. Health education is given with the purpose to expand the knowledge and the health status of the society [13][23]. Health education is given to the community of kindergarten students about how to conduct self-rescue when the earthquake occurs. The nurses' role, especially the casualty and emergency nurses as well as the community have the responsibility in organizing the society to be the society that is prepared and ready for the emergency and life-threatening situation, especially earthquake disaster. This also supports one of the activities in disaster management that are conducted before the disaster occurs by giving health education and evacuation simulation of the earthquake disaster [5-6][8]. The ready steady principle given in the health education about earthquake is expected to be able to improve society's understanding as well as their readiness in dealing with earthquake [10][15][18]. develop education that is given involves the earthquake self-rescue ways so that it can improve the active role of the kindergarten students when they experience an earthquake later on and when they might not be with their family.

2. Method

This research employs action research method. The design used is analytical observational, using health education approach with plentiful attractive activities for the kindergarten students, which are short lecture, watching cartoon movies with the theme of how to do self-rescue on earthquake, music and movement activity with "Kalau Ada Gempa" song, doing self-rescue simulation when the earthquake occurs, and conducting observation from the students' answers when they are given short questions. The sample of the observation is 34 students. The research setting is located in Indryasana Kindergarten, Babadan, Wedomartani, Ngemplak, Sleman, Yogyakarta, dated on March 9, 2019. The analysis is conducted by examining the frequency distribution of the data before the activities and after the activities. The instruments used are LCD, mega phone, laptop, active speakers, earthquake movie, and observation sheets. The data observed are the frequency distribution of the respondents' characteristics, education process, and the ability in answering the questions related to self-rescue when the earthquake occurs.

3. Result

Table 1 Frequency Distribution of Respondents' Characteristics in Health Education in Indryasana Kindergarten, Wedomartani Ngemplak Sleman Yogyakarta

Characteristic	Total: 44	
	f	%
Kindergarten		

Student	13	29,55
Female	21	47,73
Male		
Teacher	3	6,82
Frater	7	15,9

Table 4.2 Observation Data of Education Process in Indryasana Kindergarten, Wedomartani Ngemplak Sleman Yogyakarta

Observation Indicator	**Total: 34**	
	F	**%**
Initial interviews about earthquake and self-rescue	17	50
Attention in health education lecture	34	100
Attention in watching cartoon movie about earthquake	34	100
Participation in music and movement activity with the song "Kalau Ada Gempa"	34	100
Participation in doing self-rescue simulation when earthquake occurs	34	100
Participation in short interviews about self-rescue when the earthquake occurs	34	100

Table 4.3 Students' Ability in Mentioning Earthquake Self-Rescue Ways in Indryasana Kindergarten, Wedomartani Ngemplak Sleman Yogyakarta

Observation Indicator*)	**Total: 34**	
	f	**%**
Getting out of the house	8	23,53
Hiding under table	5	14,71
Protecting head	10	29,42
Avoiding glass	13	38,24
Avoiding trees or multi-stories building	6	17,65
Asking parents to turn off the electricity	3	8,83
Not panicking or crying	12	35,30

*)Some students are able to mention more than 1 indicator

4. Discussion

This is an action research study, using analytical observational approach by giving health education and self-rescue simulation when earthquake occurs. The data observed in this research are the respondents' characteristics, education process, and the ability in mentioning the self-rescue steps when earthquake occurs. The data are then processed suing frequency distribution statistics with 34 observations in total, in line with the total number of the kindergarten students being observed. The statistics test on the respondents' characteristics (44 observations) shows that the female students are of 29,55%, male students of 47,73%, teachers of 6,82%, and frater of 15,9%. At the initial examination before the activities, the team examines the students' knowledge by asking short and simple questions about what earthquake is, whether the students ever feel the earthquake, and what must be done when the earthquake occurs. Fifty percent of the students explain that when the earthquake occurs, people must get out of the house as fast as they can. Based on the discussion in the health education, it can be seen that the kindergarten students, teachers, and fraters are really enthusiastic in joining all of the activities. The activities conducted in the health education include short lecture about earthquake, watching cartoon movie about earthquake simulation, doing music and movement activity with “Kalau Ada Gempa” song, and conducting simulations or real practice on how to do self-rescue when the earthquake occurs.

Health education is a learning process that leads to growth, development, or change to be more mature, better, and more developed for the individuals, groups, or society [16-17]. This explanation means that health education is an active mutual intervention that can create society behavior to improve the health status of the individuals or the groups of society. Introducing to the health problems can be done at early age, for example in kindergartens. Kindergarten students are vulnerable community, in which at that age, children just learn how to adapt to the new world, outside their home and family [2][21]. Children must be introduced on how to defend themselves, especially on how to maintain their health and keep themselves away from the situations that can threaten their lives. Early introduction to the kindergarten students is expected to make them independent. The early health education that is given must adjust to the development tasks. The development tasks in this community group are learning to interact to the social environment, learning to fulfill basic needs independently, learning to identify the danger outside them, and learning to keep them from dangerous situations [2][21]. The appropriate method in the early health education is learning while playing [13][16-17]. The introduction to the danger of earthquake given in this health education is by watching movie, short lecture, short interviews, and music and movement activity, as well as real practice on how to get out of the classroom when the earthquake occurs.

Indryasana kindergarten in Babadan, Wedomartani is located in Ngemplak district, the regency of Sleman. Sleman is an earthquake prone area [1][3]. Earthquakes in Sleman can be caused by the tectonic and volcanic activities of Mount Merapi. Mount Merapi is a highly active volcano in Yogyakarta province, located in Sleman regency [11][14]. This activity is conducted as a concern for the kindergarten students that might be the victims of the earthquake. The education process must be interesting, not merely on the teaching but more on playing. The health education given for the children is by watching cartoon about self-rescue on earthquake.

The movie is made by IDEP foundation that focuses on society-based earthquake implementation. The movie tells about a girl in a small village who is buying an emergency bag in case the earthquake occurs. Meanwhile, the earthquake occurs when she is shopping, and eventually, the girl can perform the earthquake self-rescue very well. The movie describes what is inside the bag and what should be done during earthquake like getting out of the building or house, hiding under table, covering head, staying away from glass and trees, turning off the electricity, and not be panicked and crying. The character of the girl in the movie also describes that even a little kid can help adults when the earthquake occurs by telling the self-rescue steps and giving the emergency tools inside the bag. The girl acts as the main character that shows that even children can be strong in dealing with earthquake [22][24].

Another method used in this health education is music and movement activity with the song “Kalau Ada Gempa”. The simulation of the music and movement activity really attracts the kindergarten students and all of them join in singing the song and dancing. The lyrics of the song describes what to do when the earthquake occurs, for example by protecting the head, hiding under table, avoiding glass, and running outside to the open air. The observation results during the health education show that 100% of the participants, including 34 kindergarten students, 3 teachers, and 7 fraters, are enthusiastic in watching the movie about the earthquake and after 3 repetitions, all of them can join to sing “Kalau Ada Gempa” song and dance as well. The observation results also show that 100% of the kindergarten students are able to join the self-rescue simulation activity to find safer place when the earthquake occurs. The students get out of the class orderly when they hear the siren’s sound played by the team to signify that there is an earthquake. There is no student who looks afraid or crying when the simulation is conducted. The self-rescue simulation, getting out of the building when there is an earthquake, can be conducted perfectly after repeating the simulation for 4 times.

Based on the observation results about the indicators of the kindergarten students' ability in answering the questions about how to rescue themselves when the earthquake occurs, it shows that after the activities 23,53% of the students are able to explain that they have to get out of the house when the earthquake occurs, 14,71% of the students are able to explain that they have to hide under the table when the earthquake occurs, 29,42% of the students are able to explain that they must protect their head when there is an earthquake, 38,24% of the students are able to explain that they have to stay away from glass when the earthquake occurs, 17,65% of the students are able to explain that they must stay away from the tress or multi-stories building when the earthquake occurs, 8,83% of the students are able to explain that they have to ask their parents to turn off the electricity to prevent fires, and 35,30% of the students are able to explain that they must not be panicked or cry when the earthquake occurs. Factors influencing someone's knowledge are age and education level [13][16-17]. In the action research conducted by the researcher team, the data about the change of the knowledge is not obtained using specific knowledge measurement instrument, but obtained by conducting observation and direct interview to the participants, who are the kindergarten students. The number of the students who are able to answer the short questions given will be calculated using frequency distribution formula, compared with the total observation, which is all students who participate in the activities. Based on the initial review result, it is obtained that 0,06% of the students are able to explain that earthquake is a shaking ground, or "lindu" in Javanese. Half of the students (50%) are state that they have to leave the house right away when the earthquake occurs. While the rest of the students remain silent and do not know yet what earthquake is and what must be done when it occurs. After conducting health education, watching movie about earthquake, and doing earthquake self-rescue, there are some changes in the observation data of the students' knowledge.

Health education is needed to gain information that supports health so that eventually it can improve the life quality [16-17]. Health education conducted in this community service aims at developing the kindergarten students' independence in case they will experience an earthquake one day. Earthquake is a sudden natural condition and it may cause society concern, material loss, psychological disorder, and even death [7][9]. Therefore, there is a need to have a proper disaster management for the before disaster, during the disaster, and after disaster that aims at developing the preparedness of the society in dealing with the disaster [4-6]. Disaster management can run well without the involvement of the society. Great cooperation among the government, society, and institutions really influence the success of the disaster management [4-6]. Society as the target of the activity management in disaster management needs to be open to accept information and direction given so that the goal of the disaster management can be achieved [12]. The approach used for the society in giving the health education about disaster must also need to pay attention to the local wisdom of the society [13][20]. The interaction must be based on trust so that the health education process does not stop before disaster only, but still continue to the sustainable monitor, and eventually can achieve the target, which is the society preparedness [4-6]. Society must understand that the process of disaster management activities is as a form of protection for them before the disaster occurs, during the disaster, and after the disaster [12][20].

The health education given in the kindergarten is expected to develop the courage of the students when the disaster occurs and when they are not with their family. The health education process done by watching movie is proven to really attract the students' attention. The students look really enthusiastic in paying attention to the situation in the movie. Kindergarten students are at the age when they belong to vulnerable group [21]. This age group needs special attention from the health care provider, in this case nurses. Besides providing clinical service, nurses also have roles to give health education in communities [13][17]. The role of the nurses in health education for the kindergarten students is much needed, in this case about the earthquake self-rescue specifically. Health education given through a movie about earthquake explains that earthquake is a dangerous situation in which children might be separated from their families and they can get hurt, so by having health education they can cope with the emergency situation when the earthquake occurs and they can keep calm just like the character of the girl in the movie visualization [4-6][22].

The result of the process evaluation in this action research shows that 98% of the data belong to good category shown in the achieved several points that are expected or targeted before. The evaluation of the achievement of the service process shows that 100% of the kindergarten students and their associates listen and participate actively in all activities given in the health education, 100% of the kindergarten students and their associates pay attention and listen attentively to the health education by watching the cartoon movie about earthquake self-rescue, and 100% of the kindergarten students and their associates join the music and movement activity about earthquake self-rescue. This music and movement activity can be well-conducted by the participants after 3 times repetition. There are 100% of the students who join enthusiastically the simulation process about earthquake self-rescue for 4 times repetitions. Actually, based on the initial preparation done by the team before, it is expected that the participants can join the music and movement activity and the simulation of the self-rescue with 2 repetitions only. However, due to the megaphone siren problem, which suddenly cannot be used, then the simulation is repeated 4 times. Meanwhile, the music and movement activity is conducted 3 times due to the change of the place setting.

Health education is an activity that is used to provide health information for individuals, groups, and society [16-17]. One of the effective methods in delivering health education that can change an individual's knowledge is by giving lecture 13][16-17]. To deliver health education by doing lecture needs several tools such as power point slide, sound system, leaflet, and many more. The actual health education is one of the nursing intervention strategies that is always conducted in community nursing service [17]. Health education is an activity in giving specific information to expand the knowledge of a person or certain society group, so in its delivery, it must pay attention to the target, not merely on the purpose of the health education itself [23]. The method employed in the health education in this action research is not just giving lecture, but also watching movie, music and movement activity, and doing real practice or simulation of how to do self-rescue when the earthquake occurs. This is because the target in this activity is kindergarten students, in which at that age children are likely to play, so if the method used is only lecture, then the children might be bored, and eventually will lead to the ineffectiveness of the activities.

The data results of this action research are obtained by doing observation in the interview process with the kindergarten students about earthquake self-rescue. Health education proves to be effective and efficient in giving influence to improve the knowledge if the material delivery is given appealingly and pays attention to the education level and the age of the participants [17][23]. These theories are adapted in the activities conducted in the health education. Therefore, in this activity there are 5 methods in delivering the material, which are short lecture, simple interviews, watching cartoon movie, music and movement activity, and simulation/practicing the earthquake self-rescue. The result of the observation in this action research shows that there are changes in the students' knowledge after they are given the health education about the earthquake self-rescue. The initial observation data shows that only 50% of the students who are able to answer how to do self-rescue when the earthquake occurs, which is by getting out of the house. After they are given the health education about earthquake self-rescue, there are changes on the observation data of the kindergarten students, from 50 % to 100% of the students who are able to mention more detailed ways to rescue themselves when the earthquake occurs. This activity also serves as a real action to show that nurses' role can improve the readiness and preparedness of the society in coping with the emergency situation when the earthquake occurs [4-6][22]. Nurses have the responsibilities to breed earthquake-ready and steady generation at early times.

5. Conclusion

a. At the initial examination, 50% of the students are able to explain about self-rescue, which is to get out of the house.
b. In the health education process, 100% of the kindergarten students and their associates listen and participate actively in the activities given.
c. In the health education activities, 100% of the kindergarten students and their associates pay attention and listen attentively to the cartoon movie about the earthquake self-rescue.
d. All of the kindergarten students (100%) and their associates are able to join the music and movement activity about the earthquake self-rescue.
e. All of the kindergarten students (100%) are able to mention the ways to conduct earthquake self-rescue.
f. There are 23,53% of the students who are able to mention that they have to leave the house when there is an earthquake.
g. There are 14,71% of the students who are able to mention that they have to hide under the table when the earthquake occurs.
h. There are 29,42% of the students who are able to mention that they have to protect their head when the earthquake occurs.
i. There are 38,24% of the students who are able to mention that they have to stay away from glass when the earthquake occurs.
j. There are 17,65% of the students who are able to mention that they have to stay away from the tress and multi-stories building when there is an earthquake.
k. There are 8,83% of the students who are able to mention that they have to ask their parents to turn off the electricity to prevent fires.
l. There are 35,30% of the students who are able to mention that they must not be panicked when there is an earthquake.
m. All of the students (100%) join the earthquake self-rescue simulation process enthusiastically with 4 repetitions.

6. Recommendation

The recommendation of this service activity is to serve as a direct information source for the kindergarten students, teachers, fraters, and all levels of society in general. Specifically, the recommendations of the activities are as follows:

a. Kindergarten students are able to apply the result of the health education about the earthquake simulation, so that they become more prepared and ready in dealing with the situation whenever the earthquake occurs.
b. For teachers and fraters: as the procedure references in rescuing the kindergarten students if the earthquake occurs during the learning process
c. For nurses: conducting assistance related to numerous creativity methods in health education of the earthquake simulation for the society

Appendices

Fig 1. Lecture and Interviews about Earthquake

Fig 2. Watching Cartoon Movie about Earthquake

Fig 3. Music and Movement activity with Simulation
"Kalau Ada Gempa" song

Fig 4. Earthquake Self-Rescue

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Peran Gereja dan Sistem Kekerabatan, Budaya dan Kearifan Lokal Dalam Penanganan Pengungsi Korban Erupsi Gunung Sinabung

S. Otniel Ketaren, Ivan Elisabeth Purba

Universitas Sari Mutiara Indonesia-Medan

ABSTRAK

Panjangnya rentang waktu bencana erupsi Gunung Sinabung dimulai bulan Agustus 2010 selama sebulan dan September 2013 hingga saat ini sedikit banyaknya mengubah peri kehidupan warga desa yang terdampak yang berada di sekitar lereng Gunung Sinabung. Pada awal-awal terjadinya erupsi peran tokoh agama terutama GBKP yang mempunyai fasilitas banyak bangunan sebagai tempat pengungsian menjadi dominan. Sistem kekerabatan, budaya dan kearifan lokal menjadi modal utama membantu dalam meringankan penderitaan pengungsi. Penelitian ini bersifat deskriptif kualitatif dengan menggunakan desain studi kasus. Informan terdiri dari tokoh gereja, tokoh adat, dan beberapa warga pengungsi. Tujuan penelitian adalah bagaimana penanganan pengungsi korban bencana ditinjau dari aspek agama kristen, sistem kekerabatan, budaya dan kearifan lokal yang hidup di masyarakat Karo. Hasil penelitian menunjukkan bahwa nilai-nilai agamis dipadu dengan nilai-nilai sistem kekerabatan, budaya dan kearifan lokal sangat membantu meringankan penderitaan warga pengungsian dalam memupuk ketangguhan masyarakat. Lamanya rentang waktu penyelesaian penananganan korban pengungsi berpotensi menimbulkan resistensi dari populasi tuan rumah, dan bahkan konflik horizontal.

Kata kunci : pengungsi, peran agama, sistem kekerabatan, budaya dan kearifan lokal.

LATAR BELAKANG

Pagi subuh sekitar pukul 02.00, Minggu tanggal 15 September 2013 Gunung Sinabung secara tiba tiba memuntahkan abu vulkanik dan batu-batuan kecil yang membangunkan warga sekitar kaki gunung. Seketika semua warga desa bangun, berkumpul dan bersiap-siap mengungsi secara mandiri meninggalkan desanya. Bagi Ginting (52 tahun) warga desa Suka Meriah yang hanya berjarak lebih kurang 2 km dari puncak gunung, segera bergerak menuju Kabanjahe ibukota kabupaten Karo yang berjarak 10 km. Pengalaman warga desa 3 tahun yang lalu, tepatnya Agustus 2010 masih menyisakan kisah traumatis karena Gunung Sinabung yang menjadi kebanggaan warga, memberi kesuburan tanah, persediaan air dan udara yang sejuk, tidak pernah ada cerita tentang bencana, tiba-tiba erupsi selama lebih kurang 1 bulan, dan pada waktu itu tidak ada informasi yang jelas mengapa dan bagaimana menyikapi kejadian tersebut.

Bagi Ginting sebagaimana juga warga desa lain di sekitar kaki gunung, tidak menyangka bahwa kejadian erupsi yang dimulai tanggal 15 September 2013 itu mengubah total peri kehidupan mereka. Desa mereka lenyap sama sekali tertimbun abu vulkanik, rumah, lahan tanam-tanaman dan harta benda lainnya tidak tersisa hingga pada akhirnya mereka direlokasi.

Tidak dari Pemerintah Kabupaten, tidak juga dari khotbah-khotbah di mimbar Gereja atau rumah ibadah lainnya, mengapa Gunung Sinabung yang selama ini memberi kedamaian dan kesejukan tiba-tiba mengamuk seperti “menghukum” semua warga di beberapa desa yang terletak di kaki Gunung Sinabung. Di tengah-tengah kebingungan warga yang mengungsi di pagi hari yang dingin itu, beberapa anak muda dengan kaos berlogo Asigana nampak sibuk berusaha menenangkan dan mengurusi pengungsi yang baru datang dari lokasi bencana dan mengarahkan pengungsi ke beberapa gereja di sekitar Kabanjahe dan Berastagi. Di kompleks Gereja biasanya ada bangunan-bangunan serbaguna yang dapat dipakai untuk menampung pengungsi atau paling tidak ada halaman untuk memasang tenda. Penelitian ini dibuat dengan tujuan bagaimana respons gereja khusunya Gereja Batak Karo Protestan (GBKP) menyangkut nilai-nilai dan prinsip membantu mengurangi penderitaan pengungsi korban erupsi Gunung Sinabung, dan bagaimana nilai- nilai kekerabatan, kearifan lokal masyarakat Karo dalam menanggulangi pengungsi.

METODE PENELITIAN

Penelitian ini dilakukan dengan menggunakan metode deskriptif kualitatif dengan desai studi kasus. Informan adalah tokoh agama Kristen Asigana dan, 4 orang warga pengungsi. Pengumpulan data dilakukan terutama dengan wawancara mendalam dengan informan, observasi dan, dokumentasi.

HASIL PENELITIAN

1. Peran Gereja Dalam Menanggulangi Pengungsi

Di masyarakat Karo, sebagian besar penduduknya beragama Kristen, salah satu gereja yang paling besar yang dikenal sebagai gereja suku adalah Gereja Batak Karo Protestan (GBKP), yang berkantor pusat di Kabanjahe. Sebagai respons GBKP atas peristiwa meletusnya Gunung Sinabung pada Agustus 2010, dibentuk relawan taruna siaga bencana yang disebut dengan Asigana, yang merupakan kependekan dari Anak Singuda Siaga Bencana. Anak Singuda dalam bahasa Karo artinya anak paling bungsu, tapi dalam konteks GBKP adalah Perkumpulan Muda-Mudi Gereja. Pada saat kejadian tanggal 15 September 2013, kebetulan Asigana ini sedang mengadakan kegiatan di Retreat Center Sibolangit, 15 km dari Berastagi. Pada sekitar pukul 02.45 salah satu dari pengurus mendapat telepon dari desa Suka Meriah bahwa terjadi erupsi Gunung Sinabung, dan pada saat itu juga sebanyak 26 orang anggota Asigana langsung menuju lokasi bencana untuk membantu evakuasi mandiri warga. Mereka langsung menghubungi beberapa pendeta dan menyiapkan tenda-tenda, dapur umum, dan menyiapkan makanan pada pagi hari itu. Moderamen (pimpinan pusat) GBKP dengan dikomandoi oleh Pendeta Agustinus Purba, langsung memobilisasi semua bangunan milik GBKP di sekitaran Kabanjahe dan Berastagi untuk dapat menampung pengungsi korban erupsi. Dalam waktu hanya 3 hari saja yakni hingga tanggal 16 September 2013 ada 6000 jiwa lebih pengungsi yang ditampung di bangunan atau tenda yang disiapkan GBKP sekaligus menyediakan logistik yang dibutuhkan. Padahal pada waktu itu Pemerintah Kabupaten belum berbuat apa-apa , status tanggap darurat dan siapa komandan tanggap darurat belum jelas, padahal di lain pihak dalam hitungan jam jumlah pengungsi terus meningkat. Salah satu penyebabnya adalah informasi yang tidak cukup, sehingga warga desa yang tidak terdampak juga ikut mengungsi, karena trauma pengalaman erupsi tahun 2010 yang lalu.

Bagi gereja yang kualitas imannya didasarkan kasih, menolong dan mengurangi penderitaan sesama adalah mutlak. Di dalam Alkitab tertulis “Kasihilah Tuhan Allahmu dengan segenap hatimu dan segenap jiwamu dan segenap akal budimu”, dan kedua, yang sama dengan itu “ *Kasihilah sesamamu manusia seperti dirimu sendiri*” (Matius 22: 37-39). Selanjutnya dalam Kitab Galatia 6 : 2 ditulis. “*Bertolong-tolonganlah menanggung bebanmu! Demikianlah* *kamu memenuhi hukum Kristus*". Sebagaimana umumnya Gereja-gereja suku nilai-nilai kristiani selalu diupayakan berjalan bersama dengan nilai-nilai kekerabatan, budaya dan kearifan lokal yang hidup di tengah- tengah masyarakat. Nilai-nilai kristiani disandingkan dengan nilai-nilai kekerabatan yang hidup di tengah-tengah masyarakat Karo sebenarnya merupakan modal besar untuk meningkatkan kapasitas dalam membentuk masyarakat tangguh bencana. (Fukuyama, 2007).

Beberapa ungkapan Karo yang sejalan dengan prinsip kasih antara lain adalah *aku kap kam, kam kap aku*. Yang secara harfiah artinya aku adalah engkau dan engkau adalah aku. Susahku adalah susahmu, susahmu adalah susahku juga. Ungkapan lain yang berkembang di perkumpulan kaum bapa GBKP yang disebut *Mamre*. *Mamre erdiate, mamre erpemere* yang artinya *mamre* (bapak), *erdiate* (peduli), *erpemere* (membantu). Pada kenyataanya, bahan makanan seperti sayuran-sayuran, cabe, bawang dan lain sebagainya yang merupakan hasil pertanian daerah Karo di drop oleh warga desa lain ke pos-pos pengungsi yang dikelola oleh GBKP.

Makna dan arti gunung dalam Alkitab merupakan pernyataan Allah untuk memperlihatkan kemulian-Nya dan itu diamini oleh warga seluruh GBKP. Di dalam Alkitab terutama di Perjanjian lama, frasa gunung atau bukit sering disebutkan "*Aku melayangkan mataku ke gunung-gunung, darimanakah akan datang pertolonganku. Pertolonganku ialah dari Tuhan yang menjadikan langit dan bumi*" (Mazmur 121:1). GBKP yang dikomandoi oleh Pendeta Agustinus Purba yang menimba ilmu diakonia atau pelayanan di Jerman menerapkan prinsip pemberdayaan masyarakat dalam menangani pengungsi. Pengalaman GBKP yang memberdayakan warga pengungsi untuk mengurus dirinya sendiri termasuk menyiapkan makanan untuk kebutuhan makanan ratusan bahkan ribuan jiwa di sebuah pos pengungsi. Mendapatkan penghargaan dari Pemerintah Pusat/BNPB.

2. Sistem kekerabatan Budaya dan Kearifan Lokal

Dalam kehidupan sehari-hari, masyarakat Karo sangat kental dengan adat istiadat dan budaya yang diikat dalam suatu sistem kekerabatan. Menurut pandangan masyarakat Karo, sebagai manusia harus beradat, menunjukkan bahwa aturan-aturan adat harus dituruti dan dipatuhi. Orang tidak beradat dipandang lebih jelek dibanding yang tidak beragama. (Tarigan, 2014). Hubungan kekerabatan yang disebut dalam *sangkep nggeluh* merupakan sistem kekerabatan budaya Karo dengan semboyan *merga silima, tutur siwaluh, rakut sitelu ras perkade-kaden sepuluh buah tambah sada*. (Sukarna, 2016). Hidup saling menghargai, tolong-menolong, mengutamakan gotong royong, mengutamakan musyarawah untuk mencapai mufakat dalam setiap acara-acara adat yang disebut dengan istilah *runggu*. (Ginting, 2008).

Runggu atau musyawarah mufakat merupakan suatu kebiasaan yang sudah melekat pada kebudayaan Karo baik dalam menyelesaikan pesta adat seperti perkawinan dan kematian maupun membicarakan kegiatan-kegiatan sosial lainnya. Peran dari tokoh adat, dan tokoh agama sangat dominan. Sistem kekerabatan dan budaya saling tolong-menolong ini diwujudkan dalam sikap warga desa yang dengan senang hati menerima desanya untuk tempat pengungsi, bahkan membantu logistik dengan beberapa pos pengungsi dari hasil pertaniannya.

Kearifan lokal atau nilai-nilai tradisional yang terdapat pada budaya orang Karo umumnya dapat di lihat dalam ungkapan atau pepatah adat dan tradisi yang hidup ditengah-tengah masyarakat Karo. Misalnya filosofi *endi-enta,* artinya orang Karo memiliki prinsip memberi terlebih dahalu baru menerima. Filosofi *ngeripe* semangat bergotong royong dalam masyarakat Karo untuk mengatasi kesulitan-kesulitan ekonomi yang dialami oleh salah satu anggota keluarga. Filosofi *aron* adalah bentuk kelompok kerja yang terdiri dari beberapa anggota yang memiliki kemampuan yang berbeda, perbedaan tidak menjadi penghalang bagi mereka untuk bersatu. Perbedaan justru dijadikan sebagai potensi untuk saling melengkapi. Filosofi *purpursage,* mengutamakan orientasi kepada perdamaian, keadilan, keutuhan ciptaan, kesetaraan, pembebasan, semangat berdialog dan sikap memaafkan.

Setiap desa dan dusun di Karo mempunyai bangunan khusus untuk tempat pertemuan yang disebut dengan *jambur*. *Jambur* biasanya dibangun di tengah-tengah desa, umumnya dibangun secara swadana warga desa. *Jambur* dilengkapi dengan peralatan-peralatan tikar, alat masak-memasak dan lain sebagainya dan digunakan oleh warga desa untuk acara acara adat baik itu perkawinan, kematian, dan acara adat lainnya. Begitu pentingnya fungsi sebuah *jambur*, di beberapa desa yang jumlah warganya besar dan diperkotaan. Beberapa *jambur* yang dibangun oleh oleh perseorangan dan disewakan bagi umum. Pada waktu kejadian bencana erupsi Gunung Sinabung, jambur-jambur ini hampir semua dipakai untuk pos pengungsi, disamping bangunan lain baik milik pemerintah baik milik gereja.

Sistem kekerabatan dan sistem kekeluargaan adat-istiadat termasuk adanya ungkapan-ungkapan yang membentuk kesetiakawanan sosial dalam warga Karo sebenarnya merupakan modal utama dalam membentuk masyarakat yang tangguh terhadap ancaman-ancaman termasuk kejadian bencana.

Ketangguhan dalam menghadapi bencana adalah suatu kapasitas sistem, komunikasi atau masyarakat dalam menghadapi ancaman. Sementara itu, suatu kapasitas ditentukan oleh kemampuan suatu sistem sosial dalam mengorganisasi dirinya melalui pembelajaran dari bencana di masa lalu untuk meningkatkan kemampuan dalam mengurangi risiko bencana.

Seseorang atau masyarakat cenderung lebih tangguh terhadap gangguan dari luar, termasuk bencana jika memiliki kekerabatan, ketrampilan, dan kolektivitas tinggi. Satu faktor lain yang tidak kalah penting adalah etnisitas. Kerentanan sosial, menurut Fukuyama (2007), dapat diukur dengan mengakumulasi faktor kekerabatan, keterampilan, etnisitas, dan kolektivitas seseorang atau suatu komunitas. Dalam hal ini, kekerabatan dan keterampilan merupakan faktor internal, sedangkan etnisitas dan kolektivitas sebagai faktor eksternal.

Faktor kekerabatan, keterampilan, etnisitas, dan kolektivitas dianggap ikut menentukan tingkat kemampuan individu dan masyarakat saat menghadapi tekanan. Semakin dekat kekerabatan satu orang dengan orang lain, kekerabatan dimaknai sebagai hubungan antar manusia yang ditandai dengan kesamaan garis keturunan akan semakin tinggi kemampuannya, serta semakin rendah kerentanannya. Sama halnya, semakin tinggi kolektivitas, yakni kebersamaan dan solidaritas dalam masyarakat, semakin baik kapasitasnya saat mengahdapi tekanan.

Satu hal yang menarik adalah kecenderungan pengungsi dari satu desa yang tetap bertahan berkumpul dalam pos pengungsian. Dari pengakuan beberapa warga desa yang penulis wawancarai, keterikatan kekeluargaan yang sudah sangat kuat dalam satu desa membuat mereka maunya tinggal di satu lokasi pos yang mengungsi. Sikap seperti ini pada satu sisi menyulitkan pihak pemerintah dalam upaya penipisan jumlah pengungsi, sesuai kapasitas pos pengungsi walau di lain pihak membantu dalam pendataan pengungsi. Tidak heran pada relokasi tahap pertama di Siosar 3 desa yang direlokasi yakni desa Bekerah, desa Suka Meriah, dan desa Simacem, tetap menggunakan desanya yang lama di lokasi yang baru. Bencana erupsi yang berkepanjangan dan meluasnya areaal dan desa yang harus direlokasi pada tahap kedua dan tahap tiga yang belum sepenuhnya rampung menimbulkan rasa apatis dan kecemburuan sosial di kalangan pengungsi. Beberapa kali ada demonstrasi warga pengungsi ke kantor bupati Karo menuntut kejelasan tentang huntara dan relokasi. Pemilihan relokasi tahap II yang semula ditetapkan di desa Lingga mendapatkan penolakan dari warga desa Lingga, bahkan sempat memakan korban nyawa. Perlu pendekatan sosiologis dengan mengedepankan semangat kebersamaan melibatkan tokoh agama dan tokoh adat. Berlarut-larutnya penyelesaian relokasi pengungsi tahap kedua dan tahap ketiga pada akhirnya juga menimbulkan resistensi dari warga desa (populasi tuan rumah) yang dijadikan lokasi pos pengungsi. Kalau tahap-tapa awal fase tanggap darurat warga sangat welcome dan sangat membantu warga pengungsi akan tetapi tahun-tahun berikutnya ada kecenderungan ‘merasa terganggu’ oleh kehadiran warga pengungsi. Beberapa orangtua yang diwawancarai penulis menyatakan hal tersebut. Perkelahian kecil karena masalah sepele beberapa kali terjadi dan bukan tidak mungkin menimbulkan konflik horizontal.

Solidaritas sosial yang didasari oleh sistem kekerabatan dan semangat gotong royong dalam masyarakat Karo menjadi lebih kental dari desa per desa. Ini berbeda pada kasus korban bencana gempa bumi di Pengalengan, Kabupaten Bandung, dimana solidaritas sosial nampak berlaku terutama di kelompok-kelompok sosial yang kecil seperti di tenda pengungsian (Maarif, 2016).

KESIMPULAN DAN SARAN

Dari uraian diatas dapat penulis menyimpulakn hal-hal sebagai berikut :

1. Kejadian bencana Gunung Sinabung Agustus tahun 2010 menyadarkan pucuk pimpinan GBKP, perlunya membentuk muda-mudi yang disebut Asigana. Erupsi pada 15 September 2013 Asigana langsung turun pertama untuk membantu pengungsi. Membantu meringankan penderitaan pengungsi adalah panggilan iman kristiani yang diwujudkan oleh GBKP secara totalitas.
2. Nilai-nilai agamis dipadu dengan sistem kekerabatan dan kearifan lokal memupuk ketangguhan masyarakat dan bangkit dari keterpurukan.
3. Model pemberdayaan masyarakat pengungsi dalam mengurus dirinya sendiri di pos-pos pengungsian yang diterapkan oleh GBKP berdampak positif dalam mengurangi penderitaan sekaligus memupuk kebersamaan sesuai dengan nilai-nilai dan budaya kearifan lokal masyarakat Karo.

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Membangun Ketahanan (Resiliensi) Bencana Pada Kawasan Pariwisata (Studi Kasus: Kabupaten Pandeglang Pasca Tsunami Selat Sunda 2018)

Osmar Shalih[1], Mangapul P Tambunan[2], dan Rudy P Tambunan[3]
[1,2] Departemen Geografi, Universitas Indonesia, Depok Jawa Barat
[3] Sekolah Ilmu Lingkungan, Universitas Indonesia, Salemba, Jakarta Pusat DKI Jakarta

e-mail: osmar.shalih81@ui.ac.id[1], mangapul.parlindungan@ui.ac.id[2], rudy.tambunan@ui.ac.id[3]

Pendahuluan

Secara geografis, Indonesia terletak pada pertemuan 3 (tiga) lempeng tektonik besar, yaitu lempeng Indo-Australia, Eurasia dan lempeng Pasifik. Ketiga lempeng tersebut saling bertumbukan setiap saat dapat menimbulkan gempa bumi yang dapat diikuti bencana turunannya, yaitu bencana tsunami [1]. Pada hakikatnya, secara geografis, Indonesia rentan terhadap gempa bumi, tsunami, letusan gunungapi, dan jenis-jenis bencana geologi lain. Rangkaian bencana pada tahun 2018 seperti Gempa Bumi NTB (2018), Gempa Bumi, Tsunami dan Likuifaksi Sulawesi Tengah (2018), serta Tsunami Selat Sunda (2018) menyadarkan kita belum siap dan tahan (resiliensi) terhadap dampak bencana geologi pada skala masif tersebut.

Berdasarkan data BNPB (2013), Kabupaten Pandeglang memiliki indeks risiko bencana Indonesia (IRBI) termasuk klasifikasi tinggi [2]. Kejadian bencana Tsunami Selat Sunda bulan Desember 2018 memperkuat bahwa wilayah tersebut berisiko tinggi terhadap ancaman bencana tsunami. Fakta sejarah menunjukan, di Selat Sunda telah berkali-kali terjadi bencana tsunami yang tercatat dalam katalog tsunami. Tsunami yang terjadi ini disebabkan oleh beberapa fenomena geologi, di antaranya erupsi gunung api bawah laut Krakatau yang terjadi tahun 416, 1883, dan 1928; gempa bumi pada tahun 1722, 1852, dan 1958. Penyebab lainnya yang diduga kegagalan lahan berupa longsoran baik di kawasan pantai maupun di dasar laut pada tahun 1851, 1883, dan 1889 [3].

Pembangunan pariwisata khususnya di wilayah pesisir yang masif di Kabupaten Pandeglang tanpa diiringi mitigasi bencana tsunami, menjadikan sektor tersebut paling parah dampaknya pada saat kejadian Tsunami Selat Sunda Desember 2018. Kerusakan dan kerugian masing-masing berjumlah sebesar Rp. 16.425.350.000,- (kerusakan) dan Rp. 63.669.600.000,- (kerugian). Total kerusakan dan kerugian mencapai Rp. 80.094.950.000,-. Pariwisata merupakan sektor terdampak paling parah dibandingkan sektor pembangunan lainnya [4].

Wilayah tersebut juga rentan secara fisik dikarenakan kondisi morfologi pantai yang landai dan relatif pulau-pulau kecil di pesisir pantai tidak banyak sebagai *barrier* ancaman tsunami. Kawasan pariwisata relatif banyak tersebar di pesisir barat Kabupaten Pandeglang (seperti Pantai Carita, Tanjung Lesung, Panimbang dan sebagainya). Dari segi karakteristik bencana, tsunami termasuk tipe *sudden onset* yang artinya sangat membutuhkan kesiapan masyarakat dalam menghadapi bencana selain sistem peringatan dini yang efektif. Berbagai upaya-upaya meningkatkan ketahanan masyarakat baik sebelum (pra) dan pasca kejadian bencana tsunami tahun 2018 tersebut telah banyak dilakukan, seperti pengkajian dan pemetaan risiko bencana, pelatihan, sosialisasi dalam rangka pengurangan risiko bencana dan peningkatan kapasitas masyarakat yang pada akhirnya untuk meningkatkan resiliensi masyarakat terhadap ancaman dan risiko bencana tsunami. Secara konseptual, karakteristik mayarakat tahan bencana (*community resilience*) terdiri dari 3 (tiga) hal, yaitu: (1) kapasitas komunitas untuk mengurangi risiko atau kerusakan melalui mitigasi dan adaptasi; (2) kapasitas untuk mempertahankan fungsi-fungsi dasar dan struktur di dalam keadaan bencana, dan (3) kapasitas untuk memulihkan diri dari pasca kejadian bencana [5-7].

Dikaitkan dengan kondisi diatas, Kabupaten Pandeglang idealnya memiliki tingkat ketahanan (resiliensi) bencana yang baik dengan pertimbangan bahwa tingginya tingkat ancaman dan risiko bencana tsunami di wilayah tersebut dan upaya-upaya pengurangan risiko bencana telah diupayakan, serta pesatnya perkembangan sektor pariwisata di kawasan pesisir di wilayah tersebut. Oleh karenanya, perlu dibangun suatu sistem yang komprehensif dan *holistic* mengenai ketahanan (resiliensi) bencana pada kawasan pariwisata di Pandeglang.

Metodologi

Studi ini menggunakan metode kualitatif. Penelitian kualitatif digunakan untuk mengeksplorasi dan memperdalam suatu fenomena sosial-lingkungan yang tidak dapat digali secara kuantifikasi. Metode penelitian kualitatif ini lebih menfokuskan dalam pencarian data informasi dari informan langsung untuk memverifikasi hasil kajian pustaka (*desk study*).

Dalam peneltian ini dilakukan analisis terhadap bentuk ketahanan (resiliensi) sektor pariwisata di Kabupaten Pandeglang pasca kejadian Tsunami Selat Sunda tahun 2018. Data didapat melalui kajian pustaka terhadap karya ilmiah yang telah dipublikasikan seperti buku atau dokumen kajian, laporan penelitian, dan makalah.

Hasil kajian pustaka ditriangulasi dengan hasil wawancara terhadap stakeholder terkait, seperti Dinas Pariwisata Kabupaten Pandeglang, Badan Perencanaan Pembangunan Daerah (Bappeda) Kabupaten Pandeglang, Badan Pengelola Bencana Daerah (BPBD) Kabupaten Pandeglang, dan pelaku pariwisata. Wawancara dilakukan secara mendalam (*indepth interview*) menggunakan panduan pertanyaan dengan dasar pemikiran untuk menggali informasi secara mendalam dan menyeluruh terhadap informan atau narasumber yang dipilih tanpa dibatasi jawaban yang sudah ditentukan.

Penulis juga melakukan observasi partisipasi yaitu pengumpulan data melalui pengamatan secara langsung, merasakan serta berada dalam aktivitas pengamatan dan kehidupan objek pengamatan [8].

Membangun Ketahanan (Resiliensi) Bencana Tsunami pada Kawasan Pariwisata Pandeglang

Sektor pariwisata dapat menggerakkan ekonomi dan memberdayakan masyarakat di suatu wilayah. Pemerintah Indonesia termasuk Pemerintah Daerah Kabupaten Pandeglang telah mengakui potensi kemajuan ekonomi yang dapat dilakukan oleh industri pariwisata. Namun, demikian bagaimana membangun industri maupun kawasan pariwisata yang tangguh? Tentu diperlukan langkah-langkah yang komprehensif khususnya pada wilayah yang rawan bencana tsunami seperti di wilayah pesisir Kabupaten Pandeglang dengan mitigasi struktural dan non struktural serta meningkatkan ketahanan (resiliensi) bencana. Dengan membangun ketahanan (resiliensi) bencana, kedepan diharapkan jika terjadi bencana tsunami yang berulang seperti catatan sejarah Tsunami Selat Sunda [3], maka dampak bencana baik korban jiwa maupun kerusakan dan kerugian sektor pariwisata dapat diturunkan bahkan dihilangkan.

Pasca tsunami Selat Sunda yang terjadi pada tanggal 22 Desember 2018 mengakibatkan sektor pariwisata di Kabupaten Pandeglang lumpuh. Di wilayah sepanjang pesisir pantai barat

Pandeglang, mayoritas wisatawan yang sedang berlibur di penginapan di sekitar Pantai Carita dan Tanjung Lesung menjadi korban jiwa. Tsunami tersebut juga menyebabkan rusaknya bangunan hotel, villa, resort, pondok, homestay, penginapan dan objek pariwisata lainnya. Lebih jauh, berdasarkan informasi Pemerintah Daerah Pandeglang sampai dengan saat ini, beberapa objek pariwisata seperti kawasan pariwisata Pulau Umang Pandeglang juga belum bangkit kembali. Secara konseptual, terdapat beberapa faktor yang mempengaruhi ketahanan (resiliensi) bencana yaitu *post-disaster planning* (perencanaan pemulihan pascabencana) yang baik, pengembangan program pengurangan risiko bencana, adaptasi, dan akses terhadap modal sosial [9-10,12].

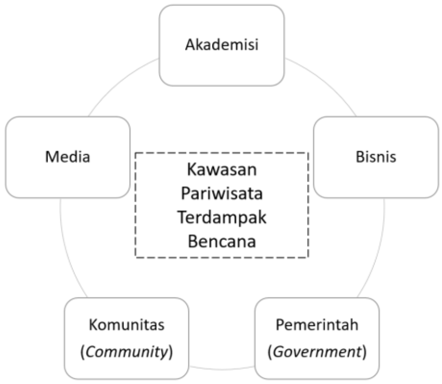
Langkah awal untuk membangun ketahanan (resiliensi) bencana tsunami pada kawasan pariwisata di Pandeglang adalah mengidentifikasi karakteristik ancaman, kerentanan dan risiko bencana Tsunami. Karakteristik meliputi sejarah kejadian tsunami, *trigger* tsunami, wilayah terdampak, serta upaya adaptasi dan mitigasi yang telah dilakukan. Berdasarakan data dan informasi, saat ini Pemerintah dan Pemerintah Daerah sedang melakukan upaya memetakan kembali zonasi ancaman tsunami di Kabupaten Pandeglang. Hasil pemetaan tersebut, dapat dijadikan dasar dalam pengelolaan pariwisata berkelanjutan. Kajian tersebut juga harus dijadikan dasar review rencana tata ruang wilayah Kabupaten Pandeglang (saat ini sudah ada Peraturan Daerah nomor 3 tahun 2011 tentang RTRW Kabupaten Pandeglang 2011-2031) [11]. Dari segi ancaman, Tsunami relatif jarang terjadi dibandingkan bencana lainnya, namun apabila terjadi maka memberikan dampak yang luar biasa dari segi korban jiwa, kerusakan dan kerugian berbagai sektor. Oleh karena bencana tsunami relatif jarang terjadi, maka perlu dibangun tanda atau simbol secara spasial misalnya dalam bentuk monumen peringatan di wilayah terdampak tsunami serta masyarakat diajarkan secara turun menurun cerita maupun literasi mengenai tsunami di wilayah terdampak tersebut. Hal ini penting untuk membangun kesadaran spasial dan budaya sadar bencana [12-13].

Langkah selanjutnya adalah membangun informasi dan sistem peringatan dini. Pencegahan bencana seperti pemantauan melalui sistem peringatan dini, latihan atau gladi ketahanan sangat penting untuk dibangun dan dikembangkan [14-16]. Kondisi saat ini sistem peringatan dini untuk Tsunami Selat Sunda yang dimiliki Pemerintah yaitu sensor seismograf BMKG di Cigeulis Pandeglang (CGJ) dan beberapa sensor di wilayah Banten serta Lampung. Sistem bencana tsunami tersebut terbatas pada sistem operasi otomatis yang berasal dari sinyal gempa bumi tektonik. Sementara Tsuanami Selat Sunda 22 Desember 2018 dianalisa para ahli disebabkan longsoran Gunung Anak Krakatau. Kedepan, perlu dibangun sistem peringatan dini terintegrasi tidak terbatas tsunami yang disebabkan aktivitas tektonik, tetapi juga aktivitas vulkanik mengingat pembelajaran peristiwa Tsunami Selat Sunda 22 Desember 2018. Lebih jauh, perlu dibangun juga sistem peringatan dini berbasis *multi hazard*. Pengelolaan informasi dan diseminasi kesiapsiagaan secara menyeluruh tidak kalah pentingnya dilakukan kepada masyarakat sekitar dan wisatawan dalam rangka mengurangi risiko akibat bencana [15-17].

Peran Pemerintah dan Pemerintah Daerah juga sangat besar dalam membangun ketahanan (resiliensi) pada tahap pascabencana [9-10,12]. Pemerintah Kabupaten Pandeglang didampingi oleh BNPB telah menyusun Rencana Rehabilitasi dan Rekonstruksi. Rencana tersebut disusun secara komprehensif dimulai dari kajian kebutuhan pascabencana (kerusakan, kerugian, dan kebutuhan) untuk seluruh sektor (permukiman, infrastruktur, sosial, ekonomi, dan lintas sektor). Rencana rehabilitasi dan rekonstruksi pasca tunami selat sunda tersebut harus dapat dipadukan dengan masterplan plan pengembangan pariwisata pandeglang berbasis mitigasi bencana.

Kolaborasi dan sinergitas menjadi kunci dalam mengimplementasikan rencana rehabilitasi dan rekonstruksi [18-19]. Model *pentahelix* yaitu unsur Akademisi, Bisnis, Komunitas, Pemerintah, dan Media harus saling mendukung untuk membangun iklim pariwisata di Pandeglang yang kondusif pasca tsunami selat Sunda. Peran akademisi antara lain membuat kajian wilayah-wilayah dengan ancaman dan risiko tsunami di wilayah pesisir Pandeglang, menyusun peta jalur evakuasi, *modelling* sistem peringatan dini dan sebagainya.

Unsur bisnis dalam mengelola objek wisata yaitu memastikan bahwa lokasi tersebut aman dari ancaman tsunami, misalnya didalam hotel memastikan adanya jalur evakuasi dan titik



Gambar. 1. Model *Pentahelix* Dalam Membangun Ketahanan (Resiliensi) Bencana Tsunami pada Kawasan Pariwisata Pandeglang

kumpul yang aman, sistem peringatan dini di lokasi wisata berjalan dengan baik, promosi pariwisata aman bencana, dan sebagainya. Unsur bisnis juga harus memulai untuk menggunakan konsep *transfer risk* seperti model asuransi bencana. Seluruh komponen pariwisata (daya tarik/daerah tujuan wisata, akomodasi, fasilitas penunjang) harus dimitigasi dari ancaman bencana alam seperti tsunami. Peran komunitas salah satunya menjadi katalisator untuk diseminasi gerakan mitigasi strukutral dan non struktural seperti menanam pohon mangrove maupun vegetasi pantai lainnya di pesisir pantai Pandeglang, sosialisasi dan pelatihan kesiapsiagaan pada skala komunitas. Kemandirian dan ketahanan komunitas merupakan salah satu indikator utama ketahanan suatu wilayah terhadap ancaman bencana [13].

Peran Pemerintah dan Pemerintah Daerah harus menjadi *bridging* dan akselerator dengan fasilitasi percepatan pelaksanaan rehabilitasi dan rekonstruksi sektor infrastruktur, ekonomi, sosial yang menunjang dalam pemulihan sektor pariwisata [9-10,12]. Pemerintah dalam hal ini juga harus berhati-hati menetapkan status kedaruratan bencana. Sektor pariwisata merupakan salah satu sektor yang paling sensitif terhadap status darurat bencana. Pembelajaran penetapan status darurat pada erupsi Gunung Agung Bali (2017), Pemerintah Provinsi Bali sangat hati-hati dalam menetapkan status darurat dikarenakan dampaknya sangat signifikan terhadap penurunan jumlah wisatawan domestik maupun asing. Peran pemerintah lainnya adalah melakukan pengendalian tata ruang. Terjadinya bencana pada kawasan pariwisata pada umumnya dikarenakan tidak memperhatikan daya dukung dan daya tampung wilayah sehingga berisiko tinggi terhadap bencana. Pemerintah harus hadir untuk melindungi segenap masyarakat setempat dan juga para wisatawan yang berkunjung ke daerah tujuan wisata.

Peran media juga tidak kalah penting dalam membangun ketahanan (resiliensi) bencana. Media berperan untuk mempromosikan bahwa Pandeglang telah pulih dan bangkit kembali dari Tsunami Selat Sunda 2018. Media juga berperan untuk media sosialisasi bagaimana kesiapsiagaan terhadap ancaman tsunami untuk membangun ketahanan terhadap ancaman bencana [20-21].

Kesimpulan

Kemandirian dan ketahanan komunitas merupakan salah satu indikator utama ketahanan suatu wilayah terhadap ancaman bencana. Dalam konteks manajemen pariwisata berkelanjutan, maka ketahanan bencana merupakan salah satu kunci utamanya. Model *pentahelix* dapat menjadi salah satu model kolaborasi dalam hal membangun ketahanan bencana pada skala komunitas.

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Management of Industrial Disaster Emergency Response in the Chemical Industry in Cilegon City

1.1.2.
1.1.3. **Arief Bagus Arjuna[1], Mirajiani[2] , Sawarni Hasibuan[3]**

[1] Industrial Engineering Study Program, Postgraduate Faculty
University of Mercubuana
[2].Center for Environmental Research and Disaster Mitigation, Institue for Research and Community Service, Faculty of Agriculture, University of Sultan Ageng Tirtayasa
[3] Master of Industrial Engineering Study Program
University of Mercubuana

e-mail: [1] arief.arjuna69@gmail.com, mirajiani@yahoo.com [2],
sawarni02@gmail.com [3]

Abstract.

Emergency response management in industries that have the risk of industrial disasters is one of the important points in industrial disaster management. Emergency response management is also closely related to the protection and work safety of workers. This paper presents emergency response management for industrial disasters, especially in the Chemical Industry. With the management of emergency response, the preparedness of the Emergency Response Team and equipment owned by the industries and the existence of the local government are very important in order to overcome industrial disasters. The study used the Qualitative Descriptive approach. Observation research techniques were carried out in the industrial area both zone/area 1, zone/area 2 and zone/area 3. Depth interviews were conducted with industry professionals / experts and Focus Group Discussion (FGD) involving community entities and local governments. In Cilegon, in carrying out emergency response handling, the industries in this region are divided into 3 zones / areas where companies in the zone are formed Emergency Response Teams. The purpose of zoning is to facilitate coordination and communication during industrial disaster management. This zoning distribution based on industrial location includes (1) zone 1 called Ciwandan Emergency Response Team/CERT, (2) zone 2 called Krakatau Emergency Response Team/KERT, zone 3 called Merak Industrial Emergency Response Team/MIERT. In the emergency response management system, several important things were found, among others: (1) hazard identification and risk assessment to reduce the occurrence of industrial disasters, (2) human resources that are competent in the fields of fire, explosion and spill (3) emergency response equipment fire, spill equipment and medical equipment, (4) collaboration between human resources and emergency response equipment must be carried out function tests and simulations / exercises

Keywords: Emergency response, disaster, chemical industry

Preliminary

Emergency response management in industries that have the risk of industrial disasters is one of the important points in industrial disaster management. Emergency response management is also closely related to the protection and work safety of workers. In essence, every workforce has the right to receive protection for his safety in carrying out work for welfare, increasing national production and productivity, and ensuring that his other people are at work. This is explained in Law No. 1 of 1970 concerning Occupational Safety. In detail explained in the Minister of Manpower Decree No. 186 of 1999 concerning Fire Prevention in the Workplace and Minister of Manpower Decree No. 187 of 1999 concerning Control of Hazardous Chemicals in the Workplace and Law No. 24 of 2007 concerning Disaster Management.

In general, potential hazards in the chemical industry that can cause industrial disasters include (1) the chemical industry uses and stores flammable, toxic, irritant, explosive, radioactive, corrosive, oxidizer, (2) loading & unloading hazardous chemicals in ports / terminal / jetty, (3) transfer of hazardous chemicals in the underground pipe between factories, (4) underground LNG pipes adjacent to the highway, (5) sudden power outages/blackout electricity. Other problems related to emergency response management which often lead to work incidents or accidents include inadequate emergency response equipment owned by the company, inadequate human resource competencies, yet integrated emergency response procedures between industries have not been made, detailed mapping of the determination of dangerous area / restricted area, government regulations are still weak and there is no law enforcement, public awareness about industrial disasters is still weak.

Of the several potential hazards mentioned above, the potential for fires is the biggest trigger of industrial disasters. This can occur in the storage process of combustible chemicals, production processes, reaction processes in reactors, refilling combustible chemicals from storage tanks to tank trucks at loading stations, the process of dismantling flammable chemicals from ships to storage tanks, flammable material storage in the warehouse. In addition there are potential dangers of leakage and spillage of chemicals that can occur during the dismantling of chemicals from ships to storage tanks, filling chemicals from storage tanks to trucks at loading stations, transfer of chemicals between one factory to another factory.

In general, the definition of an emergency is an event or situation that is abnormal and occurs suddenly, disrupting process activities that can result in accidents to humans, equipment and the environment. In defining emergencies that can lead to industrial disasters are divided into several types, namely fire, explosion, chemical leakage, chemical spills on land and sea, riots, earthquakes and tsunamis. Therefore, in operations and production in the chemical industry it is very important to provide emergency response procedures, competent resources and emergency response equipment in the context of chemical industry preparedness in overcome industrial disasters.

According to Law No. 24 of 2007, disaster emergency response is a series of activities carried out immediately in the event of a disaster to deal with adverse impacts, which include rescue and evacuation of victims, property, fulfillment of basic needs, protection, management of refugees, rescue, and restoration of infrastructure and means. In emergency response procedures are classified into 3 (three) levels, namely level 1 is an emergency condition that can be addressed by the internal company. Definition of level 2 is an emergency condition that can be addressed by the internal company and requires assistance from a neighboring company or industrial estate. Definition of level 3 is an emergency condition that can be addressed by the internal company and requires assistance from a neighboring company and requires assistance from the local / provincial / national government.

In Cilegon City, in carrying out emergency response handling, the industries in this region are divided into 3 zones / areas where companies in the zone are formed Emergency Response Teams. The purpose of zoning is to facilitate coordination and communication during industrial disaster management both from aspects of human resources and equipment. This zoning distribution based on industrial locations includes (1) zone 1 is an industry in the Ciwandan area with the name Ciwandan Emergency Response Team/CERT, (2) zone 2 is an industry located in the Krakatau Industrial Estate under the name Krakatau Emergency

Response Team/KERT, zone 3 is an industry in the Merak area under the name Merak Industrial Emergency Response Team/MIERT.

Research Methodology

The study used the Qualitative Descriptive approach. Observation research techniques were carried out in the industrial area both zone 1, zone 2 and zone 3. Depth interviews were conducted with industry experts & Focus Group Discussion involving community entities and local governments.

Result and Discussion

Industrial Disaster Emergency Management in the Chemical Industry

Industrial disaster emergency response management in Cilegon City recommends that all chemical industries that have medium and large potential hazards must ensure the availability of competent human resources and emergency response equipment aimed at tackling industrial disasters quickly, precisely, systematically and safely.

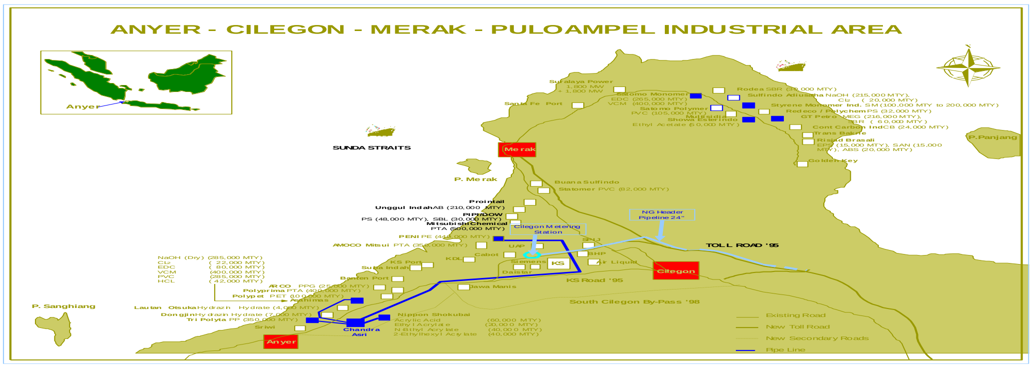


Figure 1. Map of Industry in Cilegon City
Source: Sutrisna, 2018

Based on the allocation of zones / industrial areas created by the government of the Cilegon City, it is very helpful for mapping human resources and emergency response equipment. Below is the division of zones / industrial areas in Cilegon City.

TABLE 1. DATA DISTRIBUTION OF INDUSTRIAL ZONE/AREA IN CILEGON CITY 2018

Name of company / type of industry		
Zone/Area 1	**Zone/Area 2**	**Zone/Area 3**
PT. Chandra Asri/Chemical	PT. Petrojaya Boral/Gypsun	PT. Mega Prima/Chemical
PT. Asahimas Subentra/Chemical	PT. KIEC/Industrial Management	PT. Mitsubishi/Chemical
PT. Nippon Shokubai/Chemical	PT. Archoma/Chemical	PT. Pertamina Tj Sekong/LPG
PT. Lautan Otsuka/Chemical	PT. Rohm & Haas/Chemical	PT. Pertamina Tj Gerem/Premium
PT. Indorama/Chemical	PT. Molycop/Steel	PT. Tridomain/Chemical
PT. Dongjin/Chemical	PT. Krakatau Steel/Steel	PT. Trinseo Materials/Chemical
	PT. Krakatau Poco/Steel	PT. Dover Chemical/Chemical
	PT. Cabot/Chemical	PT. Bumimerak Terminal/Chemical
	PT. Bluscope/Steel	PT. Vopak Terminal/Chemical
	PT. Cheetham Garam/Salt	PT. Air Product/Gas of Industry
	PT. Nusaraya Putra/Oil	PT. BP Petrochemicals/Chemical
	PT. Krakatau Nippon/Steel	PT. Castrol/Base Oil
	PT. Multi Fabrindo/Fabricator	PT. Lotte Titan/Chemical
	PT. Krakatau Berca/Galvanizing	PT. Unggul Indah/Chemical
	PT. Krakatau Osaka/Steel	PT. Mitsubishi PET/Chemical
	PT. Daekyung/Fabricator	PT. Tomindo Bulk/Chemical
		PT. Statomer/Chemical
		PT. PT. Orbit Terminal/HSD Fuel

Source: Emergency Response Presentation Material, Arjuna, 2018

Based on the zone table above, there are still several companies that are in the process of merging in their respective zones according to the study of the Cilegon City.

In operations in the chemical industry, it requires every industry to provide competent personnels such as chemical safety experts, fire safety experts, chemical officers, class B fire coordinators, class C fire officers, class D fire workers, first aiders, evacuation officer, rescue officer, spill handling officer.

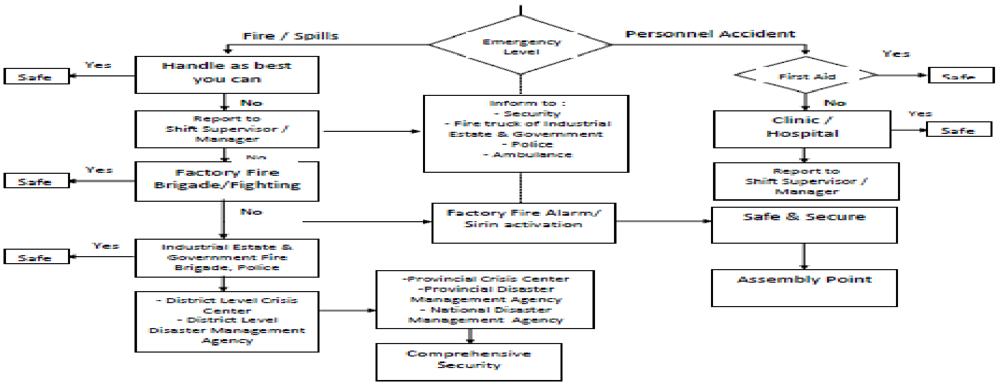
In addition, emergency equipments and personal protective equipment are needed in overcome industrial disasters including fire engines, hydrant/sprinkler/foam installation systems, fire alarm systems, self contained breathing apparatus, fire suit, chemical suit, oil boom, absorbent, full face mask, strecher, ambulance and spill kits.

In managing industrial disasters, each chemical industry must have an Emergency Response Plan to facilitate the implementation of emergency response, including (1) procedures / flowchart, (2) organizations, (3) tasks and responsibilities, (4) requests for assistance to neighboring industries and the government, (5) actions when a fire, (6) actions when leaks and spills, (7) locations of fire equipment, spill equipment and medical equipment, (8) equipment for emergency control room, (9) emergency address and telephone number, (10) list of emergency equipment.

Emergency Coordination and Communication System

An emergency can turn into a disaster if it is not quickly and precisely according to the emergency flowchart. As a result, if it is not dealt with quickly and precisely, it will cause a greater death toll, greater damage to buildings and equipment, greater environmental pollution.

EMERGENCY CONDITIONS



Gambar 2. Emergency Coordination and Communication System in the Chemical Industry
Source : Arjuna, 2018

Emergency Response Organizational Structure

In implementing emergency response, an organization is needed in accordance with the capacity of the chemical industry. This is to facilitate the handling of industrial disasters according to the duties and obligations of emergency response organizations. In general, the emergency response organizational structure owned by the chemical industry is as below

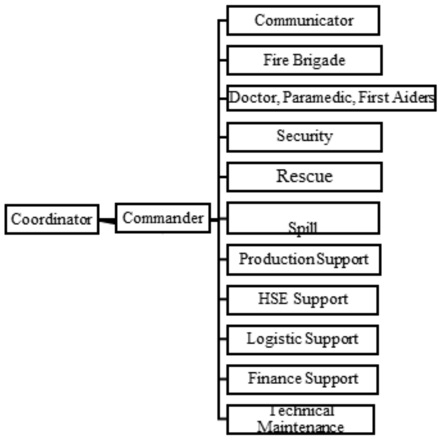


Figure 3. Emergency Response Organization Structure
Source : Draft of Implementation Guidelines for the Ministry of Industry, 2018

Tasks and Responsible of Emergency Response Teams

TABLE 2. TASKS AND RESPONSIBLE OF EMERGENCY RESPONSE TEAMS

Job Tittle	Task & Responsible
Coordinator (Director Level)	Coordinator is responsible for implementing emergency response and coordinates emergency management operations
Commander (Manager Level)	Commander is responsible to the coordinator and leads in overcoming industrial disasters
Emergency Communicator (Manager Level)	Provides an explanation of emergency events inside and outside the company; Deliver information to reporters & the community based on input from the Technical team; Request assistance from outside parties to help outages; Inform families involved in blackouts
Fire Brigade (Supervisor Level)	Execute outages as early as possible so that fires do not spread so buildings, contents, and residents avoid larger disasters; Report & follow instructions from Fire Commander
Doctor, Paramedic & First Aiders	Check and treat if there are employees who are lightly injured; Bringing the victim to the hospital if more serious treatment is needed
Security (Chief)	Regulates vehicle traffic; Close and open the gate and the access door comes out according to circumstances; As a filter that must prevent outsiders from entering the factory location during an emergency condition.
Rescue (Manager Level)	Order and guide the whole room well employees / guests are asked to leave the place to the assembly point; Look for residents or anyone who at the time of the fire is on the floor, especially in closed spaces and notify them to immediately save themselves; Calculating and evaluating the number of victims (injuries, fainting, and death).
Spill (Supervisor Level)	Carry out leak handling as early as possible so as not to expand; Following instructions from an emergency service; Handle spill and clean the incident area
Logistic Support (Manager Level)	Providing facilities needed by all implementers in the field and affected parties such as: Food, beverages and other needed equipment.
Technical Maintenance (Manager Level)	Helps in the readiness of emergency equipment; Perform technical actions in the field such as Technical service and Utility..

Emergency Assistance Request

In accordance with the classification of the level of handling of emergencies that can be an industrial disaster, it is divided into 3 (three) levels, namely level 1 (internal company), level 2 (neighboring company) and level 3 (goverment). So that in handling industrial disasters it is adjusted to the incident level by receiving instructions from Incident Commander such as (1) request assistance from the nearest industry or industrial estate, (2) goverment of local / provincial / national

Actions When Fire Occurs

In handling industrial emergencies / disasters caused by fire, the emergency response team follows emergency response procedures and systems, both at levels 1, 2 and 3 as below:

- Extinguish the fire by using the Fire Extinguisher closest to the location according to its type, for example the type of foam, powder dry chemical, carbon dioxide.

Press the fire alarm button and report fire to Supervisor or Manager by radio/Handy Talky. If the fire extinguisher is not extinguished, then prepare the fire team to extinguish it using fire hydrant, sprinkler, foam and fire monitors. The fire team uses firefighting clothes to protect the body. Announce through paging so that all employees, contractors and guests evacuate to the assembly point. If the fire is enlarged and cannot be overcome, then the Incident Commander instructs an emergency shutdown (level 1 category). Incident Commander instructs Emergency Communicator to request assistance from neighboring companies or industrial estates. Neighboring company fire team must report to the Incident Commander before helping to extinguish a fires. Incident Commander provides briefings to neighboring companies fire team / industrial estate companies in other zones that assist and work with local company emergency response teams (level 2 category)

- If fires are getting bigger and cannot be overcome by local companies and neighboring companies, the Incident Commander instructs to Emergency Communicator to request assistance from the local government (level 3 category)
- Incident Commander reports fire and countermeasures to the Coordinator of ERT (Factory Director). If a fire can be overcome, the Incident Commander instructs the Chief Fire Brigade to inspect all areas to ensure that there are no fires and coals that can cause a fire
- Chief Fire Brigade reports to Incident Commander that all areas have been declared safe
- Incident Commander instructs to the Chief Security to announce to all employees, contractors and guests through pagging that the emergency conditions / industrial disaster was declared safe and could return to their respective work locations.
- Incident Commander instructs to the Emergency Communicator to provide press releases to affected community members, the government and journalists. Incident Commander reports back to the Coordinator of ERT that the fire can be overcome.

Actions When Leaks and Spills Occur

In handling industrial emergencies / disasters caused by leaks and spills, the emergency response team follows procedures and communication systems for emergency, both at levels 1, 2 and 3 as below:

- Use PPE (rubber gloves, full face mask / half mask cartridge, safety rubber shoes, safety glasses, safety goggles, chemical suit). Close the source of the leak and localize the scene using the barricade / safety line. Give the sawdust / lime / sand on spilled chemicals
- If there is a slight spill and flows into the public sewer, immediately close the valve that flows into the public / community sewer or flows into the sea. If the spill is large and has a large impact, then press the fire alarm. Employees, contractors and guests hear the sound of sirens to evacuate to the assembly point. Attention to the wind direction by looking at the windsock direction and check the concentration of chemical gases around the affected area using a portable gas detector. All hot work classification is immediately stopped, for example welding, grinding, cutting. If conditions have been controlled, immediately collect spilled chemicals and absorbents into plastic / containers and labeled as hazardous waste. Collect ex. chemicals and absorbents to the Waste Temporary Storage. Record data of hazardous waste. Incident Commander reports to the Coordinator of ERT (Factory Director)
- If spills and leaks cannot be overcome, the Incident Commander instructs to emergency shutdown (level 1 category). If the spill and leak are enlarged and cannot be overcome, then the Incident Commander instructs to the Emergency Communicator to request assistance from a neighboring company or industrial

estate (level 2 category). If spills and leaks get bigger and cannot be overcome, then the Incident Commander instructs to request assistance from the local government (level 3 category)

- Incident Commander reports back to the Coordinator of ERT (Factory Director) that the leaks and spills can be overcome.

Conclusions

1. Hazard identification and risk assessment will reduce the occurrence of industrial disasters
2. Competent personnels in fire & spillage will be faster in managing of industrial disasters
3. Fire, spill and medical equipment are very important in emergency conditions & disasters
4. Conduct simulations / training of emergency conditions & industrial disasters

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Common Emergency Situation Picture Development for Disaster Relief Operations

Sri Sundari[1], Stefanus G. Wardhana[2], Jazmi A. Bohari[1], and Emanuel A. Bimo[2]

[1] Indonesia Defense University, Sentul, Bogor, Indonesia
[2] IDEFCON – Indonesia Defense Consulting, Gambir, Jakarta, Indonesia

E-mail: stefanusgwar@gmail.com, law.jazmiadlan@gmail.com, emanuel.bimo@idu.ac.id

Abstract. Large-scale natural disasters result in devastating impact to the affected environment and people, as well as rendering most means of communication unable to use in performing emergency response and disaster relief. In the quest of providing robust communication solution during the aftermath of natural disaster event, this paper aims to discuss the application of command and control (C2) concept and wireless mesh network (WMN) architecture in developing a common emergency situation picture (CESP) as a real-time information system solution to assist in disaster relief operations (DRO). CESP is a WMN-based application that enables real-time communication and exchange of information in the event of emergency where most communication networks does not exist or unable for use. Through the adoption of C2 concept and WMN architecture, CESP is able to turn large number of nodes in a broad area into both end-point and router, and integrate them to form a seamless network for C2 purpose in DRO. The use of CESP is beneficial in assisting disaster emergency response task force to gain full situational awareness that enables it to make timely and well-informed decision, coordinate with all involved stakeholders, and deploy resources effectively and efficiently in performing DRO.

Introduction

Indonesia is geographically positioned between several major tectonic plates (i.e. Eurasian Plate, Indian-Australian Plate, and Philippine Plate), meanwhile its location also lies in the Pacific Ring of Fire. These inherent geographic factors make Indonesia very prone to tsunamis, volcano eruptions, and earthquakes. The occurrence of these large-scale natural disasters is inevitable and resulted in devastating impacts to the affected environment and people. Thus, good early detection of large-scale natural disasters and aftermath disaster relief capabilities are imperatives to mitigate these risks.

During the aftermath of large-scale natural disaster occurrence, most public infrastructures are damaged or destroyed, and unable to be used. Meanwhile, disaster relief operation (DRO), especially in emergency response and recovery phase requires a timely and informed decision-making, real-time coordination between all involved stakeholders, effective and efficient resources deployment, and quick and effective response to every dynamics in order to rescue as many lives as possible, quickly identify the severity of damage and implications in each affected area, effectively establish emergency logistics distribution grids, build emergency shelters, and provide adequate medical and other humanitarian services for the survivors. Thus, DRO requires an alternative command and control (C2) system that enables real-time exchange of information between all stakeholders involved to gain situational awareness amidst the chaotic situation and limited public infrastructures available for use in the aftermath of large-scale natural disaster occurrence.

Rapid advancement in information technology has continuously broken many boundaries in communication and information exchange. One of the advancements is wireless mesh network (WMN) architecture, which only requires a connected access point to radio frequency or other types of ad-hoc networks in order to extend the connectivity to other nodes that are not connected and form a seamless network. Given the aforementioned feature, WMN could be harnessed as the communication backbone to support command, control, and communication in DRO.

As the user-friendly interface to assist in DRO, this paper proposes the development of common emergency situation picture (CESP), a WMN-based application that enables real-time communication and exchange of information in the event of emergency where most communication networks do not exist or unable for use. CESP design adopts C2 concept, which focus on the utilization of computer technology to promote effective, efficient, and orchestrated decision-making and execution processes in an operation. This article aims to discuss how WMN architecture and C2 concept are applied in developing CESP and the application of CESP in performing DRO.

DRO

While countries nowadays start to invest more on the prevention and preparedness phase, it cannot be denied that DRO management is vital to reduce the number of casualties. After the 2004 Indian Ocean Earthquake, which is one of the deadliest disasters in history resulting in more than 280.000 people died in 14 countries, international community began to change their perspective on how to manage disasters to save more lives by focusing more on reducing risks rather than responding to casualties and losses that already happened. However, that does not mean DRO is becoming second priority in disaster management. Due to the nature of disasters that cannot be prevented from happening, providing faster and better response to the affected community will also prevent additional casualties. This means that strengthening DRO is also included in the efforts to reduce additional risks.

DRO is more than just saving those who are injured or evacuating dead bodies. It is a whole system which includes contingency planning, organizational readiness, management of human and financial resources, availability of basic necessities, and communication and coordination between stakeholders.[1] In the contingency plan, it is essential to provide clear specification of duties and responsibilities for all stakeholders to avoid duplication of services as they are likely to have similar tasks. To carry out relief operations effectively, a leader must be appointed which usually comes from governmental bodies or military leader. The leader will command the execution of contingency plan during DRO which also consists of clusters or sectoral responsibilities to enhance the coordination between stakeholders. All relief activities should be regulated under a Standard Operating Procedure (SOP), included identifying and accessing potential resources, managing external relation and appeal for external aid, communicating with media, coordinating and liaising with other agencies, and even for managing administrative work.

Indonesia in general has placed its concern in disaster management by stipulating the Law No. 24 of 2007 on Disaster Management and recognizing disasters as one of the national threats in their National Development Plan. Through its National Disaster Management Agency (NDMA), Indonesia also has issued a set of rules governing disaster response and relief operation both for local and national scale. According to the Disaster Management Law, disaster response is a series of prompt actions during the disaster to deal with negative impacts, such as rescuing and evacuating victims and material possessions, providing basic necessities and protection, taking care of survivors, salvaging, and recovering infrastructure and facilities. Those prompt actions are and should be conducted in order of priorities as follows (1) rapid assessment of damages, location, and resources; (2) determination of disaster status, whether its local or national scale; (3) rescue and evacuation of affected people (i.e. search and rescue of victims, emergency aid, and/or evacuation of victims); (4) fulfillment of basic necessities (i.e. necessities of water supply and sanitation, food, clothing, healthcare, psychosocial service, and accommodation and dwelling place); (5) protection for vulnerable group (i.e. infants, preschoolers, and children, pregnant women or nursing mothers, the disabled, and the elderly); and (6) immediate recovery of essential facilities and infrastructure. [2]

In Indonesia, DRO is implemented based on contingency plan and operation plan. Contingency plan is drafted on the preparedness phase which contains a scenario based on researches or studies on a certain disaster severity, the extent of affected area, and mechanism of how it will happen. Based on those data, the plan will lay out assumptions on how the disaster will create impact to the population, environment, government, economy, and assets and infrastructure. From there, the plan will lay out the best policy and strategy possible including who is doing what when disaster strike. [3] On the other hand, operation plan is drafted immediately after the disaster strikes using contingency plan as its basis. Operation plan will also incorporate the result of rapid assessment and is continuously updated with real time data from other disaster-related agencies. After all data is collected, the local government will establish a command post and elect a commander which will oversee all disaster response and relief operation until the transition to rehabilitation and reconstruction phase. [4]

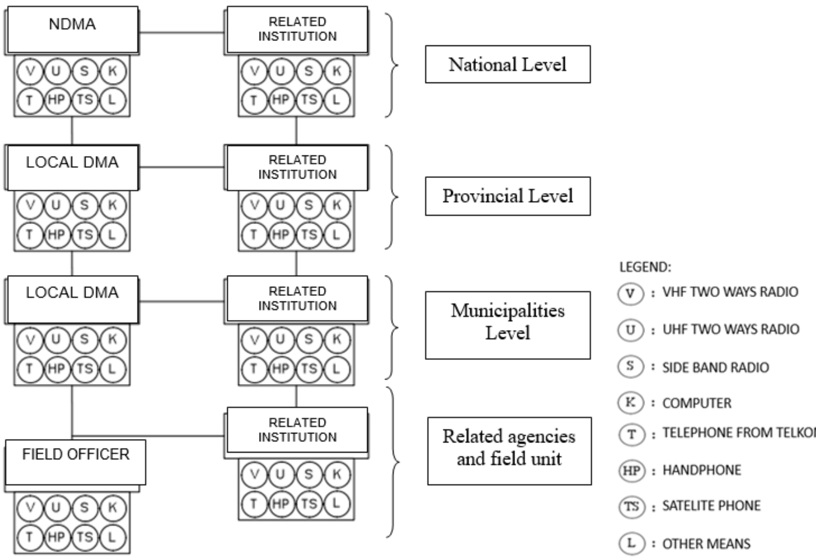

Figure 1. Configuration of communication network between disaster-related stakeholders

DRO is an elaborate activity which relies heavily on credible and accurate information. The disaster command post will mobilize its resources, both personnel and logistics, in accordance to the rapid assessment result and real time data from the affected area. To achieve this, it is compulsory to establish a strong and durable communication system to accommodate communication and coordination between NDMA, local DMA, ministries, local government, private sector, humanitarian organization, and field units and officers. As seen in Figure 1, NDMA recommends communication tools to be used in disaster response which includes high frequency radios, satellite phones, computers and handheld phone. [5] However, not all local DMAs have access to the aforementioned equipment. It is not a secret that local DMAs, mostly in municipality level, do not have adequate funding due to lack of political will or even worse, their ignorance to disaster risks. If somehow a certain local DMA has more funding than the others, it is mostly because they have experienced a catastrophic disaster which serves as a wake-up call.

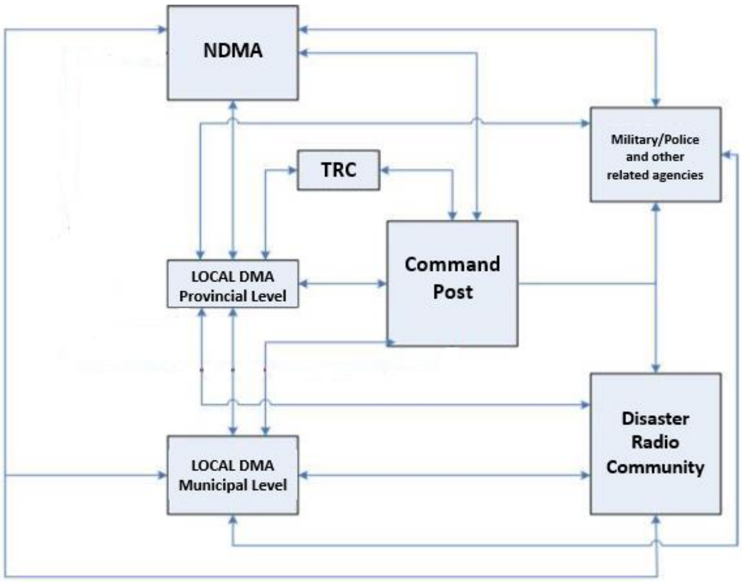

Figure 2. Communication flow during disaster response

Figure 2 shows the ideal communication flow during disaster response where the stakeholders are able to communicate with each other rapidly and simultaneously. It is necessary during DRO to have a way of communication that is stable and interconnected. However, this is not always the case. Large-scale disasters often destroy all facilities and infrastructures, including Base Transceiver Stations, which render wireless network and radio communication useless. This certainly will hamper the effort of delivering a fast disaster response and will surely increase the risk of having more casualties.

Therefore, this paper will discuss the use of CESP to provide real-time situational awareness of the chaotic situation as the result of large-scale natural disaster occurrence. The development of CESP is further elaborated in the next section.

WMN Architecture and CESP Development

CESP is a command and control interface application that enables information sharing and collation from various dispersed but related units/entities in providing real-time situational awareness for all units/entities involved in missions, which require swift coordination and response to contingencies or emergency situations where most means of communication unavailable for use. CESP works using WMN architecture as its network topology, which comes with easy configuration, resilience, quick deployment, high degree of interoperability, and minimum interdependencies to conventional telecommunication infrastructures in a heterogeneous environment. [6] WMN architecture functions by wirelessly re-routing an available source of communication network such as satellite, GSM, or ad-hoc radio frequencies from only an access point to other nodes (which serve as both endpoints and routers to extend connectivity to other nodes) in a particular area. Thus, it enables the establishment of a seamless communication network for information exchange with broad area coverage using the existing equipment.

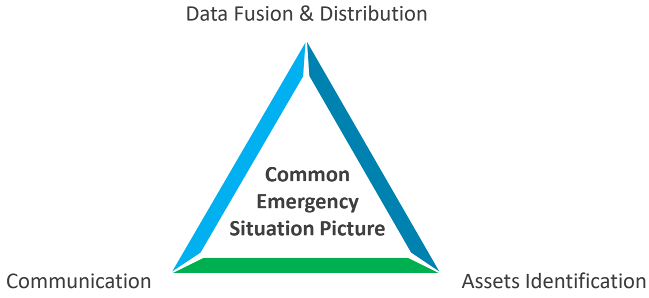

Figure 3. CESP Core Capabilities

To serve its function as a C2 system for operations in emergency situation, CESP has three core capabilities, which are data fusion and distribution, communication, and assets identification. Data fusion and distribution capabilities enables CESP to process, store, and exchange important information among all involved units/entities, both horizontally and vertically for effective and efficient decision-making and directive execution in an operation. Communication capability enables all units/entities involved in an operation to communicate, thus enabling self-synchronization to swiftly and effectively respond to any change of situation in the operation. Assets identification capability enables real-time identification and update of the location and status of all assets involved in the operation.

With the aforementioned core capabilities and user-friendly interface, CESP is able to provide essential information regarding the operation, create and share geo-referenced markings and point-of-interests (POI), picture, text, voice, and data in real-time to all/layered users within an operation, as well as provide real-time situational awareness of the operation to all users through a clear common operational picture. Furthermore, the ability of CESP to store all recorded information in the operation could assist in debriefing and post-mission evaluation by providing the detailed operation data to be evaluated in determining the operation's effectiveness and efficiency as well as improving future operations. CESP features are shown in Figure 4, while the example of how CESP is used for C2 in emergency operation is illustrated in Figure 5.

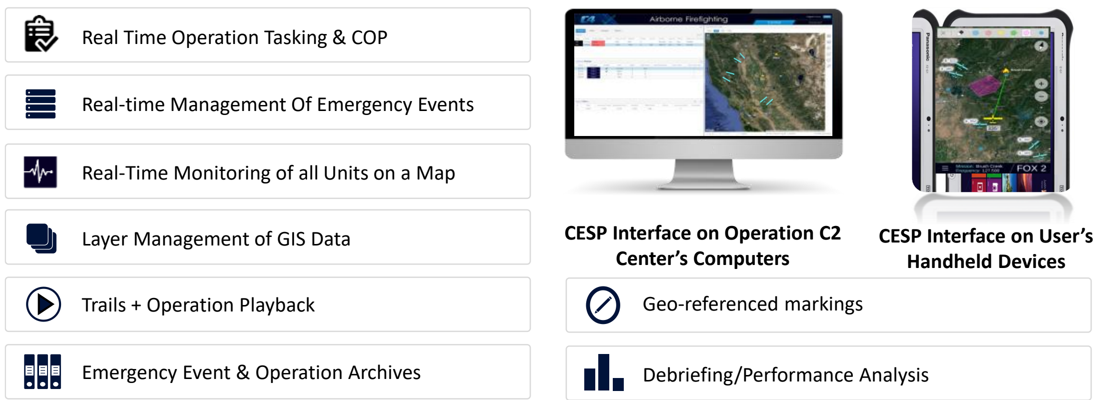

Figure 4. CESP Features

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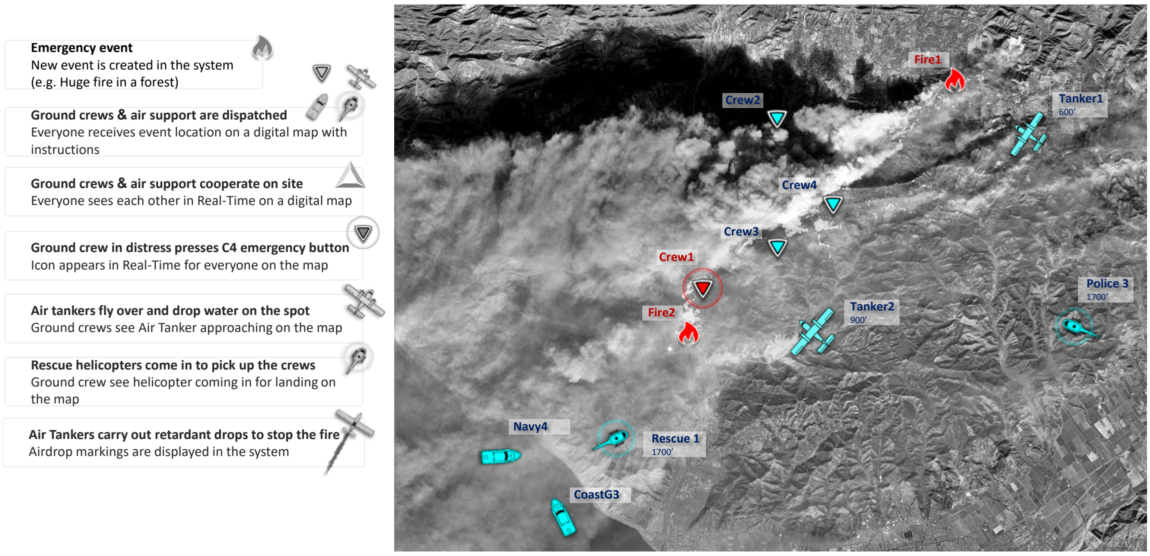

Figure 5. The Example of CESP Application for Emergency Fire Fighting & SAR Operation

In Figure 5, CESP displayed all available units (i.e. air, sea, and ground units) that are dispatched to perform emergency fire fighting & SAR operation in a particular location. By seeing CESP, the operation commander is able to understand real-time situation of the emergency event as well as the status of all dispatched units, and then direct all available units to effectively fight the fire and perform SAR for the victims. All CESP users on the field is also able to share real-time information regarding what they are experiencing on the field to enrich the situational picture, such as reporting the fire location or sending distress signal. Thus, they will be able to respond quickly and effectively to any situational changes in the field.

Discussion: The Application of CESP in DRO

Due to its emergency nature of operation, DRO required prompt actions to respond disaster aftermath and deal with its negative impacts as quickly and effectively as possible. With limited understanding regarding the situation of the affected location, fast situational update and rapid assessment are required to reduce the “fog” in the operation environment, gain situational awareness, and revise and exercise the contingency plan to cope with the actual situation effectively in timely manner. Information communication technology holds an important role as the means to support collaborative work such as planning, tracking information, data collection and distribution, and situational awareness sharing. [7] By using CESP application, the disaster emergency response task force and other first responders units/entities in DRO could quickly send information that they acquire on the affected location to the C2 center to assess the severity of damages and situation of the affected environment. The assessment result serves as the basis for determining disaster status, revision of contingency plan and preparation of operation plan, and other strategic, tactical, and operational-level decision-making activities that will be continuously updated. Afterward, the processed and collated data could be distributed to all units/entities involved according to their layer of information needs. Essential information that could be sent by the rapid response forces and other first responders units/entities in DRO using the CESP application include:

- Geo-tagged picture and video of the affected area.
- Text information that reports the number of survivors and casualties within the affected area, the available public infrastructure to sustain the survivors’ lives, and other important information to be reported.

- Voice information to quickly report and describe the situation of the affected area, as well as recording any unusual sound in the affected area.
- Geo-referenced markings to mark or highlight a particular POI for establishing basecamp and shelters, prioritization of SAR activities, critical infrastructure recovery, and other important location. Geo-referenced markings could also be used to draw the quickest and accessible routes to reach the POI for guiding other units to the POI.
- Distress signal to alert other units for any urgent actions that need to be taken or sudden emergency events that occur in a particular area.

Communication and coordination in DRO can be challenging since it involves diverse stakeholders from different sectors and hierarchy levels (i.e. national, provincial, and municipalities levels). Each stakeholder possesses different skills, competencies, knowledge, and procedures, and is demanded to work together and collaborate in DRO. [8] In national level, NDMA acts as the national coordinating agency that coordinates all involved ministries and institutions' joint efforts, the provincial and municipalities-level DMA responsibilities, and non-governmental stakeholders' assistance in DRO. This requires a good layer of information to prevent unnecessary information overload to a specific stakeholder, as well as mechanisms to enable each user from different stakeholders to directly communicate with one another.

The use of CESP enables layered information processing and distribution for the C2 Center as the leading unit to communicate, coordinate, and give commands/directives to other involved stakeholders in DRO. The layered information distribution will be based on the roles and scope of responsibilities of each involved stakeholder. For instance, the interface of CESP application for SAR team users will display the maps and POI that shows the risk and severity of damages in the POI, the estimated number of reported casualties to be rescued and all shelters/evacuation center along with the accessible route to reach each POI, while the interface of CESP application for logistics distribution team users will display the maps and POI that shows all shelters/evacuation centers along with the current logistics status on each shelter and the accessible route to reach the POI. Furthermore, CESP application also enables users from different stakeholders to directly communicate and exchange various types of information to one another to increase situational awareness and perform self-synchronization in collaborating and coping with any situational changes during the operation that require cross-stakeholders' expertise.

According to network-centric operation theory, situational awareness could be achieved if the available information has high accuracy, relevance, and timeliness. [9] The capability of CESP to provide real-time and layered information based on each user's roles directly from the operation area conforms to the aforementioned information attribute, thus enabling all involved stakeholders to gain situational awareness in the chaotic aftermath environment. The outcomes of high situational awareness are faster speed and increased effectiveness and efficiency in assessing the aftermath situation, revising contingency plan based on the actual situation, preparing robust operation plan, determining disaster status, performing SAR activities, resources mobilization and units deployment, and determining the best location to build shelters, command post, and other necessary infrastructures to sustain the survivors' lives.

For the purpose of evaluation and continuous improvement in future DRO, CESP's capability to record and store user's log, trails, and other information during DRO could provide accurate and complete data for debriefing and post-mission analysis. Thus, DRO's success could be properly measured and evaluated through the recorded data, such as the required time to perform SAR, the number of casualties rescued in the affected areas, and the required time to deliver logistics using a particular route. Furthermore, lessons learned from previous DRO for improvement in future operation could be drawn through analyzing the recorded historical operation data.

Conclusion

The use of CESP, with its capability of showing the geo-location of dispatched officer and enabling status update/text-based communication drastically improves the situational awareness of SAR officer or other institutions in charge of DRO. The improved situational awareness leads to better accuracy and less operation time in rescuing survivors in the affected areas. The utilization of Wireless Mesh Network as CESP backbone is a promising and ready-to-be deployed solution for the existing challenges faced by institutions in charge of DRO.

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Kearifan Lokal Masyarakat Terdampak Bencana Erupsi Gunungapi Kelud di Kecamatan Nglegok Kabupaten Blitar

Kuswaji Dwi Priyono[1]) dan Yusuf Mohamad Ibrahim[2])
[1]), [2]) Dosen Fakultas Geografi Universitas Muhammadiyah Surakarta
Jl. A.Yani Tromop Pos 1 Pabelan, Surakarta 57102
E-mail: Kuswaji.Priyono@ums.ac.id[1]) dan ymohamadi924@gmail.com[2])

Abstrak

Kearifan lokal merupakan produk hasil pengetahuan manusia sebagai makhluk sosial yang diperoleh lewat pengalaman berinteraksi dengan lingkungannya. Pada daerah yang terdampak bencana alam, kearifan lokal ini sangat berpengaruh terhadap tingkat kapasitas masyarakat dalam menghadapi suatu kejadian bencana. Tujuan penelitian ini mengetahui kearifan lokal dalam menghadapi bencana erupsi Gunungapi Kelud dan mengkaji peran kearifan lokal terhadap peningkatan kapasitas masyarakat di wilayah tersebut. Metode yang digunakan adalah metode kualitatif, dengan pengumpulan data melalui wawancara mendalam kepada narasumber. Analisis yang digunakan untuk menjawab permasalahan yang ada dengan kajian etnografi dan kelingkungan. Hasil dari penelitian ini menunjukkan kearifan lokal yang ada, diantaranya berupa kerukunan, sistem pengetahuan, dan sistem religi. Ketiga nilai-nilai luhur ini diperoleh dari beberapa tradisi, kelompok masyarakat, dan aliran kepercayaan diantaranya adalah *Pirukunan Purwo Ayu Margi Utamo, Manungaling Kawulo Gusti, Sirep Kayon, Suwakarsa Lembu Suro, Kalap, Larung Sesaji, Kenduri, dan Suronan.* Kontribusi nilai kearifan lokal yang pertama dalam mitigasi bencana berupa sistem pengetahuan tentang peringatan dini, sehingga masyarakat sekitar yang terdampak bencana bisa lebih siap dalam antisipasi sebuah kejadian bencana. Kedua, sistem religi sifatnya memberikan ketenangan batin kepada para pengikutnya yang membuat masyarakat menjadi lebih berfikir jernih dan rasional dalam mengambil sebuah keputusan. Ketiga, kerukunan yang berperan aktif saat terjadinya bencana dan pasca terjadinya bencana, pokok ajaran ini salah satu bentuk implementasi berupa saling bergotong royong dengan sesama.

Kata kunci : *Kearifan lokal, Kapasitas, Bencana erupsi*

A. Pendahuluan

Indonesia dilalui oleh dua deretan pegunungan yakni Mediteranian pada sebelah barat dan pegunungan Sirkum Pasific di bagian Timur, keberadaan dua pegunungan tersebut membuat Indonesia kaya akan gunung berapi yang aktif serta rawan akan gempabumi (BNPB, 2007). Batas-batas geografis ini juga memberi sejumlah pengaruh bagi Indonesia sebagai sebuah negara dengan kebudayaan yang beragam yang terdiri dari berbagai suku, agama, dan budaya, dimana setiap daerah memiliki ciri khas tersendiri walaupun telah mengalami perkembangan di daerah-daerah yang disebut dengan kebudayaan lokal (Mulyadi, 2013). Kebudayaan umat manusia memiliki tujuh unsur kebudayaan yang bersifat universal, diantaranya sistem religi, sistem kemasyarakatan, sistem pengetahuan, sistem bahasa, sistem kesenian, sistem mata pencaharian, dan sistem teknologi.

Ciri khas ini yang mendasari proses perkembangan masyarakat ini menjadi hal yang unik dan menarik bagi masyarakat luar, sehingga dapat mengenal dan memahami kebudayaan lokal yang ada di suatu wilayah di Indonesia. Masyarakat di wilayah Pulau Jawa baik di Jawa Barat, Jawa Tengah, Jawa Timur, dan Daerah Istimewa Yogyakarta mengenal yang namanya tradisi *Kejawen.*Tradisi *Kejawen* ini mempunyai keunikan/kekhasan yang berbeda-beda di tiap-tiap daerah walaupun masih dalam lingkup tradisi *Kejawen*, contoh di Kota Surakarta, Jawa Tengah pada setiap tanggal satu *Suro* (1 Muharram) masyarakat Surakarta mengarak *Kiai Slamet* (Kerbau Slamet) dan yang lain, namun karena pesatnya perkembangan zaman dan masuknya budaya asing yang turut dikembangkan di masyarakat maka sekarang ini banyak orang Jawa yang meninggalkan tradisi Jawa. Apabila dilihat dari sejarah perkembangan tradisi Jawa orang-orang terdahulu memahamankan *Wong Jowo Ojo Ninggalke Jawane* yang berarti orang Jawa tidak boleh meninggalkan Jawanya. Meninggalkan tradisi Jawa berarti melupakan sejarah Jawa itu sendiri. Beberapa diantara kearifan lokal yang ada di Indonesia ada yang erat kaitanya dengan mitigasi bencana, yang mengarah pada peningkatan kapasitas masyarakat dan pengurangan kerentanan terhadap suatu peristiwa kebencanaan.

Masyarakat di Kabupaten Blitar pada setiap pergantian tahun Jawa terdapat sebuah ritual "*larung sesaji"* yang dilakukan di pantai Laut Selatan dan kawah Gunungapi Kelud. Tradisi ini dilakukan sebagai simbol menyatunya alam semesta dengan manusia dengan harapan agar *sing mbaurekso* atau penguasa alam baik lautan atau gunung tidak marah dan menggangu umat mausia. Menurut mantan Bupati Blitar tahun 2005-2016 Herry Noegroho, bahwa setiap awal pergantian tahun Jawa selalu mempersembahkan emas batangan dan bahkan intan untuk dilemparkan ke dalam kawah Gunungapi Kelud sebagai persembahan untuk penghuni gunung agar tidak mengganggu warga di sekitar Gunungapi Kelud. Kearifan lokal seperti ini perlu untuk diungkap dan dipelajari agar tetap lestari. Etnografi adalah salah satu dari cabang Antropologi yang berfokus untuk mendeskripsikan sekaligus melukiskan tentang suku-suku dan kebudayaan yang ada di suatu wilayah tertentu. Metode ini digunakan untuk mengungkapkan dan menggambarkan kebudayaan yang ada di lokasi penelitian, pada peneliti ini mengambil lokasi penelitian di Kecamatan Nglegok, Kabupaten Blitar, Provinsi Jawa Timur.

Sesuai dengan yang tertera dalam Peraturan Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia Nomor P.34/MENLHK/SETJEN/KUM.1/5/2017 tentang Kearifan Lokal, bahwasanya kearifan lokal adalah nilai-nilai luhur yang berlaku dalam tata kehidupan masyarakat setempat antara lain untuk melindungi dan mengelola lingkungan hidup dan sumber daya alam secara lestari. Sayangnya, kini berbagai pengetahuan lokal dalam berbagai suku bangsa di Indonesia banyak yang mengalami erosi atau bahkan punah dan tidak terdokumentasikan dengan baik sebagai sumber ilmu pengetahuan. Padahal pengetahuan dan kearifan lokal dapat dipadukan antara empirisme dan rasionalisme, sehingga dapat pula digunakan antara lain untuk mitigasi bencana alam berbasis masyarakat lokal (Iskandar, 2009 dalam Permana dkk., 2011). Keberagaman kebudayaan Indonesia sangat menarik untuk dikaji secara etnografi yang mempelajari tentang pelukisan kebudayaan suku-suku bangsa yang hidup tersebar di muka bumi (KBBI). Dalam perkembangannya bangsa Indonesia sangat tertinggal jauh sekali dengan bangsa-bangsa penjajah, karena mereka bahkan lebih mengenal dan mengetahui tentang keberagaman dari kebudayaan kita (Koentjaraningrat, 1989). Hasil akhir dari etnografi ini adalah informasi detail tentang penggambaran kondisi sosial budaya di suatu lokasi yang terdampak bencana.

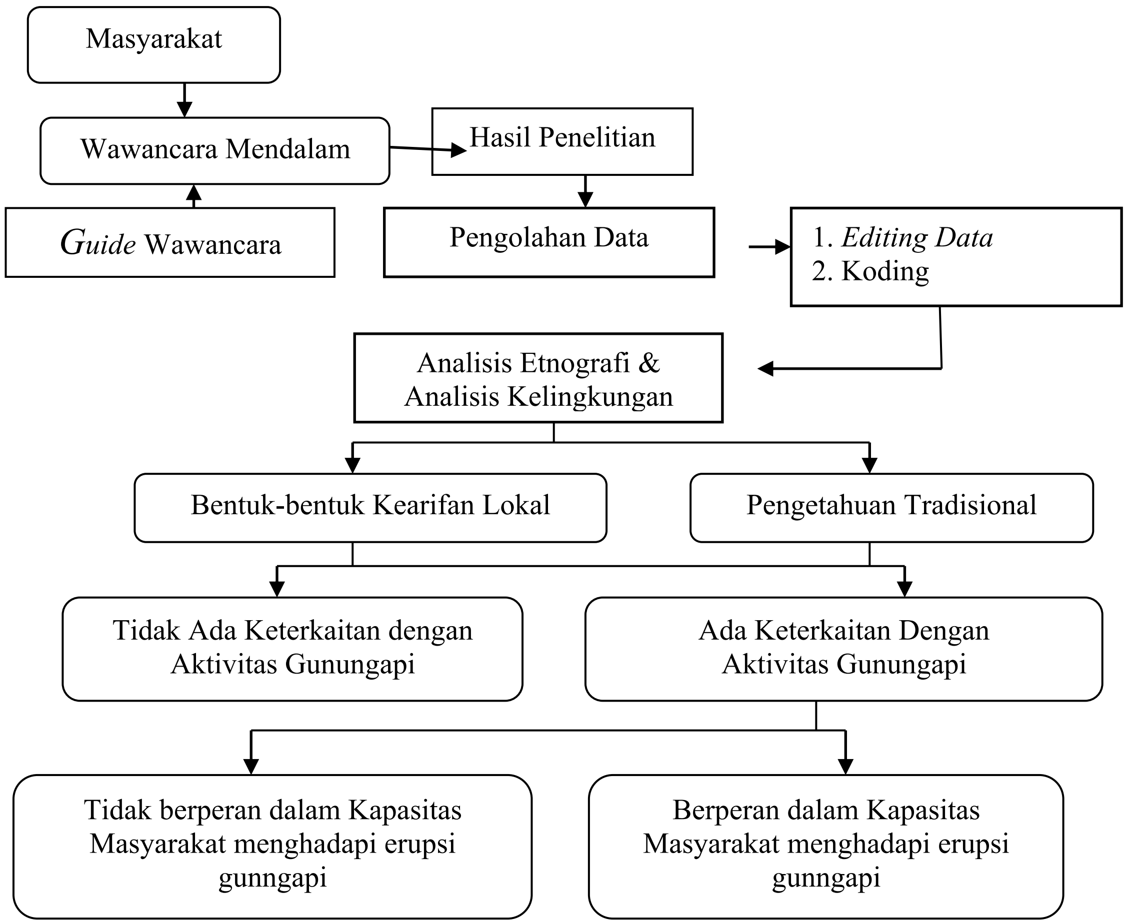
Fenomena alam yang ada sangat beragam diantaranya adalah fenomena bencana alam, bencana adalah sesuatu yang menyebabkan atau menimbulkan kesusakan, kerugian, atau penderitaan, kecelakaan, bahaya (KBBI). Bencana dari sudut pandang Badan Nasional Pengangulangan Bencana (BNPB, 2007) adalah peristiwa atau rangkaian peristiwa yang mengancam dan mengganggu kehidupan dan penghidupan masyarakat yang disebabkan, baik oleh faktor alam dan atau faktor non alam maupun faktor manusia, sehingga mengakibatkan timbulnya korban jiwa manusia, kerusakan lingkungan, kerugian harta benda, dan dampak psikologis. Salah satu cara untuk memperkecil resiko bencana adalah dengan memperkecil nilai kerentanan dan meningkatkan nilai kapsitas masyarakat. Kapasitas adalah kemampuan daerah dan masyarakat untuk melakukan tindakan pengurangan tingkat ancaman dan tingkat kerugian akibat bencana (PERKA BNPB, 2012). Salah satu bentuk dari kapasitas masyarakat adalah kearifan lokal yang memiliki nilai-nilai luhur yang diturunkan dari generasi ke generasi untuk pengelolaan lingkungan hidup secara lestari.

Daerah penelitian ini dipilih sebagai contoh gambaran tradisi Jawa yang beragam, bertujuan untuk mengungkapkan dan menggambarkan tentang kebudayaan lokal. Kecamatan Nglegok, Kabupaten Blitar berada di kawasan terpapar bencana Gunungapi Kelud. Berdasarkan latar belakang tersebut dirumuskan masalah berikut: (1) apa kearifan lokal di yang berkaitan dalam menghadapi bencana erupsi Gunungapi Kelud?, dan (2) bagaimana peran kearifan lokal terhadap kapasitas masyarakat dalam menghadapi bencana erupsi Gunungapi Kelud?. Penelitian ini secara umum bertujuan untuk pengetahuan dan pemberian informasi detail tentang nilai-nilai luhur yang ada dan berkembang di masyarakat. Secara khusus tujuan yang ingin dicapai dalam penelitian ini adalah: (1) mengetahui kearifan lokal di lokasi penelitian yang berkaitan dalam menghadapi bencana erupsi Gunungapi Kelud, dan (2) mengkaji peran kearifan lokal di lokasi penelitian terhadap peningkatan kapasitas masyarakat dalam menghadapi bencana erupsi Gunungapi Kelud.

B. Metode Penelitian

Penelitian ini menggunakan metode kualitatif yang bersifat deskriptif, dilakukan untuk penggambaran secara lebih rinci dan mendalam mengenai kearifan lokal yang berhubungan dengan mitigasi bencana dan kapasitas masyarakat dalam menanggapi bencana erupsi Gunungapi Kelud. Populasi dari penelitian ini adalah seluruh masyarakat beserta kebudayaan yang ada di Kecamatan Nglegok, Kabupaten Blitar. Objek yang dikaji dalam penelitian ini adalah bentuk-bentuk dari kebudayaan lokal yang terkaitan dengan aktivitas Gunungapi Kelud. Wawancara dilakukan kepada informan yang bersifat *purposive*, artinya informan dipilih dengan kriteria tertentu disesuaikan dengan maksud dan tujuan penelitian. Data yang digunakan dalam penelitian ini adalah data primer yang langsung didapatkan di lapangan melalui wawancara mendalam kepada informan dengan panduan *guide* wawancara mendalam.

Tahapan pengolahan data yang pertama adalah *editing*, data asli hasil lapangan diteliti kembali untuk meningkatkan mutu dari jawaban yang diberikan oleh responden sehingga bebas dari kesalahan-kesalahan. Kedua, adalah pemberian *koding* dari semua data yang sudah di-*editing* diberikan kode pada semua jawaban responden untuk membuat klasifikasi jawaban responden. Analisis etnografi digunakan untuk mengetahui fenomena terkait serangkaian kategori budaya masyarakat, pengetahuan budaya seorang informan secara sistematik semuanya berhubungan dengan kebudayaan secara keseluruhan (Spradley, 2007). Analisis dilakukan dengan menjabarkan fakta-fakta yang ditemukan, kemudian pendeskripsian dikaitkan bagaimana kearifan lokal dalam menghadapi bencana alam Gunungapi Kelud dan perannya terhadap peningkatan kapasitas masyarakat di lokasi penelitian. Gambar 1 berikut ini adalah diagram alir yang digunakan dalam penelitian ini.



C. Hasil dan Pembahasan

Secara geografis Kecamatan Nglegok Kabupaten Blitar berada di 7°21’-7°31’ LS dan 110°10’-111°40’ BT, dengan luas wilayah 9.256 ha yang terdiri 1 Kelurahan dan 10 Desa Desa. Desa Penataran merupak yang terluas dengan luas 3.156 ha dan Desa Kerenceng yang tersempit seluas 178 ha. Kecamatan Nglegok berada di posisi paling utara dari Kabupaten Blitar dan langsung berbatasan dengan Kabupaten Kediri, secara administratif berbatasan dengan Kabupaten Kediri di sebelah utara, di bagian barat dengan Kecamatan Ponggok, di bagian timur berbatasan langsung dengan Kecamatan Gandusari dan Kecamatan Garum, dan di bagiaan selatan dengan Kecamatan Kepanjen Kidul. Bentuklahan yang ada menurut klasifikasi Vestappen (2014) adalah bentuklahan asal vulkanik yang Lereng Gunungapi Atas (V3), Lereng Gunungapi Tengah (V4), Lereng Gunungapi Bawah (V5), Dataran Kaki Gunungapi (V7), dan Dataran Flufial Gungapi (V8), di beberapa tempat terdapat bentuklahan Aliran Lahar (V12) dan bentuk lahan Dataran Tinggi Lafa (V14). Tipe iklim menurut Schmidt–Ferguson adalah tipe B (Basah). Tanah yang ada relative subur dan sangat cocok untuk dikembangkan sebagai pertanian.

Struktur penduduk di Kecamatan Nglegok dari tahun ke tahun mengalami sebuah perubahan, jumlah penduduk di tahun 2016 sebanyak 69.722 jiwa sementara angka ini lebih sedikit di anding tahun 2015 sebanyak 69.774 jiwa, perbandingan jumlah penduduk laki-laki dengan jumlah penduduk perempuan (*sex ratio)* pada tahun 2016 adalah 99 angka ini menunjukan bahwa jumlah penduduk laki-laki lebih banyak daripada perempuan. Potensi ancaman bencana yang paling tinggi adalah erupsi Gunungapi Kelud, dan potensi ancaman bencana yang paling minim adalah bencana banjir bandang. Penelitian yang telah dilakukan sebelumnya oleh Wahyu Budiati 2018 yang berjudul *Kajian Kapasitas Masyarakat Dan Coping Strategis Dalam Menghadapi Ancaman Bencana Erupsi Gunungapi Kelud Di Desa Modangan Kecamatan Nglegok Kabupaten Blitar*, salah satu faktor dalam strategi pengurangan bencana adalah faktor kultural, faktor kultural yang ada di Desa Modangan (1) selamatan di perempatan desa dalam masyarakat lokal di sebut dengan “Baritan”; (2) *“Sidhem Premanem Tan Ono Sebawane Kutu-Kutu, Walang Ategoto”* yang artinya malam sebelum gunung mau meletus terasa sangat sepi; (3) penyadiaan meja khusus yang kokoh yang digunakan untuk berlindung ketika terjadi letusan.

Kearifan lokal di lokasi penelitian berupa tradisi dan aliran kepercayaan, diantaranya adalah *Pirukunan Purwo Ayu Margi Utamo, Manungaling Kawulo Gusti, Sirep Kayon, Suwakarsa Lembu Suro, Kalap, Larung Sesaji, Kenduri, dan Suronan*. Tradisi masyarakat dan aliran kepercayaan ini yang dianut oleh masyarakat dalam menanggapi erupsi Gunungapi Kelud diantaranya berupa kerukunan, sistem religi, dan sistem pengetahuan. Nilai kerukunan ini dikenal dengan *Pirukunan Purwo Ayu Margi Utamo*. Aliran kepercayaan ini sudah ada sejak lama di Indonesia dan tersebar di 20 provinsi dengan ajaran kerukunan, seperti rukun dalam keluarga, kerabat, tetangga, desa, sampai rukun negara. Aliran kepercayaan ini memiliki ajaran khusus yang harus dipatuhi dan dilaksanakan oleh semua anggotanya, nilai luhur yang paling utama adalah kerukunan dalam menjalankan *ngalah ngasor lembar ndasar mring sesamiyang intinya* adalah lebih baik mengalah berada dibawah dan membatu sesama mahluk hidup. Dalam mengaplikasikan kerukunan ini para anggota turut serta dalam membantu korban bencana erupsi Gunungapi Kelud berupa tenaga, fikiran maupun dana, karena kalau kita tidak turut serta dalaam membantu korban bencana berarti kita tidak rukun dalam bermasyarakat.

Sistem Religi merupakan sebuah nilai-nilai dari kearifan lokal yang berkembang di masyarakat yang memberikan sebuah ketenangan kepada para pengikutnya. Kelompok masyarakat maupun tradisi-tradisi lokal yang mengandung nilai sistem religi diantaranya adalah *Manunggaling Kaulo Gusti*, *Kenduri*, *Suronan*, dan *Larung Sesaji*. *Manunggaling Kaulo Gusti* adalah kelompok masyarakat yang banyak melakukan aktifitas atau kegiatan-kegiatan tradisi Jawa atau sering disebut sebagai tradisi *kejawen* yang mana banyak kegiatan yang di lakukan di bulan *Suro.* Manungaling Kawulo Gusti ini sendiri dimaknai oleh masyarakat terkhusus mereka yang tergabung didalamnya menyatunya seorang hamba dengan sang pencipta, dan ketika seorang hamba telah menyatu dengan tuhannya akan merasa aman dan nyaman dalam berkehidupan sehari hari. Salah satu kegiatan dari Manungaling Kawulo Gusti ini adalah *Ruwatan Desa*.

Prinsip ruwatan yang ada sama dengan ruwatan pada umumnya, kalau ruwatan *Bocah Mongso Kolo* mereka percaya bahwasanya jikalau anak-anak yang terkatagori sebagi *Bocah Mongso Kolo* apabila tidak dilakukan ruwatan kepada anak-anaak ini maka nyawa merek akan diambil oleh *Betoro Kolo* sejenis makhluk raksasa dalam pewayangan Jawa. Ruwatan desa ini juga bertujuan untuk menghindarkan desa dari mara bahaya, karena desa ini ada di kaki Gunungapi Kelud, bahaya yang mereka cegah adalah dari sang penguasa Gunungapi Kelud yakni *Lembu Suro.* Tradisi *Suronan* adalah tradisi yang banyak dilakukan oleh masyarakat Jawa, di Desa Modangan ada tradisi *Suronan* yang dilakukan saat pergantian malam tahun baru Jawa. Suronan ini dipimpin oleh seorang *sesepuh* desa, yang didahului ritual khusus ditujukan agar apa yang diminta lebih manjur dan terwujud. Hasil dari doa inilah yang paling ditunggu oleh masyarakat sekitar, karena mereka yakin kalau hasil dari doa tersebut pasti akan terjadi. Masyarakat memiliki keyakinan bahwasanya semua musibah pasti akan terjadingga perlu untuk mempersiapkan dalam penanggulangannya. Di Dukuh Kampung Anyar memiliki sebuah kebiasaan dalam memantau aktifitas Gunungapi Kelud, ketika melihat tanda-tanda alam akan adanya aktifitas mereka akan melakukan *Kenduri.*

Masyarakat di puncak Gunungapi Kelud melakukan selametan berupa *Larung Sesaji*, dilakukan ketika sang penguasa gunung meminta diadakan *Larung Sesaji,* biasanya akan ada tanda-tandanya yang menunjukkan kalau sang penguasa gunung meminta Larung Sesaji ini. Selain untuk memenuhi keinginan dari sang penguasa Gunungapi Kelud, masyarakat meminta sesuatu kepada sang penguasa Gunungapi Kelud keselamatan dan dijauhkan dari mara bahaya.

Kearifan lokal yang terkait dengan aktifitas Gunungapi Kelud adalah sebuah nilai-nilai luhur yang dimiliki oleh masyarakat dan di gunakan untuk melindungi dan mengelola lingkungan hidup dan sumber daya alam secara lestari. Peneliti menemukan tiga nilai-nilai luhur yang berkembang di masyarakat, yaitu kerukunan, sistem Pengetahuan, dan sistem Religi.

Kerukunan

Pada nilai luhur ini sudah menjadi tradisi orang Indonesia pada umumnya tapi karena sebuah pergeseran zaman tradisi ini sudah mulai luntur di masyarakat Indonesia. Salah satu bentuk dari kerukunan ini adalah kebersamaan, gotong royong, saling membantu, dan merasa saling memiliki satu dengan yang lainya. Di Kecamatan Nglegok ada sebuah aliran kepercayaan yang inti ajarannya adalah kerukunan, mulai dari rukun keluarga, kerabat, tetangga, bahkan sampai rukun bernegara, mereka menamai aliran kepercayaan ini dengan nama *Pirukunan Purwo Ayu Margi Utamo*. Aliran kepercayaan ini tidak hanya ada di desa ini saja melainkan sudah tersebar di 20 privinsi se-Indonesia

Sistem Pengetahuan

Sistem pengetahuan yang didalami masyarakat berupa peringatan dini akan adanya bencana. Sebuah bencana alam pasti akan di awali dengan adanya sebuah pertanda atau sebuah isyarat akan datangnya sebuah bencana, dalam pewarisannya peringatan dini ini biasanya oleh masyarakat lokal telah diubah dan disesuaikan dengan kebiasaan masyarakat, ada yang sudah diubah menjadi nyanyian, cerita dongeng, pepatah, unen-unen dan lain lain. Dalam penelitian ini peneliti mendapatkan beberapa contoh dari peringatan dini yang sama masyarakat lokal sudah diubah agar tetap bisa lestari seperti berikut.

Sirep Kayon

Sirep Kayon merupakan pertanda atau peringatan akan adanya sebuah bencana alam, akan tetapi oleh masyarakat sudah di rubah menjadi sebuah unen-unen, bunyi dari unen-unen ini adalah *Sidhem Premanem Tan Ono Sebawane Kutu-Kutu, Walang Ategoto* intisari unen-unen ini adalah pada malam mejelang letusan Gunungapi Kelud, suasana menjadi sunyi dan sepi tidak ada satu hewanpun yang bersuara. Walupun banyak yang sudah tidak mempercayai *Sirep Kayon* ini karena di beberapa letusan kemarin itu tidak ada tanda-tanda *Sirep Kayon*, tapi bagi sebagian orang yang masih mempercayai ini mejadikan sebagai pertanda akan datangnya sebuah bencana alam yakni erupsi Gunungapi Kelud, mereka meyakini bahwasanya ketika mendekati hari H terjadinya erupsi semua binatang itu pada takut dan pergi menjauh dari gunung, maka dari itu tidak ada hewan yang bersuara.

Kalap

Kalap adalah sebuah cerita rakyat, mereka meyakini bahwasanya ada beberapa dari sanak keluarganya ini ada yang dijadikan *abdi dalem* atau pelayan di Gunungapi Kelud, dan ketika nanti mendekati erupsi gunung orang yang *Kalap* tersebut akan pulang ke rumah dan memberikaan sebuah informasi bahwasanya gunung akan meletus jadi harap lebih waspada. Masyarakat sekitar mempercayai akan kebenaran dari *Kalap* ini mereka gunakan sebagai pertanda akan terjadi erupsi, karena apa yang diinfokan dari orang yang *Kalap* ini.

Swakarsa Lembu Suro

Suwakarsa Lembu Suro ini adalah sebuah organisasi kemasyarakatan yang mana mereka berperan penuh dalam membantu prosesi evakuasi bencana, akan tetaapi mereka dalam bertindak dan mengambil sebuah kebijakan mereka cenderung menggukan pengetahuan lokal seperti *Kalap* dan juga *Sirep Kayon* tetapi disini mereka juga menggunakan sebuah teknologi terbarukan untuk memantau dari aktifitas Gunung Kelud ini, karena sejatinya mereka ini adalah perpanjangn tangan dari *Vulkanologi*yang juga tergabung di organisasi Jangkar Kelud.

Sistem Religi

Adat istiadat atau tradisi yang ada pada lingkup masyarakat Jawa pada umumnya atau sering disebut dengan tradisi kejawen memberikan sebuah ketenangan batin kepada para pengikutnya, mereka akan merasa damai, nyaman, dan tentram ketika mereka telah selesai melakukan ritual-ritual dalam tradisi yang mereka percayai, mereka menyakini bahwasanya sang penguasa alam semesta tidak akan murka kepadanya, pada penelitian ini menemukan beberapa tradisi lokal yang dilakukan oleh warga sekitar yang ada hubunganya dengan aktifitas Gunungapi Kelud, diantaranya berikut ini.

Manunggaling Kawulo Gusti

Masyarakat sekitar yang mempercayai dan mengikuti aliran *Manungaling Kawulo Gusti* ini percaya bahwa Gunungapi Kelud itu dapat diprediksi melalui hitungan dan komunikasi batin. Salah satu tokohnya adalah Mbah Suroso, sebagai ketua kelompok aliran mampu dan dapat memperkirakan akan apa yang akan terjadi dengan Gunungapi Kelud, ketika ada tanda-tanda akan adanya mara bahaya mereka akan meminta petunjuk kepada mbah Suroso. Bentuk kegiatan yang ada adalah *Ruwatan*, sebagai acara rutin yang dilakukaan saat tanggal satu suro (Tanggalan Jawa). *Ruwatan* desa ini bertujuan untuk menghindarkan dari bencana yang mengancam desa, ini akan memberi ketenangan batin kepada para pengikutnya, mereka yakin bahwasanya tidak akan terjadi bencana yang menimpa pada desanya.

Kenduri

Biasanya Dukuh Kampung Anyar sini ketika melihat tanda-tanda akan adanya erupsi gunung mereka melakukan *kenduri* yang bertujuan untuk meminta perlindungan kepada sang penguasa gunung agar tidak menimpakan mara bahaya kepada desa ini. Pak Sugeng selaku ketua RW menyampaikan bahwasanya di dukuh ini tidak lagi mempunyai sesepuh, maka untuk hal-hal yang berkaitan dengan mistis sudah banyak menghilang dan mulai ditinggalkan oleh para generasi sekarang ini. Masyarakat di dukuh ini kebanyakan lebih cenderung kepada teknologi, tapi tidak menutup kemungkinan tentang adanya kearifan lokal tapi pada jaman sekarang ini masyarakat lebih menempatkan kearifan lokal hanya bersifat menenangkan saja, yang harus dipadukan dengan teknologi yang terbarukan.

Suronan

Suronan merupakan tradisi kejawen dan Mbah Gito sebagai sesepuh yang dituakan untuk memimpin doa pada acara ini, beliau terlebih dahulu melakukan ritual puasa *ngrowot* (hanya makan-makanan yang tertimbun di dalam tanah), dan padatanggal satu suro melakukan doa dengan suguhan berupa menyan dan memanggil semua danyang atau penunggu desa ini. Beberapa penunggu desa tersebut adalah Mbah Truno Menggolo, Mbah Mbeji, Mbah Gedhemukti, dari doa ini nanti akan mendapatkan jawaban langsung dari sang penunggu Gunungapi Kelud yakni Lembu Suro dan Joto Suro, jawaban inilah yang ditunggu oleh Mbah Gito dan warga sekitar bahwa Gunungapi Kelud ini akan meletus atau tidak. Masyarakat percaya bahwa tidak ada musibah atau bencana yang dapat ditolak akan tetapi musibah atau bencana itu ditanggulangi, salah satunya dengan berdoa meminta perlindungan kepada penguasa gunung. Inti dari doa ini bukan doa untuk tolak bala tapi doa untuk menyisihkan mara bahaya yang mungkin akan mengenai desa. Masyarakat yang mempercarai ini mereka akan merasa aman dan tenang.

Larung Sesaji

Larung Sesaji ini berupa ritual yang dilakukan di kawah Gunungapi Kelud dengan sesaji berupa kepala kerbau atau sapi untuk dipersembahkan kepada penguasa gunung. *Larung sesaji* ini dipercayai oleh masyarakat dapat menangkal akan terjadinya sebuah bencana alam di Gunungapi Kelud, mereka percaya bila dalam beberapa waktu penunggu Gunung Kelud akan meminta sesaji atau makan sebagai imbalan apabila masyarakat yang tinggal di kaki gunung telah banyak mengambil hasil alam dari Gunung Kelud. Ketika sesaji ini tidak dipenuhi atau apa yang disajikan kepada sang penguasa gunung tidak sesuai dengan apa yang diinginkan oleh sang penguasa gunung maka penguasa gunung akan murka dan marah, bentuk dari amarahnya adalah akan terjadi sebuah bencana yang beruntun dan menimpa masyarakat di sekitar gunung. Namun, ketika sesaji ini telah dipenuhi dan diterima oleh sang penguasa gunung mereka akan merasa aman dan nyaman dalam beraktifitas sehari-hari karena mereka akan merasa aman dari mara bahaya

Kapasitas masyarakat dapat diartikan sebagian kemampuan untuk memberikan tanggapan terhadap situasi tertentu, salah satu bentuk dari kapasitas adalah kearifan lokal yang telah turun-temurun diwariskan dari generasi ke generasi, kapasitas dalam bentuk kearifan lokal inilah yang akan diungkapkan oleh peneliti. Dalam penelitian sebelumnya oleh Wahyu (2018), kearifan lokal yang ada kaitanya dengan kapasitas masyaraakat yang ada di Desa Modangan Kecamatan Nglegok adalah *(1) Selamatan yang dilakukan di perempatan jalan desa dalam masyarakat lokal di sebut dengan "Baritan"; (2) "Sidhem Premanem Tan Ono Sebawane Kutu-Kutu, Walang Ategoto" yang artinya malam sebelum gunung mau meletus terassa sangat sepi; (3) penyediaan meja khusus yang kokoh yang digunakan untuk berlindung ketika terjadi letusan.*

Dalam prinsip mitigasi bencana ada tiga tahapan dalam mitigasi bencana yakni sebelum terjadinya bencana, saat terjadi bencana dan paska terjadinya bencana. Dalam penelitian yang dilakukan oleh Wahyu Budiati (2018) menjukkan bahwa kapasitas masyarakat adalah salah satu yang meningkatkan masyarakat menghadapi sebuah bencana erupsi Gungapi Kelud. Kearifan lokal yang ada di lokasi penelitian berperan sebelum terjadinya bencana berupa peringatan dini, karena dengan peringatan dini ini menjadikan masyarakat sekitar terdampak bencana bisa lebih antisipasi dalam menghadapi sebuah bencana yang akan terjadi, seperti menyimpan barang baraang yang berharga di tempat yang aman, agar ketika terjadi bencana tidak terjadi erugian yang besar. Selain peringatan dini sebelum terjadinya bencana ada juga kearifan lokal yang sifatnya memberikan ketenangan batin kepada para pengikutnya, dengan ketenangan batin ini menjadikan masyarakat, apabila terjadi bencana dapat lebih berfikir jernih dan rasional dalam mengambil sebuah keputusan. Peneliti juga menemukan sebuah kearifan lokal yang berperan aktif saat terjadinya bencana dan paska terjadinya bencana yakni kerukunan. Pokok ajaran ini adah tentang kerukunan, salah satu bentuk pengaplikasian kerukunan adalah saling bergotong royong dengan sesama. Ketika terjadi bencana seperti di tahun 2014 kemarin aliran kepercayaan ini turut serta bergotongroyong bersama-sama membantu jalanya evakuasi bencana, dan juga ikut serta memberikan sumbangan tenaga dan untuk para korban bencana.

D. Simpulan

Hasil penelitian mengambil kesimpulan yang sekaligus akan menjawab dari tujuan penelitian ini.

a. Kearifan lokal yang ada di Kecamatan Nglegok diantaranya adalah kerukunan, sistem religi, dan sistem pengetahuan. Kearifan lokal ini ditemukan pada beberapa tradisi, organisasi maupun aliran kepercayaan yang ada di lokasi penelitian. Seperti kearifan lokal kerukunan, *Pirukunan Purwo Ayu Margi Utamo,* yang sifatnya memberikan ketenangan batin. Hal ini ditemui pada kelompok-kelompok masyarakat maupun tradisi lokal diantaranya adalah *Manungaling Kawulo Gusti, Kenduri, Suronan*dan, *Larung Sesaji.* Kearifan lokal yang sifatnya sebagai peringatan dini ini peneliti temukan pada organisasi masyrakat maupun pada ditradisi lokal seperti *Sirep Kayon, Suwakarsa Lembu Suro, dan Kalap.*

b. Pengaruh dari kearifan lokal dalam membangun kapasitas masyarakat di Kecamatan Nglegok dalam menghadapi erupsi Gunungapi Kelud. Hal ini terlihat pada lokasi persebaran kearifan lokal yang hanya ada di tiga desa yang ada di Kecanatan Nglegok dan desa ini pada peta kapasitas menempati posisi desa dengan tingkat kapasitas masyarakat yang tinggi. Pengaruh ini bisa terjadi karena mereka lebih dulu mengenal kearifan lokal dari pada teknologi, jadi walaupun tehnologi sudah berkembang dengan maju masyarakat lokal akan lebih mengedepankan kearifan lokal dari pada teknologi dalam mengambil sebuah keputusan.

E. Ucapan Terimakasih

Terima kasih kepada Kemenristekdikti yang telah memberi dana penelitian pada tahun ke-2 ini, juga masyarakat Desa Nglegok atas bantuan dan kerjasamanya pada kegiatan survei dan pengambilan data untuk penelitian ini. Terima kasih kepada Badan Penanggulangan Bencana Daerah (BPBD) Kabupaten Blitar yang telah memberikan data serta kesempatan untuk bertukar pikiran.

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An Augmented Building Urban Community Resilience to Floods Through Social Learning: Case Studies of Surabaya and Medan Cities

Gusti Ayu Ketut Surtiari, Luh Kitty Katherina, Lengga Pradipta, Fadjri Alihar, Dwiyanti Kusumaninggrum, Ari Purwanto Sarwo Prasojo, Puji Hastuti

[1, 2, 3, 4, 5, 6, 7] Research center for population, Indonesian Institute of Sciences, Gd. Widya Graha Lantai 10, Jl. Gatot Subroto Kav. 10, Jakarta, 12710 Indonesia

E-mail: ayu.surtiari@gmail.com[1], kittykatherina@gmail.com[2], lengga.pradipta@gmail.com[3], dwiyanti.kusumaningrum@gmail.com[4], ari.prasojo18@gmail.com[5], pujisht@gmail.com[6], fadjri_alihar@yahoo.com[7]

Abstract. Building community resilience is gaining its importance due to the increasing uncertainty of magnitude and impact of floods. Studies of community resilience have been conducted over decades, but the gap is remaining persist particularly to link the complexity of the two concepts of community and resilience which working across scales. Studies find that social learning is an important aspect for community resilience to bridge those concepts. The question is how does community learn to be resilience and to what extent social learning occurs across scales. This paper aims at exploring the social learning at the vulnerable community by considering resources, actions and disaster risk governance. Vulnerable communities in Surabaya and Medan are selected as case studies and the analysis is based on field-studies in 2015-2018. The results show that social learning in two case studies is diverse referring to the risk perception and to formal flood protection and flood risk governance. A better preparedness is found in the community that have no access to formal flood protection while less preparedness found in the community that perceived that preparedness is the responsibility of government. To conclude, we recommend the need to consider multilevel learning process in order to optimize building resilience.

1. Introduction

Flood is the most frequent and widely impacted coastal cities in Indonesia [1]. The changing precipitation as one of the climate change impact impinge on the existing problem of urbanization. The over-developed and high density of population in the city has receded the capacity of water retention regarding land use change and occupation of water body as settlements. Therefore, number of people to live in the hazards prone area has increased particularly the low income groups who only have option to live in high risk areas regarding their inability to afford a house in low risk area [2], [3]. Since the vulnerable groups have to live in disaster prone areas, they have spontaneous have no option to leave, they established their strategy to cope, anticipate, recover from disaster [4]–[7]. People who live in hazards prone area spontaneously enhance their capacity to self-organize and learning to adapt which mainly based on social capital [7].

While communities build their own resilience, building community resilience is also initiated by local government and related stakeholders as such national and international NGOs. Since building resilience is stated as a global agenda [8], several global and regional platforms have been established to provide a space for risk professionals and policy makers to share their experiences and learning from others. There some platforms related to building resilience such as C40 and ACCCRN collaborates with the Rockefeller foundation to establish program 100 resilience cities. Meanwhile, at the local level, building resilience has been supported by local NGOs to increase and enhance capacity of the vulnerable people to be more resilience. Moreover, there are some cities in Indonesia has established collaboration with other cities in developed countries through a program of Sister City in order to learn intensively. For instance, Surabaya City is a sister city of Kochi in Japan. Those activities show different levels and different actors for particular program but in reality they interacted and influenced each other both direct or indirectly which categorized as a polycentric system in building resilience [9].

Building community urban resilience is not a new paradigm in Indonesia. Yet, the discussion on concept and implementation of building community resilience is still growing and gaining its importance [10]–[12] in addition the existed-discussion on the concept resilience itself [13]. Sendai Framework for disaster risk reduction (SFDRR) clearly stated that building resilience as one of priorities that can be achieved through investing in the disaster risk reduction [8]. Building resilience aims to reduce losses of lives, livelihood, and assets on economic, physical, economic, environment, and cultural of an individual, community and business (Ibid.). Terminologies of resilience and community are represented the interlinkages of multi actors across scales [10], [14]. It is related to the complex adaptive system that consists of social ecological system and psychological strands of concepts [15], [16]. However, in the research and practice, community resilience tends to be simplified [17], [18] and it is still lacking to be developed appropriately when we compare with the resilience in the context of ecosystem [19]. To identify a resilience stage at the community level, we need to understand the process in which way a community prepares, responses, and recovers and how they learn to be resilient (Ibid.). The learning process obviously describes the complex problem of disaster that represents the collective and collaborative responses that initiated by multi agencies and institutions [20].

Based on the definition of resilience as adaptive capacity of a system (individuals, communities, larger societies, corporations, social–ecological systems, ecosystems) to respond stressors and change [14], resilience is related with social network and learning communities [21], [22]. The questions are how learning process at the community level or social learning occurs in the context of risk governance. To what extent social learning influence the building community resilience particularly in the interaction between community and government strategies to respond disasters. Therefore, this paper aims to explore the building resilience through the social learning regarding the multi-stakeholder involvement and the polycentric interaction at the local level. Surabaya and Medan are chosen as the case studies by considering their social, economic, and institutional characteristic. The data collection was conducted in 2015, 2016, 2017, and 2018 under the scheme of a thematic research project funded by DIPA of Research Center for Population. The studies were conducted through mix-method approach by integrating both qualitative and quantitative approaches. The studies are focusing on the vulnerable and most vulnerable groups in the cities. The analysis is based on triangulation procedure.

This paper consists of seven parts that departed from the background of this paper followed by the literature reviews for the development of building resilience concept in the second part. The third part is presenting the two case study areas followed by the methodology of research in the fourth part. Result of the study will be at the fifth part which consists of strategies to responds disaster at the community and government levels, capacities of both community and governments, and the social learning at the community levels. The discussion is in the sixth part of this paper followed by conclusion and recommendation of building urban resilience in the seventh part.

Framework for Community Resilience by considering social Learning

Community Resilience

Community resilience consists of two terminologies which has their own complexity [17]. The community composed by individuals and household unit, thus community resilience considers the subjective factors of social aspect which represented by the perceptions and beliefs in addition to the condition that shaping the capacity of community to build resilience [17]. Resilience in this paper is defined as *the capacity of a community as a system to absorb disturbance and reorganize themselves while undergoing change in order to preserve fundamentally their function, structure, identity, and feedbacks* [23], [24]. The capacity can consist of capacity to anticipate, cope, recover, and learn to adapt [7], [25]. Therefore, community resilience should be observed from social ecological systems and psychological perspectives [17]. Communities have internal capacity to adapt [26] and they can learn from experiences [27], [28]. The cultural factor of individual and household unit that scaled up as a community influence the internal capacity to learn to adapt and to interact with external factors such as policies, regulations and external program from other stakeholders [7].

As a system, community internally has capacity to self-organize to respond shocks and stressors [29], [30]. For instance, to respond flood, among the poor has committed to the optimization of family members, task division and utilization social network [4], [7]. However, the capacity at the household and community level is rather independent. The limits and barriers to absorb, recover from disaster, and learn to adapt for instance closely related to the broader system beyond the community. The social system, in this case, community system is always interact with the broader society including regional and national governments and other stakeholders [31], [32]. The interaction across scales and levels is obviously depicted from the progressive establishment of global platform and also national and regional platform for resilience. The 100 resilience cities is an the global platform that assists cities across the world to build community resilience. They provide capacity building to the local government and also supervision at the community level to increase and enhance their capacity to be resilient.

Recognizing the complexity of the understanding of community resilience, a framework has been developed in the case of heatwaves in UK [17]. The framework considers three components: resources and capacities, actions, and learning which conjoin among them and embedded in the layers of disaster risk governance and the community process and structures (Ibid.). Disaster risk governance encompasses the laws, policies, and responsibilities of multi-stakeholders and actors that could direct and indirectly influence the building resilience at the community level (Ibid.). Moreover, framework also presents an extra-community processes and structures as another layer is to represent the condition of context while changes and disturbance as another factors that influence the community resilience. For instance, the economic crisis at the national and regional level lead to the changes of livelihood and thus will influence their sensitivity and capacity to adapt.

Figure 1. Community resilience building. The component of **actions** consists of social protection (vulnerability reduction and social safety net), and disaster management (social protection). The component of **learning** consists of risk/ loss perception, problematizing risk/ loss, critical reflection, experimentation and innovation, dissemination, monitoring and reviews. The component of **resources and capacities** consists of natural/ place based socio political, financial, physical, human.

Source: Pelling, et al. (2015) [33]

Based on the framework, this paper explores deeply on the role of social learning in addition to actions, and resources and capacities. Since the studies are focus on the low income group and vulnerable communities who live in high flood prone areas (case studies in Kampung Aur, Medan), we argue that the social capital is rather dominant among the affected communities. Studies about vulnerable communities and communities in slums reveal that they could response and recover from disaster based on social capital such as social networking and the role of informality [7], [34]–[37]. Thus, the important part to be elaborated is the part of learning process.

Social learning to lead community resilience

The community as a social system has to deal with changes continuously as such environment, social, economic and institutional. Therefore, the understanding of resilience in the context of social-ecological system is prominent which include understanding the social learning [24]. The terms or social learning is used to describe the complexity in the context of process to adapt which involve multiple actors at the different scales who brings various perspective and point of views [38]. Learning process is important for a system to be more adaptive [31], [39], [40] and also important in order to establish collaboration for the sustainability [41] as well as disaster risk reduction [10]. Social learning in the context of environment subjects can be understood as the process to result social outcomes including new skills and knowledge through the process of collective and communicative learning [42]. It is also commonly used as an entry point to learning in the context of environmental issues [43]–[45].

Recently, social learning is still mixed between the understanding of the concept itself and the method of approach to find out social learning and the outcomes or outcomes obtained [46]. An example of the similarity between the concept and the methodology is that it is often mentioned that social learning is also a form of participation and certain behaviors of a person related to inclusive environmental management (Ibid.). In fact, it is often not too distinguished between learning from individuals and for wider learning (Ibid.). Therefore, social learning it must be clear what type of social learning is done, by whom, when, and why it is done [33], [44], [46]. There are three things that need to be considered to really be able to mention a process as social learning, namely: 1) showing the existence of a change from the individuals involved, 2) showing that change at the individual level then impacts on wider changes for example at the community level and broader units, 3) all of these occur through social interactions and processes between actors involved in social networks [46]. As a process, social learning need to consider interventions from outside or based on individual experiences and learning from the surroundings [46], hence the process is nonlinear [33].

As mention earlier, social learning is a process which consists of interaction several actors at different scales. Departed from the concept of risk governance developed by IRGC [47], there are several dimensions that affect risk governance, namely: 1). organizational capacity that responsible for dealing risk from individual level to the national and also international level. 2). Political and regulatory culture which will be diverse among countries. 3) Actor network, that will be different depend on risk and situation which consists of politicians, regulations, business, NGOs, media, and public. 4). Social climate and risk culture that useful to identify the level of preparedness for the change and the potentially of a system to accept risk. Moreover, the concept developed by IRGC highlight the core risk at the governance process is consisting of pre-assessment, risk appraisal including risk assessment, evaluation which represent tolerability, acceptability, judgment, risk management, and risk communication. It is clearly showed that the process involve subjectivity in the decision making process in addition objectivity through the risk assessment.

2. Methodology of Research

This paper is based on the thematic research during the four year of study using mix method between quantitative and qualitative approaches in 2015, 2016, 2017, and 2018. Each year of the data collection was collected based on different topics. The first year, the study focuses on the mapping the risk to hazards in combination with the urbanization. The second year focused on vulnerability assessment, and the third year emphasized the capacity of government and community to respond floods. To link those three years with the concepts of resilience, the four-year study was highlighting risk perception and social learning. The mapping of vulnerability is based on the statistical data published by BPS namely *Potensi Desa* 2014, Medan in Figures 2015, Surabaya in Figures 2015. The calculation of vulnerability uses the formula from World Risk Index that applied at the district levels with the number of variables is based on availability of the data at district level. Vulnerability is composed by exposure with the indicators of number of flood events. The susceptibility is referring to the data of public infrastructures, housing condition, nutrition, and poverty. Adaptive capacity consists of variables of education and physical environment.

The analysis of the capacity of government and community is based on the semi-structured interviews as well as the data collection for risk perception and social learning. The analysis of community resilience that is conducted by the systematic desk review by analyzing and combining all the four years of findings. In Surabaya, the study was conducted in the sub district of Sumberejo that located in Pakal distric, Sub districts of Jagir and Darmo that located in district Wonokromo, and sub district of Bulakbanteng is located in district of Kenjeran. In each district, we select one up to two neighborhoods that represent their geographical location namely close to the river, close to the coastal line and in the city center but highly prone to flood.

Our study of environmental vulnerability in Medan City in 2016 was carried out in 3 different regions, first, conducted in Kampung Aur, Medan Maimun District, second, in Kwala Berkala, Medan Johor District and third, Sungai Sekambing D, Medan Petisah District. The three districts have different characteristics and flowed by three different rivers. Kampung Aur, Medan Maimun District flowed by the Deli River which is prone to river flood, Kwala Bekala Village flowed by the Babura River which is prone to river flood and inundation and Sei Sekambing D Village, and flowed by Sei Sekambing and Sei Putih which is also prone to river flood and inundation. Medan Kota Belawan, the northern part of coastal district in Medan is prone to tidal flood. Moreover, the in-depth exploration for the qualitative is conducted in one Kampung in Medan, namely Kampung Aur to represent the vulnerable group in the city who struggling to live with flood but also located in a middle to up level of economic condition.

Semi-structured interviews with the managerial level of local governments or the respective staffs were conducted at the city level. They are from Development Planning Agency, Disaster Management Agency, and Public Work Agency that directly responsible for the flood protection construction.

3. A Case Study of Surabaya and Medan: Two cities vulnerable to floods

Surabaya

Surabaya is a capital city of East Java with a population of 2,755,487 people and population density is 8.305 people per kilometer square [48]. As a center of development, Surabaya is destination of potential migrants from their surrounding neighborhoods that lead to over urbanization. The limited capacity of low income migrants to afford standard housings trigger the numbers of informal settlements in hazards prone areas such as along the river which cause them living with floods.

The population of Surabaya City is very diverse in characteristics, social status and livelihoods. For example, in *Sumberejo* area, which is always affected by *Kali Lamong* flood, they are native people (born and raised in *Sumberejo*). Most of *Sumberejo* residents work as shrimp farmers, and they have been facing floods since decades ago. While residents in others areas, such as *Jagir* and *Darmo* which located in city center are tend to have heterogeneous characters, there is not only indigenous people who lived in these areas, but there are also migrants from several cities outside Surabaya. In this area, the livelihoods of the people are also diverse, some work as entrepreneurs, government officials and some are retired military officers. In addition, there are also people who have informal work lived in these areas. If we tried to look at their preparedness system towards flood disaster, it can be assumed that their effort is very minimal, because they still depended on Surabaya city government to overcome the flood. Furthermore, in *Bulakbanteng* area, a slum area which always attacked by tidal floods, the people also has unique background. They are mostly come from Madura district, and their main livelihoods are in trading sector.

The vulnerability assessment in Surabaya shows that most of the district in Surabaya categorized as vulnerable from high to moderate. The north part of Surabaya and along the river is the most vulnerable to floods. The floods that occurred in the city of Surabaya consisted of river flood, tidal flood, and inundation. Surabaya as a downstream area is very vulnerable to flood during the rainy season. This is due to the geological, hydrological and average rainfall conditions are quite high. The most severe river flood found at Kali Lamong area within DAS Bengawan Solo (Sub-DAS Lamong) or Pakal District and Benowo District, in the northwest of the city center of Surabaya. While tidal floods occur in the coastal areas of Surabaya City, such as in Kenjeran District, Tambak Weci, and Lebak Indah. Whereas urban floods or inundation occur mostly in residential areas in the city center where the drainage canal is not sufficient to accommodate the existing surface flow due to the lack of recharge areas.

According to a record of the disaster events of the BNPB, one of the biggest floods in Surabaya was flooding that occurred in the fishpond area (*tambak*) in Sumberejo Village, Pakal District which affected approximately 2800 people. According to the regional profile in the Surabaya City RPMJD document, several areas in the city of Surabaya experienced inundation with heights varying from 10 to 70 cm with a maximum inundation time of at least 6 hours.

The problem of flooding in the city of Surabaya is closely related to drainage conditions and flood control infrastructure. Alike other cities, the drainage network in the city of Surabaya was originally an irrigation network that was built for agricultural sector. This transition requires a lot of efforts to lower the elevations [49]. It is clear considering that the principle of irrigation and drainage is different (the principle of irrigation raises water, while drainage lowers water.

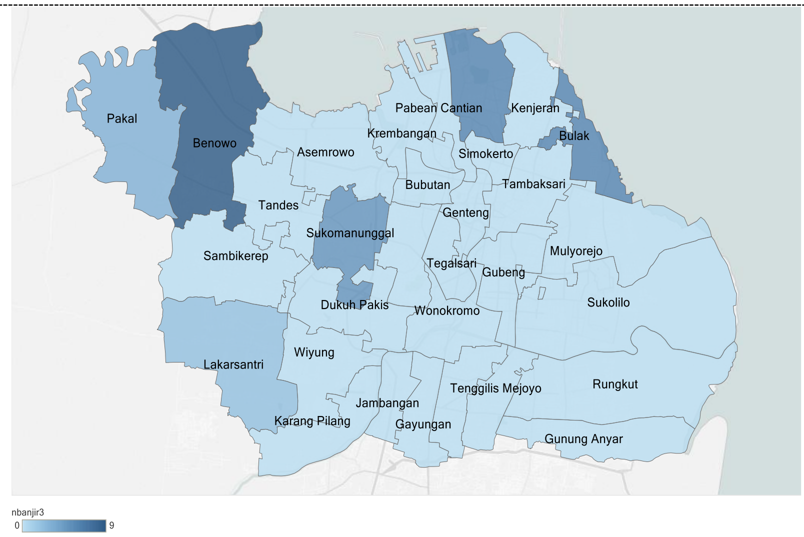

Figure 2. Frequency of floods in Surabaya City from 2011-2013

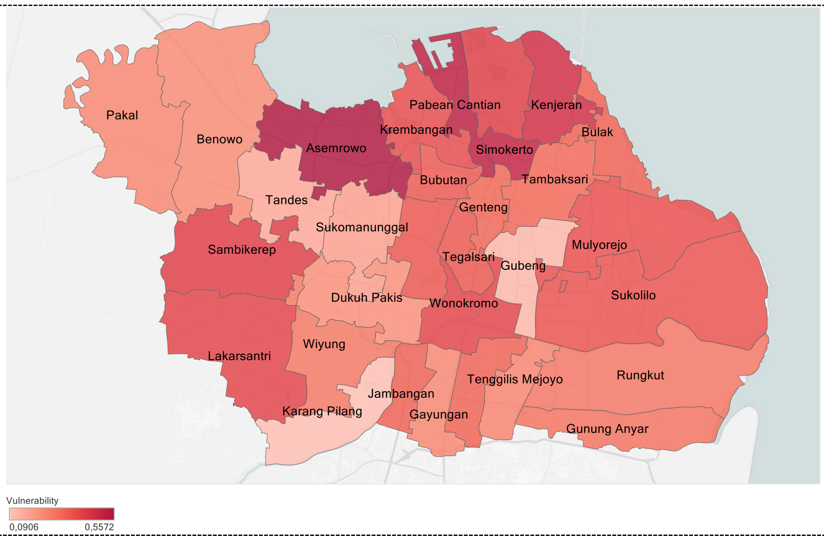

Figure 3. Flood vulnerability in Surabaya City

Medan

Since the 1980s, Medan has begun to be a populated city due to the number of migrants who come to Medan [50]. As in the case of Surabaya, the number illegal settlements along Deli River is increasing in line with the growing of the city. Deli river is considered as a strategic location and accessible for the low income groups. One of the slum that has been existed over decades in the city in Aur Village (*Kampung* Aur) which also selected as a case study to explored the capacity of vulnerable community to respond flood. Kampung Aur has existed since the 1900s, during the Dutch colonial rule which was originally a valley and bamboo shrubs on the banks of the river. Currently, the settlement has grown as settlement with high density of housings and population. Kampung Aur is transformed into a crowded slum that is often flooded due to overflowing river water. The physical housing condition is furthermore contributing to the vulnerability of the population to flooding. Most of the settlement are semi-permanent with combination materials between brick walls, boards and bamboo pillars. Buildings made of boards and pillars of bamboo are relatively easy to be damaged particularly when it affected by floods. The non-permanent and semi-permanent settlements are mainly located next to the river and the more permanent ones are located away from the river.

However, they the majority of the houses are having a storage on the second floods as a place for evacuating their valuables stuffs and also for the people during floods.

Surabaya is vulnerable to flood also regarding its location as lowland with the elevation ranging from 2 meters to 27 meters above sea level. There are at least seven rivers flowing in to this city, namely: 1) Sungai Deli, is the largest river in Medan and has five tributaries. The length of the Deli River is 73 km. This river flows from Karo Regency, Deli Serdang Regency across the city of Medan, and finally empties into the Malacca Strait. 2) Babura River, is the second largest river in the city of Medan, flows half of the city and has 1 (one) tributary, the Bekala River. 3) Sikambing River, 4) Putih River, 5) Badra River, 6) Belawan River, 7) Sulang Saling River, or Kera River.

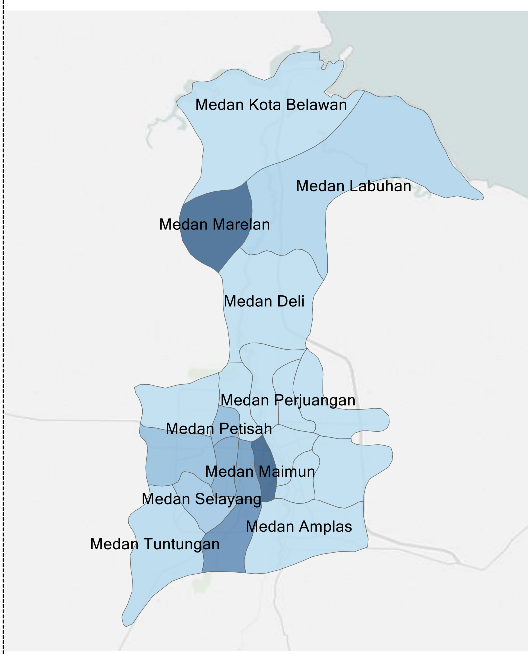

Figure 4. Frequency of floods in Medan City from 2011-2013

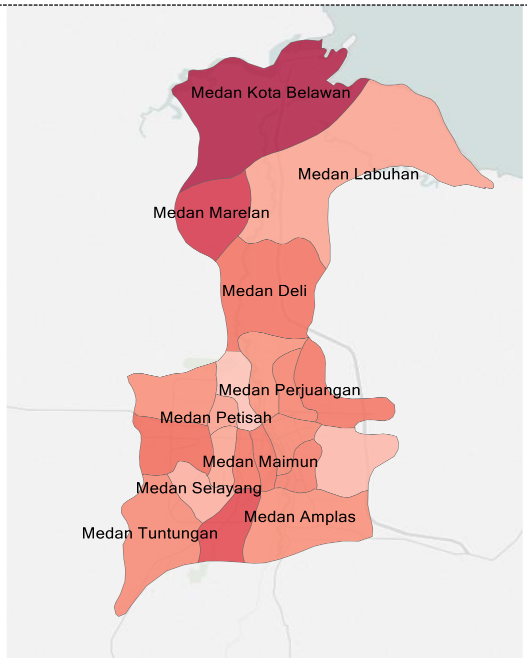

Figure 5. Flood vulnerability in Medan City

It is interesting to see that the vulnerability assessment based on secondary data published by BPS namely PODES 2014, district of Medan Maimin has middle scale for flood vulnerability. This can be accepted due to the status of Kampung Aur as one of the slums in the high income group of the district. Thus, it is also urgent to highlight the gap between the data for policy makers and the reality on the grassroots that could not captured by the statistical data.

Result

Case study of Surabaya

There are three types of flood in Surabaya. Firstly, the flood that caused by the Kali Lamong is triggered because of the hard rain in the upstream (Gresik and Mojokerto) which continued to Surabaya. Besides, the dams which were built by government are not strong to prevent the floods hence causes severe flood. Secondly, the flood caused by the low quality of drainage system in the city center that unable to retain water during high-density of rainfalls. The low quality of drainage system is related to the refunction of irrigation system into drainage system for floor protection. Thirdly, inundation caused by tidal floods from the sea-tides. The combination between sea tides inundation together with the heavy rain and overflow water from the upstream are causing severe flood in the city.

Instead of having experiences to floods, the Government of Surabaya has developed various efforts to improve the drainage system while manage risk to floods including inundation from sea-tides. The construction of drainage infrastructure in Surabaya has succeeded in significantly reducing the inundation that occurred in Surabaya City from 2005 to 2013 [49]. Until now, the city of Surabaya has built several types of infrastructure including retention basin/ reservoirs/*embung*, river embankments/dyke, and pumphouses in five areas /*wilayah rayon* (Rayon Genteng, Gubeng Rayon, Jambangan Rayon, Rayon Wiyung and Rayon Tindes). The pump house serves to drain rainwater that cannot flow by gravity. Based on data from BAPPEDA of Surabaya City, currently, the city has 54 pump houses spread over the riverside and coastal areas. The pump house consists of 40 pumps belonging to the Surabaya City Government, 12 pumps belonging to the Central Government, and 2 pumps belonging to the

East Java Provincial Government. The master plan of drainage system of Surabaya mentions that there are also planned pump distributions, namely pump plans built by the Surabaya City Government (8 pumps) and planned pumps built by the Central Government (11 pumps). In addition to the pump house, the Surabaya Government is also working to overcome flooding, especially the Lamong River flood by building embankment structures along the Lamong River which crosses the Sumberejo Village and also built a water reservoir/*embung*.

Whereas some measures for flood mitigation have been installed, but floods are still persisting particularly in certain points as such for the community who lived in Kali Lamong. The vulnerable communities in that areas experience floods almost every year. Interestingly, not all inhabitants in that neighborhood clearly understand why floods is still occurring while government has programs to manage flood. However, some respondents mention that they concerned about the quality of flood protection for instance the quality of dams. They perceived that the dam is vulnerable to be broken if there is overflow of surface water. Therefore, they said that government needs to revamp the dams to be stronger. They believe the proper infrastructure will minimize their level of worry in facing floods. For another floods like the floods which occurred in city center floods and coastal area in Surabaya, communities are very depended on local government's initiative. Actually, in 2017 after the severe flood in Surabaya, the Government of Surabaya planned to initiate to build natural protection that made from soil-buckets which covered three to six meters of land and soil. But, communities are still persuaded local government to rebuild the dams in Sumberejo district. For example, in Darmo district, there are some pumping houses system which were built by local government and now, those pumping-house-system is utilizing to decrease the water level of floods.

The condition is getting worse since the early warning system is absent in the neighborhood in Kali Lamong. Among the fish farmers, early warning is significantly matter for their assets. The absent of early warning has caused significant loss for their fish ponds and in contrast, for those who get information or warning of the flood could prepare their strategies and thus reduce their loss. During floods, information about flood is distributed through the kinship or friendship network and the information is not widely disseminated. In contrast, in the case study of neighborhood in district of Jagir, communities have already prepared themselves to anticipate flood such as build up their house by elevating the floor, build paving blocks which can absorb water and to reduce run-off of water. The anticipation is based on their experiences affected by flood. The pattern of the flood is recorded by the inhabitants and without proper early warning system, they can reduce losses and devastated damage. The experience of community with floods is closely related to their perception of risk. Personal experiences such as loss and damage of property could be recorded and resulted as the factor that might increase the risk perception to flood. Some studies also revealed that previous experiences will create and shape people's attitudes and responses to floods. In terms of the process of learning to adapt, the community who lived in Kali Lamong who experienced floods regularly, perceived risk to flood is triggered by the insecure feeling caused by the quality of the dams. They worry that the devastated flood will occur if the dam is broken. As the consequences, the people perceived that government is the most responsible for the disaster preparedness instead of they have to anticipate by themselves.

Case study of Medan

Basically, floods that occur in Medan are mainly caused by poor drainage systems. The technical problem lies in the condition of drainage that is narrow, shallow and severe topping of waste along the river. Meanwhile, in terms of networks, there is no integration between drainage networks due to drainage closures due to road construction.

To respond the increasing floods, the local government has installed progressive flood protection namely Medan Floods Control (MFC) project that completed in 2007. It is recognized that the MFC leads to the declining of the number of medium and large flood events. Although at the beginning of operation has not showed a significant influence but in some period of time it shows its benefit hence the devastated floods look like in 2002 has never been occurred. In terms of response, the regional government of Medan City was very responsive, especially the BPBD, which already have a good coordination with TAGANA and the TNI (army). When there was a report of rising water on the Deli River, the BPBD immediately went down the location. However, the disaster preparedness is still lacking in its portion compare with response strategy. The good coordination is showed by the monthly meetings that are held regularly in the form of coffee mornings to coordinate all BPBD in Medan and its surrounding cities.

Flood characteristics in Kampong Aur can generally be grouped into 3 groups, first small flood with height of 50 cm to 1 meter, occurring about 2-4 times in a month, secondly, moderate flood (2-3 meter) happened 2-3 times in the last year and the last big flood of 5 (five) annual cycles with an average flood height of 4 meters. Based on the interview with the Head of Environment Agency of Surabaya, it is said that the intensity of flood in the last 3-4 years has increased especially for small scale of floods. Meanwhile, the medium and large scale of floods are relatively less frequent. Originally an average of small floods 2-4 times a month, in January 2017 reached 6 times a month. The greatest flood that people in general remembered was the floods in 2002 that drowned most of the houses in neighborhoods. Large and moderate floods occurred around 2002 to 2012, after which flood characteristics were dominated by small and relatively frequent floods.

However, the small scale flood still regularly occurs but only for the short duration. Floods generally rise in the night until early morning (22:00 - 03:00 in the morning) then began to recede in the morning and in the afternoon people can clean up again. Not only cleaning their homes, residents also have to work hard to clean up the environment so that they can continue their daily activities as usual. This situation seems to be contradictory to the existence of flood protection facilities that have been provided by the government, since 2008 the channel and flood control project have been inaugurated as the second phase of flood protection.

Most of the inhabitants in Kampung Aur are informal sector workers, especially street vendors of food on the area or in outside area, laborers in the market, and shop employees. Flood is significantly affect their daily activities particularly for the food traders because they unable to cook also unable to sell their product because the place to sell is submerged in water. However, usually shop employees and labourers in the market can still go to work, unless the conditions of their homes and families are in threatened condition. In terms of capacity to cope and anticipate to flood, the inhabitants in Kampung Aur is influenced by their experiences to deal with floods. The actions they take are an accumulation of local knowledge that they have been getting both handed down by parents and from their own experience. The experience of facing floods has made people familiar with the signs of the arrival of floods. The two main features of a sign of water going up are the sound of river water rumbling and its color is more turbid. Spontaneously residents on the riverbank forwarded their information to other residents and packed up to save household items and small children first. Rescue can be done to the second floor of a house or family whose home location is safer.

The anticipation of the inhabitants is showed by the two-storaged house among the residents can be seen as their strategy to adapt to floods based on their experiences. The second floor of their house has purpose to save their assets and evacuation of the family members. The first floor is used as a storage for less valuable stuffs of the house. Moreover, at the community level, the inhabitants working together to protect their neighbourhood before and after the flood. Through *gotong royong* or mutual assistance the community members working to clean up the garbage and maintain the local drainage system for instance from the accumulation of mud as a sedimentation of the river. In terms of adaptation strategy, residents of Kampung Aur have developed a spontaneous flood early warning. The warning is started when the river water was more turbid and thunderous, and brought a lot of garbage, residents on the riverbank immediately packed up and informed other residents that large water was coming soon. If it is predicted that the floods will be relatively high, and cover a wider area, residents will use the mosque to tell other residents, so that all residents are alert and prepared.

The strong kinship relationship among the inhabitants (90% of its inhabitants have background ethnic of Minang) is forming a strong social ties that play a major role in the face of floods. Local leadership, close kinship is the capital to form a strong adaptation capacity. The presence of youth groups who are ready and spry to help evacuate both goods and people when flood events formed due to strong social ties because of the feeling of destiny. The strong social assets have succeeded to be maintained because of their experiences affected by floods and also there is lacking of attention from the government to their neighborhoods. Respondents stated that all people have to survive and find solutions independently to survive. The government only active during the emergency response but less in the preparedness.

There are no long-term adaptation activities to reduce the impact of flooding. Beside due to unsecure land tenure, the limited economic conditions and floods that come almost once a week has taken the limited resources of the inhabitants instead of to think about long-term solutions to the reduction of flood impacts and losses. Economic limitations also make the population in the study area tend to give-up with the faith in the face of flooding. Residents tend to let the floods come and then clean the house and the environment back when the water has receded, repeating itself for so many of years. The limited resources they have make them limited in carrying out sustainable adaptation measures. Floods that have repeatedly spent their time improving conditions, often the damage caused by the former flood has not been repaired already hit by the next flood, resulting in more severe damage. But on the other hand poor conditions make them do not have many valuables property to be protected so they tend to think the flood is not a high threat to their assets.

Discussion

Community resilience in our case studies shows interesting features which can be seen from the social learning process. As a vulnerable group in the city, low income population are mainly relying on social capital to anticipate, cope and recover after disaster. However, their perception to flood is also prominent to decide the level of their preparedness. As explained in the literature review part, resilience is a process of a system that interlink across scales and multi stakeholders, this study also confirms that the self-capacity preparedness is constructed by the affected community by relating their situation with what government for reducing and managing risk in their neighbourhood. Meanwhile, spontaneous action to adapt and anticipate are also obviously revealed by this study but tend to for short term coping mechanism.

The result show that the case study in Surabaya and Medan have similar characteristic of exposure and social economic characteristic of the people but the learning process is different. The interaction of actors across scale in Surabaya case study is clearly observed where affected communities link their situation to the larger scale condition. For instance, people are aware that flood is still becoming risk but not the top risk among the communities but their preparedness is low because they have particular perception about sharing risk. They perceived that the best solution for flood is the construction of dams and it leads to the responsibility of the local government. Instead of take voluntary action to cope floods, local early warning system also has developed among the community which benefit to avoid fatal loss and damage caused by floods. The initiative to develop voluntary early warning system is emerged from the awareness that they have limited access to the formal flood protection. In the case of urban poor in Medan, they are aware that they are away from public facilities including disaster preparedness program thus they decide to strengthen their capacity to anticipate and cope risk through manual early warning system. This study also confirmed that social capacity is the only capacity that fully support their building resilience.

Referring to the learning process, the affected communities has limited circle to learn to adapt. First, they learn from their own experiences and only few of them could link their experiences with the larger scale, for instance the flood protection implemented by government. But the flow of learning is only one direction where affected community has their perception that constructed by the level of their knowledge. This means the government is still lacking to do dissemination about the flood protection such as dams. Ideally, instead of relying on government, voluntary disaster preparedness is still important and needed to be established. As a complex system, a community has to interact with other system at different level. But the interaction should be in the positive way. When it interaction is leading to the negative direction, it will cause unintended consequences. Moreover, the challenges of building resilience by fully relying on self-capacity is the limited capacity to the longer term and sustainability benefit. In the case of inhabitants in Kampung Aur, Medan, they are almost give up with the situation and lost their faith thus they only survive instead to build back better from their current situation. The concern of the social learning is in the one side of learning process whereas government will be in the front during the emergency response. However, the learning across scales and across actors failed to optimize the existing social asset among the community. Even though they have strong capacity to help and support each other’s but it needs more intervention to enhance their capacity for the long term and sustain strategy to adapt to risk. The lacking of government intervention in the slums and informal settlement is regarding laws and regulation of urban development. Basically, the settlement on the river and water body is prohibited by laws and regulation that makes government have no access to formally provide support to the inhabitants. However, during the emergency response, there is no barriers to support them.

This paper discusses community resilience based on the framework community resilience that consider three components namely actions, response or capacity and learning process. Beyond three dimension there are disaster risk governance which focusing on the programs applied by government. Furthermore, the interaction among three dimension will be classified based subjectively or empirical judgement to identify the propensity of the community resilience.

Departed from the result, this study categorized three communities into three types:

- **Type** 1: Dominated by actions, internal learning process at one scales, and low resources. Low risk governance lead to better disaster preparedness at the local level. This represent the case of Kampung Aur, Medan Maimun district where the vulnerable people succeeded to build their own resilience based on social capital. The process learning is based on their experiences that transferred from generation to generation. In the limited condition, community developed their own early warning to reduce loss during flood. The warning is manually informed by the people who stay close to the water gate and inform all the neighbourhoods to safe their property. This procedure could reduce loss.
- **Type 2**: Dominated by less actions, low learning process, and high resources particularly at the regional scale. In this condition, vulnerable people have low disaster preparedness. Low of preparedness is based on their perception that flood management is the responsibility of government. The community rely on the robust flood protection such as dams to retain surface water and it can reduce their worry. Based on the process on learning process, less worry will reduce their intention to establish self-preparedness. In that case, community also have less intention to develop local early warning.
- **Type 3**: Three dimensions of actions, resources, and learning process have their similar proportion at the community level. In this condition, community has a potency to enhance and maintain their capacity to building resilience. In this case, the action or strategy to cope and anticipate flood is still in line with the flood protection implemented by government. They also have resources which mainly come up from social capital for instance the commitment to establish early warning system voluntarily in order to avoid fatal loss and damage caused by flood. However, the learning process is leading to show the interaction with the higher scale of actors but only one way. The third type of community resilience has a better effectiveness in order to building community resilience.

Conclusion

The objective of this paper to explore an augmented community resilience particularly in urban areas by considering social learning. Social learning recently has less attention in the discussion of community resilience particularly among low income group or the most vulnerable group in the urban areas. The findings show that the social learning play an important role to build resilience in addition its interlinkage with actions and resources. Social learning can indicate the community resilience particularly in terms of their consideration to anticipate disaster.

Moreover, this study reveals that the interaction across scales and among different levels should not only occur in the social learning process but more important is in the dimension of action and resources.

We are clearly acknowledging that this result is departed from some cases study in selected neighbourhood in the cities which could not represent the city as a whole. However, the representation of vulnerable community in the cities could convince us to understand how community resilience is built and benefit to government and stakeholders to optimize their program.

We argue that in order to support the implementation of Sendai Framework and sustainable development goals, we have to consider everyone in the process of risk reduction. Therefore, the consideration of local existing capacity among the vulnerable group need to be included in the planning of resilience at the regional scale or larger scale.

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Effectiveness of First-aid Training in School among High School Students in Indonesia

Sutono[1], Achmad BF[1]
[1]Department of Basic and Emergency Nursing School of Nursing
Universitas Gadjah Mada Indonesia

ABSTRACT

The cardiovascular disease, especially the sudden cardiac arrest, was the main cause of death and disability throughout the world. The first-aid that should be taken by the first responder or witness was an important part in the chain of survival out of the hospital that could improve the prognosis and avoid the rest of the symptoms. Hence, it is important for common people to know and possess the skill, especially the cardiopulmonary resuscitation, to handle the emergency situation. Schools became the appropriate place to organize the first-aid training because the students were more conditioned in emotional, social and cultural terms. This research utilized the quasi-experiment method. The total number of research subject was 124 students, divided into three groups using three different methods, namely lecturing-discussion, poster demonstration, and audio-visual media. This research proved that the first-aid training in the school gave effect on the improvement of the knowledge and skill in handling the emergency situation, particularly the cardiac arrest through cardiopulmonary resuscitation. The pre-test and post-test results showed that there was a knowledge improvement after the training using the lecturing, poster and audio-visual methods. The difference of the pre-test and post-test scores was higher in the audio-visual group. The cardiopulmonary resuscitation skills in three groups showed the improvement after the first-aid training in school.

INTRODUCTION

Cardiac arrest was one of the causes of main death throughout the world. American Heart Association stated that more than 1000 persons experienced non-traumatic cardiac arrest that happened out of the hospital, including 26 children in the United States[1]. The first-aid training which was done by the first responder or witness was the important part in the chain of survival out of the hospital. Cardiopulmonary resuscitation (CPR) that was performed by the first responder enhanced the life possibility and avoided the rest of the symptoms. On the contrary, the delay in handling the cardiopulmonary resuscitation decreased the life possibility 5-10% every minute[2]. Therefore, it is important for ordinary people to be given the training in relation to the emergency situation, especially the CPR. Someone who has received the first-aid training would perform first-aid better and more confident in doing the CPR compared to those who have not participated in the training[3].

BACKGROUND AND SIGNIFICANCE

The cardiovascular disease, particularly the sudden cardiac arrest was the main cause of the death and disability in the whole universe. Around 17.7 million people per year died of cardiovascular disease within which the incidence of cardiac arrest always increased[2]. The 70% events of the cardiac arrest happened out of the hospital *(Out-of-hospital cardiac arrest*/OHCA) whom the first responder was the common people such as the family members, friends, neighbors, and other people close to them[4]. The life possibility of the people who experienced the cardiac arrest could increase significantly, two to three times, using the cardiopulmonary resuscitation by the people who first found them. This would reduce the brain damage and improve the return of the circulation. However, not all people knew the CPR technique. The individual competence level in performing the CPR had connection with the knowledge and the skills[5]. Therefore, the education and training for the first responder became an important matter[6].

The training and education about CPR will be more otimum if it is given to students in the level of senior high school. The students in the age of more or less 17 years are able to understand the materials of the first-aid and handling the emergency situation. This is in accordance with the consensus stating that in general the student in the age of 15-16 years or above have possessed the maturity to participate in the training, proper skill in performing the cardiopulmonary resuscitation, the willing to give assistance to the family, friends, or other people[7]. Schools in general are the environments that support the learning of emergency measures, particularly CPR, to identify the skills and knowledge to save lives. For the students individually, the training of CPR will enhance the knowledge and skills to save lives, increase mental awareness and preparedness in case of emergency, improve confidence and contribute to the community[1].

In Indonesia, the research on first-aid trainings in school have not been conducted much. The researcher noted one similar research with this research, that is, ”*Pelatihan First-aid untuk Meningkatkan Sikap dan Pengetahuan Guru di Sekolah Dasar”* (The first-aid training to Improve Teacher’s Attitude and Knowledge in the Elementary School)[8]. There were some innovations, such as the method of the training in this research varied in terms of lecturing, poster demonstration, audio-visual media, and simulation. In addition, the subjects of the training in this research were senior high school students, while in the previous research the subjects were elementary school teachers. This motivated the researcher to conduct research on the effectiveness of first-aid training in schools, particularly CPR for senior high school students in the level of knowledge and skills.

PURPOSE

This research aimed at investigating the effectiveness of first-aid training in improving the first-aid skills of school students in Indonesia.

METHODS

Design of the study

This research was a quasi-experimental research with one group pre and post-test design using quantitative approach. The data gathering was implemented by means of observation which was conducted before the experiment (T0) called pre-test and after the experiment (T1) called post-test. The difference between T0 and T1 (T1-T0) was assumed as the effect of intervention. The data gathering in this research was done in pairs, namely (pre-test and post-test) with the ratio data scale .0 and T1.

Setting and population of the study

The implementation of the intervention in this research took place in November 2018. The location of this research was in senior high schools SMAN 1 Kalibawang and SMAN 1 Samigaluh in Kulonprogo Regency, Province of Yogyakarta, Indonesia. This research used purposive sampling technique. The subjects of this research were 124 students who were divided into three group with different methods of intervention. The criteria of inclusion in this research were: 1) the eleventh grade students in SMAN 1 Kalibawang and SMAN 1 Samigaluh; 2) never involved in the first-aid training. This criteria of inclusion did not include the absent students when the data gathering was implemented. The research subjects joined voluntarily in this research.

Training characteristic

The intervention in this research was first-aid training in the schools that were conducted using three different methods, namely, lecturing-discussion, poster demonstration, and audio-visual media. First, the research subjects were divided into three groups that received the materials of First-aid in School about the CPR using three different methods. The subjects in three groups worked on the pre-test in 20 minutes. The material delivery to the three groups was conducted within 100 minutes, which consisted of 3 topics, namely: integrated emergency management system, introduction to emergency precautions, and the CPR based on the guideline from the American Heart Association 2015 (Table 1). After the material delivery, the subject in three groups worked on the post-test within 15 minutes. The pre-test and the post-test aimed at identifying the level of knowledge.

Table 1. Topics of Training

Topic	Sub Topic	Duration
Integrated emergency management system	1. The concept of Integrated emergency management system 2. Telephone numbers for emergency	20 minutes
Introduction to emergency	1. Introduction to cardiac arrest indicator out of the hospital 2. Introduction to the chain of survival	20 minutes
CPR based on the guideline of the American Heart Association 2015	1. CPR technique 2. High quality CPR	60 minutes

Second, three groups took part in the simulation training to perform the CPR in accordance to the guideline of the American Heart Association (2015). Before doing so, the subjects had worked on the CPR practice pre-test corresponding to their prior knowledge, each took 2 minutes (5 cycles of the CPR). The delivery of CPR skill materials with the methods of simulation was implemented using mannequin. The presenter delivered the CPR materials within 100 minutes and the subjects tried to perform the CPR one by one, each spent 2 minutes to finish 5 cycles of the CPR. The pre-test and post-test aimed at assessing the subject skills in performing the CPR.

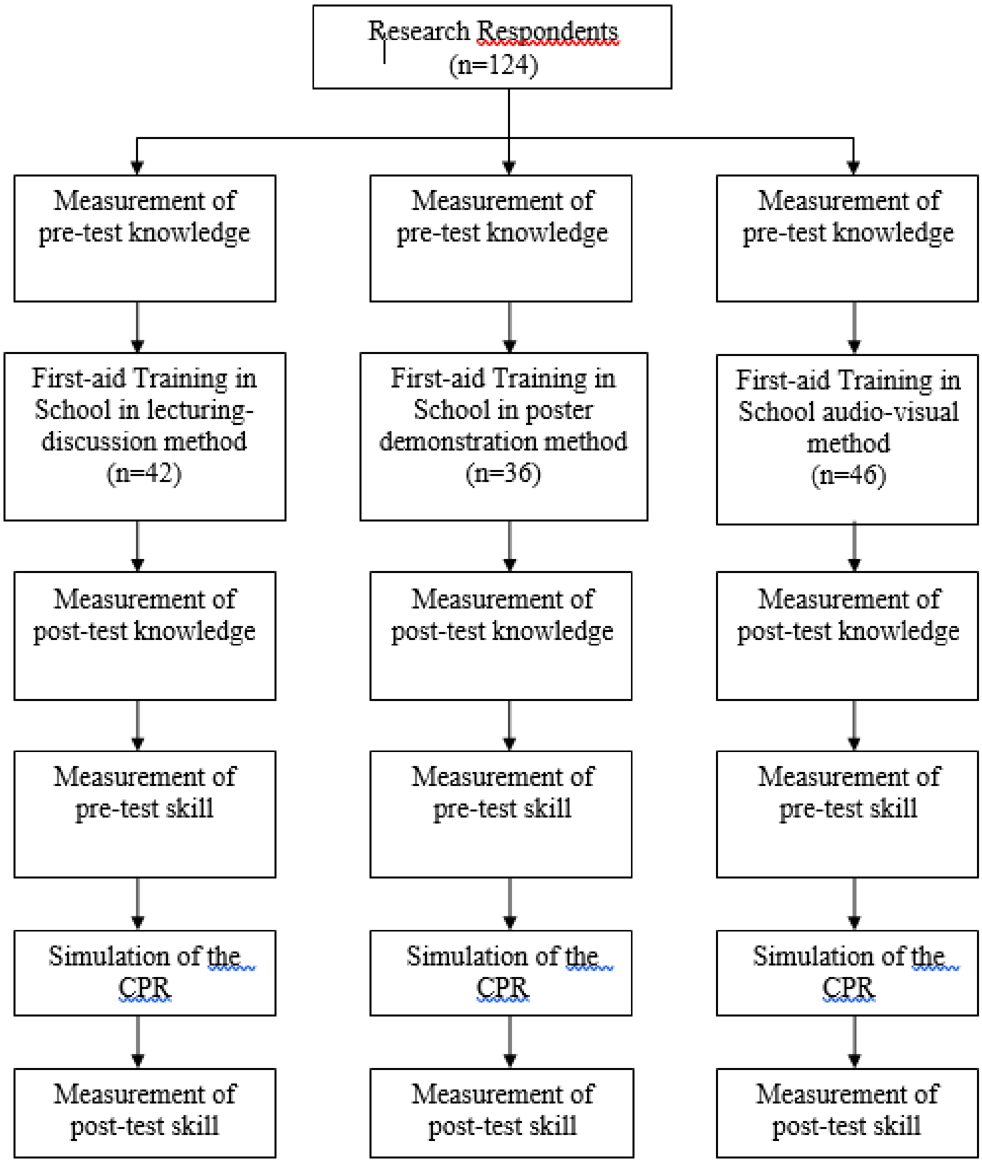

Figure 1. Research Flow

Instrument

The research instrument was the items of pre-test and post-test to measure the knowledge, and the other instrument was the skill checklist of the CPR skill laboratory of Nursing Science Study Program, Gadjah Mada University to measure the CPR skills.

The materials employed in the intervention of the First-aid Training in School were composed by the researcher team based on the AHA Guideline 2015. The pre-test and the post-test were developed based on the delivered materials, in the form of 10 items of multiple choice test with five options of answer.

Ethical Approval

The research ethical approval was issued by the Ethic Committee of the Faculty of Medicine, Public Health, and Nursing, Gadjah Mada University in registration number KE/FK/0016/EC/2019. The student participation in this research was voluntary and without any compensations.

Statistical Analysis

The research data were analyzed using SPSS version 22. The demographic data of the respondents were analyzed in term of univariate. In the categorical data, the data were presented in the form of frequency table and in the percentage, while the ratio data were presented in the forms of mean and standard deviation. The variable data of knowledge and skill were the numerical data with the pair samples, so the measurement of comparison between T1 and T2 utilized the Wilcoxon test because the data were not normally distributed. Before implementing comparison test, the normality test was done using Kolmogorov-Smirnov test.

RESULT

1. **Characteristics of the Respondents**

   The respondents in this research were 124 individuals. The respondents were the grade XI in two senior high schools, namely SMA N 1 Kalibawang numbering 96 individuals (77.42%) and SMA N 1 Samigaluh numbering 28 individuals (22.58%). Most of the respondents were female in the range of age 0-17 years. The selected respondents were never involved in the First-aid Training in School before. The characteristic of the respondents could be seen in Table 2.

Table 2. The Characteristics of the Respondents (n=124)

No	Characteristic (n= 124)	f	%
1	Gender		
	Male	53	42.74
	Female	71	57.26
2	Age		
	14 – 17 years	113	91.13
	18 – 20 years	11	8.87
3	School Origin		
	SMA N 1 Kalibawang	96	77.42
	SMA N 1 Samigaluh	28	22.58

2. **The level of knowledge and skill before and after the First-aid Training in School**

   The respondents in this research were divided into three groups and received the material of the First-aid Training in School in three different methods, namely, lecturing-discussion, poster, and audio-visual media. The level of knowledge before and after the First-aid Training in School were measured using pre-test and post-test. The result of the research indicated that the three methods of delivering the materials performed the significant improvement statistically (p=0.000) in the result of the pre-test and post-test. In this research it could be identified that the highest score difference between the pre-test and the post-test was in the method of audio-visual media.

Table 3. The Difference of the Level of Knowledge before and after the Training with the methods of Lecturing, Poster, and Audiovisual media (n=124)

Knowledge	Pretest		Posttest		p
	Mean	SD	Mean	SD	
Lecturing (n= 42)	43.57	13.58	87.38	11.70	0.000
Poster (n= 36)	38.06	12.61	81.39	12.22	0.000
Audiovisual (n= 46)	36.09	12.20	88.26	12.87	0.000

3. **The Skill before and after the First-aid Training in School**

The three groups of respondents in this research (lecturing, poster, and audio-visual media) joined the same training to increase the skill of cardiopulmonary resuscitation. The skill training to the three groups was conducted in the same method, namely pre-test, the material of the cardiopulmonary resuscitation skill, and post-test. The respondents performed the pulmonary cardio recitation as a form of pre-test and post-test. The result of research showed that there was a significant improvement statistically (p=0.000) in pre-test and post-test first-aid, particularly the cardiopulmonary resuscitation in the three groups.

Table 4. The Difference of the Level of Skill before and after the Training with the methods of Lecturing, Poster, and Audiovisual media (n=124)

Skills	Pretest		Posttest		p
	Mean	SD	Mean	SD	
Lecturing (n= 42)	24.52	11.16	84.76	11.84	0.000
Poster (n= 36)	37.00	6.63	84.97	13.20	0.000
Audiovisual (n= 46)	42.89	19.14	83.13	10.44	0.000

DISCUSSION

Many kinds of accident and emergency cases often happen in the school surrounding and can cause the risk of disability up to death. The accident and emergency need quick and proper rescue[8]. The cases of emergency often occur in the communities, one of them is related to the cardiovascular disease. This matter became the foundation for the American Heart Organization (AHA) to campaign the training for the students in junior high schools and senior high school to conduct the cardiopulmonary resuscitation training. Cardiopulmonary resuscitation training for the senior high school students gives benefits to reduce death due to the out of the hospital cardiac arrest[9]. Even though the incidence of cardiac arrest occurs in school is only 2.6 % of all sites in general, the training delivered to students in school can increase the CPR skill needed in any locations. Based on the research mentioning that the teen spent more time in public places, such as malls, most cardiac arrest incidences occurred in that kind of places. Hence, the introduction to CPR to the senior high school teenagers would yield significant effect to the cardiac arrest handling in the communities[7].

The prior knowledge on the First-aid in three groups, based on the pre-test scores, indicated the low result. However, after the material delivery, the result of the post-test indicated significant differences in the three groups. The highest difference between the pre-test and post-test scores could be found in the audio-visual group. It indicated that the audio-visual method was the highest method in increasing the knowledge on the first-aid. This was supported by the research reporting that the audio-visual method was considered to be more easily adapted and applied[10]. The leaning by the audio-visual media, through video show, increased the retention of the knowledge and skill after the training had finished[1].

In this research, it was found that the skill to perform the CPR increased statistically from the period before and after the first-aid training in school. This research utilized the method of hands-on experience so that all subjects who participated in the training would try to perform the CPR to the mannequin. The use of the method of practice while watching and hands-on experience would increase the psycho-motoric skill in CPR[6].

The first-aid training to the senior high school students decreased the fear in giving the rescue in the cases of emergency. The senior high school students possessed enough cognitive and physical skill as the first responder of the emergency case, especially cardiac arrest[7]. The First-aid Training in Schools, particularly to the senior high school students, exhibited the effective result. The research recommended the schools to conduct the first-aid training periodically. This is important to introduce to the students about how to handle emergency in a practical manner[11].

LIMITATION

The limitation of this research is that the training was focused only on the cardiopulmonary resuscitation technique for ordinary people, hence it can be added with the material of using Automatic External Defibrillation (AED) for ordinary people to increase the life chances in the case of cardiac arrest. This research can be developed to conduct further research to evaluate the retention of knowledge and skill after several months the first-aid training in school had been accomplished.

CONCLUSION

The implementation of first-aid training in schools gives benefits in handling emergency situations, especially out of the hospital cardiac arrests. This research has proved that the implementation of First-aid Training in schools affects the improvement of knowledge and skill in handling emergency, particularly cardiac arrests through the CPR. There was an increase of knowledge from before to after the training with the methods of lecturing, poster, and audio-visual media. The highest difference of pre-test and the post test scores was in the audio-visual group. The skill of cardiopulmonary resuscitation in the three groups indicated the improvement from before to after the first-aid training in schools.

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1.1.4. Application of Geographic Information System (GIS) for Landslide - prone Areas Determination: Case Study of Menoreh Mountains

Rachmad Padli[1], Maulani Rukya[2], and Titan Nicola Hoda[3]
Department of Geological Engineering, Faculty of mineral technology,
Pembangunan Nasional University, Yogyakarta 55283, Indonesia

E-mail: rachpadli@email.com

6. Abstract. Menoreh Mountain is one of the mountains in the Central Java province which is in the area that is prone to landslides. For this reason, landslide prone maps need to be made that can produce information about positions related to the level of landslide vulnerability around incised mountains. This map can be used as a reference in decision making for prevention of landslides in vulnerable areas, thereby reducing the number of casualties and material as well as planning in the construction of facilities and infrastructure. This analysis is carried out with geographic information systems by scoring parameters that affect the occurrence of landslides, namely: slope, soil type, rainfall, geomorphology and geology, Geomorphology of the Menoreh Mountains are dominated by two forms of origin, namely, denudation and fluvial. From the results of the study, it was found that zones that were prone to disasters had slope levels (15-45%) and in this prone area were dominated by weathered rocks, while safe areas had slope slopes (<15%).General instructions

7. Keywords: Geomorphology, Geographic information systems Menoreh mountains, Landslides,

1. INTRODUCTION

Based on astronomical location, Indonesia is located in (6°LU-11°LS). According to its location, indonesia known as a country with a tropical climate that has high rainfall and temperature intensity. Indonesia also has a varied topography form, such as lowlands, highlands, mountains, hills, and oceans. The high rainfall and sloping topography can increase the level of erosion that may occurs. Because of these factors, Indonesia become the one of country with a high risk natural disaster. For example earthquakes, landslides, floods, volcanic eruptions, and others.

Landslide is a natural process due to the influence of the earth's gravitational force, unstable slopes, and watertight rocks as a field of slip for the soil or rock body on it (Shape, 1938 in Thornburry, 1958). According to Van Wasten (1993), the causes of landslides consist of natural physical aspects and human aspects. Natural physical aspects include geological, geomorphological, slope, and climate conditions which consist of rainfall, humidity, and temperature. While the human aspect consists of land use, making road networks, and mining activities. These aspects are important for study consideration of landslide vulnerability.

Identification of potential landslide hazards by using a Geographic Information System (GIS) can be done quickly, easily and accurately. Landslide hazards can be identified quickly through the Geographic Information System by using overlaying and scoring methods on landslide parameters such as slope, soil type, lithology type, and rainfall, while non-natural factors include: land use and vegetation density. Through the Geographic Information System, it is expected that it will facilitate the presentation of spatial information, especially those who related to determining the level of landslide hazards, and can analyse, obtain the new information in identifying the target area of landslides.

2. METHODS

2.1 Basic Assumptions

The method that used in this study is a quantitative method with a geographical information system analysis procedure such as scoring and digitization of several parameters which become an influential factors of landslides. The results from this study are zoning of areas prone to landslides around the Menorah River, so it can be expected to be beneficial for the government and the community in overcoming and anticipating the danger of landslides.

The analysis phase is done by dividing the landform units. While the synthesis stage is done by combining the existing data, both primary and secondary data. Making landslide prone zoning maps are using Arc GIS software. This software is used to calculate the slope percentage, and evaluate the parameters that affect the landslide.

Table 1. Weighting natural physical parameters

Parameters	Verification	Weight	Score
Geology	Alluvial		1
	Limestone		2
	Marl	1	3
	Andesite		4
	Sandstone, Breccia		5
Geomorphology	Flood Plain, Alluvial Plain	3	2
	denudation Hills		5
Rainfall	50 - 100 mm/year		3
	101 - 165 mm/year	2	4
	166 - 200 mm/year		5
Soil Type	Alluvial		3
	Latosol		4
	Grumosol	1	5
Slope	0 -8 %		1
	8 - 15 %		2
	15 - 25 %		3
	25 - 45 %	3	4
	>45 %		5

2.2 Method of Getting Parameters

Five parameter maps are used to create landslide hazard maps, land maps, slope maps, geological maps, and rainfall maps. Parameter data comes from existing topographic maps, aerial photographs and field surveys.

The slope map is obtained from the processing of digital elevation model (DEM) data using arcgis 10.5 which is processed through geoprocessing and then adjusted its classification based on the slope map which has been successfully classified.

Geomorphological maps can be obtained through interpretation of aerial photographs and using a digital elevation model (DEM) which has been converted into hillside so that land forms can be seen 3 dimensional form in the Menorah mountains and classified into two land forms namely denudation and fluvial.

Geological maps, soil type maps, and rainfall maps are build from the results of digitization using a global mapper software then processed using arcgis and make a parameter map based on the limits on each parameter.

2.3 Scoring Landslides

Landslide hazard zones consist of spatial probabilities of landslide events that can be carried out by the different hazardous zone areas or by the occurrence of events that trigger landslides disaster. An alternative method for creating a landslide hazard map is needed to solve the problem in that area. Quantitative systems can be used to bridge qualitative and quantitative methods by evaluating parameters on making landslide hazard maps (Van Westen et al. 2003).

An indirect mapping approach can be applied to establish different landslide hazard zones using the digitization method using geographic information systems (GIS) after making maps that represent factors which affect landslides. Then, create a mapping unit to assess the danger of landslides using the five existing parameters.

Prepare geomorphological maps, slopes, geology, soil types, and rainfall before overlaying the existing parameters. From each parameter gives a score and weight, and a landslide hazard map can be obtained by calculating the total score through a combination of adding and multiplying each parameter map in GIS using the following basic formula:

Landslides Hazard Zonation = ({Slope}*3) + ({Geomorphology}*3) + ({Rainfall}*2) + ({Geology}*1) + ({Soil Type}*1)

2.4 Parameter Maps

Geomorphology of Menoreh Mountains are include 3 land forms, such as denudation hills, flood plains, and alluvial plains. The denudation process can be clearly identified in the research area, because it has high hills and can be seen in a particular process of erosion or landslides. Very intensive denudation process usually occur in agricultural areas. The flood plain is identified because it is close to the river, while the alluvial plain is seen as a plain that is used as agricultural land.

The composing rocks that make up the incised mountains are located in the progo stratigraphy where all the rocks that form the formation in Kulon Progo are all in the Menoreh Mountains. The Menorah Mountains are composed by the lithology in the form of andesite brick which is the result of intrusion of the Menorah mountains, besides that it is also found andesite breccia, sandstone, and sea deposits such as limestone, marl, and alluvial deposit.

Slope map is the result of digital processing and divided into 5 classes based on slope perceptions in the menorah mountains. It can be classified into 0 - 8% and the steepest is > 45% slope gradient. In the study area almost 40% of the area are dominated by steep slopes.

Rainfall map and soil types were obtained from BPS Progo 2012 and RKPD Kulon Progo 2016 then carried out to get the map.

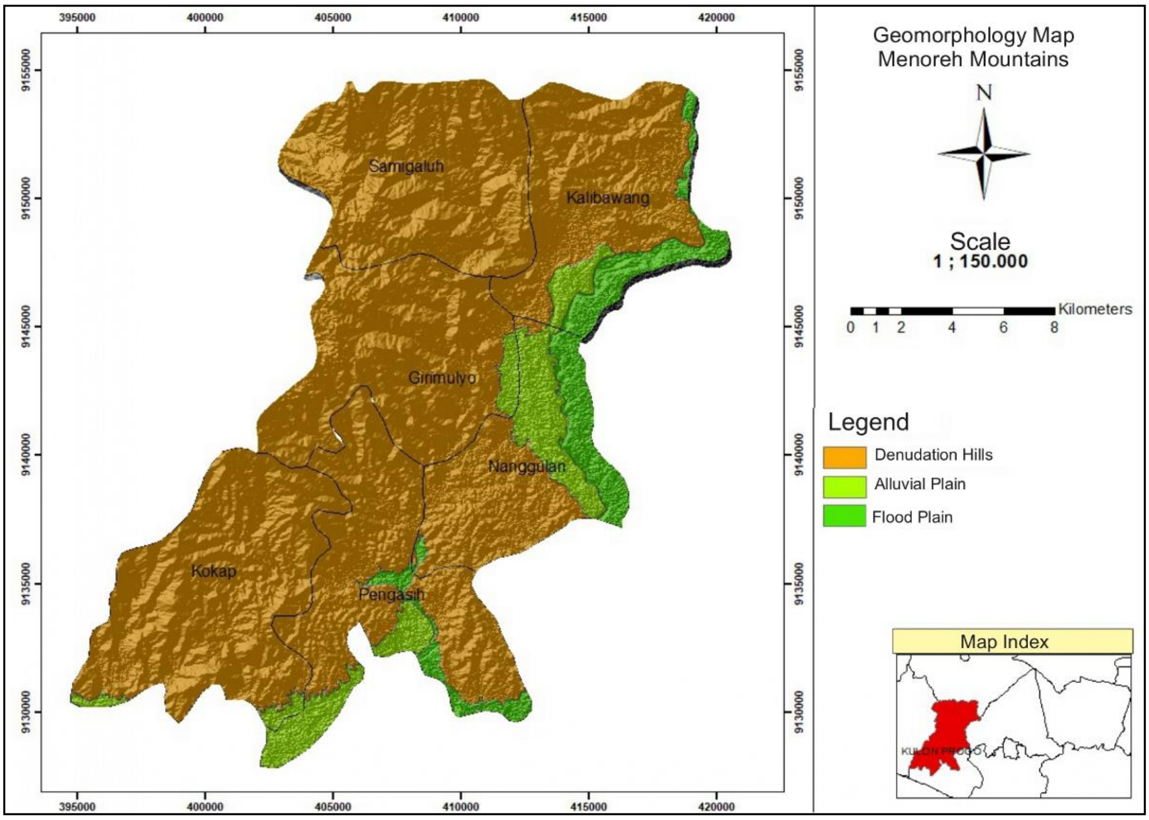


Figure 1. Geomorphological map of the study areas in the Menoreh Mountains

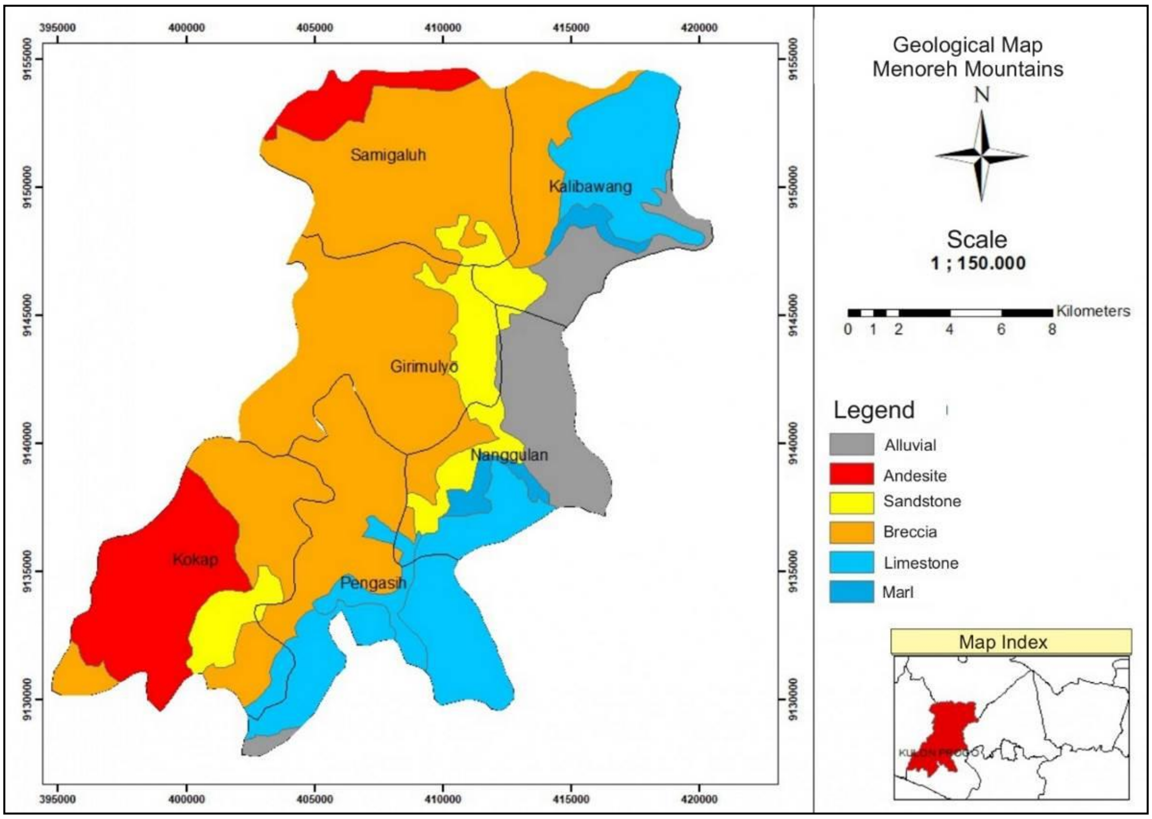


Figure 2. Geological map of the study areas in the Menoreh Mountains

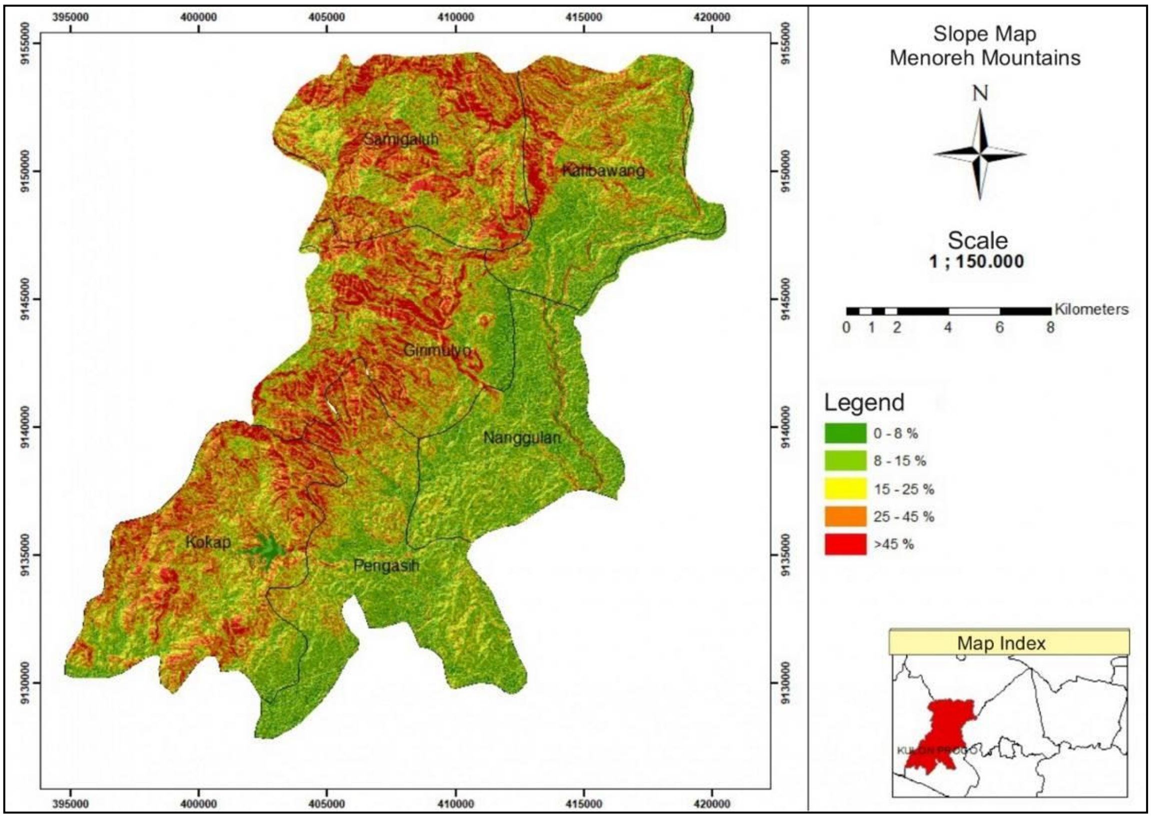


Figure 3. Slope map of the study areas in the Menoreh Mountains

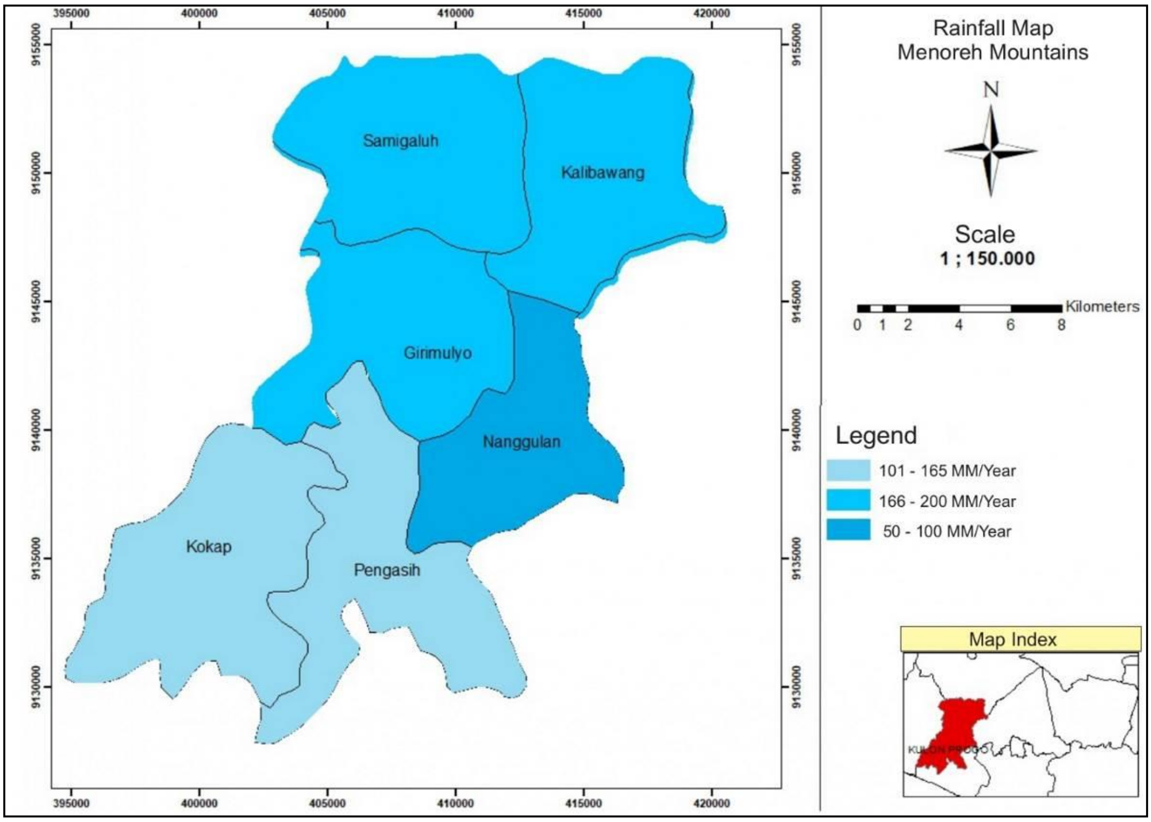


Figure 4. Rainfall map of the study areas in the Menoreh Mountains

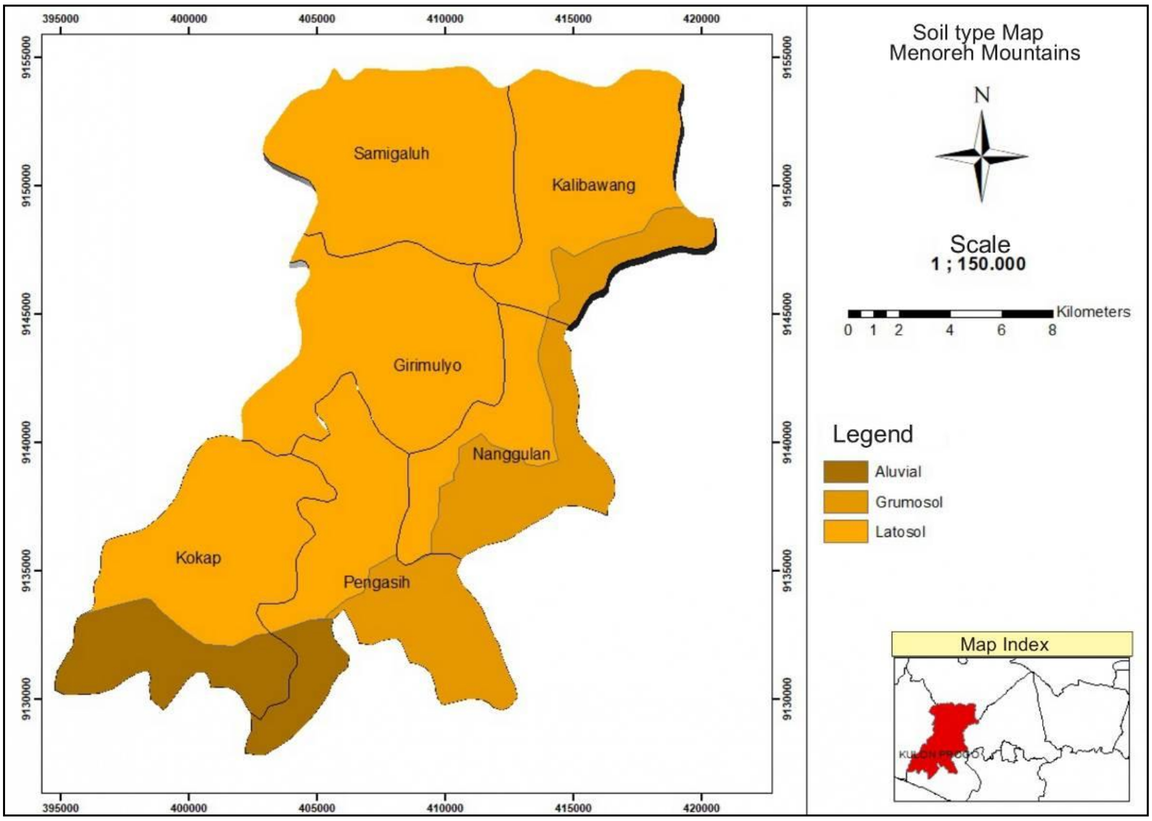


Figure 5. Soil Type map of the study areas in the Menoreh Mountains

3. Results and Discussions

From the analysis using arcgis software there are several danger zones which divided into 5 zones. Low danger zone (safe), can be interpreted as a stable and safe area without any identifiable land movements, and that safe areas are located on gentle slopes (0-15%). This area is often associated with the morphology of alluvial plains and floodplains and covered by loose or alluvial material. The percentage of the total area classified as a low hazard zone is (25%).

Moderate hazardous zones are usually associated with small landslides. These areas cover the lower slopes of the Menoreh mountains including the foot of the slope of the denudation hill. Approximately (60%) is classified as a moderate hazard zone, which is characterized by steep slopes (15-25%). Geologically, this zone is usually occupied by weathered rocks, while the slope is parallel to the slope. The incidence of landslides is relatively high, around 10-25 landslides occur every year. (BAPPEDA).

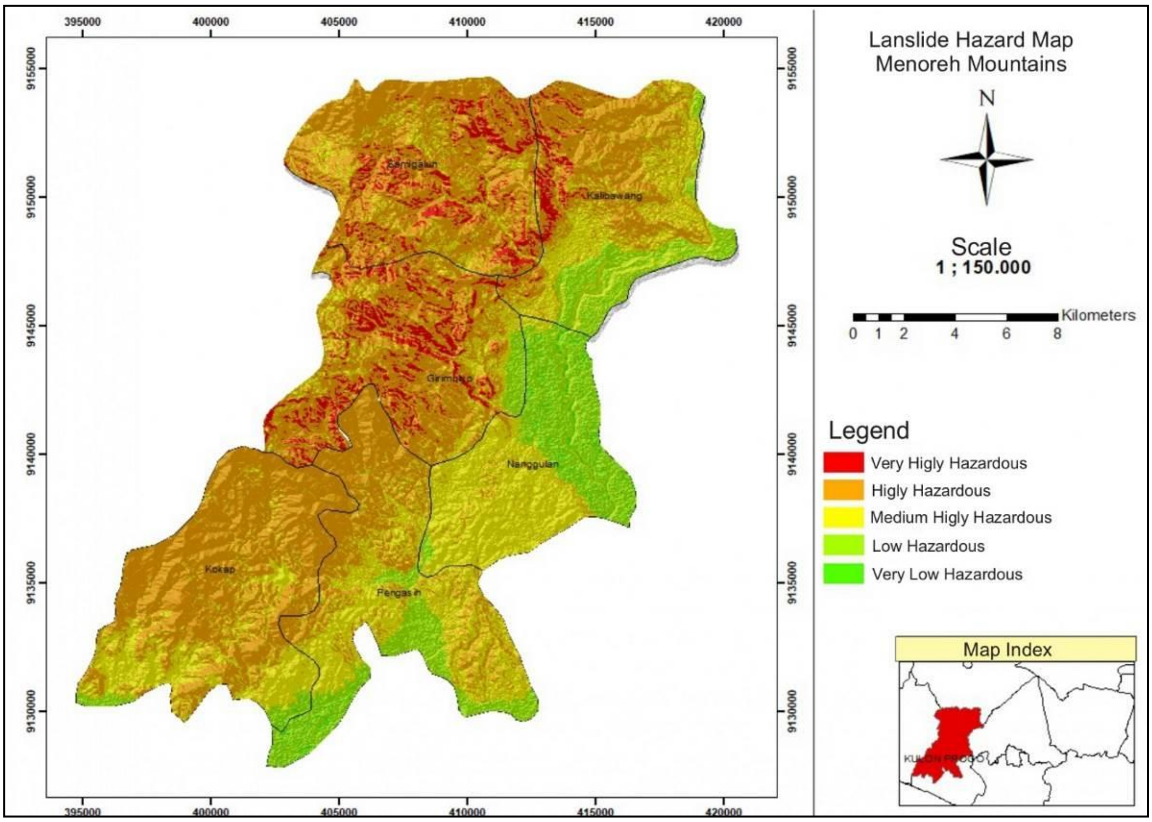
The percentage of the total area that has very high or vulnerable landslide vulnerability is 15%. The slope in these areas is more than 45%, the slope is parallel to the slope, the rocks found are usually porous rocks such as sandstones and breccia. In the case of technical geology, the area that has the highest risk of landslides must be avoided from the construction of facilities or infrastructure due to dangerous areas.

In the high hazardous zone, many landslides occur. These areas clearly show evidence that this problem can be identified from active landslides or reactivation in some parts of the location of old landslides. The percentage of the total area with a very high landslide vulnerability is 15%. The slope in these areas is more than 45%, rocks that have many fractures, more than 25 landslides occur every year. Landslides are expected to cause casualties, damage infrastructure, buildings and agricultural areas. Construction of buildings must be avoided in this area or at least not until effective mitigation measures are installed

Table 2. Index Scoring of Landslides

NO	Slope Percentage	Index of Hazardous
1	0 - 8 %	Very Low Hazardous
2	8 - 15 %	Low Hazardous
3	15 - 25 %	Moderately Hazardous
4	25 - 45 %	High Hazardous
5	>45 %	Very High Hazardous

Figure 6. Landslide Hazard map of the study areas in the Menoreh Mountains



4. Conclusions

The analysis results using a geographic information system by combining several parameters resulting in disaster-prone zone maps that categorized into 3 zones, safe zones (25%), moderate (60%) and prone (hazards) (45%). From landslide hazard map analysis have a correlation with geomorphological maps and slope maps. It is show with some areas that has morphology and gentle slopes and usually in the form of alluvial plains and floodplains with loose material as their constituents. Medium prone areas have morphology and gentle slopes - rather steep and usually correlated by denudation landforms and the rate of morphology associated with steeply slope. It is also followed by denudation hill landforms and arranged by porous rocks such as breccia or sandstones.

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Surabaya: Flood Management in The Past and City Management in Today

1.1.5. **Erlita Tantri, Choerunisa Noor Syahid[1]**

[1]Research Center for Regional Resources, Indonesian Institute of Sciences, Widya Graha Building 8th Floor, Jl. Gatot Subroto Kav. 10, Jakarta Selatan, 12710, INDONESIA

E-mail: erlita_tantri13@yahoo.com, c.runisa@gmail.com

Abstract. Through historical and the latest literature studies, this paper tries to look into the flood control in Surabaya in the 20th century and city management of Surabaya city in the 21st centuries or today. Surabaya was one of the important city behind Batavia in the colonial period. As the center of an economic hub, Surabaya 20th century tried to limit and negotiate any natural problems such as flood problem. Dutch administration applied some technologies and management to control flood and its impact by building water works, river maintenance, and *kampong* improvement. Likewise in the 21st century, Surabaya flood control was focused on river maintenance since Surabaya surrounded by some rivers. Besides, after becoming a decentralized city, Surabaya today tries to become a sustainable city by creating a good and friendly environment. Through community participant awareness to the environment, the local government tries to manage and build good/smart city today. However, communities in *kampong* areas that usually threatened by the flood, their awareness are still important in creating a good, smart, liveable and green city.

Introduction

As the second largest city behind Jakarta, Surabaya faces a number of environmental challenges. One of the problems often faced by Surabaya is a flood. Flood disasters in urban areas are usually caused by two things, namely natural hazard and human behavior [1]. Susetyo (2008) states that flooding which caused by natural hazard mostly by high rainfall, wind, and rob, whereas due to human activities are ignoring the environment, littering the river, trapped water due to poor drainage channels, and the misfunctions of land. These are most causes that flood frequently happened in urban areas such as Surabaya.

Since Surabaya developed became city after Indonesian independence and became a decentralized city in the 1990s, Surabaya tries to become a sustainable city by facing urban problems such as a flood. Surabaya attempts to create the friendly environment by increasing community awareness to ecology. Hopefully, it becomes the way to decrease one of flood threat in Surabaya. Then, this paper would like to describe Surabaya flood problem in the past and the Surabaya's management city in today to create a well environment.

Surabaya Flood Control in 19th to 20th Century: Water works, River Maintenance, *Kampong* Improvement

Flood is one problem in deltaic areas and Surabaya is one of deltaic city that face flood problems since colonial era. Before the twentieth century, Surabaya was frequently flooding that caused by the Brantas River overflowing. The Brantas River is the second largest and the important river in East Java. It has branches and one is Surabaya River that divides into two other rivers, Kali Mas (plus Pegirian River) and Wonokromo River. Besides irrigation, river was very important in colonial periode as the source of water for colonial agricultures and plantations.

Irrigation of the rice fields and plantations in Java indirectly controlled the water flow, particularly in the rainy season. Wim Ravesteijn mentions that Dutch knowledge about water management was very useful in preventing flood. Yearly floods (*banjir*) in the Netherlands Indies became a challenge for Dutch engineers and Dutch water management was generally directed towards water level control and connected to irrigation systems [2]. Under a *hoofdwerken* (head works), Dutch built *stuwdammen* (dams), *inlaatsluizen* (inlets), and *hoofskanalen* (canals) which was used to control the water (*stelselmatig*) distribution and management. Furthermore, the work was increased to dry out places that contained water *(ontwatering*).

The Dutch flood works departement was established in 1854 on the name of a Public Work Department (*Burgerlijke Openbare Werken* Department – B.O.W.). It had a division of Irrigation and Drainage (*Irrigatie en Waterafvoer*) [3] that worked to improve the irrigation systems by using *roldeuren* (floodgates) and *schuifdeuren* (sliding doors). This division indirectly played a role in managing and accelerating the water flow that were useful for flood defense in the rainy season. For the matter, the irrigation system was created to collect water and discharge it to certain areas for farming and plantation. As a flood control, the irrigation systems collected the water from the river and rainwater, then stored as reserve water for the dry season.

In 1917, the *Waterstaatsafdeeling* planned flood-free planning for the central city by a radical change in the hydraulic conditions surrounding Wonokromo [4]. The Wonokromo Canal was constructed, while a big ditch and drains were built near Kali Mas and Wonokromo. These works were carried out to overcome flooding of the frequently high river-water level between Wonokromo and Gubeng [5]. The Wonokromo project, encompassing a drainage system, canal, floodgate construction, and land elevation, was handled by the *gemeentewerken* (Division of City Works) and supported by the Mayor and Division of City Health. The importance of the Wonokromo project motivated the *gemeentewerken* and B.O.W to set up a special bureau, the *assaineeringsbureau* (1920), with the special aim of taking out puddles and floodwater in *gemeente*'s and *particulier*'s (private) lands [6].

Generally, drainage system as a flood control in Surabaya was connected to public work and health. Public works in the construction and development of the drainage system in Surabaya in the early twentieth century were followed by some improvements and maintenance on the rivers. The river has a role as a final disposal and primary drainage within the city. Improvements are to the river by dredging, widening, cementation of the river side, and dike reinforcement. River maintenance is called river normalization which is aimed at restoring the river's condition, which in turn can overcome the risk of an overflowing river.

The floods in Surabaya in the early twentieth century were frequently caused by river overflow and poor drainage. The increasingly silted rivers with sedimentation of waste, garbage, mud, sand, and debris had disturbed the rivers' capabilities to accommodate the water and act as a traffic line in the city. The widening and dredging of the Kali Mas was carried out downstream to Ujung in order to improve water capacity, strengthen the banks of the Kali Mas, and to widen the traffic line [7]. The broadening of the Kali Mas enhanced the mobility of products to the station, where some warehouses were located. This, however, eventually decreased the labourers' income, as they had previously brought the trade products from Kali Mas to the station and vice versa.

Before the twentieth century, floods frequently took place in the poor areas or indigenous *kampong* squares, which had the problem of clogged sewers. Most sewers could not work well in the rainy season and stank unpleasantly in the dry season. The poor sewage system remained in place because the habitants could not afford to construct their own, good sewers. Besides, the head of the *kampongs* did not have the bravery or encouragement to report the condition of the sewers to the local or central authority.

Post-flood problems in Surabaya City had showed that every area was vulnerable. The impact of the floodwater had become the basis of improvement, particularly for the areas that were suspected as the source of the problem. Most floods within the city were caused by poor drainage systems which could not accommodate the rainwater. Many existing or traditional drains were in poor condition. Clogged drains and stagnant water became a problem for residents' health and was viewed to have come from crowded indigenous enclaves. Therefore, after the 1911 plague, the hygiene of *kampongs* began to be measured. The Health Service (*Dienst der Volksgezondheid* - D.V.G) was founded in 1911 and the Local Health Service (*Plaatselijken Gezondheidsdienst* - P.G.D) was established in 1916 in Surabaya as a part of the hygienic service of East Java [8]. Following the disease eradication effort in 1920s in Surabaya, *kampong* improvement began in 1924 by the establishment of drains and sewers. Special improvements on the drainage system were conducted based on the impact after the flood season. In 1925, *kampong* improvement was performed systematically and directed at establishing drains, gutters, pump-stations, public baths and toilets [9].

Gemeente Soerabaia Besluit No. 77/No. 3276.12, April 14th 1917 stated that Surabaya's assistant resident requested that the city pay attention to *kampong,* canal and drainage improvement, carried out by the *gemeentewerken*. About *f* 320 was provided for 80 metres of small canal and sewer constructions. Money was taken from the municipal budget for the malaria eradication program which was given by central government (about *f* 25,000) [10]. Initially, the *gemeenteraad* showed not intention to participate in *kampong* improvement. Although *kampong* improvement received funds from various parties, plus tax and rent from communities, the *gemeenteraad* Mr. Morren felt that the effort was too excessive and could not be tolerated. The city's tax and land rent revenues were assumed to be lower than the cost of *kampong* improvement [11].

Kampong improvement was often directed at regions that had health and hygiene problems. The areas typically had many puddles and widespread stagnant water that triggered health hazards such as malaria, pests, and typhus for *kampong* dwellers and their surroundings. Indirectly, *kampong* improvement was aimed in forming good drainage and sanitation after the effects of plague [12].

The role of *kampong* improvement was related to the effects of flooding on the outbreak of diseases such as malaria, cholera, and dysentery. The diseases mainly broke out in the crowded and disorganized indigenous settlements. The *Kampong* improvement program included drain and sewer construction, and this improvement constituted part of the efforts to avoid flooding in the indigenous squares.

The issue of health became a dominant reason for preventing floods in some areas, even though methods such as floodgates simply diverted floodwater to another place to protect the certain areas. For instance, the floodgates of Gubeng and Ngemplak or Gunung Sari were controlled to protect the industrial areas (Ngagel), new high-class settlements, influential infrastructures (railways, main road), and trade centers. Finally, flood control was usually planned to improve public facilities, which were developing quickly alongside economic and population growth. Flood works were also usually conducted after an exceptional flood, based on the condition and location, and highly dependent on uncertain city cash or central government funds. Therefore, preventing flooding was difficult for a developing city, especially in terms of finance. Eventually, a master plan would be considered useless because of unpredictable economic, social, and natural conditions.

8. Surabaya City Management Today: An Integrated of Hard and Soft Infrastructure Planning

After reform that occurred in 1990s, urban governance in Indonesia has much impact. Earlier before reform, centralized was dominated but after reform, it was changed to be decentralized and developed to good governance. At present, the development of governance is focus more on community participation. Community active role is important as the basis for city development. Active participation from the community is the key in many cities in the world. Surabaya city government really belief with this point and community engagement are become their commitment to realize Surabaya environmental-friendly city.

As nationally perspectives, Indonesia had experienced in hard situation that occurred in the end of New Order era. This degenerate situation was suffered in the end of 1997 and the peak happened in 1998. At that hardest period, Indonesia became paralyzed country. It was very noticeable in many major cities in Indonesia, include Surabaya. During this period, Surabaya experience with dramatic and drastic decline in every single line sectors, such as economic, social, and environment as well. The most highlighted of these period was the degenerated of government system implementation. It was exposed that the government system was not managed properly, and then it has a huge significant impact to the development in Indonesia. Moreover, in the New Order era, Indonesia used centralistic system which were local government very depends on the national government. Since this situation, by the time Indonesia suffered monetary crisis, then it also has significant impact the local level. However, eventhough Indonesia need sometime to rebuild after monetary crisis, but for the government and administrative system it was become an entry point for a new paradigm. Nowadays, this system has been growing rapidly with significant improvement.

The changing of administrative system from centralize to decentralize has brought Indonesia into significant alterations, including development planning process in urban areas. Previously, in the New Order era, the power was absolutely placed in the national government's hands, both in legislative and executive level. This authority was emphasized by law of UU 1945 in clause 1 paragraph 2 that stated "Authority is in the hands of the people and it carried out exclusively by People Consultative Assembly (Majelis Permusyawaratan Rakyat or MPR)". However, after the New Order era collapse, then this clause changed into "Authority is in the hands of the people and carried out according to the 1945 Constitution (UUD 1945)". This statement directly changed the existing government and its administrative system at that time.

Decentralize system has brought Indonesia into a new phase of government and governance system. Decentralize system give full authority to the local government. Through law UU no. 22/1999 about Local Governance [13], it stated that governance system in Indonesia has changed, from centralize system to decentralize system. The idea of changing system on governance process was a way to give a concrete step to democratic process for Indonesia. Through decentralize system, national government gave a real power, responsible, and authority for the local government. This local government right established in 1999 through UU law no. 22/1999, that mentioned in article 11 verse 2 about the Sub-National government's authority and responsibility, especially in District and City levels. The responsibility were included in managing public works, health, education and culture, agriculture, transportation, trade and industries, investment, environment, land, cooperatives and labour.

As previously mentioned, after decentralize system has been implemented the local government in city/district level more powerful to choose their city development path. Related to this, based on the Long Term Development Plan (2005-2045), Indonesia is eager in realizing sustainable development goals. Currently, BAPPENAS as the national plan department has indicate three keys of development in the city level, which are (1) liveable city, (2) green and resilient city that able to face a antural disaster, and (3) smart city with technological based and competitive [14] (Bappenas, 2016). Those three keys are the framework of Indonesia future plans.

In Surabaya's case, the mayor and local government interpreted the national goals in achieving sustainable development into their city's vision and mission. Nowadays, the

Surabaya city's vision is "to make better Surabaya become the trade and service city with global competitiveness, civilized, smart and environmental friendly" (Surabaya city government, 2015) [15] but stands for natural hazard such as flood. This city's vision is continuity from the previous major in 2001. After decentralize system implemented in Indonesia, Surabaya want to improve the city's administrative governance at that time. Currently, Surabaya has been successful in elevating their economic growth and be more competitive after monetary crisis suffered years ago. At the same time, the governance improvement has been effectively brought back public trust to the local government.

Surabaya has vision to make this city civilized, smart and environmental friendly at the same time. The people of Surabaya's on ecological awareness become important to be highlighted, particularly in case of flood threat. Actually the environmental issue is not an innovative issue in urban development, since during the New Order era on Pelita III (third of five years plan) in 1979, environmental issues has been arise [16]. This issue was recognized after many countries joint on Bruntland Commission conference in developing Sustainable Development concept. However, at that time Indonesia looked the environmental issues was separated part from social and economic aspect. During the New Order era, environmental management in urban areas was regulated by the central government. In addition, at that time since the environmental management was fully-handled by the central government, then it lead to the lack of community's awareness.

Related to the developing of community's environmental awareness, there is an interesting statement from Prof. Johan Silas, who act as Surabaya's city consultant. During the interviewed he said that, the city mayor of Surabaya always listen what do the community needs and desires. In addition, on his statement he also mentioned that Surabaya want to be a smart, liveable, and green. Through realizing these three points, the Surabaya will contribute to Indonesia's development goals. However, what the Surabaya city government has been done was motivate and stimulate their citizen to keep aware about what the government doing.

Based on Prof. Johan Silas statement, through community participation processes Surabaya really found what they have and what they should have in managing the city. Social capital is the important point, especially in constructing trust between community and also between community and local government. Robert D. Putnam in Martti Siisiainen (2000) [17] see that there are three components of social capital, which are moral obligations and norms, social values related to trust, and social network. Trust will be delivering and encouraging a person or community's interest to be actively involved. Through this processes, the creativity and innovative can be growing and can be used to improve their city image.

The community participation awareness in development planning becomes an important point that considered by the city planner and it stated in government regulation. Especially after sustainable development issues arise, stakeholder collaboration are the most important issues. Community awareness hepefully care to flood threat and causes. Smart city development is a tool to realized sustainable development. Smart city raised in the technological era with the massive of urban population growth. The main objective of this smart city processes is to realize liveable, accessible, and socio-environmentally comfortable [18].

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The Community Capacity of Kampung Warna-Warni, Malang City in Dealing with Floods and Landslides

Turniningtyas Ayu Rachmawati[1)], Dwi Rahmawati[2)], dan I Wayan Suyadnya[3)]
[1,2] Urban and Regional Planning, Universitas Brawijaya
[3] Jurusan Sosiologi, Universitas Brawijaya

e-mail: t_tyas@ub.ac.id[1)], rahma_dwi15@yahoo.com[2)], wayan_suyadnya@yahoo.com[3)]

Abstract. Kampung Warna-Warni meaning colourful village (hereinafter refer to as "Kampung Warna-Warni") is one of the thematic villages in Malang City that is prone to floods and landslides. The development of the Village for tourism activities increases the risk of floods and landslides. Community capacity, the ability to respond and recover from disasters, is crucial in disaster risk reduction. Community capacity towards disasters can be measured by calculating the asset pentagon where through five perspectives (human capital, natural capital, financial capital, physical capital, and social capital) the capacity of the Kampung Warna-Warni community in dealing with floods and landslides is obtained. The results of the analysis show that the Kampung Warna-Warni community capacity in dealing with floods and landslides is in the low category. The low level of asset ownership is caused by low household financial capital.

Kata Kunci: Kampung warna-warni, pentagon asset, capacity.

1. Introduction

To improve the quality of the village thus realize the *1-0-100 program* (a program of providing 100% access to drinking water, 0% of slum areas, and 100% of sanitation and drainage facilities) Malang City organized a village thematic program to eradicate slums as implemented in Kampung Warna-Warni. The initial idea of the Kampung Warna-Warni program was a private initiation supported by the government. Improvements on the visual and environmental aspects makes Kampung Warna-Warni become one of the tourist destinations in Malang City offering beautiful spots for taking photographs and selfies, from which the community take benefit by selling unique souvenirs, parking fees, and entrance tickets.

Kampung Warna-Warni, based on the 2017 Malang City Disaster Management Plan document, is one of the areas prone to floods and landslides thanks to its location on the banks of Brantas River. Due to its floods and landslides potentials, and tourist visits, the community is required to be able to cope with the disaster independently to minimize loss of life and property. Therefore, it is necessary to review how the capacity of the Kampung Warna-Warni community in dealing with floods and landslides.

Capacity is a combination of all strengths, completeness and community resources, social groups or organizations that can be used to achieve agreed objectives, including matters relating to disaster risk reduction [1]. Households that have assets and are called high-capacity households are generally more resilient and more able to create livelihood strategies than are non-asset households. The ability to create livelihood strategies depends on the material and social basis, as well as the tangible and intangible assets that the community has. The sources of creating livelihoods can be seen as basic capital for different productivity, depending on what kind of livelihood that is built [2]. These community capital are known as livelihood assets. In realizing the achievement of livelihoods, the community needs a number of assets, including various strategies to process and utilize available assets.

Livelihood assets are known as pentagon assets as they have five assets that people need in their livelihoods. Pentagon assets are at the core of the livelihood framework in the context of vulnerability. Pentagon assets are developed so that information about people's assets can be presented visually and can show the connection between assets [3]. These assets are human capital, natural capital, financial capital, social assets, and physical assets [2] [3]. The balance between assets is a particular community specificity resulting in the importance of describing the accuracy of the assets of each community [4]. The components of livelihood assets are:

1. **Natural Capital**: a beneficial condition for livelihoods, that can be viewed from the ease of access to clean water and the environment around the residence [5] [10].
2. **Financial Capital**: Poor households without financial capital (savings, property, access to credit), that can become poorer when affected by a disaster. Communities with higher economic levels will have lower financial losses compared to those with low economic levels [6].
3. **Social Capital**: the higher ownership of social capital will form joint actions to achieve common goals in the recovery of the impact of disasters, and reduce conflict because of the high level of trust among fellows [7] [10].
4. **Human Capital**: investment in knowledge and skills, that can also be in the form of education, training and health [5] [8] [9]. The higher the level of the knowledge, the greater the level of household capacity in facing threatening hazards.
5. **Physical Capital**: an asset owned by a household and is used to sustain life. Physical capital also interprets the physical conditions of the living environment to guarantee security from the negative impacts that threaten a person.

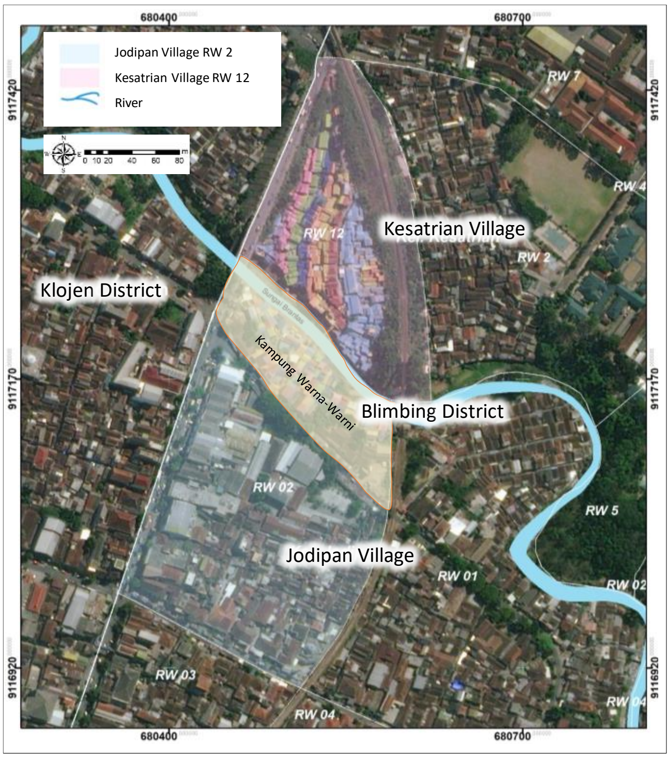


Figure. 1. The location of Kampung Warna-Warni

2. Method

The analysis technique used is descriptive quantitative using pentagon assets analysis. The location of the study in Warna-Warni Village is covered in the administration of RW 02, Jodipan Village, Blimbing District, Malang City **(Figure 1)**. Sampling is determined through probability sampling techniques and taken randomly (simple random sampling) from a total population of 109 households. Using the Isaac and Michael formulas the number of samples is 85 families.

Calculating Kampung Warna-Warni's capacity for disasters through the asset pentagon analysis is carried out through the following stages:

1. Calculating the average answer to the respondent's questionnaire,
2. Classifying the average answer according to **Figure 2**.
3. Calculating the index of each capital based on the respective parameter score,
4. Calculating the pentagon area of each village with the following formula:

$$Area_{pentagon} = \left(\frac{1}{2}\,ab.\sin 72^0\right) + \left(\frac{1}{2}\,bc.\sin 72^0\right) + \left(\frac{1}{2}\,cd.\sin 72^0\right) + \left(\frac{1}{2}\,de.\sin 72^0\right) + \left(\frac{1}{2}\,ea.\sin 72^0\right)$$

5. Mapping asset ownership on the pentagon diagram (**Figure 3**).

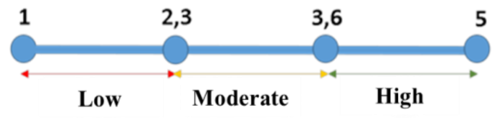


Figure. 2. Range of values and classification of questionnaire answers for each capital

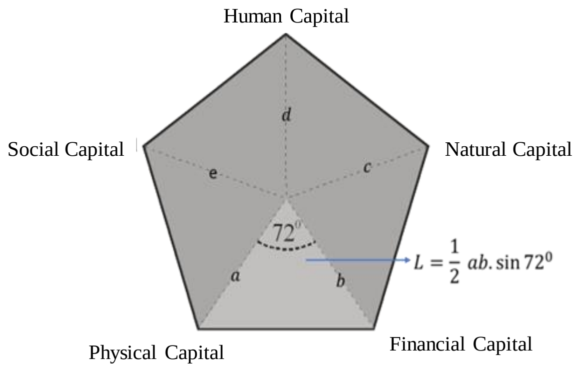


Figure. 3. Pentagon Area

3. Result and discussion

The capacity of the Kampung Warna-Warni community for floods and landslides is identified by several parameters by classifying each parameter **(Table 1)**. Calculating the capacity level parameters and aspects obtains the level of ownership of human capital, natural capital, social capital, financial capital and physical capital that will be classified into high, medium and low category. The identification results of the five capitals will produce a pentagon shape for each village which is the basis for classifying the level of community capacity in three typologies: high, medium and low capacity.

A. Human Capital

Human capital reviews more about the readiness and attitudes of the Kampung Warna-Warni ommunity in responding to disasters and maintaining the existence of their village. There are people who are not aware that they live in disaster-prone areas, who are less likely to be ready to deal with disasters, neither is aware of how to behave nor bear the consequences of their adverse effects. This is due to the fact that they have never participated in disaster training, only 25% participated in disaster training. The lack of knowledge of the disaster is the basis for conclusions that the people in Kampung Warna-Warni need additional insight into disaster.

TABLE I
INDEX CLASSIFICATION AND PARAMETER VARIABLES OF KAMPUNG WARNA-WARNI CAPACITY

Capacity Aspects	**Parameter**	**Capacity and Parameter Classification**		
		Low	**Moderate**	**High**
Human Capital	Percentage of people aware of living in disaster prone area	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
	Percentage of people joining disaster mitigation training	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
	Percentage of people joining PKK activity	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
	Percentage of people joining thematic village management training	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
Natural Capital	Average score of thematic village usefulness towards community	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
	Percentage of community having septic tank	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
	Percentage of community covered by garbage attendant service	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
	Average score of Brantas river usefulness according to community	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
	Average score of fresh water access easiness	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
Social Capital	Average regular discussion meeting in the village area	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
	Village organization Involvement	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
	Average specific discussion frequency on thematic village topic	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
	Average trust level on community officials and leaders	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
Modal Finansial	Average income	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
	Average savings	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
	Percentage of people having sufficient reserves	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
Modal Fisik	Percentage of respondents having other properties	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
	Vehicle ownership	Index 0-0,33	Index 0,34-0,66	Index 0,67-1
Capacity		**Pentagon area 0-0,79 unit^2**	**Pentagon area 0,8-1,59 unit^2**	**Pentagon area 1,6-2,38 unit^2**

The household welfare development in a village is usually fostered by PKK, that stands for Pembinaan Kesejahteraan Keluarga, a women empowerment community for Family Welfare Development (hereinafter refer to as PKK). Not all mothers attend the PKK meeting. The Kampung Warna-Warni PKK's routine activities include managing savings, treasury for the community emergency and such any collective purposes as community events, excursion, etc. Training session includes DHF counseling, cooking, and drug abuse issue. Respondents said that these activities were not considered family welfare development because the activity output was not significantly beneficial for the family economy, shown 85% of respondents never participated in PKK. In Kampung Warna-Warni hows that not every person participated in thematic village management development activities held both by inside or outside parties because not all villagers not all people are the members of Kampung Warna-Warni community association. Such development activities, according to the results of interviews with the local RW leader, are prioritized among the association members and village officials.

B. Natural Capital

The natural capital in this study emphasizes how the village provides benefits to the community and returns to the community in protecting the environment. **Figure 4** shows the peoples varying opinions that the existence of Kampung Warna-Warni is useful if not very useful, very useless, and no significance. People who think it useless say that they do not benefit from the tourism business. They feel financially disadvantaged, if not disturb their daily activities such as excessive hustle that disturbs their napping time and privacy. They truly never get the advantage from the tourist visits.

Brantas River is considered to be quite beneficial to the community **(Figure 5)**, but **Figure 6** shows

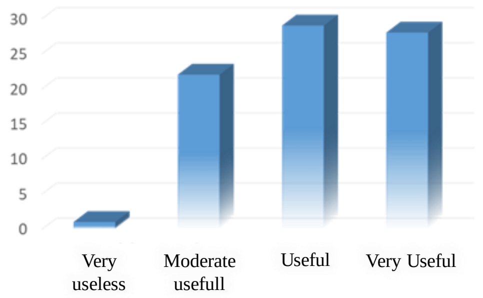
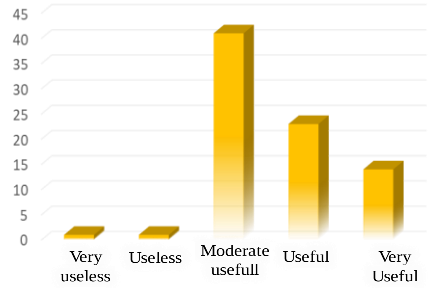


Figure. 4. Usefulness of Kampung Warna-Warni



Gambar. 5. Usefulness of Brantas River in Kampung Warna-Warni

that the majority of the community still dumps their domestic waste into the river since only 26.2% have septic tanks both communal and private. This is why Brantas River is dirty and muddy. Therefore, domestic waste management system is of an urgent necessity. The construction of a communal septic tank on a yard on the riverbank was previously planned until the flood submerged the planned construction site. The construction plan has never been realized since then. Therefore, another study and an alternative solution to provide septic tanks should be highly considered.

Figure 7 shows that well is the major water source for most Kampung Warna-Warni community, which needs to be considered in the future septic tanks construction plan for regulating the distance between septic tanks and the wells used by the community. In addition, there are still 3% of the community that are not reachable by garbage attendant services, that makes them throw their garbage into the river or burn it when possible.

C. Social Capital

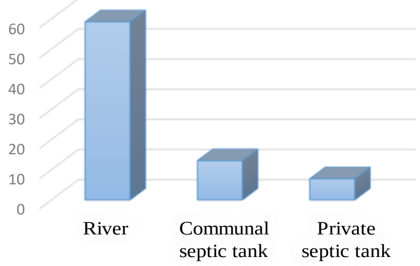


Figure. 6. How people dispose their wastes

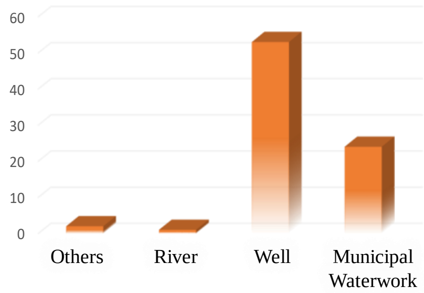


Figure. 7. The community fresh water source

Social capital determines the emotional relationship between individuals in a community, how they care about each other, and the organization around them. Social capital will lead to harmonious relations in the community, information transfer, and the realization of programs that involve the community. Kampung Warna-Warni has regular meetings held three times a week. These meetings includes community meetings, RW meetings, PKK meetings, etc. The majority of people attend only one of the meetings in a month, and the rest never attend any. Regular meetings specifically discussing

Kampung Warna-Warni management are held a maximum of 5 times in a month. The average community attends 3 meetings in a month. It implies that in a forum, not all residents are members, some are only the members of the association and the RW administrators, some are only the members of PKK, meaning that that when a program is being socialized, the community should choose the organization that is most often joined by the community, for the case of Kampung Warna-Warni community it is PKK. Judging from the questionnaire recapitulation, Kampung Warna-Warni community are categorized as actively involved in the village organization/association they participate in. Therefore, it is necessary to consider involving existing organizations in a socialization event such as PKK regular meeting, even a disaster-related training in Kampung Warna-Warni.

The community in Kampung Warna-Warni trust in their community leaders. The results of the questionnaire recapitulation showed that the most of the community trust the existing community leaders (such as the RW leader, association leader, PKK chairperson, and religious leaders). This trust makes it easy to organize people in various interests or activities with the help of existing community leaders, for example in distributing aid during disasters or organizing village improvement activities.

D. Financial Capital

Financial capital is reviewed to measure the community’s capability to cope with unexpected financial problems. Financial capital will make it easier for an individual to survive thanks to sufficient reserves to cover their needs when the financial problems occurs. The survey results show that the majority of the population in Kampung Warna-Warni are, respectively, private employees in stores or companies/factories, housewives, and traders. Their average income is in the range of 500 thousand rupiahs per month, which is classified as low compared to the national average income of more than 2 million rupiahs per month.

The low average income of the community means low saving ability. On average they are able to save <100 thousand rupiah per month. As a result, the majority community has no reserves for urgent events including disasters. Thus, the tourism activities in Kampung Warna-Warni slightly improves the community financial capacity. They claimed to improve economically due to the tourism activities of Kampung Warna-Warni, 59% of whom reveal that they make money from selling stuffs to tourists, charging parking fee, and entrance ticket. From the data collection, 7 people previously did several jobs such as drivers or street sellers before managing parking area in Kampung Warna-Warni, 14 housewives and sellers outside the village run the ticket gate, people who previously are just housewives or worked outside the village now run their own stalls or shops. The income from the tourism businesses, especially from tickets and parking fees, are now able to be used as operational rejuvenation funds in addition to salary for those working for it, whereas the association officials claimed that the income from the activities is unable to cover the operational cost.

E. Physical Capital

Physical capital in this review is more to find out how people mobilize in the event of a disaster and whether the community has the ability to mobilize on their own and have alternative shelter in the event of a disaster that may damage their house. Few people in Kampung Warna-Warni do not have motorized vehicles (10%), where 90% of which are two-wheeled vehicles. Majority of Kampung Warna-Warni community do not have other property than where they live now in Kampung Warna-Warni. Therefore, the community certainly requires temporary shelter when the disaster damage their homes.

F. Level of Capacity

After calculating each index of ownership of human capital, natural capital, social capital, financial capital and physical capital **(Table 2)**, it shows that Kampung Warna-Warni has mostly moderate-category capital ownership, high-category natural capital capital is high, yet low-category financial capital, revealing low-category on overall capital owned by the community, as indicated by the pentagon area of 0.38 units^2, equivalent to 15.8% of the maximum pentagon area **(Figure 8)**. That means the community is not ready and is considered not sustainable to disaster. Efforts to improve the

TABLE 2
KAMPUNG WARNA-WARNI COMMUNITY CAPACITY CALCULATION

Capacity Aspects	Parameter	Questionnaire results	Index	Parameter Classification	Composite Index	Capital Classification
Human Capital	Percentage of people aware of living in disaster prone area	69,6%	0,70	High	0,41	Moderate
	Percentage of people joining disaster mitigation training	25,3%	0,25	Low		
	Percentage of people joining PKK activity	15,4%	0,15	Low		
	Percentage of people joining thematic village management training	54,6%	0,55	Moderate		
Natural Capital	Average score of thematic village usefulness towards community	4,09 (useful/very useful)	0,77	High	0,68	High
	Percentage of community having septic tank	26,2%	0,26	Low		
	Percentage of community covered by garbage attendant service	97,3%	0,97	High		
	Average score of Brantas river usefulness according to community	3,63 (moderate/ useful)	0,66	Moderate		
	Average score of fresh water access easiness	3,96 (moderate to easy)	0,74	High		
Social Capital	Average regular discussion meeting in the village area	1 time	0,4	Moderate	0,57	Modera
	Village organization Involvement	3,75 (involved/moderately involved)	0,69	Moderate		
	Average specific discussion frequency on thematic village topic	2,89 (jarang/ cukup sering)	0,47	Moderate		
	Average trust level on community officials and leaders	3,88 (trusted/moderately trusted)	0,72	High		
Financial Capital	Average income	1030000,00	0,02	Low	0,13	low
	Average savings	175000,00	0,18	Low		
	Percentage of people having sufficient reserves	20,50%	0,21	Low		
Physical capital	Percentage of respondents having other properties	10,09%	0,10	low	0,36	Moderate
	Vehicle ownership	61,3%	0,61	High		

community capacity in dealing with disasters are crucial especially through improving the economy of the community.

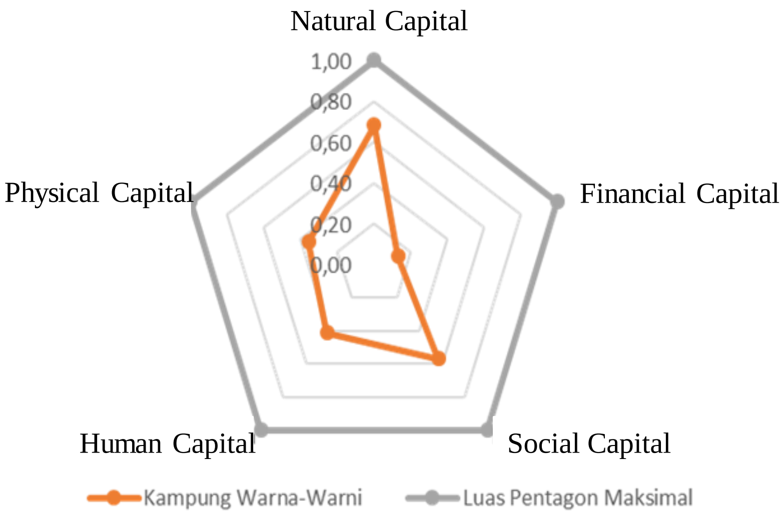


Figure. 8. Pentagon asset of Kampung Warna-Warni

4. Conslusion

Based on the results of the pentagon asset analysis, Kampung Warna-Warni has a low capacity in dealing with floods and landslides. The low capacity is caused by:

1. 40% of the community are not aware of living in floods and landslides prone area
2. Low community involvement in counseling on disaster and coordination in the village environment
3. 26% of the community throw their waste into the river, which means they are still environmentally unconscious
4. Low-income income and savings and reserves for the event of disaster
5. 40% of the community does not have a vehicle and place to live outside the village, meaning that they have limited mobility and has no self-prepared shelter in the event of disaster.

Reviewing the results of the analysis, ways to improve the community financial condition and its capacity to deal with disaster independently, not fully dependent on disaster relief or the government are needed.

Acknowledgement

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Strengthening Government, Community and Industry Collaboration for Industrial Disaster Risk Reduction in Cilegon City

Mirajiani [1), Arief Bagus Arjuna [2)]

[1)].Center for Environmental Research and Disaster Mitigation, Institute for Research and Community Service, University of Sultan Ageng Tirtayasa
Faculty of Agriculture
University of Sultan Ageng Tirtayasa

[2),] Industrial Engineering Study Program, Postgraduate Faculty
University of Mercubuana

e-mail: [1)] mirajiani@yahoo.com , arief.arjuna69@gmail.com[2)],

Abstract
Cilegon City is included in the Banten Province which has a high level of industrial disaster risk. Cilegon City is one of the major industrial centers in the Banten Province. There are three groups of industries / regions in Cilegon City, including the Merak industrial area, KIEC industrial area and Ciwandan industrial area which are large industrial areas / processing areas and chemical industries which have the risk of technological failure which has the potential to cause industrial disasters. Therefore in this region requires collaboration of government, society and and industry in an effort to reduce the risk of industrial disasters. The study used the Qualitative Methodology approach with research techniques Observation Expert Depth Interview, People Depth Interview, Literature Study and Focus Group Discussion (FGD). The results of the research on awareness and preparedness for industrial disaster risk reduction in Cilegon were presented descriptively. From the formal regulatory aspect, the government, society and industry (business world) have their own main duties, functions, rights and obligations and roles in the implementation of disaster management. However, it is necessary to strengthen collaboration between the three in programs with the aim of optimizing the achievement for reducing the risk of industrial disasters. In the future, collaboration between government, industry and society to be important for the goal of industrial risk reduction.
Keywords : *strengthening collaboration, industrial disasters, risk reduction*

Introduction

Industrial disasters constitute a threat to regions that have become major industrialization centers, especially manufactured and chemical industries. Learning from industrial disaster events in the world, has caused many casualties, material and non-material. Among the historical records of industrial disasters that have occurred, one of the worst events is the Bophal disaster. The Bhopal disaster, also referred to as the Bhopal gas tragedy, was an incident of gas leakage in India, which was considered the worst industrial disaster in the world in 1984 at the Pescide Union Carbide India Limited (UCIL) plant in Bhopal, Madhya Pradesh. More than 500,000 people were exposed to methyl isocyanate (MIC) gas and other chemicals. The estimated death toll is 2,259 people. Another tragedy of Nuclear Accident Chernobyl, Soviet Union (1986), one of the Chernobyl Nuclear Power plants exploded. It is estimated that the explosive power is equivalent to 500 nuclear bombs, causing a fire for nine days. The explosive roof of the reactor releases dust from radioactive particles into the atmosphere. According to official data after the accident, about 60% of radioactive material fell in Belarus. Poisonous rain destroys plants and causes animal mutations and devastating effects are also felt in Scandinavian, Swiss, Greek, Italian, French and British countries. More than 100 thousand people were evacuated from the area after the disaster occurred. The World Health Organization (WHO) states, around 4000 people die from radiation exposure. In addition, about 4000 cases of thyroid cancer also occur after a nuclear disaster

The most recent industrial disaster in 2019 was the result of an explosion at a chemical plant complex in Yancheng, China, on Thursday, March 21, 2019. The Yancheng City government reported the death of 47 more than 600 other people were rushed to the hospital for further treatment. AFP reported that the explosion was so strong that it caused a small earthquake, demolished a number of factory buildings and broke windows of houses located several kilometers from the location. This explosion was a Tianjin disaster repetition that occurred in 2015. A massive explosion of chemical plants took place in the port city of Tianjin, China. The fire that arose caused various explosions and uncontrolled fires for a week. As a result of this incident, more than a hundred people were killed and hundreds of other people were injured, thousands of vehicles caught fire and buildings around it were destroyed.

Cilegon City is included in the Banten Province which has a high level of industrial disaster risk. Cilegon City is one of the major industrial centers in the Banten Province. There are three groups of industries, including the Merak industrial area, KIEC industrial area and Ciwandan industrial area which are processing areas and chemical industries which have the risk of technological failure which has the potential to cause industrial disasters. Therefore in this region requires collaboration of government, society and and industry in an effort to reduce the risk of industrial disasters.

Metodology

The study used the Qualitative Methodology approach with research techniques Observation, Expert Depth Interview, People Depth Interview, Literature Study and Focus Group Discussion (FGD). The results of the research on awareness and preparedness for industrial disaster risk reduction in Cilegon were presented descriptively.

Result and Discussion

Potency and Risk of Industrial Disaster in Cilegon City

Based on its geographical location, Cilegon City is located on the western end of Java Island covering an administrative area of 17,550.0 Ha with 4 sub-districts which have been divided into 8 sub-districts (Ciwandan, Citangkil, Pulomerak, Grogol, Purwakarta, Cilegon, Jombang, and Cibeber). Cilegon City is an area of industrial development in a separate area both in the form of a managed industrial estate or industrial concentration in an industrial allotment area.

TABLE 1. CILEGON INDUSTRIAL DATA 2015

Industy	Amount
Chemical – Petrochemical Industry	68
Metal Industry	32
Agro Industry	17
Construction and Services	10
Storage Tank and Services	7
Industrial and Port Areas	5
Transportation Services	4
Machinery and Elektronics Industry	3
Power Plants	3
Total	**149**

Source: Cilegon Industrial Data 2015

The chemical-petrochemical industry has a high risk of industrial disasters. There are three industrial groups that use chemicals (Nedved and Imamkhasani. 1991), namely (1) chemical industries, that process and produce chemicals, for example the industries of fertilizers, pesticides, sulfuric acid, paints, detergents and others , (2) chemical industry that uses chemicals, that use chemicals as process assistants, for example in the textile, leather, paper, electricity coating, metal processing, pharmaceutical industries, etc. (3) laboratories, places of activity for quality testing, research and development and education.

Industrial hazards that can be caused by the operation of large industries, especially chemical industries and metal processing industries include (1) fires, the presence of combustible chemicals such as organic solvents or gases that come in contact with heat sources can cause Fire. Heat sources can be open fire, hot metal, embers or electric jumps. Fires can also cause the breakdown of other materials that might cause toxic substances or cause other explosions that are more powerful, (2) explosions, are very fast reactions and produce large amounts of gases. Blasting can occur by reactions of explosives or combustible gases or reactions of various types of organic peroxide, liquid or high-pressure gas that is uncontrolled, (3) irritation, is damage or inflammation or sensation of moist body surface like skin , eyes and respiratory tract by corrosive or irritant chemicals such as trichloroacetic acid, chlorine gas, sulfur dioxide, bromine, sulfuric acid vapor, hydrochloric acid and so on, (4) poisoning, which is the entry of toxic chemicals into the body can be fatal or acute and chronic. Acute poisoning as a result of the absorption of large amounts of chemicals and short periods of time can cause death, such as carbon monoxide (CO), and hydrogen cyanide (HCN) poisoning. Chronic poisoning is the absorption of toxic chemicals in small amounts but for a long time, for example due to chronic leukemia due to Pb benzene and vapor, asbestosis by asbestos dust and cancer by carcinogenic substances, (5) danger to the environment, namely the disposal of materials dangerous chemicals that are not controlled and eventually enter the drinking water channel and pollute the environment. If it is not controlled, it will require living aquatic biota and can pollute drinking water / food.

Some hazardous chemicals that have caused incidents in the industry include natural gas and liquid gas, chlorine (gas), gasoline, ammonia and ammonium compounds, vinyl chloride, hydrochloric acid, hydrogen, sulfuric acid, ethylene and ethylene oxide. From several causes of industrial disasters, among others are (1) unsafe tools or materials, namely the use of less safe tools and the use of hazardous chemicals, (2) unsafe conditions, including contaminated workspaces, high temperatures, storage warehouses not safe, (3) human error, including negligence of workers, not in accordance with standard work procedures and not disciplined, (4) lack of supervision, including improper supervision procedures, cannot anticipate hazards and no enforcement of work discipline.

Based on the BNPB Disaster Risk Assessment (2015) the industrial hazard level is calculated using the hazard index, Cilegon has a high level of technological failure (industrial disaster) with an index value of > 0.666-1.

TABLE 2. TYPES AND HAZARD LEVEL OF DISASTER IN CILEGON CITY

NO	Hazard Types	Hazard Level
1	Floods	High
2	Flash Flood	High
3	Cuaca Ekstrim	High
4	Epidemic and Diseases	Low
5	Extrime Waves dan Abrasion	Medium
6	Earthquake	Medium
7	Forest and Land Fires	Medium
8	**Lack of Teknology/Industrial Disaster**	**High**
9	Drought	Low
10	Landslide	High
11	Tsunami	High

Source : BNPB 2015

TABLE 3. PROBABILITY AND IMPACT OF DISASTER IN CILEGON CITY

NO.	Disaster Threat	Probability	Impact

1.	Flood	5	3
2.	Falsh Flood	3	4
3.	Tsunami	4	5
4.	Landslide	3	3
5.	Extreme Weather	5	1
6.	**Lack of Teknology/Industrial Disaster**	**5**	**5**

Source : BNPB T 2015

Given the high danger, the probability of threats and the impact of industrial disasters, disaster management management is needed, where the role of government, society and industry must be integrated. Of course the most needed factor is increasing awareness and preparedness of all parties to reduce the risk of industrial disasters.

Strengthening Government, Community and Industry Collaboration in Industrial Disaster Risk Reduction in Cilegon City

The role of the regional government in regional disaster management in Banten Province was strengthened by the Banten Province Regional Regulation No.3 of 2010 concerning the Provincial Disaster Management Agency. As a continuation of the regulation, the Government of Cilegon City formed the Regional Disaster Repeat Agency (BPBD) based on the Cilegon Regional Regulation Number 5 of 2014 concerning the Regional Apparatus of Cilegon City. Based on the Regional Regulation of the City of Cilegon, the BPBD has the task of: (a) establishing guidelines and directives on disaster management efforts that include disaster prevention, emergency response, rehabilitation, and reconstruction fairly and equally. (b) establish standards and requirements for implementing disaster management based on laws and regulations, (c) compile, determine and inform disaster-prone maps, (d) prepare and establish disaster management procedures, (e) report disaster management to the Mayor every once a month under normal conditions and at all times in a state of disaster emergency, (f) controlling the collection and distribution of money and goods, (g) taking responsibility for the use of the budget received from the APBD and other legitimate receipts, (f) implementing other obligations in accordance with statutory regulations -invitation.

To carry out the main tasks above, the BPBD of Cilegon City has the functions of: (1) formulating and stipulating disaster management and refugee handling policies by acting quickly and precisely, effectively and efficiently, (2) coordinating the implementation of planned, integrated and comprehensive disaster management activities , (3) the implementation of other duties given by the Mayor in accordance with their duties and functions. From this regulation, it can be shown that the role of the regional government through the BPBD institution as a coordinator and policy formulator is related to disaster management efforts / programs in Cilegon, including efforts to reduce industrial disaster risk.

The role of the community in disaster management is regulated in the Regulation of the Head of the National Disaster Management Agency Number 11 of 2014 concerning Community Participation in Disaster Management. This regulation is a mandate of Article 26 of Law Number 24 of 2007 concerning Disaster Management, Article 2 Government Regulation Number 21 of 2008 concerning Implementation of Disaster Management and Article 4 of Government Regulation Number 22 Year 2008 concerning Funding and Management of Disaster Assistance.

In this case, the community has the right to (1) obtain social protection and security, especially for disaster-vulnerable groups, (2) get education, training, and skills in disaster management, (3) obtain information in writing and / or verbally about disaster management policies, (4) participating in the planning, operation, and maintenance of programs to provide health service assistance, including psychosocial support, (5) participating in decision making on disaster management activities, especially those relating to themselves and their communities, (6) supervise in accordance with the mechanism regulated in the implementation of disaster management. The community also has the obligation: (1) maintain a harmonious social life of the community, maintain balance, harmony, harmony and sustainability of environmental functions, (2) carry out disaster management activities, (3) provide correct information to the public about disaster management.

The role (industry) is regulated in articles 28 and 29 of the Act. No 24 of 2007, where in article 28, business institutions get the opportunity in the implementation of disaster management, both individually and jointly with other parties. Article 29, (1) business institutions adjust their activities to the policy of implementing disaster management, (2) business institutions are obliged to submit reports to the government and / or agencies given the task of conducting disaster management and informing the public transparently, (4) business institutions are obliged to heed humanitarian principles in carrying out their economic functions in disaster management.

From the formal regulatory aspect, the government, society and industry have their own main duties, functions, rights and obligations and roles in the implementation of disaster management. However, it is necessary to strengthen collaboration between the three in real efforts / programs with the aim of optimizing the achievement of objectives, specifically reducing the risk of industrial disasters. In industrial disaster management there are work stages. Guidelines for Preparation of Disaster Management Plans, that these stages include pre-disaster stages, is that the situation does not occur in a disaster and the situation is a potential disaster. Stages at the time of the disaster are emergency response activities carried out in situations of disaster. While the post-disaster stages are carried out in the time after the disaster. Pre-disaster stages consist of preparedness, early warning systems and disaster mitigation. Preparedness is a series of activities carried out to anticipate disasters through organizing and through appropriate and efficient steps. Early warning is a step taken to be prepared before a disaster occurs. Disaster mitigation is a series of efforts to reduce disaster risk through physical development and awareness and capacity building in the face of disasters. In the context of mitigation, there are several approaches, namely technical approaches, human approaches, administrative approaches and cultural approaches. The technical approach is how the technical design of buildings, tools and infrastructure can reduce the potential for disaster risk. The human approach is related to increasing community awareness and preparedness. Administrative approaches related to the preparation of regulatory / regulatory systems and licensing systems, disaster risk planning and analysis systems. The cultural approach on how to identify cultural and local wisdom in the community, so that prevention and disaster risk reduction actions can be prepared based on cultural specificities and local wisdom

Stages at the time of disaster related to emergency response management can be realized with activities carried out immediately at the time of the disaster to deal with the adverse impacts which include rescue and evacuation of victims, property, fulfillment of basic needs, protection, management of refugees, rescue and recovery of infrastructure and facilities. This includes a quick and precise assessment of the location, damage and resources so that it can be known and estimated the area affected and the estimated level of damage and determination of the status of a disaster emergency. The emergency response team is expected to be able to handle all forms of disasters, therefore it must be organized and designed to be able to handle various possibilities of industrial disasters.

In the post-disaster phase, it covers the rehabilitation and reconstruction activities with the aim of recovering disaster conditions. Rehabilitation means repairing and restoring damaged facilities and infrastructure which has caused public service aspects to be disrupted, while reconstruction involves rebuilding infrastructure, including the existing institutional system.

In the context of industrial disaster management, mitigation implemented in three types of plans, including: (1) industrial disaster management plan, this plan is arranged in normal conditions and is forecasted, the scope of activities is general and distribution sectoral tasks, (2) industrial disaster preparedness plan and (3) industrial mitigation plans, this plan is also set up in normal conditions, based on data on hazard, vulnerability, capacity and disaster risk, serves as a guideline or direction in the preparation of sectoral plans and its activities are focused on aspects of prevention and mitigation. Overall, the implementation of the three plans can be identified, including: (1) recognizing hazards, (2) identifying based on Probability / possible occurrence of disasters and their intensity / impact, (3) analyzing high-risk disasters, (4) managing risks with prevention (risk avoidance), mitigation (risk reduction) transfer risk (risk transfer), (5) acceptance of danger (risk acceptance), but the community remains alerted, and (6) Increasing community capacity and monitoring the development of vulnerability of the community

TABLE 4. INDUSTRIAL DISASTER MANAGEMENT PLANNING

Pra Disaster	Disaster	Pasca Disaster
Compile industrial disaster manajemen plan	Compile operational plan	Compile rehabilitation plan
Compile industrial disaster contingency plan)	Compile emergencies plan	Compile recontruction plan
Compile industrial mitigation plan		

Increased collaboration of government, industry and society is needed in planning in the implementation of industrial disaster management. The process of planning the program carefully, measurably, and systematically and involving the government, industry and society to the stage of decision making can provide different functions and roles but can be coordinated and communicated, so that roles and functions can be arranged in a synergic and harmonious manner. The basic prerequisites for fulfilling these objectives require the equal perception, will, and enthusiasm of all three.

TABLE 5. IMPLEMENTATION OF GOVERNMENT, INDUSTRY AND COMMUNITY COLLABORATION IN DISASTER MANAGEMENT ACTIVITIES

ACTIVITY	COLLABORATION TEAMWORK
Identification and Hazard Assessment	Industry can identify hazards and communicate to the government to be able to plan together to reduce potential hazards and the risk of disasters. The community is involved to be able to build public awareness of the potential hazard
Identification and Preparedness Assessment	Industry, government and the community jointly identify and review and develop joint plans and disaster preparedness SOPs
Compile Emergencies Response and Action Plan)	Industry, government and society together form joint plans and actions for emergency response systems, which can be implemented with activities 1. Joint industrial disaster emergency 2. Equipments identification, facilities and infrastructure and competencies to synergize and complement each other 3. Compilation of SOPs for joint emergency response system
Impact of Disaster Mecanism	Industry, government and the community develop joint plans and action actions to mitigate the impact of disasters

Several collaborative activities and exercises with elements of government, industry and society have been carried out during the 2015-2018 period. In the future, collaboration between government, industry and society can be sought to be improved so that the objectives of industrial risk reduction can be realized.

TABLE 6. COLLABORATION OF INDUSTRIAL, GOVERNMENT AND COMMUNITY ACTIVITIES IN DISASTER MANAGEMENT

No	Tanggal	Kegiatan	Partisipan	Lokasi
1	29 April 2015	Spill and Fire Simulation	Emergency Response Team, Factory Employees, Sector Police, Community, Industry	Dover Chemical Co
2	16 December 2015	Simulation of Handling Oil Spills in the Sea	Emergency Response Team, Factory Employees, Sector Police, Community, Industry, KSOP	Dover Chemical Co
3	15 December 2017	Spills and Fire Simulation	Emergency Response Team, Factory Employees, Community	Dover Chemical Co
4	15 December 2017	Fire Fighting Exercise	Emergency Response Team, Factory Employees, Community, goverment	Dover Chemical Co
5	16 October 2018	Chemical Leak and Spill Response Simulation	Emergency Response Team, Factory Employees, Community	Dover Chemical Co

Conclusion

Cilegon City is a region that has a high level of industrial disaster risk. Disaster management need the role of government, society and industry where must be integrated. Of course the most needed factor is increasing awareness and preparedness of all parties to reduce the risk of industrial disasters. The government, society and industry have their own main duties, functions, rights and obligations and roles in the implementation of disaster management. However, it is necessary to strengthen collaboration between the three in programs with the aim of optimizing the achievement for reducing the risk of industrial disasters. In the future, collaboration between government, industry and society to be important for the goal of industrial risk reduction.

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Sistem Monitoring Adaptasi dan Mitigasi Bencana dalam Standard Pengelolaan Destinasi Pariwisata dan Pengelolaan Lingkungan dalam Prkatek Pembangunan Pariwisata Berkelanjutan

Muhamad
Sekolah Pascasarjana Universitas Gadjah Mada Yogyakarta
drmuhammad@ugm.ac.id

Abstrak
Tujuan kajian ini adalah mengetahui bagaimana system monitoring yang dilakukan dalam ekosistem kepariwisataan yaitu: destinasi, pemerintah daerah dan perguruan tinggi setempat berjalan dan sesuai dengan standard yang sudah ditentukan. Sistem monitoring dalam kajian ini lebih terfokus pada standard yang ditentukan oleh Global Sustainable Tourism Council (GSTC) yaitu pada standard pengelolaan destinasi pariwisata dan pengelolaan lingkungan. Sistem monitoring terfokus tentang bagaimana upaya destinasi pariwisata dalam mengurangi resiko bencana. Lokasi kajian mengambil sampel di kawasan rawan bencana (KRB) III yaitu di kecamatan Turi yang merupakan kawasan yang memiliki desa wisata terbanyak diantara kecamatan lainnya di Kabupaten Sleman. Metode kajian ini dilakukan melalui snapshoot assessment dan observasi melalui indikator pembangunan pariwisata berkelanjutan yang terdiri dari 4 standard, 42 kriteria dan 102 indikator. penilaian dilakukan oleh asesor berdasarkan hasil *self-assessment* dengan hasil visitasi lapangan termasuk hasil cek dokumen. Penilaian diberikan atas setiap elemen pada masing-masing standar, dimana setiap standar akan diberikan nilai skala likert dari 1-7. Kriteria yang digunakan adalah kriteria standard pengelolaan yang sesuai dengan ketentuan dari GSTC yang sudah ditentukan meliputi yaitu menggunakan standard D yaitu memaksimalkan manfaat bagi lingkungan dan meminimalkan dampak negative yang terdiri dari : D1 Risiko Lingkungan, D2 Perlindungan Lingkungan Sensitif, D4 Emisi Gas Rumah Kaca, D11 Polusi Cahaya dan Suara, D12 Transportasi Ramah Lingkungan. Hasil penelitian menunjuklan destinasi pariwisata sudah mempunyai standard dalam pengelolaan destinasi dan pengelolaan lingkungan tetapi belum melakukan praktek adaptasi dan mitigasi bencana dalam kerangka pembangunan pariwisata berkelanjutan. Hasil dari penilaian tersebut diperoleh kriteria skor 45,5% sudah terimplentasi, 0% implementasi dalam 12 bulan ke depan, 3,5% implementasi lebih dari 12 bulan ke depan, 21,5% dalam tahap perencanaan, 25% tidak, 0% tidak yakin, dan 4,5% tidak menjawab.
Kata kunci: Sistem Monitoring, Adaptasi Dan Mitigasi Bencana, pengelolaan Lingkungan, Pariwisata Berkelanjutan

PENDAHULUAN

Pada akhir-akhir telah banyak terjadi musibah kebencanaan yang terjadi hampir diseluruh wilayah Indonesia dengan berbagai macam jenis kebencanaan yang terjadi. Kebencanaan yang terjadi di Indonesia mengakibatkan kerugian yang tidak sedikit. Baik secara tidak langsung maupun secara langsung yang dapat memakan korban jiwa, kehilangan harta benda, ruskanya infrastruktur dan lingkungan hidup dan mengakibatkan beban kejiwaan bagi para korban yang telah selamat (traumatik). Untuk pengurangan resiko bencana sendiri telah diatur dalam dalam undang-undang no 24 tahun 2007 tentang penanggulangan bencana, penanggulangan bencana ini telah membawa perubahan paradigma dalam pengelolaan bencana di Indonesia yang telah dimasukan kedalam berbagai sektor, salah satunya adalah sektor bidang kepariwisataan dan merupakan bagian dari pembangunan pariwisata berkelanjutan.

Pembangunan pariwisata berkelanjutan merupakan proses dan skema untuk memenuhi kebutuhan wisatawan dan masyarakat sekitar pada masa kini, tanpa mengorbankan pemenuhan kebutuhan generasi pada masa yang akan datang. Konsep ini didasari prinsip untuk tetap memperhatikan ekosistem sesuai dengan kemampuan daya dukung (*carrying capacity*), mewujudkan kepentingan masyarakat setempat, meningkatkan kualitas hidup manusia dalam aspek fisik, rohani, sosial dan budaya dalam jangka panjang, serta mendorong pemanfaatan sumberdaya alam yang efektif dan efisien. Kebutuhan ekonomi, sosial dan estetika dapat terpenuhi tanpa mengabaikan pelestarian integritas budaya, proses-proses ekologis penting, keanekaragaman hayati dan berbagai sistem pendukung kehidupan yang menjadi modal kekuatan pariwisata Indonesia, yang berdaya saing dan berkelanjutan.

Strategi pembangunan destinasi pariwisata berkelanjutan sejalan yang diamanatkan dalam UU No. 10 Tahun 2009 tentang Kepariwisataan. Kementerian Pariwisata memiliki agenda besarterkait pembangunan destinasi pariwisata berkelanjutan, yaitu Indonesia harus menjadi *benchmarking* pariwisata berkelanjutan di Asia Tenggara. Program ini diawali di tahun 2015 dengan ditandatanganinya nota kesepahaman dengan 20 Kabupaten/Kota sebagai bentuk komitmen pemerintah daerah dalam mendorong pembangunan pariwisata berkelanjutan. Selain itu, Kementerian Pariwisata juga telah membentuk Kelompok Kerja Nasional yang bertugas merumusakan langkah-langkah dan strategi pembangunan destinasi pariwisata berkelanjutan. Penerapan, pembangunan kepariwisataan di Indonesia juga harus dapat meningkatkan kualitas hidup masyarakat (terutama masyarakat lokal), menciptakan nilai tambah dan mengeratkan budaya lokal dan juga nilai-nilai sosial serta kearifan lokal.

Inisiasi program *Sustainable Tourism Observatory* (STO) ditujukan untuk mengukur dampak ekonomi lingkungan, sosial dan budaya atau bahkan isu global dunia lainnya. Pusat Monitoring pariwisata berkelanjutan memiliki kapasitas (*big and deep data*) untuk menyediakan data dan informasi agar dapat dianalisis guna memberikan manfaat yang sebesar-besarnya dari kegiatan pembangunan kepariwisataan nasional dengan tetap menerapkan prinsip dan indicator pembangunan berkelanjutan. Seperti yang telah dijelaskan, dalam pelaksanaan Pusat Monitoring pariwisata berkelanjutan di Indonesia tidak dapat berdiri sendiri karena harus didukung oleh berbagai pemangku kepentingan terutama pemerintah daerah bersama institusi (akademisi atau lembaga penelitian).

Kabupaten Sleman memiliki beranekaragam jenis destinasi wisata yang menarik untuk dikunjungi wisatawan. Jenis destinasi wisata tersebut diantaranya adalah wisata alam, wisata candi, wisata budaya, museum, wisata buatan, dan desa wisata. Kondisi seperti ini menjadi daya tarik bagi wisatawan, sehingga jumlah kunjungan wisatawan di Kabupaten Sleman meningkat setiap tahunnya (Tabel 1). Berbagai macam alternatif pilihan ini menjadikan Kabupaten Sleman sebagai salah satu tujuan yang harus dikunjungi jika berada di Yogyakarta.

Tabel 1. Jumlah Kunjungan Wisatawan Kabupaten Sleman 2013-2017

	2013	2014	2015	2016	2017
Wisatawan Mancanegara	337.974	340.599	255.194	246.136	262.071
Wisatawan Nusantara	3.274.980	3.882.432	4.695.740	5.439.165	6.552.487
Jumlah Total	3.612.954	4.223.031	4.950.934	5.685.301	6.814.558

Sumber : Buku Statistik Kepariwisataan DIY 2017

Salah satu jenis wisata di Kabupaten Sleman yang memiliki banyak pilihan adalah desa wisata. Indonesia memiliki 1302 desa wisata yang tersebar di masing-masing Provinsi dengan 6 peringkat teratas jumlah keberadaan desa wisata (Kemendikbud, 2016). Enam peringkat teratas tersebut adalah 138 desa wisata di Jawa Barat, 132 desa wisata di Jawa Tengah, 114 desa wisata di Jawa Timur, 92 desa wisata di Nusa Tenggara Timur, 87 desa wisata di Sumatra Utara, dan 57 desa wisata di Daerah Istimewa Yogyakarta (Kemendikbud, 2016). Desa wisata di Kabupaten Sleman diantaranya adalah Brayut, Tanjung, Grogol, Mlangi, Garongan, Gabugan, Kelor, Gamplong, Tunggalarum, Pentingsari, Jetak II, Dome, Pancoh dan Pulesari.

Jumlah desa wisata yang banyak di Kabupaten Sleman menyumbang kontribusi kunjungan wisatawan (Tabel 2). Kontribusi jenis wisata desa wisata menjadi tolak ukur dalam efek pemberdayaan masyarakt di desa dalam memanfaatkan potensi di desa. Dalam (Tabel 2) diketahui kontribusi dari tahun 2013 – 2016 meningkat, sedangkan di tahun 2017 menurun. Hal ini memberikan interprestasi bahwa desa wisata di Kabupaten Sleman menempati posisi tertinggi atau masa puncaknya di tahun 2016. Kaitannya dengan jumlah desa wisata pada tahun tersebut banyak pilihan desa wisata baru yang menyajikan berbagai pilihan produk wisata.

Pemanfaatan dana desa sebagi modal dalam pemberdayaan masyarakat mengakses pariwisata di desa juga menjadi salah satu penyebab. Tahun 2013 – 2016 menjadi awal perkembangan desa wisata yang memberikan kontribusi pada jumlah kunjungan wisatawan di Kabupaten Sleman. Akan tetapi di tahun 2017 mengalami penurunan kontribusi terhadap jumlah kunjungan wisatawan. Berbagai penyebab penurunan ini bisa diinterprestasikan dari kondisi yang terjadi. Kondisi tersebut diantaranya adalah menurunnya jumlah desa wisata karena tidak adanya perencanaan yang matang dalam pengelolaan, kecenderungan produk wisata yang memiliki kesamaan, kesiapan masyarakat dalam mengelola desa wisata, pemasaran yang tidak tepat sasaran, kejenuhan wisatawan dalam memilih desa wisata dan alasan-alasan lainnya.

Tabel 2. Kontribusi Desa Wisata Dalam Kunjungan Wisatawan di Kab. Sleman Tahun 2017

Tahun	2013	2014	2015	2016	2017
Kabupaten Sleman	3.612.954	4.223.031	4.950.934	5.685.301	6.814.558
Desa Wisata	157.770	218.512	255.932	548.107	206.934

Kontribusi	4,37%	5,17%	5,16%	9,64%	3,03%

Sumber : Olahan Buku Kepariwisataan DIY, 2017

Pelibatan pemerintah daerah ini menjadi vital dan penting selaku penyelenggara pemerintahan di daerah, sedangkan universitas atau lembaga penelitian menjadi Pusat Monitoring menjadi pilihan strategis karena institusi tersebut dinilai memiliki kemampuan riset, objektivitas, integritas serta menghasilkan analisis dan rekomendasi yang handal, terpercaya dan dapat diimplementasikan (*implementable*), serta analisis yang dilakukan dapat diandalkan. Proses monitoring di destinasi pariwisata yang menjadi fokus utama lokasi pemantauan penerapan pariwisata berkelanjutan yang dilaksanakan oleh Pusat Monitoring MCSTO Universitas Gadjah Mada Yogyakarta untuk melakukan pemantauan dan evaluasi dampak ekonomi, lingkungan dan sosial budaya melalui penggunaan aplikasi yang sistematis, dan teknik manajemen informasi.

Terdapat 9 isu dan indikator besar destinasi dalam proses pemantauan meliputi: 1) musim pariwisata, 2)pekerjaan dan lapangan pekerjaan, 3)membangun destinasi pariwisata, 4) tata kelola dan ekosistem pariwisata, 5) kepuasan lokal dalam pariwisata, 6) pengelolaan energi, 7) pengelolaan air, pengelolaan limbah cair, 9) pengelolaan limbah padat . Semua isu besar tersebut merupakan area inti permasalahan, dalam pariwisata berkelanjutan tersebut kemudian dikategorikan menjadi beberapa komponen dan dijelaskan melalui indikator dengan beberapa isu dasar (*baseline issue*).

Tabel 1: Indikator dengan beberapa isu dasar (*baseline issue*) dalam pariwisata berkelanjutan di Indonesia:

No	Kriteria dan Standard	Penjelasan dari Kriteria
1	Pengelolaan Destinasi	Kriteria ini menilai aspek tata kelola mulai dari perencanaan, pengelolaan, pemantauan dan evaluasi yang meliputi indikator antara lain: strategi destinasi yang berkelanjutan, pengaturan perencanaan, standar keberlanjutan, organisasi manajemen destinasi, pengelolaan pariwisata musiman, akses untuk semua, akuisisi properti, keselamatan dan keamanan, manajemen krisis dan kedaruratan, promosi, monitoring, inventarisasi aset, atraksi pariwisata, adaptasi perubahan iklim, dan kepuasan pengunjung.
2	Pemanfaatan Ekonomi bagi Masyarakat Lokal	kriteria yang menilai aspek manfaat atau kontribusi ekonomi bagi masyarakat dan meliputi indikator antara lain: pemantauan kontribusi ekonomi dari pariwisata, peluang kerja bagi masyarakat lokal, partisipasi masyarakat, opini masyarakat lokal, akses bagi masyarakat lokal, fungsi edukasi Sadar Wisata, pencegahan eksploitasi, dukungan untuk masyarakat, dan dukungan bagi pengusaha lokal dan perdagangan yang adil.
3	Pelestarian Budaya	kriteria yang menilai aspek pelestarian budaya bagi masyarakat dan pengunjung dan meliputi indikator antara lain: perlindungan atraksi wisata, pengelolaan pengunjung, perilaku pengunjung, perlindungan warisan budaya, interpretasi tapak dan perlindungan kekayaan intelektual.
4	Pelestarian Lingkungan	kriteria yang menilai aspek pelestarian lingkungan dan meliputi indikator antara lain: ketersediaan sistem menangani risiko

		lingkungan, perlindungan lingkungan sensitif, perlindungan alam liar (flora dan fauna), sistem pengukuran emisi gas rumah kaca, konservasi energi, pengelolaan air, sistem keamanan air, kualitas air, sistem pengolahan limbah cair, pengurangan limbah padat, panduan mengenai polusi cahaya dan suara, serta sistem transportasi ramah lingkungan

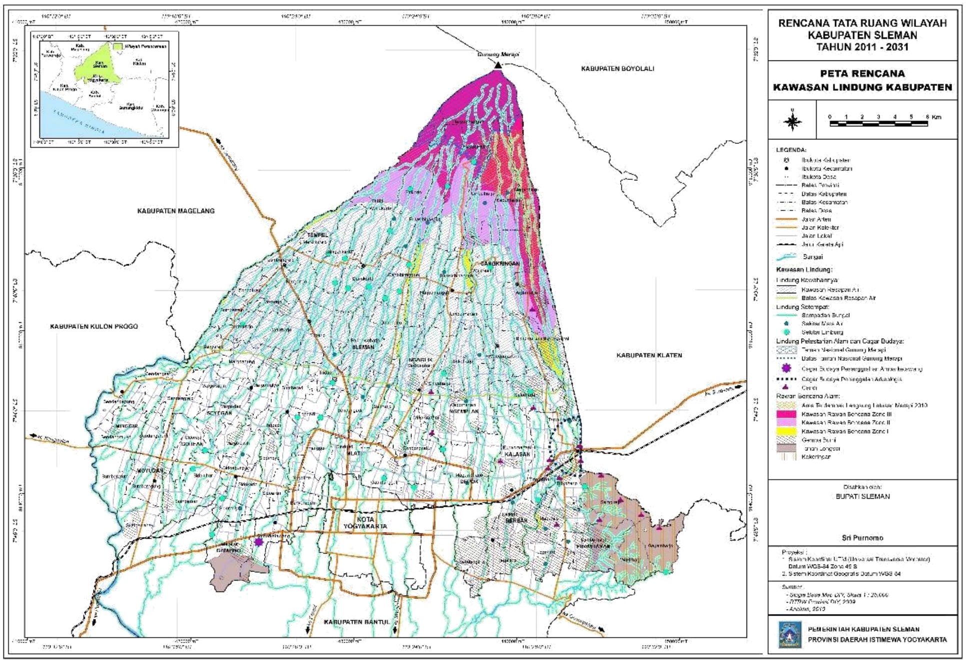
Sumber: Kementrian pariwisata dimodifikasi, 2016

Deskripsi Wilayah Kajian

Bencana alam adalah peristiwa atau rangkaian peristiwa yang mengancam dan mengganggu kehidupan dan penghidupan masyarakat yang disebabkan oleh faktor alam, sehingga mengakibatkan timbulnya korban jiwa manusia, kerusakan lingkungan, kerugian harta benda, dan dampak psikologis. Bencana alam antara lain berupa banjir, letusan gunung berapi, gempa bumi, tsunami, tanah longsor, kekeringan, angin puting beliung, dan kebakaran liar. Beberapa bencana alam terjadi tidak secara alami, misalnya kelaparan, yaitu kekurangan bahan pangan dalam jumlah besar yang disebabkan oleh kombinasi faktor manusia dan alam

Kabupaten Sleman yang terletak di Daerah Istimewa Yogyakarta (DIY) memiliki risiko bencana, antara lain banjir, letusan gunung berapi, gempa bumi, tanah longsor, kekeringan, kebakaran bangunan, dan kebakaran hutan/lahan. Gunung Merapi yang terletak di perbatasan antara Kabupaten Sleman dengan Kabupaten Magelang, Klaten, dan Boyolali adalah salah satu gunung berapi paling aktif di dunia karena periodisitas letusannya relatif pendek, yaitu 3-7 tahun.

Wilayah DIY yang dilalui sesar Kali Opak - Oyo di bagian timur dan patahan sepanjang Kali Progo di bagian barat merupakan zona yang sangat rentan terhadap gempa bumi. Akibatnya Kabupaten Sleman memiliki wilayah-wilayah yang beramplifikasi tinggi terhadap gempa. Wilayah- wilayah tersebut akan memiliki dampak kerusakan yang lebih parah apabila terjadi gempa (terutama gempa di atas 5 SR dan episentrumnya dekat), dibandingkan dengan wilayah yang masuk kategori amplifikasi rendah dan sedang. Wilayah yang beramplifikasi tinggi di Kabupaten Sleman, antara lain Kecamatan Berbah, Prambanan, dan Kalasan. Oleh karena itu, pada saat gempa melanda Yogyakarta tahun 2006, ketiga wilayah tersebut mengalami dampak terparah dibanding kecamatan lain di Kabupaten Sleman.



Gambar Peta Rencana Kawasan Lindung Kabupaten Sleman

Sumber: Rencana Tata Ruang Wilayah Kabupaten Sleman, Tahun 2011-2031

Bencana alam tahun 2017 yang terjadi di Kabupaten Sleman adalah banjir, tanah longsor, dan kebakaran lahan yang melanda beberapa wilayah kecamatan. Berdasarkan Lampiran Tabel 37 yang bersumber dari Badan Penanggulangan Bencana Daerah tahun 2017, banjir melanda kecamatan Pakem, Tempel. Akibat bencana banjir di Kecamatan Pakem menyebabkan 1 rumah rusak dan diperkirakan kerugian mencapai Rp 700.000,00 . Akibat banjir di Kecamatan Depok menyebabkan 5 rumah, 1 kios dan satu kendaraan roda 4 rusak. Sedangkan banjir yang terjadi di Kecamatan tempel merendam 1 rumah setinggi 1,5 m. Kondisi cuaca, degradasi lingkungan, dan perilaku masyarakat menjadi pemicu terjadinya banjir. Banjir yang terjadi di Kabupaten Sleman umumnya akibat aliran air permukaan (run off) yang tidak dapat meresap ke dalam tanah akibat berkurangnya area peresapan air sebagai dampak banyaknya alih fungsi lahan. Lahan-lahan terbuka untuk peresapan air hujan banyak diubah fungsinya menjadi bangunan fisik seperti hotel, apartemen, perumahan, pertokoaan, dll. Banjir atau aliran permukaan ini kemudian menuju ke sungai dan menyebabkan beberapa sungai juga meluap.

Terhadap permasalahan ini telah dilakukan upaya oleh Pemerintah Kabupaten Sleman melalui kewajiban membangun sumur peresapan air hujan (SPAH) bagi usaha/kegiatan yang dituangkan dalam Peraturan Bupati Sleman Nomor 49 Tahun 2012 tentang Petunjuk Pelaksanaan Peraturan Daerah Kabupaten Sleman Nomor 5 Tahun 2011 tentang Bangunan Gedung. Peraturan SPAH juga diatur dalam Pearturan Daerah Kabupaten Sleman Nomor 1 Tahun 2016 tentang Pelindungan dan Pengelolaan Lingkungan Hidup. Selain kewajiban SPAH di dalam Perda Kabupaten Sleman Nomor 1 Tahun 2016 juga diatur penyediaan ruang terbuka hijau seluas 20 % dari luas lahan yang digunakan usaha/kegiatan serta kewajiban Pemerintah Desa mengalokasikan 20% tanah desa untuk ruang terbuka hijau. Kegiatan fisik lainnya untuk mendukung penanganan banjir berupa kegiatan TELAGA DESA dan WANA DESA yang merupakan kerjasama dengan BLH DIY. Pemerintah Kabupaten Sleman menyediakan lokasi untuk pembuatan embung atau hutan rakyat, sedangkan pendanaan pembangunan fisik oleh BLH DIY.

Dari Lampiran Tabel 38 dan Tabel 39 yang bersumber dari BPBD Kabupaten Sleman dapat diketahui bahwa pada tahun 2017 terjadi kekeringan di sebagian kecil wilayah Kecamatan Gamping dan Kecamatan Prambanan. Pemerintah Kabupaten Sleman melalui Badan Penanggulangan Bencana Daerah (BPBD) Kabupaten Sleman melakukan dropping air bersih sebanyak 6 tangki untuk Kecamatan Gampin dan 44 tangki untuk Kecamatan Prambanan. Selama tahun 2017 terjadi kebakaran lahan di 10 lokasi dengan perkiraan luas lahan dan kerugian belum diketahui yaitu : Depok 5 lokasi, Gamping 1 lokasi, Ngaglik 2 lokasi, Ngemplak 1 lokasi, Prambanan 1 lokasi.

Bencana tanah longsor Pada tahun 2017 terjadi 38 kejadian tanah longsor dan 2 kejadian gempa bumi. Kejadian ini menyebabkan 2 rumah rusak ringan akibat gempa. Total kerugian akibat bencana tanah longsor dan gempa bumi ini sebesar Rp 255,252.000,00. (Lampiran Tabel 40). Bencana tanah longsor yang terjadi pada umumnya dipicu oleh curah hujan yang tinggi dan perubahan penggunaan lahan. Berdasarkan data sejak tahun 2012, di Kecamatan Prambanan setiap tahun selalu terjadi bencana longsor. Hal ini dapat disebabkan topografi kecamatan tersebut didominasi oleh lahan dengan kemiringan curam, sehingga saat musim penghujan tiba, wilayah ini perlu mendapat perhatian ekstra. Bencana alam akibat angin kencang juga terjadi di Kabupaten Sleman pada tahun 2017, yang terjadi di semua kecamatan yang mengakibatkan 578 mengalami kerusakan dengan total kerugian diperkirakan mencapai Rp. 643.800.000.

Upaya pengurangan resiko bencana dilakukan dengan melakukan pemangkasan pohon baik dari ketinggian maupun lebat daunnya. Upaya yang lain juga dilakukan inventarisasi pohon yang berumur tua untuk dilakukan pemotongan dan diganti dengan pohon baru. Termasuk kebijakan di kampus Universitas Gadjah Mada Yogyakarta telah dilakukan pemangkasan vegetasi yang sudah berumur tua dan mempunyai tajulk damn batang pohon yang tinggi. Hal tersebut dilakukan untuk menghindari jatuhnya batang pohon. Beberapa kebijakan pemangkasan dan pemotongan batang pohon tersebut anatara lain dilakukan di arboretum di beberapa Fakultas.

Tabel 4.1. Kegiatan Dinas Lingkungan Hidup Kabupaten Sleman Tahun 2018

No	NAMA KEGIATAN	KELUARAN	VOLUME	SATUAN
1	2	3	4	5
	Penyediaan sarana dan prasarana Pengelolaan Persampahan	Kompartement adipura	50	unit
		Kompartemen	48	unit
		Gerobak sampah (DAK)	10	unit
		Terbangunnya TPS	4	unit
21	Konservasi SDA dan Pengendalian kerusakan Sumber- sumber Air	Pembangunan SPAH	74	unit
		Tutup lubang biopori	2.000	buah
		Alat bor biopori	220	buah
		Bibit tanaman	1.500	batang
		Sosialisasi	15	kali

22	Pengendalian Dampak Perubahan Iklim	Pemantauan usaha/kegiatan pengguna bahan perusak ozon.	25	usaha/kegiatan
		Inventarisasi gas rumah kaca.	25	buku
		Pembinaan usaha/kegiatan pengguna bahan perusak ozon.	1	kali
		Pembinaan Kampung Iklim	2	kali
		Sosialisasi	5	kali
		Lomba Kampung Iklim	3	prestator
23	Pengelolaan Konservasi Sumber Daya Alam	Laporan Menuju Indonesia Hijau (MIH).	10	buku
24	Pengelolaan Keanekaragaman Hayati dan Ekosistem	Pembinaan masyarakat pemanfaat Kehati	4	kali
		Inventarisasi kerusakan lahan, lahan kritis dan penghijauan	10	buku
		Demplot pelestarian KEHATI	1	lokasi
		Fasilitasi Saka Kalpataru	25	orang saka
		Pengadaan tanaman	1.000	batang
25	Peningkatan peran serta masyarakat dalam perlindungan dan konservasi SDA	Peringatan hari lingkungan hidup	1	kali
26	Pembinaan Program Kampung Hijau	Pembinaan dan pendampingan kampung berwawasan lingkungan	2	desa
		Bibit tanaman	35.000	batang
		Komposter	35.000	buah
		Kompartemen	60	buah
		Pelaksanaan pembinaan kepada pemerhati lingkungan	60	prestator
		Penanaman di lahan rusak	1	lokasi
27	Peningkatan edukasi dan komunikasi masyarakat di bidang lingkungan	Pembinaan sekolah	9	prestator
		Pembinaan pondok pesantren	3	prestator
		Pelaksanaan lomba pembuatan film dokumenter	5	prestator
		Pelaksanaan lomba cerdas cermat	10	prestator
28	Pengembangan Data dan Informasi Lingkungan	Buku Data SLHD Tahun 2016.	30	buku
		Buku Laporan SLHD Tahun 2016.	30	buku
		Draft Buku Data SLHD 2017.	1	draft
		Draft Buku Laporan SLHD 2017	1	draft
29	Pengujian Emisi Kendaraan Bermotor	Terlaksananya lomba emisi kendaraan bermotor.	29.221	kali/kendaraan

		Terlaksananya uji petik pengujian emisi kendaraan bermotor.	1/250	kali/kendaraan
		Pemeriksaan Pb dalam darah	15	orang
		Workshop hasil uji emisi	1	kali
		Sosialisasi bahaya merokok bagi siswa SMA/SMK	1	kali
31	Pemeliharaan Ruang Terbuka Hijau	Terpeliharanya taman dan lahan terbuka hijau	70	lokasi
		Terpeliharanya tanaman perindang jalan	22.000	batang
33	Peningkatan Peran Serta Masyarakat dalam Pengelolaan RTH	Tersosialisasinya Pengelolaan RTH	48	lokasi
34	Perencanaan Pengembangan Ruang Terbuka Hijau	Penyusunan Master Plan Ruang Terbuka Hijau	1	dok
		Penyusunan DED Penataan Lapangan Denggung	1	dok

Sumber: Dokumen Informasi Kinerja Pengelolaan Lingkungan Hidup Daerah Kabupaten Sleman Tahun 2017

ANALISIS DAN PEMBAHASAN

Metode yang dikembangkan dalam penilaian pembangunan pariwisata berkelanjutan dengan pendekatan mixed methodes atau metode campuran. Mixed methodes merupakan pendekatan yang mengkombinasikan bentuk kualitatif dan kuantitatif. Metode ini menutupi keterbatasan dan kekurangan setiap metode sehingga kekuatan penelitian menjadi lebih besar (Creswell, 2009: 4, 14). Strategi metode campuran yang digunakan merupakan prosedur metode campuran konkuren (concurrent mixed methodes). Metode ini memungkinkan dapat memperluas temuan dari satu metode dengan metode lainnya, dimana satu strategi pengumpulan data turut membangun strategi pengumpulan data yang lain. Beberapa langkah dalam pelaksanaan dilakukan snapshoot assessment (penilaian langsung) dengan menggunakan alat skala Likert dengan skala 0 hingga 5 yang merupakan alat pengukur yang sudah ditetapkan oleh GSTC (*Global Sustainable Tourism Council*) melalui penilaian langsung di lokasi. Snapshoot assessment dilakukan berlokasi di, Desa Donokerto Kecamatan Turi, Kabupaten Sleman Provinsi D.I. Yogyakarta pada tahun 2016. Pemilihan lokasi penelitian dilakukan secara random dan terpilih dari beberapa desa wisata yang dianggap mempunyai keunikan yang masih mempertahankan kehidupan sosial budaya masyarakat. Selain itu, berdasarkan penetapan yang dipilih oleh pemerintah setempat dan disetujui oleh kementrian Pariwisata. Desa wisata diharapkan dapat menjadi percontohan (*rule model*) pengembangan desa wisata di Indonesia yang mampu menerapkan pembangunan pariwisata berkelanjutan.

Dalam penilaian yang sudah dilakukan dengan metode penilaian langsung di lapangan untuk memperoleh fakta, menggunakan teori pendukung, mencari penelitian terdahulu yang terkait dengan objek dan variabel, wawancara dengan pengelola dan dokumentasi fakta di lapangan. Hasil dari penilaian tersebut diperoleh kriteria skor 45,5% sudah terimplentasi, 0% implementasi dalam 12 bulan ke depan, 3,5% implementasi lebih dari 12 bulan ke depan, 21,5% dalam tahap perencanaan, 25% tidak, 0% tidak yakin, dan 4,5% tidak menjawab.

Dari hasil penilaian ini diperoleh bahwa desa wisata di kecamatan Turi telah melakukan usaha-usaha dalam meminimalkan dampak dan memaksimalkan manfaat lingkungan. Perlu proses untuk memenuhi semua kriteria hingga mencapai 100%. Dari data dapat diperoleh bahwa kondisi sebenarnya lebih besar dalam tahap yang belum terimplementasi. Desa wisata yang berada di kecamayan Turi telah memahami manfaat dari lingkungan dengan tetap menjaga kearifan lokal untuk menghormati lingkungan. Kondisi ini ditunjukkan dengan sudah membuat perencanaan dan akan diimplentasikan kriteria mengenai lingkungan lingkungan hidup.

Hasil penilaian sangat juga didukung dengan terjaganya tradisi dan budaya lokal untuk menghormati karunia alam yang diberikan. Bentuk tradisi dan kebudayaan tersebut seperti tetap menyelenggarakan ritual tahunan seperti sedekah gunung, berdoa mengelilingi perkampungan, dan aktivitas lainnya yang merupakan turunan dari leluhur. Masyarakat telah memahami hukum alam sebab akibat jika mereka berbuat baik pada alam maka alam akan baik pada manusia yang hidup diatasnya.

Hasil penilaian terhadap adaptasi dan mitigasi bencana dalam standard pengelolaan destinasi pariwisata dan pengelolaan lingkungan dalam prkatek pembangunan pariwisata berkelanjutan yang ditujukan terhadap pengelola desa wisata di beberapa desa wisata di Kecamatan Turi, dengan hasil seperti hasil olahan dibawah ini:

Tabel hasil penilaian dan Kriteria skor penilaian

No	**Kriteria Skor Penilaian**	**Total**	**Nilai**
1	Sudah Terimplementasi	13	45,5%
2	Dalam Pembangunan (implementasi dalam 12 bulan ke depan)	0	0
3	Dalam Pembangunan (implementasi lebih dari 12 bulan ke depam)	1	3,5%
4	Dalam Tahap Perencanaan	6	21,5%
5	Tidak menjawab	1	4,5%
6	Tidak Yakin	0	0
7	Tidak	7	25%

Sumber: hasil Analisis, 2019

Tabel hasil penilaian D1 Resiko lingkungan

Indikator	1	2	3	4	5	6	7	Keterangan
Penilaian keberlanjutan dari destinasi dalam lima tahun mengindentifikasi resiko lingkungan.								Identifikasi resiko lingk dengan melihat jenis resiko bahaya erupsi Gunung
Sistem di tempat (lokasi) untuk mengatasi resiko yang teridentifikasi								Terdapat system untuk jalur evakuasi dalam mengatasi resiko kebencanaan dari pemerinbtah daerah

Sumber: hasil Analisis, 2019

Berdasarkan hasil pengamatan lapangan yang dilakukan di Desa Wisata Pulesari. Pengelola telah berhasil mengidentifikasi resiko-resiko lingkungan yang mempengaruhi keberlanjutan desa Pulesari sebagai sebuah desa wisata. Keberhasilan mengidentifikasi resiko lingkungan utama tidak hanya dimiliki oleh pengelola desa wisata saja, melainkan dimiliki oleh masyarakat di Desa Wisata Pulesari. Hal ini terlihat dari pengetahuan dan tingkat kesiapsiagaan masyarakat dalam menghadapi bahaya erupsi gunung Merapi. Pemerintah desa juga telah menyiapkan regulasi yang didukung oleh Badan Penanggulangan Bencana Daerah (BPBD) dengan membentuk regulasi tentang proses evakuasi dan lokasi-lokasi yang akan dijadikan sebagai lokasi evakuasi ketika resiko lingkungan terbesar di desa Wisata Pulesari terjadi, yaitu Erupsi Gunung Merapi.

Meskipun pengelola Desa Wisata Pulesari telah berhasil mengidentifikasi resiko lingkungan utama yang ada, namun resiko-resiko lingkungan lain belum diidentifikasi secara maksimal dan belum diturunkan kepada hal-hal yang lebih teknis seperti kebijakan dan rencana tindak lanjut.

Resiko-resiko lingkungan lain yang memiliki kemungkinan untuk terjadi di desa wisata antara lain resiko bencana alam lain seperti: (i) longsor, dan (ii) banjir. Letak geografis desa wisata yang berada di lereng dan yang berada di kaki gunung Merapi dan berada di antara 2 sungai yang menjadi jalur aliran lahar hujan memungkinkan desa wisata yang berada di Kecamatan Turi mendapatkan resiko lingkungan dalam bentuk banjir dan longsor. Meskipun keduanya merupakan turunan dari resiko lingkungan utama yang telah berhasil diidentifikasi, namun desa-desa wisata tersebut belum memiliki rencana lebih lanjut untuk mengurangi resiko lingkungan tersebut.

Untuk itu perlu dipertimbangkan terutama Pemerintah Daerah dalam hal ini Kabupaten Sleman untuk lebih memperluas resiko-resiko lingkungan yang kemungkinan bisa saja terjadi di. Hal ini perlu dilakukan karena erupsi merapi sebagai resiko lingkungan utama memiliki beberapa dampak, baik langsung dan tidak langsung. Pada kondisi sekarang ini, desa-desa wisata lebih mempersiapkan untuk menghadapi dampak langsung dari erupsi merapi, sedangkan dampak tidak langsung seperti (banjir lahar hujan dan longsor) belum dipersiapkan dengan baik dan merupakan bagian dari agenda penting dalam pengelolaan berkelanjutan dalam pengurangan resiko bencana.

Kesimpulan

1. Mitigasi bencana merupakan suatu konsep merupakan tahapan awal dalam manajmen bencana yang mempunyai keterkaitan dengan proses kebijakan publik, yang sangat menentukan suatu posisi mitigasi bencana dalam kebijakan public dan dapat dijadikan suatu keputusan dari siklus kebijakan publik (input-output) merupakan tahap mitigasi bencana yang merupakan kondisi empiris terhadap kawasan dan daerah rawan bencana.
2. Paradigma penanggulangan bencana berdasarkan Undang-Undang Nomor 24 Tahun 2007 memberikan wewenang sepenuhnya kepada daerah untuk membentuk pola pembangunan yang selaras dalam usaha-usaha untuk menanggulangi kebencanaan secara berkelanjutan.
3. Desa wisata di kecamatan Turi yang berada di lereng Merapi telah melakukan usaha-usaha dalam meminimalkan dampak dan memaksimalkan manfaat lingkungan.
4. Usaha usaha dalam memenuhi untuk memeinimalkan dampak Perlu proses untuk memenuhi semua kriteria hingga mencapai 100%.
5. Hasil analysis dan dari data dapat diperoleh bahwa kondisi sebenarnya lebih besar dalam tahap yang belum terimplementasi. Desa wisata yang berada di kecamayan Turi telah memahami manfaat dari lingkungan dengan tetap menjaga kearifan lokal untuk menghormati lingkungan. Kondisi ini ditunjukkan dengan sudah membuat perencanaan dan akan diimplentasikan kriteria mengenai lingkungan lingkungan hidup.

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The perception of community related with risk element, as a baseline for evaluating the disaster management training program in the prone areas of Mt. Merapi

Subandriyo[1], Dewi Sri Sayudi[2], dan Raditya Putra[3]
[1, 2, 3]Balai Penyelidikan dan Pengembangan Teknologi Kebencanaan Geologi – Kementerian Energi dan Sumber Daya Mineral

e-mail: jsubandriyo@gmail.com[1], dewisrisayudi@yahoo.com[2], radityaputra@email.com[3]

Abstract
Disaster risk reduction efforts are carried out through strengthening community capacity with disaster management training activities. Disaster management training in disaster-prone areas of Mt. Merapi, known as the Obligatory Practice for Disaster Management (Wajib Latih Penanggulangan Bencana/WLPB) that has been carried out since 2008. To find out the success of disaster management training, it is measured through the level of knowledge, awareness and behavior of the community related with understanding nature of disaster sources and early warning system. Survey to the community have been carried out in the disaster-prone areas of Mt. Merapi, with aims to determine level of community understanding and awareness related to disaster risk reduction efforts. The questions included three parameters, these are understanding the nature of source disaster of Merapi volcano, concept of disaster prone area map and early warning system.
Methods of collecting data used probability sampling applied to the residents living in the disaster-prone areas of Mount Merapi. The method is systemic random sampling where the first element is selected as a random sample, then the selection of the next elements is determined at certain intervals.
Based on data from 668 respondents, it was concluded that the community had understood the type of source of the main disaster threat of Mt. Merapi was pyroclastic flow (73%). Awareness of the source of threats reaches 55%, meaning that people know what have to do when the pyroclastic flow occurs. Knowledge of the concept of the Mt. Merapi disaster prone area map has only reached 45%, meaning that the explanation of the meaning of the prone area map in the disaster management training cannot be understood well by the participants. But when viewed from the aspect of awareness of the Mt. Merapi prone area map, the results reached 83%, meaning that when the threat of an eruption disaster becomes more apparent, the community already knows what actions to take. Related to the behavior of living in a disaster-prone area that is in accordance with the recommendations, it has only reached 46%. This means that recommendations regarding relocation are not fully acceptable.
The knowledge of the G. Merapi danger early warning system is well understood by the community, where the survey results reach 70%. Attitudes and behavior of

community when there is an early warning of eruption, 96% answered that they could take the right action to save themselves.
Keywords: disaster risk reduction, training in disaster management, knowledge_attitudes_behavior, disaster-prone area of Mount Merapi, early warning system

1. Introduction

The publication of Law No. 24 of 2007 concerning Disaster Management is a step forward in disaster management in Indonesia, with a disaster risk management paradigm. The law explicitly regulates the rights and protection of the community against the threat of disaster. However, the Law does not regulate obligations for people living in disaster-prone areas. Therefore it is necessary to enlighten the awareness of people living in disaster-prone areas about their obligations to take an active role in disaster management.

In the context of Mt. Merapi's disaster risk reduction efforts, the Merapi Forum was formed in 2008, the first disaster risk reduction forum in Indonesia, which was a collaboration between 4 regencies surrounding Mt. Merapi, namely Sleman Regency, Magelang Regency, Boyolali Regency and Klaten Regency with the Agency Geology is supported by non-government institutions including UNDP, GTZ, PSMB UPN etc. One of the programs is to strengthen the capacity of the community, the Geological Agency introduced a disaster management training program, hereinafter referred to as the Compulsory Training for Disaster Management (WLPB). The WLPB activity has been ongoing since 2008 until now in the disaster-prone area of Mt. Merapi, which involves direct and sustainable community participation.

The short-term goal of the WLPB can be a strategy to increase the capacity of disaster management in disaster-prone areas, while the long-term goals of the WLPB can be used as social engineering tools for disaster resilience (community disaster resilience) characterized by a culture of disaster preparedness , where the community always uses risk considerations in their daily activities against the eruption danger of Mt. Merapi.

After 10 years, this mandatory training program for disaster management needs to be evaluated. Evaluation includes procedures for organizing, types of training lessons and selection of locations and participants. The evaluation was based on the results of a community perception survey in disaster-prone areas, where disaster management training had been carried out. The purpose of the evaluation is that the mandatory training program for disaster management is more effective and efficient.

2. Survey Method

The disaster management training called Compulsory Training for Disaster Management (WLPB) in Mount Merapi has been started since 2008. Training participants are prioritized in the disaster-prone areas of Mount Merapi, which are divided into Disaster Prone Areas (KRB) III, Disaster Prone Area II (KRB II) and Disaster Prone Area I (KRB I). Disaster-prone areas Mount Merapi covers 4 districts, namely Boyolali Regency, Magelang Regency, Klaten Regency, Central Java Province, and Sleman Regency, DIY Province. In the WLPB organization, the determination of participants is determined by the local government through the relevant agency, not by the training organizer. Therefore the participant population was random, spread in the disaster-prone areas of Mt. Merapi, which included 4 regencies region.

The method of data collection uses probability sampling of residents in the areas of Disaster Prone Areas I, II and III on Mount Merapi. The method used by systemic random sampling is taking the first element as randomly selected members of the sample and selecting the next elements systematically using certain intervals.

Collecting data and information related to the object of the investigation is carried out by interviewing respondents in the field conducted by the enumerator. Before conducting a survey in the field, the enumerator is first conducted an enumerator training by the implementing team regarding interview techniques and data collection.

Data processing is carried out by the implementation team by tabulating data presented in tables, graphs, summary numbers, total numbers, averages, percentages, proportions, ratios, index numbers, correlation coefficients and regression. Correction of field data questionnaires is carried out by data verifiers before data is entered in the tabulation.
The results of the field survey were one of the inputs in the Focus Group Discussion (FGD_Focus Group Discussion) program which invited disaster management stakeholders, volunteer communities and residents around Merapi, community self-help organizations that focused on disaster problems and academics.
There are 3 topics of questions about public perception related to the implementation of WLPB that have been carried out since 2008, namely:
- the nature of source disaster of Merapi volcano
- concept of disaster prone area map of Merapi volcano and
- early warning system.

Analysis of survey results using descriptive statistics to find out how far public awareness after disaster management training has been carried out on the parameters of the types of sources of disaster threats, KRB maps and early warning systems. The results will be used as a reference for improving the method of training in disaster management that is more effective and efficient.

3. Results of WLPB Participant Perception Survey

The purpose of the survey was for WLPB participants in the disaster-prone area of Mount Merapi to find out the extent to which people's understanding and awareness was related to disaster risk reduction efforts. The following is an illustration of the distribution of sample populations spread across the Mt. Merapi disaster area, including Magelang District, Boyolali Regency, Klaten District and Sleman Regency.

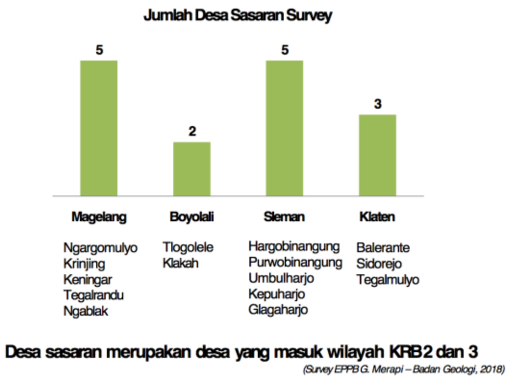


Figure 1. Target locations of surveys in disaster-prone areas
covering 4 districts around Mt. Merapi

The technique of sampling respondents uses probability sampling where units within the population have certain opportunities to become respondents. In this case the population is participants who have attended disaster management training and lived in Disaster Prone Areas 2 and 3 of Mount Merapi. The Harry King nomogram is used to determine the total number of pairs. Based on the nomogram, the number of respondents in Sleman Regency was 286 respondents, Magelang Regency 253 respondents, Boyolali 56 respondents, and Klaten District 7 respondents. There were respondents who refused to be interviewed as many as 2 people, one person each in Boyolali Regency and Magelang Regency. Based on female gender 42% and men 58%, so that gender is almost balanced.

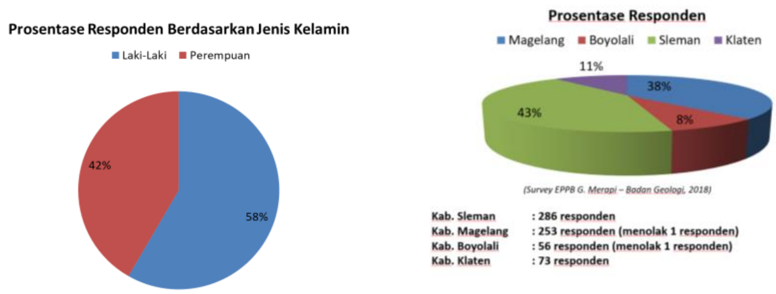


Figure . 2. Graphs of percentage of respondents based on gender and administrative region

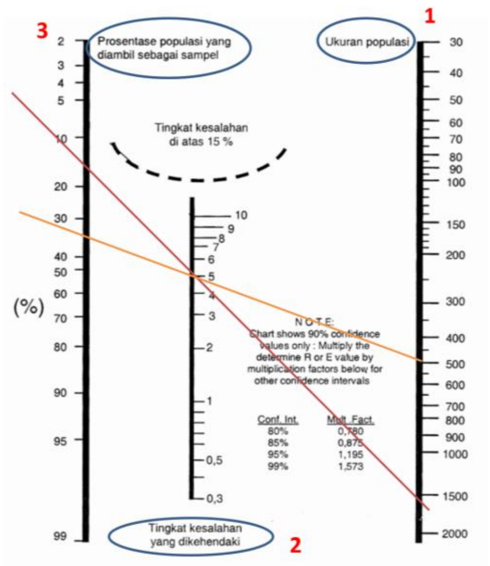


Figure. 3. The Harry King nomogram used
to determine the number of samples

Sleman Regency has a higher percentage of respondents compared to other districts. Based on a risk analysis study after the large eruption in 2010, Sleman Regency had the highest risk index compared to other districts around Mount Merapi. The target of the respondents was residents who had attended disaster mitigation training and community members who had not yet attended training but lived in the KRB 2 and 3 areas of Mount Merapi. This is intended to find out how far the impact of training on residents around them.

The questions in the questionnaire are divided into 3 themes, namely: understanding the types of sources of eruption of Mount Merapi, understanding of the Map of the Disaster Prone Areas of Mt. Merapi and understanding the early warning system. The enumerator will guide the respondent in explaining the purpose of the question if the respondent has difficulty understanding the questions from the questionnaire.

3.1 Understanding of Disaster Threat Sources

To find out the community's understanding of the source of the disaster threat, the question was what kind of main threat the Mt. Merapi disaster was. From the respondents' answers, most answered hot clouds as much as 75%. This means that the community's understanding of the types of sources of the threat of a volcanic eruption is good. This is the most important capital in the effort to reduce the risk of Mount Merapi disaster when it occurs in the future

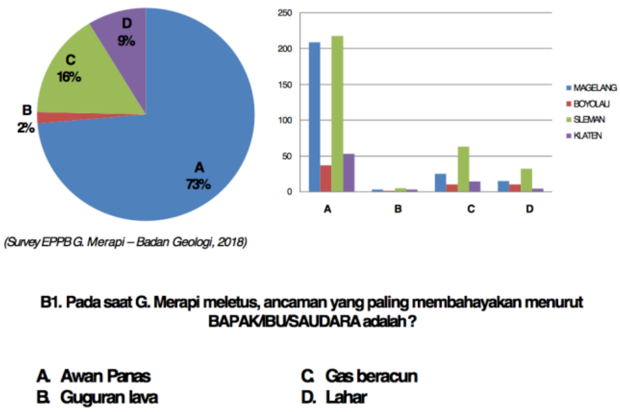
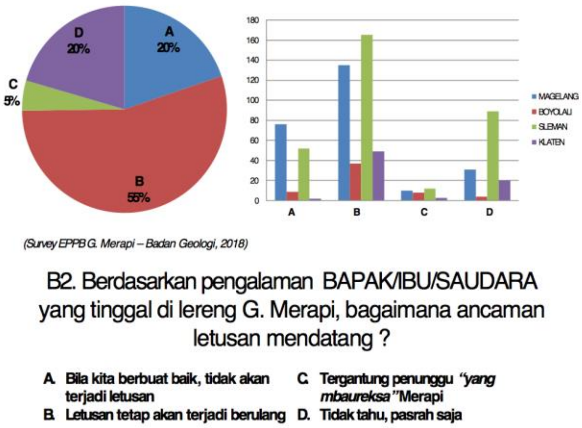


Figure. 4. Respondent's answer to a question about understanding
the types of sources of threats to Mount Merapi disaster

Public perceptions of the threat of Mt. Merapi disaster in the future, 55% of respondents responding to the eruption will occur repeatedly. This means that people have thought rationally about natural disasters. While 20% of respondents answered A that is if doing good there will be no eruption. This means that some people understand disasters from a spiritual moral aspect. For answer C (5%), that depends on "Sing mBaurekso Merapi". This means that a small portion of society still believes in the supernatural power that controls disasters. Those who answered "don't know, just give up" (D) as much as 20%. This perception of society is possible as attitudes and mindsets blend in with nature.



Picture. 5. Questions about understanding character threats and early warning information sources

3.2. Community Perception of the Disater Prone Area Map of Mt. Merapi

Map of volcanic disaster prone areas is a map that shows the level of vulnerability of a region to a type of volcanic eruption hazard. This map is based on the history of the related volcanic eruptions. In efforts to reduce disaster risk, maps of disaster-prone areas are used as the basis for the preparation of disaster mitigation-based spatial plans. The rehabilitation and reconstruction program after the eruption of Mount Merapi in 2010, maps of the disaster-prone areas of Mt. Merapi were used as the basis for the policy of relocation to the population affected by the eruption. At first, there was a lot of resistance to the map of the Merapi disaster prone area. Therefore, it is necessary to know the public perception regarding the map of the disaster-prone area of Mount Merapi so that disaster management stakeholders can take appropriate policies in the effort to reduce disaster risk going forward.

What is the community's perception of the map of Mt. Merapi disaster prone areas as one of the tools used as the basis for disaster risk reduction policies. To find out the extent of public knowledge about maps of disaster-prone areas, questions were asked regarding the contents of the recommendations for spatial use. Based on the results of the survey it turns out that most answered disaster-prone areas III should not be for housing as much as 49%. This means that the community understands the recommendations given by the Geological Agency in spatial use in the disaster-prone areas of Mt. Merapi.

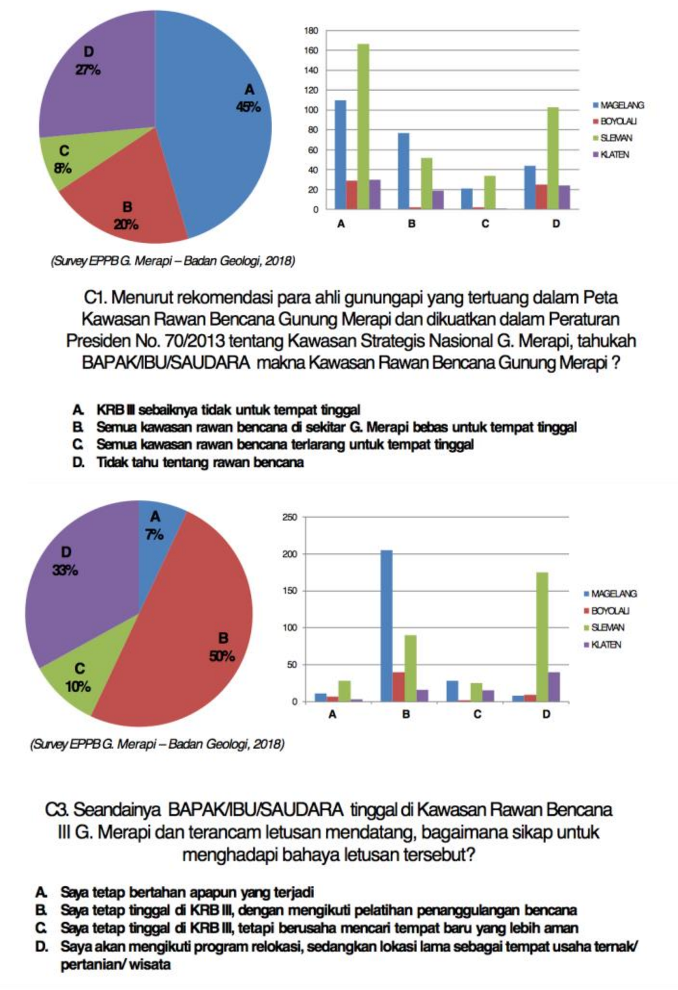


Figure 6. The results of a survey of community perceptions regarding the Map of the Disaster Prone Areas of Mt. Merapi and the implications of government policy on spatial planning

What are the actions and attitudes of the community in facing the threat of eruption of Mount Merapi, they answered that they remained in disaster-prone areas by participating in training (answer B, 50%). They assume that if they have attended training, they hope they can make their own decisions to save themselves and their families. Some people want to take part in the relocation on condition that the land is owned by an old location as a place of business. This is to guarantee their lives and welfare in the future.

How do the perceptions of the people affected by the eruption of G. Merapi respond to the relocation program? The survey results showed 45% said they did not agree to relocation and wanted to stay in their original place. While those who answered agreed 46% by reason of wanting to live in a safe place. This means that between those who agree to relocation and those who refuse are in a balanced position. This result is an important note when implementing relocation policies in the context of disaster risk reduction. The issue of relocation is very sensitive for people who are victims of disasters. Experience of the 2010 eruption relocation program that succeeded in relocating around 2500 families, a persuasive approach was needed through a long dialogue between the government, non-governmental institutions and the community.

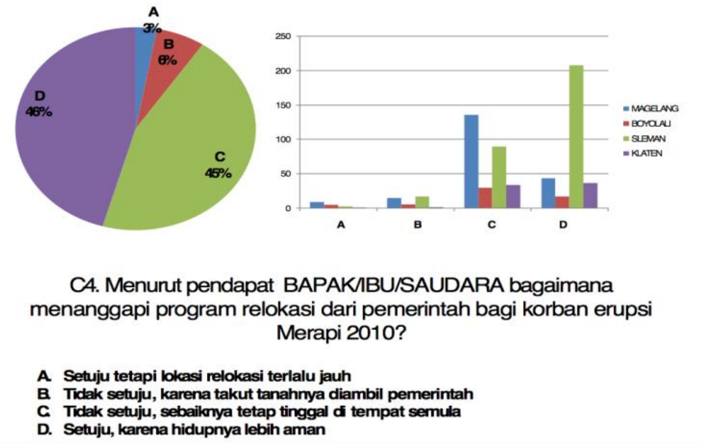


Figure 7. Results of a survey of community perceptions of relocation policy after the 2010 eruption disaster

3.3. Public perception of the early warning system

One of the keys to success in disaster mitigation is people's understanding of the early warning system. The number of victims of Mount Merapi eruption in 2010 was because the community did not understand the early warning provided by the government. Therefore, in disaster management training, the community must understand well the early warning system provided, so that they can take prompt and appropriate action.

What is the community's understanding of the danger of early warning from Mount Merapi? As we know that volcanic hazard warnings consist of 4 levels, namely Normal (level 1), Waspada (level 2), Siaga (level 3) and Awas(level 4). To find out how far the understanding is, questions are asked when disaster-prone areas must be evacuated or in other words when they have to evacuate. Most of the respondents (70%) answered at the level of Awas (level 4). This means that the majority of the population has understood well the danger early warning system of Mount Merapi. It can be concluded that they already understand if the alert in status Awas (level 4) must evacuate. This is important knowledge for the community in facing a volcanic crisis.

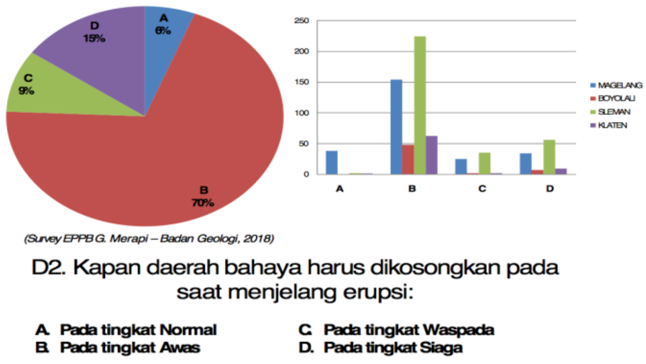
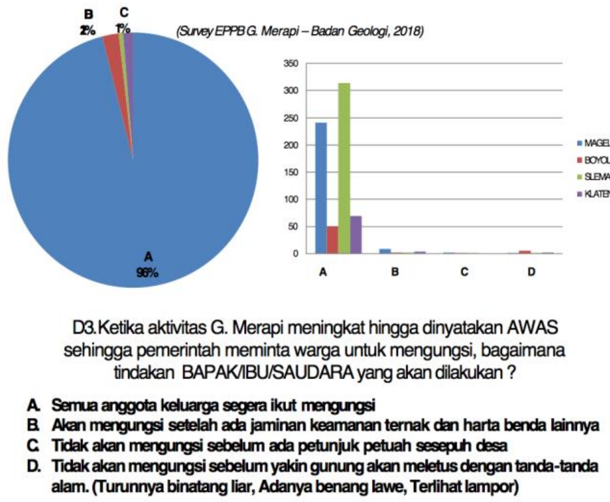


Figure 8. The results of the community perception survey related to the knowledge of the early warning system of Mt. Merapi



Picture. 9. Survey results to determine the community's response to early warning to evacuate

Based on the experience of several eruptions of the Mount Merapi eruption, when asked to evacuate because of the increasingly critical situation and threatening the safety of the population, some people refused to evacuate. As a result, many residents became victims. This is related to community attitudes and behavior in responding to early warning. To find out the attitudes and behavior of the community towards early warning, questions are asked when the early warning is on the alert Awas (level 4) and ordered to evacuate, how the action will be taken. The response of the community of 96% answered that they would evacuate with their families. This reflects no reluctance to evacuate. It can be concluded that knowledge, attitudes and behavior of the community towards the early warning provided by the government have been very good.

4. Conclusion

Based on perceptual data from 668 respondents, it was concluded that the community understood the main threat source of Mt. Merapi, namely hot clouds (73%). Awareness of the threat source reaches 55%, meaning that people know what actions to take when a hot cloud occurs.

The knowledge of the concept of the Disaster Prone Area Map of Mount Merapi only reaches 45%, meaning that the explanation of the meaning of maps of disaster-prone areas has not been well understood by the community. But awareness of the recommendations of maps of disaster-prone areas reached 83%, which means that when the eruption threat of Mount Merapi becomes more apparent, people already know what actions to take. Regarding the behavior of living in the disaster-prone area of Mount Merapi, it only reached 46%. This means that recommendations provided by the Geological Agency related to maps of the disaster-prone areas of Mount Merapi, especially those relating to relocation policies are not fully acceptable to the community.

Knowledge of the danger of early warning of Mount Merapi, is well understood where the survey results reach 70%. The attitude and behavior when there is an early warning of Mt. Merapi is conveyed, most people (96%) can take the right actions to save themselves.

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Prevent Health Problems in the Refugee Camp with Huntara Tents as Family Shelter Post Natural Disasters

Ikhsan Yoga Utama[1,*], **Nirmala Bayuningtyas**[2,**]

[1] Defense Economics, Indonesia Defence University, Indonesia
[2] Medical Science, Malang Islamic University, Indonesia

*ikhsanyogut@gmail.com
**nirmalabayuningtyas@gmail.com

Abstract. Indonesia often experiences natural disasters. After natural disasters occur, various types of health problems can arise in the refugee camp. The cause of this because basic health needs are not fulfilled. In the minimum standard for managing health problems due to disasters and handling refugees, one of the things related to basic health needs is a family shelter. Minimum standards are made so that the minimum living needs of refugees can be fulfilled, so as not to cause health emergency problems. Anticipating this, the PU Settlement Research and Development Center developed a Huntara Tent. However, the use of Huntara Tent by related institutions is still limited. Based on the above problems, the purpose of this study is to explain the prevention of health problems in the refugee camp with Huntara Tent as family shelters post natural disasters.
This study uses qualitative research methods with a descriptive approach. The results of the study show that Huntara Tent has specifications that are in accordance with the family shelter key benchmarks and the minimum standard of assistance shelter/ temporary shelter, so that can be used as a family shelter to prevent health problems in the refugee camp post natural disasters.

Keywords: Natural Disasters, Refugees, Health Problem, Family Shelter, Huntara Tents

1. Introduction

The territory of the Republic of Indonesia (NKRI) has geological, geographical, hydrological, demographic, sociographic conditions that make it potential, vulnerable and often experiencing disasters, both natural disasters, non-natural disasters, and social disasters.[11] Various things have to be done in an emergency when natural disasters occur. Everything was done in a hurry and all in a while, including in terms of providing accommodation for refugees.[8] In the past five years, data on natural disaster information in Indonesia can be seen in **Table 1** below.

Table 1. Natural Disasters in Indonesia 2014-2018. Adopted from [4]

Years	Natural Disaster Events	Victims (soul)		
		Death & Lost	Injured	Affected & Evacuated
2018	2.572	4.814	21.083	10.333.309
2017	2.853	360	1.042	3.674.168
2016	2.302	569	2.675	3.161.231
2015	1.691	276	370	1.215.816
2014	1.951	601	2.104	2.778.092

After the occurrence of natural disasters, making survivors and injured people have to evacuate in refugee camps in open tents. Such conditions can make refugees exposed to various types of health problems. Sleeping in the open, lack of food and clean water exacerbates their condition.[2]

Health problems that can arise after natural disasters among them infection disease such as cholera, typhoid fever, dysentery, leptospirosis, malaria, and dengue fever, and hepatitis A and E. Most post-disaster diseases are caused by poor sanitation, lack of safe drinking water, and contaminated food.[1]

It should know that disasters that are followed by refugees cause health problems that are initiated by other sectors. Referring to the Decree of the Minister of Health of the Republic of Indonesia (Kepmenkes RI) Number 1357/Menkes/SK/XII/2001 concerning the minimum standards for managing health problems due to disasters and handling refugees, in Chapter 4 Point 5, it is mentioned things related to basic health needs, one of which is family shelter.[5]

The family shelter in question is that when an emergency starts, residents get enough closed space to protect them from climate impacts that can endanger them. They get boards that are sufficient to meet health requirements (warm, fresh air, safe and give privacy) to ensure their dignity and well-being.[5]

The minimum standard in overcoming health problems due to disasters and handling refugees is a standard used in the International World. This minimum standard is made on the premise that if there is no fulfillment of the minimum life needs of the disaster victims or refugees, both directly and indirectly will result in emergencies of health problems.[5]

In anticipating this, the PU Settlement Research and Development Center (Puslitbang PU Settlement) introduced a product in the form of a tent for temporary shelter, hereinafter called a Huntara Tent. This tent has two floors that can accommodate six people and has an iron frame that is covered with a tent fabric which is waterproof and hot.[8]

However, as a result of research and development technology, the use of Shelter Tents and Family Tents is still limited because the tents used in disaster response areas vary greatly. Ranging from very simple tents to foreign-made tents. Related to this, it is hoped that this research and development technology can be communicated concretely to related institutions such as the National Disaster Management Agency (BNPB).[10]

In this study, it was devoted to discussing the importance of preventing health problems refugees by providing family shelter after natural disasters that are in accordance with minimum standards. This research also focuses on the use of Huntara Tents which are the results of research and development technology to be used as family shelters. Based on the above problems, the purpose of this study is to explain the Prevention of Health Problems in the Refugee Camp with Huntara Tents as Family Shelter Post Natural Disasters.

2. Literature Review

2.1 Natural Disaster

A disaster is an event or series of events that threatens and disrupts people's lives and livelihoods caused by natural factors and/or non-natural factors and human factors resulting in emergence human casualties, environmental damage, property losses, and psychological impacts.[3]

Natural disasters are natural phenomena or symptoms caused by geological, biological, hydrological, and meteorological conditions, or caused by a process in the natural environment that threatens the life, structure and economy of the community, and can cause havoc.[7] Disasters caused by series of events caused by nature include earthquakes, tsunamis, volcanic eruptions, floods, droughts, hurricanes, and landslides.[3]

2.2 Refugees

Refugees are people or groups of people who leave their homes due to the pressure of physical and/or mental violence resulting from disasters to seek protection and a better life.[7] They are forced or forced to leave their homes for a period of time that is uncertain as a result of the adverse effects of the disaster.[3]

2.3 Health Problems

Health problems are a social problem in the field of health as a result of events by nature, humans and/or both that are meaningful and must be addressed immediately because they can cause disruption to the life and livelihoods of the community.[6]

2.4 Shelter/Temporary Shelter

Temporary shelter is one type of assistance to fulfill basic needs of disaster victims. A temporary shelter is a temporary place of residence as long as disaster victims are displaced, both in the form of mass shelters and families, or individuals.[11]

Temporary shelter assistance is provided in the form of tents, barracks, or public/social facilities buildings, such as places of worship, sports buildings, village halls, etc., which make it possible to use them as temporary shelters. The minimum standards of assistance for temporary shelters include the following:[11]

- Measuring 3 (three) square meters per person.
- Have security and health requirements.
- Having accessibility to public facilities.
- Ensure privacy between sexes and various age groups.

2.5 Family Shelter

Family shelter is enough closed space to protect refugees from climate impacts that can endanger them at the site of disaster evacuation. Family shelter is one of the basic needs of health in accordance with the minimum standards for managing health problems due to disasters and handling refugees. They get boards that are sufficient to meet health requirements (warm, fresh air, safe and give privacy) to ensure their dignity and well-being. The key benchmarks for family shelter include the following:[5]

- Closed spaces are available per person on average 3.5 to 4.5 square meters.
- In a warm and humid climate, these spaces allow optimal air flow and protect the inhabitants from direct sunlight.
- When the climate is hot and dry, the building materials are heavy enough to ensure maximum heat release capacity. If only tents or plastic sheets are available, consider providing multiple roofs or heat-releasing layers.
- In cold air, material and space construction ensure optimal air regulation. The temperature that is comfortable for residents is obtained by means of insulation combined with warm clothes, blankets, beds, and sufficient calorie consumption.

2.6 Huntara Tents

Huntara Tents are products introduced by the Settlement Research and Development Center of the Ministry of Public Works (Puslitbang PU Settlement) in the form of temporary shelters in the form of tents.[8] Huntara Tents are tents designed to function as a temporary shelter for disaster victims. Some of the advantages of the Huntara Tents are as follows:[9]

- Large and height of space that gives freedom of movement.
- Separation of the family room and bedroom provides comfort in carrying out activities.
- Air circulation system that provides comfort in the tent.
- A strong and sturdy frame system.
- Practical in installation.
- Easy to carry.

3. Research Methods

This study uses literature or qualitative study methods. The data used are secondary data that comes from literature reviews and related websites. Data is collected through library study methods, namely by studying the literature related to research. The data analysis technique used is descriptive qualitative.

4. Results and Discussion

4.1 Health Problems in the Refugee Camp

Some types of diseases that often arise in emergencies, one of which is caused by shelter problems do not meet minimum standards, along with preventive measures can be explained in **Table 2** below.

Table 2. Identification of health problems in the refugee camp.

NO.	DISEASE	SYMPTOMS	CAUSE	PREVENTIVE ACTION
1.	Diarrhea	Soft and fluid stool, abdominal pain and cramps, nausea, and vomiting, headache, loss of appetite, continuous thirst, fever, dehydration, and blood in the stool.	Settlements are too dense, Water and food pollution, Sanitation is bad.	Providing sufficient area, education about health, giving clean soap, awareness of food and personal hygiene, providing clean water and adequate food.
2.	Smallpox	Fever, nausea and body feel not fresh, no appetite, headache, fatigue, muscle aches or pains, and itchy rashes on the skin.	Settlements are too dense, vaccinations don't work.	Provide sufficient area, immunization for children under five.
3.	Respiratory Disease	Nasal congestion or runny, often sneezing, lung feels blocked, often feeling tired and fever, coughing, throat and body aching.	Slum housing, lack of blankets and clothes, smoking in public places.	Provide sufficient area, adequate protection such as proper clothing and adequate blankets.
4.	Malaria	High fever, headache, cold sweat, nausea and vomiting, muscle aches, diarrhea, anemia, seizures, and bleeding bowel movements.	High fever, headache, cold sweat, nausea and vomiting, muscle aches, diarrhea, anemia, seizures, and bleeding bowel movements.	Eradicate breeding grounds for mosquitoes by spraying and maintaining environmental hygiene, providing mosquito nets, providing preventive drugs that are safe for small children and pregnant women.
5.	Meningitis	Fever, headache, stiff neck, seizures, behavioral disorders, sensory disorders, and decreased consciousness.	Overcrowded settlements.	Minimum standards for a decent place to live, immunization in accordance with the doctor's recommendations.
6.	Tuberculosis	Coughing, coughing up blood, no appetite, weight loss, fatigue, fever, night sweats, chills, chest pain, urine turns reddish or cloudy.	Overcrowded settlements, malnutrition, vulnerability to TB virus.	Minimum standards for proper living, immunization.
7.	Typhoid	High fever, stomach and chest pain, diarrhea or severe constipation. faeces are the generally greenish, delirious, very bloated stomach.	Overcrowded settlements, poor hygiene awareness, lack of clean water, lack of sanitation.	Minimum standards for decent living, adequate clean water, adequate sanitation, awareness of the importance of cleanliness.
8.	Worms	Shortness of breath, coughing, fever, chest discomfort, blood in mucus, diarrhea, weight loss, decreased appetite, abdominal discomfort, stomach nausea, severe pain and vomiting.	Dense settlements, inadequate sanitation.	Minimum standards for decent housing, proper sanitation, wearing footwear, awareness of individual health.

9.	Scabies	Itching during the night between fingers, armpits, groin and folds, lumps like small pimples and grayish crust.	Dense settlements, lack of awareness of personal health.	Minimum standards for a decent place to live, enough clean water and soap is available.

4.2 Huntara Tents as Family Shelter

Some specifications of Shelter Tents that comply with the minimum standards of shelter assistance and key benchmarks for family shelter can be explained in **Table 3** below.

Table 3. Specifications of huntara tents according to minimum family shelter standard.

NO.	KEY BENCHMARKS FOR FAMILY SHELTER	MINIMUM STANDARDS FOR SHELTER ASSISTANCE	HUNTARA TENT SPECIFICATIONS
1.	Closed spaces are available per person on average 3.5 to 4.5 square meters. The temperature that is comfortable for residents is obtained by means of insulation.	Ensure privacy between sexes and various age groups. Measuring 3 (three) square meters per person.	Has 2 floors (double deck), with the function of each floor: - Ground floor as a family room. - Upstairs as a sleeping area. 4.8 meters long, 3 meters wide and 3.8 meters high.
2.	In a warm and humid climate, these spaces allow optimal air flow. In cold air, material and space construction ensure optimal air regulation.	Have security and health requirements.	Air circulation system day and night. Concrete rebate floor mix 1 cement: 6 sand, 5 cm thick.
3.	When the climate is hot and dry, protect the inhabitants from direct sunlight. The building materials are heavy enough to ensure maximum heat release capacity. If only tents or plastic sheets are available, consider providing multiple roofs or heat-releasing layers. Combined with warm clothes, blankets, beds, and sufficient calorie consumption.	Having accessibility to public facilities.	Hollow iron frame structure 4 x 4 cm 1.2 mm thick. The frame door of the hollow is covered with D300 tent fabric which is waterproof and hot. A tent container that serves as a bed base.

The design of the Huntara Tent can be seen in **Figure 1**, **Figure 2** and **Figure 3** below.

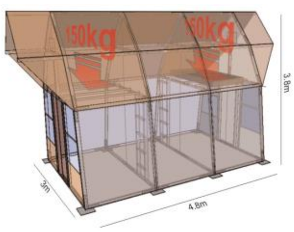

Figure 1. Space Function. Image adopted from [9].

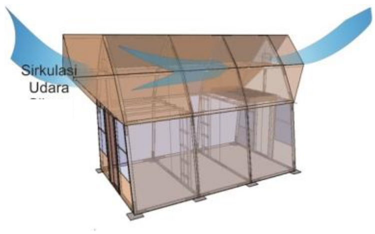

Figure 2. Circulation System Image adopted from [9]

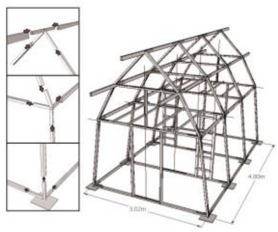

Figure 3. Frame Structure. Image adopted from [9].

5. Conclusions and Recommendations

Based on the identification of health problems in the refugee camp, several types of diseases often arise due to the lack of basic health needs. One of the basic health needs that are not met is a proper shelter. Therefore to prevent health problems in the refugee camp, one of them is by providing shelter that is in accordance with minimum standards.

Family shelter are one of the basic health needs that is in accordance with the minimum standards for overcoming health problems due to disasters and handling refugees. The family shelter has several key benchmarks that comply with the minimum standards of assistance for temporary shelters.

Based on the key benchmarks of family shelter and a minimum standard of temporary shelter assistance, the Huntara Tent with all its advantages also has specifications that are in accordance with the family shelter key benchmark and the minimum standard of temporary shelter assistance. For that, Huntara Tents which are the result of research and technology can be used and used as family shelters to prevent refugee health problems post natural disasters.

6. Acknowledgements

I would thanks to all lecturer and civitas academica of Malang Islamic University, Indonesia Defence University, and all researcher that incorporated in this team.

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The Study Of Coastal Dynamics Of Jabon Coast from Impact Lumpur Lapindo Disaster, Sidoarjo, Indonesia

Supriyadi[1], N Hidayati[2], and A Isdianto[2], Ari Widodo[1], Elvis[1]

[1]Student of Maritime Security, Faculty of National Security, Indonesia Defense University
[2]Lecturer of The Faculty of Fisheries and Marine Science, Brawijaya University, Veteran Street 65145, Indonesia

E-mail: supriyadi@kn.idu.ac.id

Abstract. Coast is a dynamic coastal region in which its shape and shoreline change over time due to natural processes and human activities. The shoreline changes occur due to abrasion and accretion. Meanwhile, the main cause of abrasion and accretion are the action of waves, winds and tides. The study is necessary to describe the dynamic of Jabon Coast. The purpose of this study was to find out the condition of hydro-oceanography, the type, the kind, the distribution of sediment, the condition of coastline change seen from satellite imagery in 1986, 2001, 2011 and 2016, and the coastal dynamics on Jabon Coast Sidoarjo. The study was conducted from November to April 2017. The current velocity on Jabon Beach was 0.1 m/s - 0.2 m/s whose direction was to the west while the direction of the current velocity near the mouth of the river was to the east. The wave height on 18 December 2016 was 0.08 - 0.09 m. The direction of the deep ocean waves was to the northeast, therefore, the influence was very small on the dynamics of the coast. The tidal type of Jabon Coast was mix tide prevailing semidiurnal. Moreover, most sediments consist of silt and clay. The results of the dynamic study show that Jabon Coast was sedimented. Based on google earth, the change of shoreline in 2011-2016 was ±1 to ±5 meters. The same result also occurs when sediment and current data are plotted in the Hjulstrom curve. This sedimentation condition will affect the fishing voyage in fishing and cause floods in the upstream area, correspondingly This sedimentation affects the development plan on Jabon Coast, Sidoarjo.

1. Introduction

A beach is a meeting place between land, sea, and air where there is a dynamic interaction between water, wind and sedimentary material beneath it so that the coastal changes are quite high. This will cause damage to coastal areas. Beach damage can be caused by wind, currents, and waves causing shoreline changes [1]. Shoreline change is a result of a process called littoral transport, which is responsible for moving eroded material in the coasts by means of waves and currents in the nearshore zone [2]. Shoreline change may occur due to both natural and man-made processes. While the effects of waves, currents, tides, and winds are primary natural factors that influence the coast, the other aspects eroding the coastline include the sand sources and sinks, changes in relative sea level, geomorphological characteristics of the shore etc. Anthropogenic effects that trigger beach erosion are the construction of artificial structures, mining of beach and, offshore dredging or building of dams or rivers [3].

Coastal areas are very important for human beings since ancient time. About one-third of the human population is living within 100 km from the shoreline. Various developmental projects have been set up in the coastal zone, placing great pressure on it, leading to diverse coastal hazards like sea erosion, seawater intrusion, coral bleaching, shoreline change etc [4]. Coastal areas are often used as residential areas, places of tourism, cultivation areas, reclamation areas and other public facilities such as roads. Interaction due to the influence of the sea such as currents, waves, or other hydro oceanographic parameters can lead to coast dynamics in a relatively faster time [5].

Some human activities as mentioned above will have impacts such as coastal erosion that destroys residential areas and urban infrastructure in the form of coastline retreats, sedimentation as a result of coastal sediments and leads the advent of coastlines, deflection or sedimentation of river mouths that can lead to clogging of river streams Resulting in flooding in the upper reaches (Triatmodjo, 1999). Shoreline change is considered one of the most dynamic processes in coastal areas It has become important to map shoreline change as input data for coastal hazard assessment. Knowledge of shoreline position is the basis for overcoming coastal problems. The extraction of shoreline and water bodies is a useful task for various applications such as coastline change detection, coastal zone management, watershed definition and flood prediction [6].

The estuary of the Porong River is relatively high. Concentrations of suspended sediment for 15 days were concentrated ranging from 3.803 mg / l - 240.448 mg / l with the orientation to the southeast. It can be concluded that the largest siltation is in the southeast region of the mouth of the Porong river. The current occurring around the mouth of the porong river at full moon reaches 0.270 m / s and the current velocity at the time of the farm reaches 0.080 m / s. Its orientation at low tide goes from east to west and then northward along the shape of its coastline and at high tide to the ebb and flow of orientation oriented from north to south and then to the east following the shape of the coastline [7].

The dynamics of Jabon Sidoarjo Beach is very high due to the sediment transport from the Lapindo mudflow through the Porong River. The condition of coastal jabon when viewed in the image of Google Earth in 1986, 2001,2011 and 2016 experiencing sedimentation so it needs to be studied about the dynamics of the beaches that are there. Research on the dynamics of Jabon Beach to date has not been investigated, therefore research is needed that combines shoreline change data with physics parameter data such as currents, waves, tides, and sediments, by knowing the dynamics in Jabon Beach then we can do Coastal area development planning is much better. As a result of silting or sedimentation in the mouth of the river can cause flooding in the upper reaches or changing the cruise lines of fishing vessels.

2. Research Methods

2.1 Time and Location Research

This research was conducted from November to April 2017. The analysis of laboratory data was carried out from December to February 2017 at the Land laboratory UB Faculty of Engineering. Data processing conducted from February to April 2017. The research location was in Jabon Beach, Jabon Sub-district, Sidoarjo Regency (Figure 1).

2.2. Data Collection Procedures

Primary data taken are data flow direction, current velocity, and sediment sampling at each station. Secondary data include coastline change data obtained from Google Earth as comparison data in coastline change analysis, tidal prediction data with TMD and wave data from BMKG Maritime II Silver, Surabaya. Sediments of sediment grains and current velocities are connected in the Hjulstrom Chart to determine the transport conditions of sediment. Measurement Current in this research current measurement is implemented by applying eularian method that is using current digital meter type FP111.2.3 Tidal Prediction with TMD

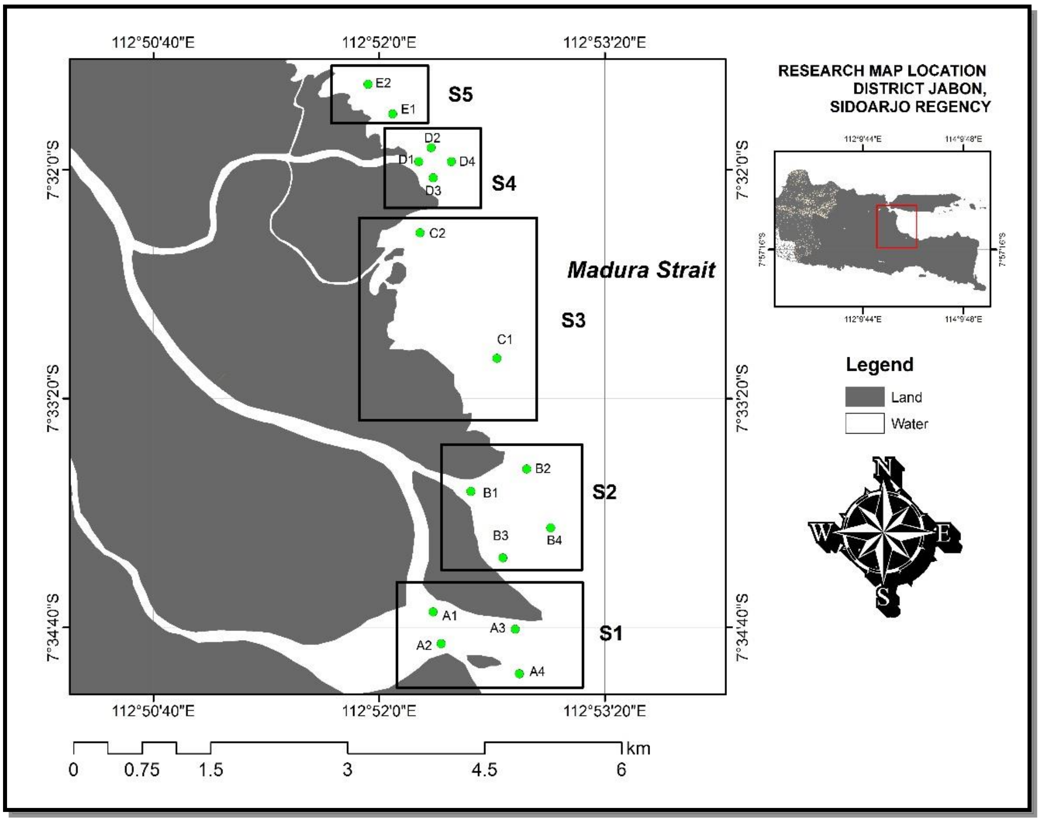

Figure 1. Research Location

The first step in the tidal prediction using the TMD method was clicked the "Add with Subfolders" menu to include all the commands in the TMD folder. The next step comes to a new window that says "Open Model Files Listed In". The function of this window was to open the programming model from the TMD toolbox that will run afterward. The TMD folder contains the "data" folder with the model file titled "Model_ind". Click the model files and click open, so it appears Tidal Model Driver Programming results from Lana Erofeeva. Enter coordinate data, and check the tidal component. Change the date to 12 (December) in 2016. Tidal prediction results can be obtained from the "Predict Tide" menu. The resulting data is open in Microsoft excel to obtain the tidal graphs as well as the component components of the Formzahl number. According to [8] after obtaining the values of M2, S2, K1, and O1, the Formzahl number of formula F = (K1 + O1) / (M2 + S2) where F = Formzahl number, K1, O1 = single daily tidal constant Main, M2, S2 = the major double tidal constant constant. The value of F then in the classification according to the division as follows:

- Double daily tide, if F = ¼
- Tidal mixed double-skew daily, if ¼ <F <1½
- Tidal mixed single daily skew, if 1½ <F <3
- Single daily tide, if F> 3.

2.4 Sediment Sampling

Suspended sediment is a major determinant in numerical models of shoreline changes and salt marsh response to sea level rise. Suspended sediment concentration is easier to quantify and can help improve the predictive power shoreline change models [9]. Sediment Trap is used to determine the volume of sediment in a week then Grab Sampler to determine the type of sediment. The sediment trap is made of PVC pipe with a diameter of 9 cm (3 dim) with a length of 50 cm tied to a bamboo with a length of 1.5 meters. The sediment trap construction to 16 research points with each point is two sediment traps.

2.5 Laboratory Test

Laboratory sediment research consisted of 3 stages: sample and sieving drying, granulometry analysis to analyze grain size of sediment, and also hydrometer analysis for silt type sediments consisting of silt and clay.

3. Result and Discussion

3.1 Overview of Jabon Beach

According to [11] the physical characteristics of the coastal base of Jabon sub-district shaped sloping with sedimentation of mud. The result of sediment from soil and mud carried by river flow (Surabaya and Porong River) formed the land so that the soil type was soft without the hard rock. Characteristics of coastal areas of Sidoarjo Regency has an area of 634.39 km2 with the following boundaries:

North : Surabaya City and Sidoarjo Regency
South : Pasuruan Regency
East : Madura Strait
West : Mojokerto Regency

3.2 Condition of Hydro-Oceanography Parameters

3.2.1 Current and Wave

The greatest current velocity as seen in Figure. 2. was at the point A1, B1, C1, D1, D3, E2 due to the near mouth of the river so that the current velocity is 0.2 m / s. Point E2 although not near the big estuary but gets the influence of branching estuary small estuary around it. The points A2, A3, A4, B2, B3, B4, C2, D2, D4, and E1 have a current velocity of 0.1 m/s.

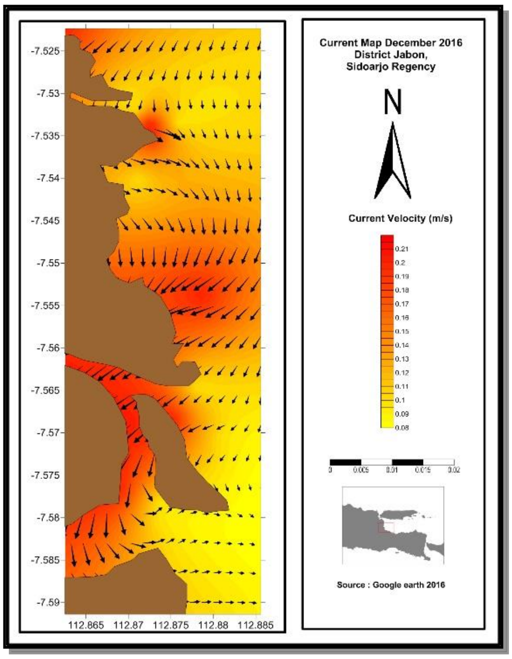

Figure 2. Current Map Jabon Beach. Measurement with current meter digital FP111. Red colour image shows current water faster flow rate. The arrow show direction about flow water current.

Demonstrates the largest wave in July 2016 with a height of 0.52 meters. The highest wave height in December 2016 was 0.03 meters. The dominant direction of December to the northeast. Observation of wave data on December 18, 2016 wave height in Jabon Beach when the study from 08:00 to 16:00 pm for 0.09 to 0.08 meters. The wave height will affect the sediment distribution vertically. The direction of the waves on 18 December 2016 to the East.

3.2.2 Tidal Waves

The result of formzahl number obtained was K1 = 0.38, O1 = 0.21, M2 = 0.48, S2 = 0.36 to determine the type of tides Jabon Beach. Highest sea water level occurred on December 14, 2016, at 15:00 pm. The lowest retreat also occurred on December 14, 2016, at 22:00 pm. Formzahl number results (F=((O1+K1))/((M2+S2))) was 0.69 so that it can be concluded in December 2016 there was a double tidal mixed daily tidal type. This tidal condition will affect coastal stability when the tide of water pressure to the coast was at the top so that if there is a change of current or wave condition will cause the beach stability change in the position of the top shoreline as well.

3.3 Sediment Type, Kind, and Distribution Analysis

Sediment analysis consisted of Sediment Type, Kind, and Sediment Distribution and Sediment Volume Analysis. The result of sediment analysis (Figure. 1) has obtained sediment data at points A1, A2, A3, B1, B2, B4, C1, C2, D4, E1 and E2 were dominated by sediment type Clay and silt. The highest percentage of mud sediment was found at point E2. Other points such as point A4, B3, D1, D2, D3 sediment composition dominated by sand sediment type. The percentage of sediments from all medium sand dots with the size of 0.25 mm - 0.5 mm at most stations D1, D2, D3 whereas in station A4 and B3 sediment most found sediment with the type of fine sand that has a size of 0.125 mm to 0.25 mm.

The sedimentation volume result was the average of sediment trap sedimentation at each sediment sampling point besides this data was taken within one-week interval. At station 3 the volume of sediment tends to be less when compared to other stations, this is because station 3 is not directly opposite the estuary of porong river and river estuary kedunglarangan. Station 4 shows a fairly high volume of sediment due to the influence of clay grain densities that are easily carried by the current so that the sediments carried into the sediment trap PVC tube are also quite large. Station 4 also faces the mouth of the Bajul river which is located on Jabon Beach. Station 1 has the second highest number of sediment volumes from several existing stations of 402.7 cm^3. This condition was caused the sediment in station 1 tends to mud so easily enter and carried into the sediment trap tube. Station 3 sediment volumes were very far from the porong river flow so that the volume of sediment collected in a week is only 95.4 cm^3

3.4 Dynamics of Jabon Beach

Results Hjulstrom curve analysis (Figure 3) shows that the average sediment was at a point A1, A2, A3, B2, B3, B4, C1, C2, D4, E1 and E2 have the condition Erosion of unconsolidated mud or beach conditions will experience Erosion when the sediment was in suspended or non-clotted clay sediment conditions. The sand-shaped sediments at points A4, D1, D2, and D3 will experience transport as bedload which means the sediment will move in the bottom of the water.

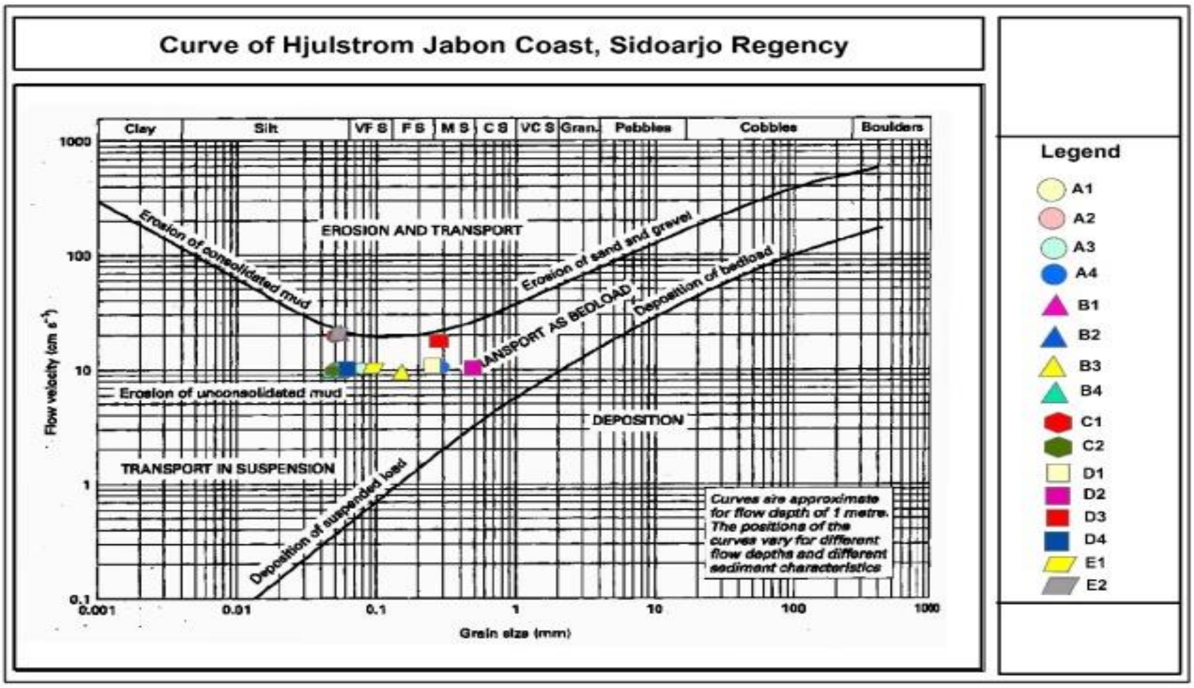

Figure 3. Plotting in Curve of Hjulstrom

The shoreline change if we connect with the Hjulstrom chart shows a positive correlation with sedimentation. Hjulstrom graph shows most experienced erosion unconsolidated sediment mud or sediment erosion when the conditions do not form clumps, but the percentage of sediment in the field most of the percentage of silt and clay which was more than the sand so the beach was difficult to erode. The term "unconsolidated mud" is also called transport in suspension so that suspended sediment conditions if not in the form of clumps in the waters. Judging from the overall sedimentation type in Figure 4, it shows that the estuary type found in stations 1 and 2 is an estuary type dominated by river flow or river discharge. Estuary characteristic feature of this type was the formation of the delta that is in Porong River estuary south, in addition to the effect of the waves was not too significant because of the average wave height in December 0.03 meters in the direction toward the northeast. The direction of the waves that are not towards the shoreline so that the waves are very small. Station 3 north in previous years are eroding due to the supply of sediment carried by the river flow more in the estuary of the river south (Stations 1, 2, & 3 south), but starting in 2011, has undergone sedimentation caused by the sediment supply of Lapindo mud. Station 4 and 5 in 2011 began to experience sedimentation, this type of estuary was dominated by tidal, seen from the pattern of bell-shaped mouth or funnel.

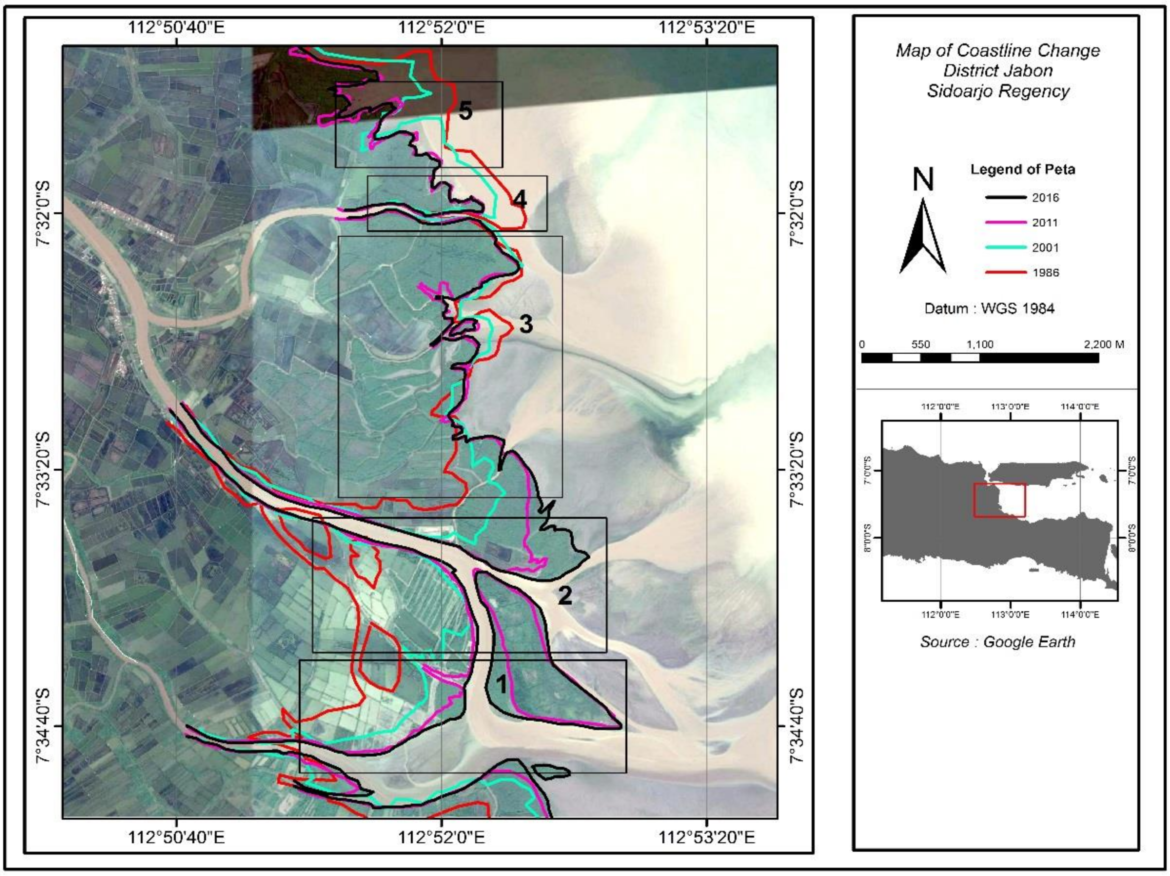

Figure 4. Coast Line Changes 1986 – 2016

4. Conslusion

In the Jabon Beach the direction of the waves was dominant in the northeast, the highest current velocity was in the estuary, and tidal type was mix tides prevailing semidiurnal.

Most types of sediments in Jabon Beach is silt and clay with the highest volume of sediment in station 1 and station 2. During 1998 to 2001, the sedimentantion was not significant while between 2011 and 2016 there was significant sedimentation in the Jabon beach that was supported by the Hjulstrom curve analysis.

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Forest and Land Fire Mitigation Efforts for Air Quality Changes

Nurul Safitry and IDK Kerta Widana

Indonesia Defense University
IPSC Complex, Bogor 16810, Indonesia

Email: nurulsafitry779@gmail.com

Abstract. The case of forest and land fires is one of the disturbances that often occurs during the dry season in Ogan Ilir district. The impact of forest and land fires are emergence of smog, decreasing diversity of flora and ecosystems, and decreasing air quality. To explain the level of air quality, an air pollution standard index (ISPU) is made. Based on data, it is known that in 2015, the air pollutant standard index in the prone to forest areas and land fires has reached the category of sulfur dioxide and *particulate matter* hazardous categories of carbon monoxide parameters. This study aims to analyze the role of forest and land fire prevention on changes in air quality in Ogan Ilir District. The research design was *cross sectional* using secondary data from various institutions across programs related to forest and land fires in Ogan Ilir District. Data analysis equipped by triangulation methods. The results showed that the hotspots and burning land were significantly reduced and air quality was increased after various efforts to overcome forests and fires in the stages of prevention. In 2017 the sulfur dioxide (SO_2) was in the unhealthy category, *particulate matter* (PM_{10}) was in the moderate category, and carbonmonoxide (CO) was in the unhealthy category from previously in the dangerous category.

Keywords: Forest; Land fires; Air quality.

1. Introduction

Area of peat and wetlands in Indonesia is very broad, which is around 19 million hectares or 10 percent of the territory of the country. However, the land has been damaged by fire due to several factors, including high economic needs, increased hotspot distribution, the influence of the El-Nino phenomenon, and draining of peatlands [1]. If the wetlands are damaged, it will be very sensitive to burning again, because it is more accessible and the vegetation is more flammable. The community will quickly utilize the open area and the damaged area gradually and continue to expand from the river bank to the inland peat area. Drained peatlands can become the main fire location every year. In some areas, these peatlands are very closed to the location of people's lives. Gustafson said that the government should have attention focused on the risk that fire poses to people living in the so-called wildland-urban interface, where human communities are located in proximity to large blocks of undeveloped land[1].

In 2015, the El Nino phenomenon caused a prolonged drought and dry season in Indonesia, which became one of the factors causing forest and land fires, especially in Ogan Ilir District. Ogan Ilir has a strategic value and is close to the city of Palembang which is the capital of the Province of South Sumatra. Ogan Ilir Regency has an area of ± 266,607 Ha, with 35% being a swampy lowland stretch [2]. The case of forest and land fires is one of the disturbances that often occur during the dry season. Based on data compiled by the Regional Disaster Management Agency, observations of the satellite *National Oceanic Atmospheric Administration (NOAA 18)* mention there were 211 *hotspots* and ± 309.5 hectares of land burned in Ogan Ilir District of South Sumatra Province that year. The impact of forest and land fires, namely the emergence of smog so much that disturbs the functioning of people's lives, both in the fields of economy, education, politics, social and defense. Forest fires also cause ecological damage, decreasing the diversity of flora and ecosystems, and decreasing air quality [3].

To explain the level of air quality, an air quality index is created called the air pollution standard index (ISPU). The ISPU value has a range from 0 (good) to 500 (dangerous). Based on the Decree of the Minister of Environment Number 45 of 1997, the basic parameters for ISPU include *Particulate Matter* (PM_{10}), sulfur dioxide (SO_2), carbon monoxide (CO), Ozone (O_3), and Nitrogendioxide (NO_2). While smoke from forest and land fires generally contains CO, $COgas_2$, H_2O, soot and dust (particles) coupled with existing elements in the air such as N_2, O_2, CO_2, H_2O, and others [4]. Based on data obtained from the Ogan Ilir District Health Office, it is known that in 2015, the air pollutant standard index had reached a very unhealthy category of sulfur dioxide and parameters and particulate matter dangerous categories of carbon monoxide parameters. This study aims to analyze the role of forest and land fire prevention on changes in air quality in Ogan Ilir District.

2. Research Methods

This study was conducted in the Ogan Ilir Regency area with a focus on research in land fire-prone areas, namely North Indralaya sub-district in 2015-2017. The type of research is a descriptive analytic study. The research design was cross-sectional using secondary data from various cross-program and cross-health institutions related to the prevention of forest and land fires in Ogan Ilir District. These institutions are risk that have effect positive and negative. This hierarchy below illustrate the model of cross sectional design that using for this research (figure 1).

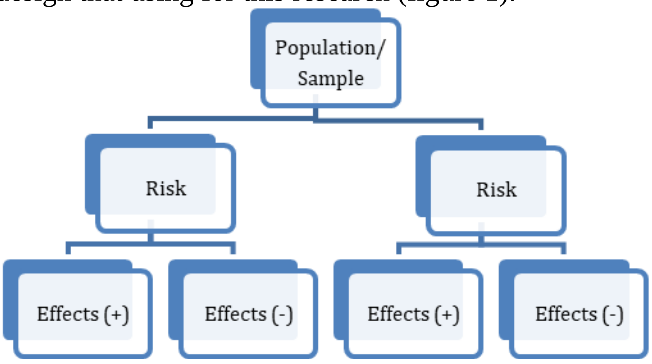

Figure 1. Cross Sectional Design Research

The sample is determined using purposive sampling, namely the technique of determining the sample with special consideration. In other words, researchers determine certain considerations that have been prepared in advance. In this case, the samples determined are regions based on hotspot data which are fire-prone areas. In addition, to produce data that can be accounted for, it is carried out diligently and continuously. Data analysis was carried out descriptively and manually to see the picture of handling forest and land fires with changes in air quality. Besides that, triangulation is also carried out, meaning that in the study data is checked with various sources, methods or techniques at various times.

3. Results and Discussion

3.1 Forest and Land Fires

Fires are one of the serious factors that are the cause of current air pollution problems because they act as the largest source of carbon monoxide (CO) emissions. The form of pollutants from the fire is in the form of smoke containing many particulates[5].The causes of forest and land fires in Indonesia are generally caused by two factors, namely human factors and natural factors. First, human negligence when carrying out activities in the forest and intentionally opening plantation land by burning. Land clearing by burning is done both for new land and rejuvenation of industrial plants in the forest area. Second, natural factors also affect the incidence of forest and land fires in Indonesia. The El Nino phenomenon that occurred in 2015 caused a long summer so the plants dried up. Dry plants are potential fuels if exposed to sparks that appear on the surface or from other combustion either intentionally or unintentionally[6]. This caused *ground fire* and *surface fire.* In 2015, an area of ± 309.5 hectares of land was burnt from 32 villages in Ogan Ilir District (BPBD, 2016). This fire is the biggest fire in the last decade. The hotspots density as consequence of forest and land fires in 2015 in Ogan Ilir District is given by data monitored via the National Oceanic Atmospheric Administration (NOAA 18) satellite (figure 2)[7].

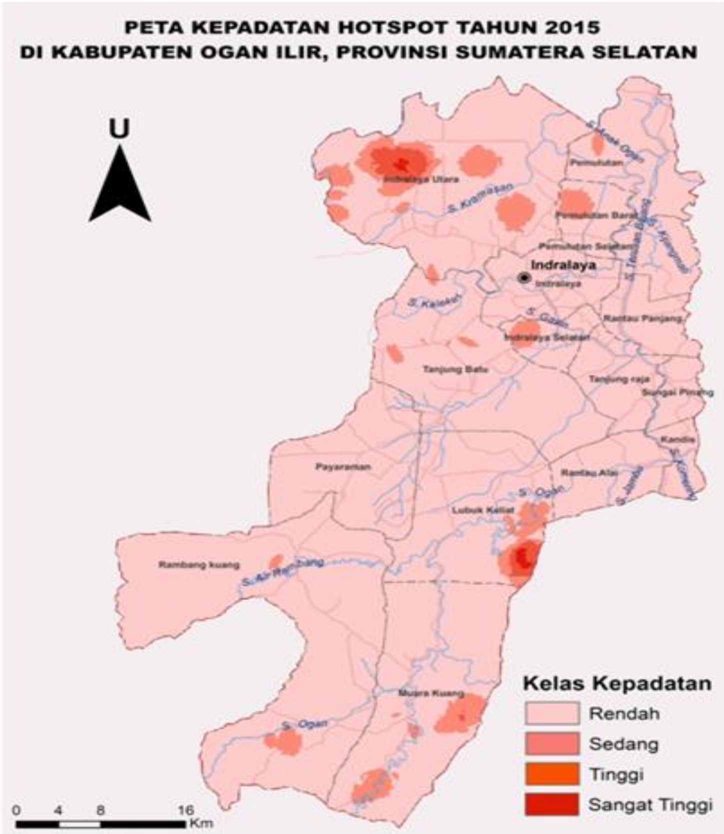

Figure 2. Hotspot Density Map in 2015 (Source: Regional Disaster Management Agency of Ogan Ilir)

3.2 Air Quality

Air is the main component to sustain life. Metabolism in the body of a living creature cannot take place without oxygen coming from the air. In addition to oxygen there are other substances contained in the air, namely carbon monoxide, carbon dioxide, formaldehyde, fungi, viruses and so on. These substances if they are still within certain limits can still be neutralized, but if they have reached the threshold, the neutralization process will be disrupted and the increase in the concentration of substances in the air is mostly caused by human activity [8].

To explain the level of air quality, an air quality index is created called the air pollution standard index (ISPU). The ISPU value has a range from 0 (good) to 500 (dangerous). That is, the higher the ISPU value, the lower the air quality. Based on the Decree of the Minister of Environment No. 45 of 1997, the basic parameters for ISPU include *Particulate Matter* (PM_{10}), sulfur dioxide (SO_2), carbon monoxide (CO), Ozone (O_3), and Nitrogen dioxide (NO_2).

The frequent occurrence of forest and land fires in Ogan Ilir Regency causes a decrease in air quality in the area (high ISPU). This condition can have a negative impact on every aspect of people's lives. The following are 3 (three) locations of air quality sampling points in Ogan Ilir District especially in areas prone to forest and land fires (table 1).

Table 1. Results of Calculation of ISPU Value of Ogan Ilir District on 9 September 2015

No	Location Points andCoordinates	Air Parameter		
		SO_2 **(μg / m^3)**	CO **(mg / m^3)**	PM_{10} **(μg / m^3)**
1.	Terminal Indralaya Km.32 -3 ° 12'19,991 "S 104 ° 39'14,765" E	193,5	291,1	210, 2
2.	Jalan Palembang-Indralaya Km.27 -3 ° 12'22,999 "S 104 ° 39'7,959" E	200.2	305.0	248.9
3.	Integrated Command Post Karhutlah -3 ° 8'39,071 "S 104 ° 41 '36, 179 'E	203.2	301.7	258.8

Based on the table, the content of sulfur dioxide (SO_2) and *particulate matter* (PM_{10}) reached the very unhealthy category. According to Minister of Environment Decree No. 45 of 1997, in this category the level of air quality is harmful to humans or groups of animals that are sensitive or can cause damage to plants or aesthetic value. In addition, the content of carbonmonoxide (CO) has reached a dangerous category which means that at this level of air quality it can harm serious safety in the population.
According to Malilay in Akbar, the high ISPU from forest and land fires is identical to the high air pollutants, because the components of smog consist of combustion, both gases (CO, SO_2, NO_2, aldehydes, O_3, CO_2, and hydrocarbons) and other irritant particles [9]. In 2017, air quality was again measured in the same place from 2015 with the aim of comparing the percentage of air pollutants (table 2).

Table 2. Results of Calculation of ISPU Value of Ogan Ilir District on 9 August 2017

No	Point Location and Coordinate of	Air Parameters		
		SO_2 **(μg / m^3)**	CO **(mg / m^3)**	PM_{10} **(μg / m^3)**
1.	Integrated Command Post - 3 ° 8'39,071 "S 104 ° 41'36,179" E	123.5	114.2	90.2

Carbon monoxide is a gas that is colorless, odorless and tasteless arising from incomplete combustion of fuel, which contained carbon. CO gas is classified as a toxic gas that enters the body through breathing and is then absorbed into the bloodstream. This gas is also able to bind hemoglobin, which functions to carry oxygen in the blood with a binding capacity of 240 times greater than the binding capacity of hemoglobin and oxygen, thus decreasing the supply of oxygen throughout the body and weakening the contraction of the heart and reducing the volume of blood distributed. This will then affect the function of organs such as the brain, liver, nerve center and fetus [10]. The other impact caused by pollutant indicators in the form of nitrogen oxides is reduced visibility. Nitrate particles can block the transmission of light and form fog, which disturbs the view. With disruption of visibility, it affects the smooth operation of transportation which has an impact on the stability of everyday life.

More dangerous things can also be caused by SO gas content$_2$ too high. Sulfur Dioxide gas can cause irritation to the respiratory system, such as the mucous membranes of the nose, throat, and airways in the lungs. These health effects get worse in people with asthma. According to Harrop in KLH, because SOgas$_2$ has the potential to produce sulfate aerosols as secondary pollutants, the case of increasing mortality due to respiratory failure, especially in parents and children, is often associated with SOconcentrations$_2$ and particulate simultaneously. Particulates are defined as fine particles derived from solids or liquids suspended in gas (air). These solid or liquid particles are generally a mixture of several organic and non-organic materials such as acids (particles of nitrate or sulfate), metals, or dust and soil particles. Particle size is very important to know because it affects the impact of these particles on humans and the environment. PM_{10} is a particle measuring 10 micrometers or smaller.

Particle size plays an important role in determining the location of settling particulates and the impact they cause when sucked into the lungs. Large enough particles will usually be filtered in the nose and throat and cause no harmful effects, while smaller (inhalable) particles such as PM_{10} will go deeper into the human respiratory system and cause respiratory problems, even increasing numbers Dead [11]. At a concentration of 140 µg / m^3, PM_{10} can reduce lung function in children, while at a concentration of 350 µg / m$^{3\ it}$ can aggravate the condition of bronchitis sufferers.

The incidence of forest and land fires in 2015 which resulted in very low air quality became an important lesson for the government and the community. Various efforts have been made to improve air quality, this is evident in the calculation of the ISPU value on August 9, 2017, it was found that the sulfur dioxide (SOcontent$_2$) was in the unhealthy category and content *particulate matter* (PM_{10}) was in the medium category. Significant increase was seen in the content of carbon monoxide (CO), which is in the unhealthy category of those previously in the dangerous category.

3.3 Management of Forest and Land Fires

According to Law No.24 of 2007, the implementation of disaster management is a series of efforts which include the establishment of development policies that risk the occurrence of disasters, pre-disaster activities, when a disaster occurs, and post-disaster. This means that the capability of the Government is highly demanded in controlling forest and land fires. Capability is a form of capability that must be possessed by both the government and the community in facing every challenge caused by the development and change of a phenomenon. This capability must also be able to overcome some aspects of life functions that are disrupted such as economics, education, health, transportation, and security[12].

The capability in question is manifested in a form of forest and land fire prevention efforts in the pre, current and post-fire stages. Disaster management is defined by Damon P.Coppola (2007), namely: *"Disaster management is a complex discipline, it involves actions that seek to mitigate the effects of hazards, ensure that they are prepared for disasters should they occur,* *facilitate the response to that occurs, and help nations and people recover in months and years following disaster events "*. Disaster management is a complex discipline, covering actions to reduce the impact of hazards, ensuring that the community is prepared for a disaster, facilitating an emergency response, and helping restore life after a disaster occurs[13].

In the pre-disaster phase which aims to avoid the negative impacts of a forest and land fire hazard (prevention), the government can make efforts to supervise, prohibit and enforce the law. Some legal products that can be issued by the government, among others in the form of a regional head's decision on emergency alert status as well as other regulations, as in Ogan Ilir District have referred to the following two legal products as a legal basis in preventive efforts of forest and land fires.

- South Sumatra Regional Police Chief Declaration Number: MAK / 03 / IV / 2015 concerning prohibition on burning forest, land, weeds / bushes
- Regent Ogan Ilir Decree Number 103 / KPTS / BPBD-OI / 2016 dated March 7, 2016 concerning Determination of Emergency Disaster Status of Smoke Disaster

According to Suwari Akhmaddian, law enforcement is very important as a preventive effort. Conceptually, the core of law enforcement lies in the activities of harmonizing the relationship of values outlined in the principles of solid and action as a series of final stages of the translation of values to create, maintain and maintain the peace of life[14].

Law No. 32 of 2009 concerning Protection and Management of the Environment provides three kinds of enforcement of environmental law, namely the enforcement of administrative, civil and criminal law. Among the three available law enforcement, enforcement of administrative law is considered as the most important law enforcement effort. This is because administrative law enforcement is aimed more at efforts to prevent pollution and environmental damage. Besides that, administrative law enforcement also aims to punish perpetrators of pollution and environmental destruction. For example in the implementation of law enforcement based on the announcement of the South Sumatra Regional Police Chief above, if the perpetrators of forest burning, land or weeds / shrubs intentionally cause fires, they will be subject to a maximum 12-year prison sentence and fifteen billion rupiah fine.

Disaster management activities also include mitigation, both structurally in the form of infrastructure and non-structural development such as community empowerment. With the recurrence of fires in several regions of Indonesia, especially Ogan Ilir District in 2014 and 2015, new innovations emerged from the environmentalists who were fully appreciated by the local government about controlling forest and land fires. The new thinking is that land fires must be handled by communities that are close to the initial event. The fires that have arisen have come from small fires that have been ignited by humans using fire on land, while land that has been proven to experience fires every year is agricultural lands and farms belonging to the community. According to Acep Akbar (2008), several considerations that underlie the need for community-based land fire control are as follows:

- Forest and land fires in Indonesia are generally caused by factors of human negligence, therefore the participation of the community in fire prevention will reduce the potential for forest fires and Land
- The groups most disadvantaged by forest and land fires are generally people who live around the fire location, therefore it is only natural that the community is actively involved in efforts to control forest and land fires.
- The community has local wisdom-based resource potential, so it is very potential to carry out an innitial attack to prevent fires from enlarging and expanding.
- The community has a culture of using fire to open up agricultural land so that to apply zero burning (without burning) is still very difficult. The most likely compromise at this time is

"how to manage fire" so that the fire created does not have a large negative impact on the environment.

According to the Head of BPBD in Ogan Ilir Regency, after the 2015 land fire, the Ogan Ilir District Government took the initiative to form village fire squads called the Community of Fire Care (MPA). This MPA is in charge of being the main actor in theperiod golden time who is equipped with standard equipment and capabilities in controlling forest and land fires. The MPA formed in each of the fire-prone villages was also involved in a communication network connected with the BPBD, Manggala Agni, Babinsa, and Babinkamtibmas in the region.

The role of the community formed by the government had an impact on reducing the incidence of forest and land fires so that the area burned was also reduced in Ogan Ilir District in 2016 and 2017. Based on data obtained from the BPBD Emergency Operation Center, Ogan Ilir Regency, compared to 2015, the area burned decreased by 87.8% in 2016 and 84.7% in 2017. This figure indicates that there was a significant change in the risk of forest and land fires from prevention efforts carried out by the Government and the community.

When entering the dry season and there is the potential for fire threats, the emergency alert period is set by the Regional Head and relevant agencies to carry out various emergency standby operations, including coordination meetings, fire-prone areas, patrol operations and monitoring of vulnerable areas, health service operations, and operation of public facilities and infrastructure.

Increasing temperatures in the dry season and negligence of the community in activities on the land resulted in the potential for fire threats to turn into disasters, so that in accordance with the stages of disaster management the status was raised to an emergency response. At this time, the Ogan Ilir District Government through the Regional Disaster Management Agency as the leading sector activated the operation control center (pusdalops) into a command post (Posko) through the Decree of the Head of Regional Disaster Management Agency Ogan Ilir District Number: 11 / SK / BPBD- OI / 2016 Dated June 6, 2016 Regarding the Appointment of Officers of Haze Disaster Mitigation Command Post due to Forest and Land Fires at Ogan Ilir Regency BPBD Command Post.

According to Nurjanah, *et al*. (2011), the post is a gathering place for representatives of agencies / organizations that function as centers of coordination, control and command and for vertical and horizontal communication to ensure that emergency response efforts can be carried out quickly and accurately [15]. The control of forest and land fires in Ogan Ilir Regency is known as the smoke emergency post which was carried out by a joint team from the BPBD of Ogan Ilir, Manggala Agni, Babinsa, Babinkamtibmas, and the Civil Service Police Unit.

In emergency response operations, fire suppression activities are carried out through both land and air routes *(waterbombing)*. This is done so that the hotspots do not spread to other areas that are wider and cause smog. In the event that the fire has been extinguished by officers and the emergency response period has ended, further efforts are made to revive the socio-economic conditions of the community due to the fires that have occurred so that the community / disaster victims can be helped to accelerate the acquisition of sources of income or livelihood[16].

Recovery is the beginning of a rebuilding effort. Recovery management activities are carried out since the process of assessing damage and losses, planning, implementing, monitoring and evaluating the implementation of rehabilitation and reconstruction activities as well as adequate funding-supported supervision. In the context of forest and land fires, generally the land burned in the form of peat land and vacant land belonging to the community so that the recovery effort undertaken is mapping the burned area for conservation at a later stage.

4. Conclusions and Recommendations

From the research that has been carried out it can be concluded that: (1) Air quality in Ogan Ilir Regency shown through the Air Pollution Standard Index (ISPU) in 2015 was in the dangerous category; (2) After various efforts to overcome forest and land fires were carried out in the prevention, emergency, and recovery, hotspots and burned land significantly reduced and air quality increased; (3) Based on ISPU value measurements at several fire-prone points, compared to 2015, in 2017 sulfur dioxide (SOcontent$_2$)was in the unhealthy category, *particulate matter* (PM_{10}) are in the moderate category, and carbonmonoxide (CO) is in the unhealthy category of those previously in the dangerous category; and (4) Efforts to control forest fires and land in Ogan Ilir can alter air quality significantly in the area. Some future research recommendations are: (1) In 2016 and 2017 there are hotspots in small quantities, therefore prevention efforts undertaken should be increased; (2) involvement of the world efforts in fire prevention efforts are still minimal so that real cooperation is needed to realize the triangular synergy of disaster management, namely the government, society and the business world..

Acknowledgements

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Hydram Ram as a Supply Water Needs and Drought Solution in Mountain Areas

Ahmad Sazrhi*, Faisol Abdul Kharis, Khadijah, Sovian Aritonang and I Nengah PA
Indonesia Defense University, IPSC Sentul, Bogor 16810, Indonesia

*Email: ahmad.sazrhi@tp.idu.ac.id

Abstract. Water is an element that is needed by living things including humans. In some regions, the need of water can be fulfilled by the availability of easily available sources of water, but in other area this will be difficult. Drought in an area can cause land and forest fire and loss of water reserves. The purpose of this article is to determine the discharge of water flow requirements needed and the availability of water that can be produced using a hydram pump and analysis using the Epanet 2.0 application to see the distribution of water flow more accurately. The results show that by using two artificial hydram pump type PDH 3 can lift water from the water source to the reservoir resulting debit of 0.5 LPS. The rest of the pressure head is 2,517 meters, total energy loss is 0,177 meters and using reservoir with volume 10.20 m^3 to accommodate water requirement at peak hour that is 10.087 m^3/hour. The simulation results of drainage using EPANET 2.0 showed the lowest pressure value at 5.00 meters and the highest at 25.62 meters, the piped water flow at the lowest requirement limit of 0.02 LPS and the highest of 0.46 LPS, the velocity of the lowest flow of 0.17 m/s and the highest of 0.65 m/s, the lowest energy loss of 3.89 m/km and the highest of 19.50 m/km.

Keywords: Drought; Hydram pump; Raw water; EPANET 2.0

1. Introduction

Water is an element that is needed by living things including humans. The function of water for life cannot be replaced by other compounds. One of the uses of water is to fulfill household, agricultural, and other work needs. Aside from being a primary need for human survival, water also plays a role as a determinant of public health.

In some regions, the need of water can be fulfilled by the availability of easily available sources of water from wells, rivers, ponds, springs, etc. In certain other areas, this need for water can only be obtained from very limited water sources. especially in the dry season.

This symptom is often seen in mountainous areas, because of its topographical conditions, even to get minimal water needs, it must be reached with difficulty and waste a lot of time and energy. Getasan District in Semarang Regency is a highland area at the foot of Mount Merbabu. If the rainy season retreats from the estimated end of October or early November, the drought in Getasan will expand. The impact of drought in mountainous areas not only makes it difficult for people to clean water, but also a fire disaster emerges like the 400 Ha Mount Merbabu fire occurred in October 2018 due to sparks on dry land.

One effort to fulfill water needs, especially for areas with a higher position than springs, is to use a water pump. The type of pump commonly used today is an electric motorized water pump that uses fuel oil (diesel or gasoline). For urban areas, fuel needs may not be a significant problem. As with the rural or remote areas, the existence of fuel is very limited and at an expensive price.

Therefore, it is necessary to find an adequate pumping system, using appropriate, efficient and economical technology so that the management does not depend on electricity or other fuels, a technology that requires cheap operational costs and does not accompany the community in its operation. One of the technologies that began to be developed was a pump hydram ram or commonly called a hydram pump.

The purpose of writing this article is to determine the discharge of water flow requirements needed and the availability of water that can be produced using a hydram pump. The analysis will then be simulated using the Epanet application to see the distribution of water flow more accurately.

2. Methods

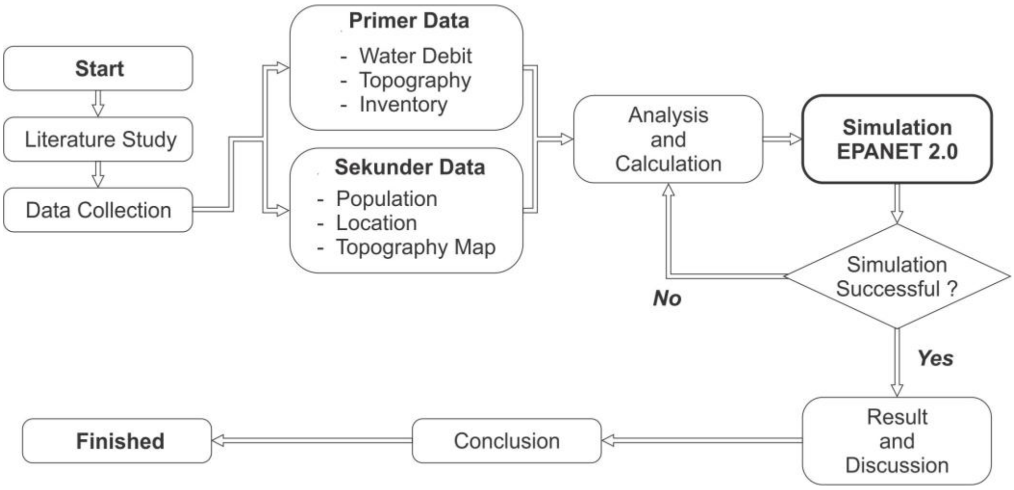

Figure 1. Framework of thinking

2.1. Literature Study
Literature study is a method used to collect data or sources related to the topic raised in a study. Literature studies can be obtained from various sources, journals, documentation books, internet and libraries. From the source of the data obtained the basics of theory and parameters - parameters used in analyzing problems in a case.

2.2. Data Collection
Data collection will be used as a reference for preparation and calculation based on the results of the study.

2.3. Data Analysis and Calculation
Data analysis and calculation are carried out based on the data that has been obtained, then identified according to the objectives of the problem so that the problem solving analysis can be obtained.

2.4. Simulation with EPANET 2.0
If the results of analysis and data processing have been carried out, the simulation phase can be done. Simulation of water distribution was carried out using the EPANET 2.0 program. Simulation is based on actual data in the field.

3. Results and Discussion
3.1. Population Growth Analysis
Population growth is predicted to grow in the next 10 years with population growth data taken from population data of the last 8 years. The growth rate of the population of Batur Village in

Getasan District in the last 8 years and the average population growth is based on the following table:

Table 1. Average Number of Population Growth 2011 - 2018

No.	Year	L	P	Total	Population Growth (%)
1	2011	3407	3492	6899	0
2	2012	3436	3513	6949	0,007
3	2013	3447	3528	6975	0,004
4	2014	3449	3538	6987	0,002
5	2015	3445	3525	6970	-0,002
6	2016	3473	3535	7008	0,005
7	2017	3483	3581	7064	0,008
8	2018	3616	3638	7254	0,027
Average Population Growth (r)					0,007

The population of Gondang, Batur Village in 2018 is 412 people. Analysis of population growth using geometric methods is planned for the next 10 (ten) years.

n = 10 years in 2028
r = 0,007%

P2028 $= P2018\,(1 + r)^{10}$
$= 412\,(1 + 0{,}006)^{10}$
$= 412 \times 1{,}065$
$= 443$ people

3.2. Analysis of Water Needs

a. Parameter specified

This parameter is a constant and data for the basis calculation. The parameters obtained are based on the criteria of the Directorate General of Cipta Karya (1996) as follows:

1) Domestical needs

Home connections	=60 l/p/d
Loss of water	= 20%
Maximum daily requirement	= 115
Peak hours requirement	= 1,75

2) Non-domestic needs

Mosque	= 10 lt / person / day
Office	= 10 lt / employee /day
School	= 5 lt/ student / day

b. Total population and service level

Population and service level are based on the following calculations:

- Projected number of populations in 2028 is 443 people
- Service level 70%
- Amount population based on service level.

With the existing population then using the clean water planning criteria issued by the Directorate General of Human Settlements of the Ministry of Public Works and Public Housing, as previously explained, obtained the water requirements for the flow areas as follows:

Table 2. Water needs

No.	Flow Needs	Debit (LPS)
1	Domestic Needs	0,215
2	Non-Domestic Needs	
	Mosque	0,036
	School	0,005
	Village Office	0,002
3	Headloss	0,009
	Total	0,267

3.3. Analysis of Hydrant Pump Discharge

a. Calculation of Water Availability

The measurement of the intake discharge is done by calculating the volume of water stored in the bucket and the time is calculated using a stop watch which is done five times. The results are as follows:

Table 3. Source debit measurement results

Experimental	Time (s)	Volume (l0)	Debit (LPS)	Average (LPS)
I	5	9,48	1,89	
II	5	9,5	1,90	
III	5	8,9	1,78	1,85
IV	5	9,12	1,82	
V	5	9,2	1,84	

(Source: Candrika, M: 2014)

b. Input Pipe Diameter

To find out the size of the delivery pipe in accordance with the provisions based on the following table:

Table 4. Pipe length of conductor based on diameter

Conduit Pipe Diameter (mm)	Length (m)	
	Minimum	Maximum
13	2	13
20	3	20
25	4	25
30	4,5	30
40	6	40
50	7,5	50
80	12	80
100	15	100

(Source: Candrika, M: 2014)

Whereas to determine the diameter of the conveying pipe, it can usually be adjusted to the size of the hydram pump recommended by the manufacturer as shown in the following table.

Table 5. Delivery pipe diameter based on pump

Size Hydram Pump Size (inch)	Pipe Diameter Conducting (mm)
1	32
2	38
3	51
3.5	63,5
4	76
5	101
6	127

(Source: Candrika, M: 2014)

Based on the size of the hydram pump or delivery pipe, it can be seen the water flow needed by the delivery pipe as shown in the table below :

Table 6. Based conductor pipe diameter pump size

hydram ram Size (inches)	Debit needed Conductor Pipe (LPM)
1	7-16
2	12-25
3	27-55
3,5	45-96
4	68-137
5	5136-270
6	180 - 410

(Source: Candrika, M: 2014)

Based on the table above, the diameter of the pipe used is 76 mm in size.

c. Determination of Hydram Pump

Determination of hydram pump based on maximum daily requirements, peak hour requirements and also the intake pipe diameter. From the calculation results, the maximum daily requirement is 0,481 LPS and the peak hour requirement is 0,731 LPS with the intake pump size being 76 mm (3 inches). With these data, the hydram pump is used by CV. OTODA with the following specifications:

Type : PDH 3
Pump Diameter : 3 inches
Diameter Inlet : 3 inches
Diameter Outlet : ¾ inch
Discharge Output : 0,25 LPS
Head Pressure : 50 meters

To fulfill the maximum water demand discharge, two pumps of the same size will be used and the output will be parallel so that the output discharge becomes 0,5 LPS.

d. Determination of Reservoir Dimensions

Determination of reservoir dimensions based on the requirement of peak hours (Q_{peak}). From the calculation, it has been known that the water requirement at peak hours is 0,467 LPS. With pump output discharge of 0,5 LPS and peak hours assumed to be 4 hours in the morning (04.00 - 08.00 WIB) and 2 hours in the afternoon (17.00 - 19.00 WIB), the required capacity is:

$$
\begin{aligned}
Q_{add} &= Q_{peak} \times 6 \\
&= 0{,}467 \times 6 \\
&= 2{,}802 \text{ LPS} \\
&= 10{,}087 \text{ m}^3 / \text{hour}
\end{aligned}
$$

To meet the additional capacity requirements, the dimensions of the reservoir is planned with a size:

Length	: 2 meters
Width	: 2 meters
Height	: 3 meters
Upper limit	: 2,75 meters
Lower Limit	: 0,20 meters

The upper limit is planned to be 2,75 meters and given a drain pipe of 1 inch so that the water does not overflow out of the reservoir. The lower limit is planned to be 0,20 meters so that the water in the reservoir remains and there is no vacancy. Thus, the capacity of water that can be accommodated in the reservoir is:

$$
\begin{aligned}
Qr &= pxlx\,(ba - bb) \\
&= 2 \times 2 \times (2{,}75 - 0{,}20) \\
&= 10{,}2 \text{ m}^3
\end{aligned}
$$

e. Energy Lines Springs to the pump

The energy lines in the input pipes can be drawn with do the Bernoulli Equation. With source discharge 0,00185 m^3/ sec and the diameter of the intake pipe of 3 inches or 0,076 meter (A = 0,004 m^2), the flow rate can be calculated at 0,411 m / s. Head losses can be calculated in the following details:

$$
\begin{aligned}
H_L &= f\frac{L}{D}\frac{V^2}{2g} \\
&= 0{,}00015\,\frac{60}{0.076}\,\frac{0.411^2}{2 \times 9.81} \\
&= 0{,}00102
\end{aligned}
$$

Because the headlos value is very small, the value can be ignored. Next calculate the pressure head using the Bernoulli Equation as follows:

$$
\frac{P_{sumber}}{\rho g} + \frac{v^2}{2g} + z_{mata\,air} = \frac{P_{pompa}}{\rho g} + \frac{v^2}{2g} + z_{pompa}
$$

$$
0 \quad + \frac{0{,}411^2}{2 \times 9{,}81} + \quad 8 \quad = \frac{P_{pompa}}{\rho g} + \frac{0{,}411^2}{2 \times 9{,}81} + 0
$$

$$
0{,}021 + \quad 8 \quad = \frac{P_{pompa}}{\rho g} + 0{,}021
$$

$$
\frac{P_{pompa}}{\rho g} = 8\,m
$$

The value head pressure is zero because it is on the surface and the head speed value in both quadrants is the same because it is one flow.

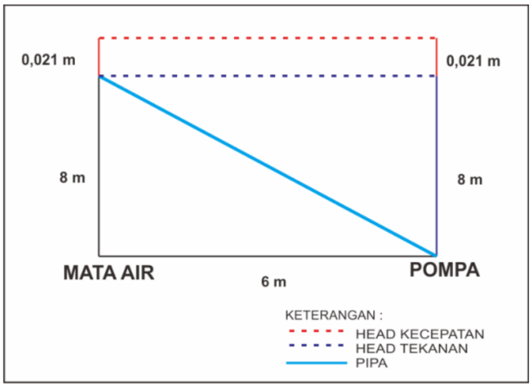

Figure 2. Energy line of the input pipe

f. Pump to Reservoir

The energy line on the delivery pipe can be drawn by calculating Bernoulli Equations. With an output discharge of 0,000 m^3/ sec and an intake pipe diameter of 3/4 inch or 0,0254 meters (A = 0,00051 m^2), the flow rate can be calculated at 1 m / s. Head loss can be calculated as follows:

Table 7. Calculation Headloss

Pipe	*f* (PVC)	L (m)	V (MPS)	D (m)	g (m / s^2)	Hl s(m)
1	0,00015	104	1	0,0254	9,81	0,031
2	0,00015	177	1	0,0254	9,81	0,053
3	0,00015	61,3	1	0,0254	9,81	0,018
4	0,00015	63,9	1	0,0254	9,81	0,019
5	0,00015	88,6	1	0,0254	9,81	0,027
6	0,00015	92.3	1	0,0254	9,81	0,028

In the calculation of the energy line, the Head value, the pressure uses the pump head because the water comes out of the pump and the head speed value in both quadrants is the same because it is one flow. The results of calculations with equations are calculated as in the following table:

Table 8. High Head Pipe Output

Pipa	$\frac{P_1}{\rho g}$ (m)	Hl (m)	Z (m)	$\frac{P_2}{\rho g}$ (m)
1	50,000	0,031	8	41,918
2	41,918	0,053	13	28,813
3	28,813	0,018	4	24,744
4	24,744	0,019	9	15,674
5	15,674	0,027	4	11,596
6	11,596	0,028	9	2,517

From the table above it can be seen that the remaining pressure at the end of the discharge pipe (channel 6) is 2.517 m. So, using a hydram pump made by CV. PDOD type OTOD 3.

3.4. Simulation with EPANET 2.0

The results of the simulation using Steady-State Analysis as follows:

a. Total Head

The total head pressure is the number of heads pressure plus the ground elevation. The results for the total head can be seen in the following picture:

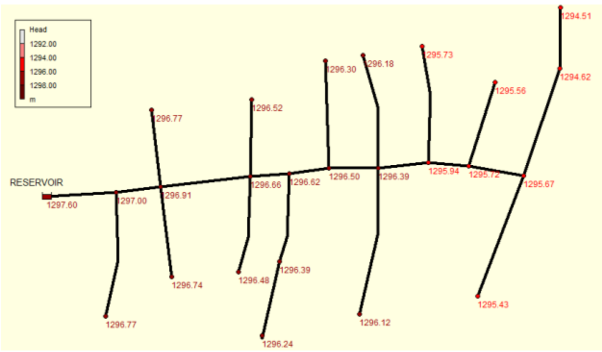

Figure 3. Total head

b. Water Pressure

Water pressure in the system depends on the elevation and number of branches. From the simulation results it can be seen in several connections that there is a reduction in pressure due to branching.

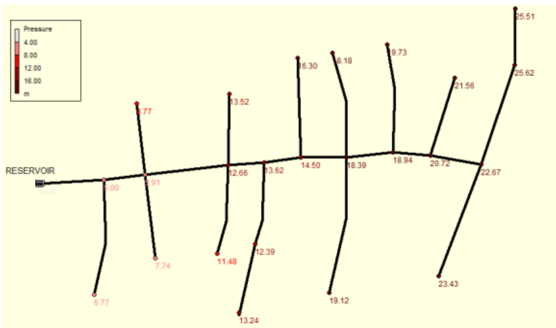

Figure 4. Water pressure

c. Water Flow

Water requirements in the simulation use the peak hour requirement of 0,467 LPS which is divided into 24 nodes, each of which is 0,019 liters / sec. From the simulation results in all regions sufficient for the water needs.

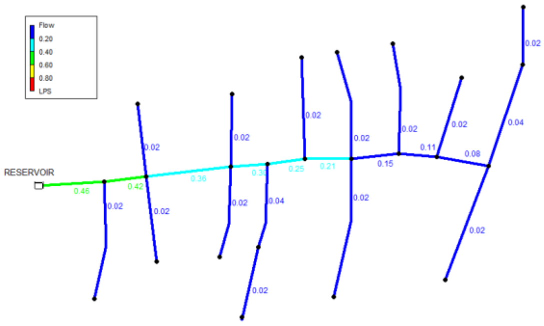

Figure 5. Water Flow

d. Velocity

From the simulation results the velocity of water flow varies between 0,15 – 0,65. in this condition some streams are still below the monila 0,3 speed but the tolerance can be tolerated because it is in the branching. On the main road there is one channel that has speeds below the minimum speed.

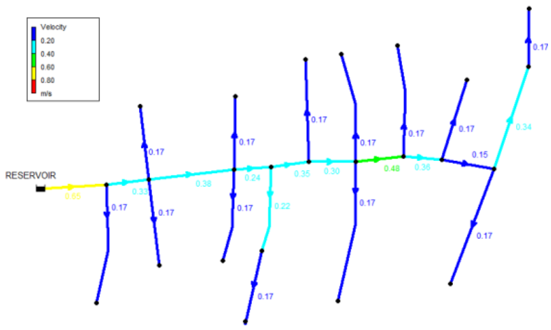

Figure 6. Flow velocity

e. Energy losses on the channel

Energy losses between 1,98 - 18,50 m / km. total energi losses are still on the minimum tolerance.

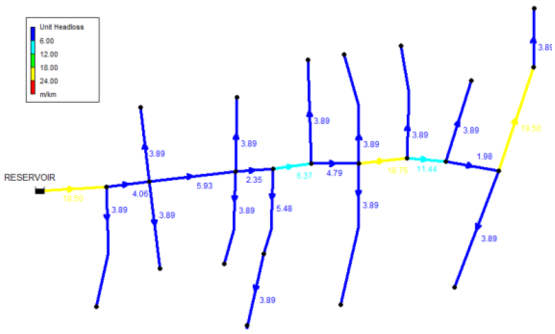

Figure 7. Headloss hydram

4. Conclusion

- By using a hydraulic pump, there is already enough water in the operational area with the resulting discharge of 0,5 LPS above the requirement of 0,467 LPS
- The simulation results using the epanet application still have a lack of pressure and speed on several channels, but the water flow in each channel is in accordance with the requirements.

- Hydram ram can be used as an alternative provider of clean water for highland areas whose springs are below. The availability of water reserves will minimize the occurrence of land and forest fires.

Acknowledgements
This research was partially supported by Head of Batur Village, Getasan District who have provided data and information. We thank to Disaster Management Agency (BPBD) in the District of Semarang who have provided data and information about drought hazard, land and forest fire disaster. Hopefully the results of this study can be useful for determining policies regarding the utilization of ram hydrams to provide water needs in mountainous areas.

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The Preparedness in Disaster Management: A Case Study of State Private School 1 Badung Facing The Potential Earthquake and Tsunami Threats

Zahrotul Khumairoh[1], Dewi Apriliani[2] and Taufiq Prasetyo[1,2]

[1]Disaster Management, Indonesia Defense University, Bogor 16810, Indonesia
[2]Disaster Management, Indonesia Defense University, Bogor 16810, Indonesia

E-mail: chumik.zahro@gmail.com

Abstract. Nowadays, it is necessary to increase the preparedness of the physical components of the school (buildings and other infrastructure) and HR capacity, because the school community is one of the stakeholders that is very important for preparedness in anticipation of natural disasters. The research formulas consist of three main questions. The first, how is the preparedness structure of State Private School 1 Badung in facing of the earthquakes and tsunamis threats. The second, how is the non-structural preparedness of State Private School 1 Badung, Bali in facing of the earthquakes and tsunamis threats. The last, what are recommendations to improve preparedness against the earthquakes and tsunamis threats in State Private School 1 Badung, Bali. This research uses the mixed method using a qualitative approach equipped with quantitative data. Based on the results of data, the priority of recommendations in this research is to increase the non-structural preparedness of State Private School 1 Badung. The suggestion for the next research is to involve the other school community members such as: school principals and students, so that the assessment of school preparedness in accordance with the Guidance Book for the Implementation of Disaster Prepared Schools issued by LIPI can be fully implemented.

1. Introduction

Earthquakes are natural disasters that are relatively common in Indonesia due to the interaction of tectonic plates and volcanic eruptions, along the west coast of Sumatra which is a meeting of the Asian Continent and Indian Ocean plates; Australian and Asian Continent plates; which forms an earthquake pathway with thousands of epicenter centers and hundreds of disaster-prone volcanoes in Indonesia. Earthquakes that occur at sea can result in tsunamis (sea waves), especially in earthquakes occuring in the deep sea followed by underwater deformation, generally causing large-scale loss of property and lives, taking a long time to carry out rehabilitation and reconstruction . This is quite alarming because events that have occurred in a relatively short time can destroy buildings and infrastructure which have been the result of decades of development [1]. One of them is in the education sector, namely damage to buildings, infrastructure and school infrastructure that have a negative impact on the sustainability of the school community, both teachers, students and other school residents. Furthermore, based on the 2010 to 2014 National Disaster Management Agency (BNPB) disaster plan, there are at least 23 provinces in the high risk category of earthquakes in Indonesia and more than 130.000 school buildings have the potential to be hit by earthquakes and also threaten school students along with all facilities. The results of a study conducted by LIPI also showed that school communities in seven locations (Bengkulu, Aceh Besar, Serang, Cilacap, Sikka, Biak, and Ternate) were still not ready to anticipate earthquakes and tsunamis [2].

Therefore, it is necessary to increase the preparedness of the physical components of the school (buildings and other infrastructure) and HR capacity, because the school community is one of the stakeholders that is very important for preparedness in anticipation of natural disasters. The school community is a potential agent of change to disseminate knowledge about the earthquake and tsunami phenomena and motivate people to improve preparedness [3]. One of them is State Private School 1 Badung located on Jl. By Pass Ngurah Rai Jimbaran, Jimbaran, South Kuta - Kabu, Badung Province, Bali, which has carried out one of the disaster mitigation efforts with the installation of disaster evacuation routes [4]. Based on a circular letter from the Minister of National Education number 70A/MPN/SE/2010 concerning appeals to all regional heads to implement strategies influencing the importance of disaster risk reduction in schools. Therefore, important research is needed to analyze the preparedness of State Private School 1 Badung in facing the earthquakes and tsunamis thretas and providing recommendations for efforts to improve preparedness parameters.

The research formulas consist of three main questions. The first, how is the preparedness structure of State Private School 1 Badung in facing of the earthquakes and tsunamis threats. The second, how is the non-structural preparedness of State Private School 1 Badung, Bali in facing of the earthquakes and tsunamis threats. The last, what are recommendations to improve preparedness against the earthquakes and tsunamis threats in State Private School 1 Badung, Bali. The directions of this research are to analyze the preparedness structure of state private school 1 Badung in facing of the earthquakes and tsunamis threat, to analyze the non-structural preparedness of State Private School 1 Badung, Bali in facing of the earthquakes and tsunamis threats; and to identify the recommendations to improve preparedness against the earthquakes and tsunamis threats in State Private School 1 Badung, Bali. The measurement of checking the sctructural and non-structural preparedness in dealing with the earthquakes and tsunamis threats uses the guideline parameters for implementing disaster preparedness schools issued by LIPI in 2013.

2. Method

This research uses the mixed method using a qualitative approach equipped with quantitative data. The nature of the research is descriptive and analytical. The selection of this method is based on the consideration that in the discussion of the study will provide an overview of the preparedness of State Private School 1 Badung, Bali in facing the earthquakes and tsunamis threats. Quantitative data is used to measure disaster preparedness indices based on guidelines for implementing disaster preparedness schools issued by LIPI in 2013. The strategy used in this study is a case study, which is to obtain a detailed picture of a phenomenon. The object studied in a case study research is considered in portraying itself deeply, detailed and completely to obtain a wholeness in the sense that the data collected in the study is studied as a whole, intact, integrated [5]. The very specific nature of the object of study is the main consideration for researchers to elaborate it by exploring it in depth. The study was conducted for 4 (four) days from 25-28 February 2019. The location of the study at State Private School 1 Badung was based on the location of the coast of South Bali which has the potential risk of a tsunami due to the collision between the Indo-Australian plate and the Eurasian plate [6]. Primary data is obtained through interviews with principals, teachers, and students, direct observation in the field and the results of filling out survey forms by principals, teachers and school staff.

Secondary data was obtained through literature studies on legislation, regional regulations, school policies / regulations, and other literature that supports the preparation of research. The research was conducted in several stages, namely: in the initial stages the researcher distributed the survey form to measure the structure and non-structural preparedness index at State Private School 1 Badung, Bali. Due to the limitations of the study, the survey form was not given to students at SLBN 1 Badung. Next the researcher conducted observations at the research location and analyzed school disaster preparedness by conducting in-depth interviews with selected respondents (principals, teachers, officers other than teachers and students). In the final stage the researcher calculates the results of the survey form to measure the school preparedness index and verifies the results of the interviews that have been conducted.

The sample selection uses probability sampling techniques, because probability sampling is a sampling technique that provides equal opportunities for each element (member) of the population to be selected as members of the sample [6]. The size of the sample in this study was determined by the Slovin formula. The survey form refers to attachment 6 (Non-Structural Preparedness Monitoring Form) and appendix 7 (Structural Preparedness Monitoring Form) guidebook for implementing the LIPI disaster preparedness school in 2013. The values will be catagorized to three stages of index value (%): 67 - 100 is in high level; 34 - 66 is in medium level; and 0 – 33 is in low level. The school preparedness index value is a combination of the preparedness index structure and non-structural preparedness index.

3. Result and Discussion

3.1. Results

Retrieving research data at SLBN 1 was conducted by spreading the form of school structure preparedness questionnaires and school non-structural preparedness to 30 teachers. The questionnaire form used refers to the Guidebook for the Application of Disaster Preparedness Schools issued by LIPI [7]. Because of the limitations of the study, taking the number of samples does not use the Slovin formula, but uses the theory of Gay and Diehl (1992) which states that for descriptive research the minimum number of samples is 10% of the population, at least 30 elements of population research, 30 elemental causal comparison research group, and for experimental research 15 elements per group [8]. According to Cohen, et. Al., (2007, p. 101), the larger the sample size of the population is the better, but there is a minimum number of limits that must be taken by the researcher, which is 30 samples. As stated by Baley in Mahmud (2011, p. 159) which states that for studies that use statistical data analysis, the minimum sample size is 30.

3.1.1. Structural Preparedness. The results of school structural preparedness:

- Structural of Buildings uses the indicators Foundation, Beam, Column, Wall and Roof Building Structure through 10 questions
- Architectural uses the indicators Architectural Partitions, Ceilings, Doors and Windows, Permanent Ornaments, Stairs, Floors and Ceramics through 12 questions
- School Furniture uses the indicators Electrical Equipment, Furniture, Pictures and Boards, Hazardous and Toxic Materials through 15 questions
- Electrical Equipment uses the indicator Placement Support Equipment through 6 questions

The preparedness index per parameter is calculated by the following equation:

$$\text{Parameter Index} = \text{Answer Quantity} / \text{Maximum Quantity of Questions} \times 100\% \quad (1)$$

Using the formula above to the results of the questionnaire 30 teacher respondents obtained the following results:

Table 1. the results of the questionnaire 30 teacher respondents

Parameter	Preparedness Index per parameter
Structural (S)	74%
Architecture (A)	70%
Furniture and Contents (Pi)	67%
Supporting Equipment (Pp)	67%

Furthermore, the school structure preparedness index is assessed by the following equation:

Index = (10/43) x index S + (12/43) x index A + (15/43) x index Pi + (6/43) x index Pp
Index = (0.23 x index S) + (0.28 x index A) + (0.35 x index Pi) + (0.14 x index Pp)
= (0.23 x 0.74) + (0.23 x 0.7) + (0.35 x 0.67) + (0.14 x 0.67)
= 0.69

The school structure preparedness category is determined as follows:

Table 2. Preparedness Index Value of Disaster Preparedness School Category based on LIPI in 2013

Index Value (%)	Preparedness Category
67-100	High
34-66	Medium
0-33	Low

The structural preparedness of State Private School 1 Badung, Bali is high (69%) with details for each parameter as follows:

- Structural building has a high preparedness category (74%)
- Architectural buildings have a high preparedness category (70%)
- Furniture and contents have a high preparedness category (67%)
- Other supporting equipment has a high preparedness category (67%)

3.1.2. Non-structural Preparedness. The results of school non-structural preparedness:

Due to research limitations the questionnaire was only given to teachers, while other school community members (principals and students) were not given a questionnaire form.

- Knowledge (K) uses the indicators Disaster Knowledge, Physical Vulnerability, School Capacity, and Attitudes towards Disaster Risk through 10 questions
- Emergency Response Plans (EP) uses the indicators Plans to Respond to Emergencies, First-Aid Evacuation Plans-Safety-Rescue, Compliance with Basic Needs, Equipment and Supplies, Important Public Facilities, Training and Simulation / Rehearsal through 17 questions
- Traditional Local Disaster Warning System (WS) uses the indicators Technology, Installation, Warning Dissemination and Mechanism through 8 questions
- Resource Mobilization (RMC) uses the indicators Institutional Arrangement, Communication and Coordination between Relevant StakeHolders, Human Resources through 6 questions

The preparedness index per parameter is calculated by the following equation:

$$\text{Parameter Index} = \text{Answer Quantity} / \text{Maximum Quantity of Questions} \times 100\% \quad (1)$$

Using the formula above to the results of the questionnaire 30 teacher respondents obtained the following results:

Table 3. the results of the questionnaire 30 teacher respondents

Parameter	Preparedness Index per parameter
Knowledge (K)	35%
Emergency Response Plans (EP)	77%
Disaster Warning System (WS)	56%
Resource Mobilization (RMC)	73%

Furthermore, the non-school preparedness index is assessed by the following equation:
Total index = (10/39 x index K) + (17/39 x index EP) + (8/39 x WS index) + (4/39 x index RMC)
= (0.26 x index K) + (0.44 x index EP) + (0.2 x WS index) + (0.1 x index RMC)
= (0.26 x 0.35) + (0.44 x 0.77) + (0.2 x 0.56) + (0.1 x 0.73)
= 0.61

Using Table 3 in section 3.1.2, the non-structural preparedness of State Private School 1 Badung, Bali is in the category of moderate preparedness (61%) with details for each parameter as follows:

- Disaster knowledge has a moderate preparedness category (35%)
- Plans for disaster activities have a high preparedness category (77%)
- Disaster warning has a moderate preparedness category (56%)
- Resource mobilization has a high preparedness category (73%)

Furthermore, the total value of disaster preparedness index is a combination of the preparedness index structure and non-structural preparedness index values calculated by the following equation:
Total Index = (43/82 x structural preparedness index) + (39/82 x index non-structural preparedness)
= (0.52 x structural preparedness index) + (0.48 x non-structural preparedness index)
= (0.52 x 0.69) + (0.48 x 0.61)
= 0.65
From the above calculation, it can be concluded that the preparedness index of State Private School 1 Badung, Bali is as follows:

Table 4. the preparedness index of State Private School 1 Badung, Bali

Parameter	Value and Catagory
Structural	69% - High
Non-Structural	61% - Medium
Total	65% - Medium

3.2. Discussion

3.2.1. Structural Preparedness. The results of school structural preparedness:Based on calculations in point 3.1.1, namely structural assessment of school preparedness based on parameters: building structure; architecture; school furniture; and supporting equipment, using the 2013 LIPI standard disaster preparedness index preparedness formula school. So, the following results are obtained:

- The Structural Index (S) with a percentage value of 74% is included in the high category in disaster preparedness schools facing earthquakes and tsunamis.
- The Architectural Index (A) with a percentage value of 70% is included in the high category in disaster preparedness in schools facing earthquakes and tsunamis.
- The Furniture and Content Index (Pi) with a percentage of 67% included in the high category in disaster preparedness schools facing earthquakes and tsunamis.

- The Supporting Equipment Index (Pp) with a percentage value of 67% is included in the high category in disaster preparedness schools facing earthquakes and tsunamis.

3.2.2. Structural Preparedness. Based on the calculations in point 4.1.2, namely the assessment of school readiness in a non-structural manner based on parameters: a) knowledge of the disaster; b) plan for disaster activities; c) disaster warning; and d) resource mobilization, using the 2013 LIPI standard disaster preparedness index preparedness formula school. So, the following results are obtained:

- The Knowledge Index (K) with a percentage value of 35% is included in the medium category in disaster preparedness schools facing earthquakes and tsunamis.
- The Emergency Response Plan Index (EP) with a percentage value of 77% is included in the high category in disaster preparedness schools facing earthquakes and tsunamis.
- The Disaster Warning System Index (WS) with a percentage value of 56% is included in the medium category in disaster preparedness schools facing earthquakes and tsunamis.
- The Resource Mobilization Index (RMC) with a percentage value of 73% is included in the high category in disaster preparedness schools facing earthquakes and tsunamis.

From the results of the two types of preparedness indexes, namely structural and non-structural, the disaster preparedness school preparedness index can be seen as a combination of the two. Then, the school preparedness index results are obtained as follows:
The Structural School Preparedness Index with a percentage value of 69% is included in the high category in disaster preparedness schools facing earthquakes and tsunamis. Meanwhile, the Non-Structural School Preparedness index with a percentage value of 61% is included in the medium category in disaster preparedness schools facing earthquakes and tsunamis. The two percentage values are processed as follows:

$$\begin{aligned}\text{School Preparedness Index} &= 0.52\ \text{IKSS} + 0.48\ \text{IKSNS} \\ &= (0.52 \times 0.69) + (0.48 \times 0.61) \\ &= 0.65\end{aligned}$$

So, the value of the preparedness index of State Private School 1 Badung, Bali in facing the earthquakes and tsunamis is 65% which is included in the category of moderate preparedness.

3.2.3. Recomendations. Based on the calculation of the data above, the recommendations given by researchers related to the improvement of State Private School 1 Badung, Balischool preparedness in the face of earthquakes and tsunamis are as follows:

- Increasing knowledge and attitudes, including the ability to explain and mention types, sources, causes, disaster incensities, types of disasters post earthquake, vulnerability of the environment and physical buildings of schools, and motivate school communities to anticipate potential natural disasters.
- Maintaining the implementation of emergency response plans, including the availability of school fixed procedures for disaster emergencies, availability of document back-up and access to important public facilities and improvement of simulations and rehearsals for students, teachers and school residents in the vicinity. facing the earthquake and tsunami disaster.

- Improving disaster warning systems includes access to traditional and local disaster warning information, TEWS (Tsunami Early Warning System), availability of procedures for distributing disaster warning information.
- Maintaining resource mobilization includes the availability of a special team in handling emergency response conditions, the availability of fixed procedures in one command so that the victims' rescue movement is faster and more effective, improving the quality and skills of teachers in emergency response preparedness and management.

4. Conclusion and Suggestion

Based on the results of data, the priority of recommendations in this research is to increase the non-structural preparedness of State Private School 1 Badung. Particularly related to knowledge and attitudes including the ability to explain and mention types, sources, causes, disaster incensions, types of disasters after the earthquake, vulnerability of the environment and physical buildings of the school, and motivate the school community to anticipate potential natural disasters. In addition, the recommendations are to improve the disaster warning system includes access to traditional and local disaster warning information, TEWS (Tsunami Early Warning System), and the availability of procedures for distributing disaster warning information.

The suggestion for the next research is to involve the other school community members such as: school principals and students, so that the assessment of school preparedness in accordance with the Guidance Book for the Implementation of Disaster Prepared Schools issued by LIPI can be fully implemented.

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Preparedness of tourist managers in Bali for facing disaster risk

Deddie Wijayanto [1], Novita A Nainupu [2], Oktavia P Rahmawati[2] and Santi Oktariyandari [2]

[1]First affiliation, Indonesia Defense University, Bogor Wesr Java 16810, Indonesia
[2]Second affiliation, Indonesia Defense University, Bogor Wesr Java 16810, Indonesia

E-mail: deddienganjuk@gmail.com, nainupunovita@gmail.com

Abstract. The rapid development of tourism in Indonesia, shows that the tourism sector is the largest foreign exchange earner for Indonesia. Bali's cultural tourism, which is very popular at the international level and has been named the best destination in the world, is the biggest contributor of foreign exchange to Indonesia's tourism sector by 70%. One of the major threats in the tourism industry is that it is very vulnerable to disasters, if not managed properly, the impact of which will affect the tourism ecosystem and even the achievement of tourism performance targets. Mitigation and disaster risk reduction are appropriate actions in dealing with threats and should be placed as a form of investment in tourism development. Mitigation actions can take the form of the role of information from the management of related tourism objects to provide assurance of a sense of calm and security that is needed by tourists in carrying out their holidays. This study uses qualitative methods with the type of descriptive research based on consideration of the implementation of disaster management mitigation efforts involving various aspects that must be explored more deeply and comprehensively. Mitigation efforts carried out are a form of preparedness to respond to the challenges faced by the tourism sector in Bali in particular is to provide a sense of comfort and security for tourists who come and all forms of threats must be anticipated by the parties concerned.

1. Introduction

The development of tourism in Indonesia is extremely rapid. Data from the World Travel and Tourism Council (WTTC) reported that the Top-30 Travel and Tourism Countries Power Ranking was based on absolute growth in the 2011 and 2017 periods for the four main travel and tourism indicators showing Indonesia was number 9 as a country with fastest growing tourism in the world. In the list issued, China, the United States, and India occupy the top three positions. For the Asian region, Indonesia is number 3 after China and India. Whereas in Southeast Asia, Indonesia's position is best among other Southeast Asian countries, such as Thailand which is in number 12, Philippines and Malaysia in number 13, Singapore number 16 and Vietnam number 21.

Indonesian tourism has many competitive advantages and comparative advantages. It can be seen from the number of foreign tourists to Indonesia which continues to increase by an absolute 55%, from 2014 amounting to 9 million, to 14 million in 2017. These figures indicate that the tourism sector is the largest foreign exchange earner. Mr. Putu Agus Yudiantara A.PAR., M.PAR, as Head of the Tourism Section of the Bali Province Tourism Office stated that, tourism in Indonesia which contributes the largest foreign exchange is Bali Tourism which is able to contribute Rp. 150 Billion/ month for foreign tourist tourism or around 70 % for the tourism sector in Indonesia. But behind it all, the tourism industry is very vulnerable to disasters, if not managed properly, the impact will affect tourism ecosystems and achieve tourism performance targets. Tourism is often associated with pleasure, and tourists see safety and comfort as an essential thing in traveling. Disaster is one of the most vulnerable and real factors that will affect the ups and downs of demand in the tourism industry.

Balinese cultural tourism which is very popular at the international level has developed since the 1920s that attracts tourists, including foreign tourists. In Kompas.com (2017) Bali Island was named the best destination in the world, this award was given by TripAdvisor through the Travelers' Choice Awards 2017. In this award Bali was ranked first of the 25 best destinations in the world beating London (England) and Paris (France) The development of foreign tourist arrivals (tourists) to Bali in the last 5 years has increased quite rapidly, namely from 6,394,307 people (2014), to 7,149,115 people (2015), to 8,643,680 (2016), to 8,735 .633 people (2017), and 9,757,991 people (2018) (Bali Provincial Tourism Office, 2018). In recent years, tourism visits to Bali have continued to increase. The star hotel occupancy rate (TPK) in the Province of Bali in August 2018 reached 73.83% and also clarified the level of tourists in Bali Province (BPS, 2018). However, the number of visits can be affected by natural disaster factors in Bali. Mount Agung Eruption in Bali in 2017 caused 1 million tourists to decrease and losses reached Rp 11 trillion in the tourism sector.

Mitigation is very much needed by Bali Province to maintain the stability of the number of tourists who come. Disaster mitigation must be placed as one of the priorities in the development of the tourism sector. Mitigation and disaster risk reduction should be placed as investments in tourism development itself. The Bali tourism service, supported by the Indonesian Ministry of Tourism, made 4 tactical steps to respond to the crisis situation due to the eruption of Mount Agung that had occurred. Multihazard in the Province is very threatening to the Bali Provincial Government, therefore the Bali Provincial Government has initiated several mitigation actions to overcome all forms of threats from the tsunami disaster as preparedness efforts.

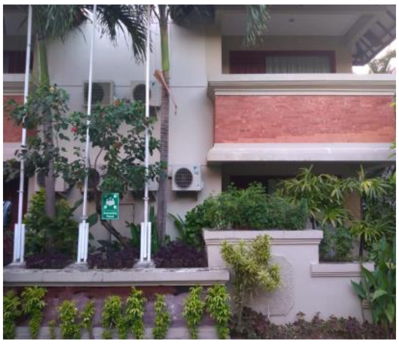
2. Research Method

In line with the focus of the problem and the purpose of the study, this study uses qualitative research methods with descriptive research types. The researcher used qualitative methods based on consideration of the implementation of disaster management mitigation efforts involving various aspects that must be explored more deeply and comprehensively. Qualitative research is research that is used to understand the phenomenon of what is experienced by research subjects such as behavior, perception, motivation, action, etc. holistically, and by describing it in the form of words and languages, in certain natural contexts and by utilizing various natural methods (Moleong, 2007: 6). This research is expected to be able to obtain various information that can be used in supporting mitigation actions in an effort to reduce disaster risk to tourists both domestic and foreign tourists in Bali Province.

3. Result and Discussion

Bali has various types of stunning tourist attractions that can attract domestic tourists or foreign tourists (tourists) from various countries in the world. However, there is no denying its geographical location. Bali asks for help from various disasters such as Mount Meletus, Tsunami, Flood, Hurricane, etc. (Governor of Bali Province, 2019). The Regional Government of Bali has carried out strong coordination both to the government and institutions in terms of submitting potential disasters in Bali Province specifically for tourist areas. The Bali Province Disaster Management Agency (BPBD) has responsibility for accountability related to District BPBDs throughout Bali Province, BMKG, Basarnas, PMI, NGOs, and others to ensure the security of tourist sites in the face of difficulties. BPBD in the Bali Province is an institution that has a very good study in maximizing work programs to provide disaster related information. Some things that have been done by BPBD Bali Province is the establishment of cooperation in maximizing the work of the Early Warning System (EWS) that has been provided in 9 coastal points needed by the Tsunami. Every response is 26 Every month at 10.00 WITA Provincial Government Bali, which is assisted by BPBD and BMKG, always conducts Siren EWS trials that are available throughout all points in Bali. This is being done to find out whether there are EWS that are still done well or not. Besides that, Bali Province BPBD also has standard earthquake resistant hotels with proof of certification issued by Bali Province BPBD with indicator requirements in accordance with applicable regulations. Currently there are 60 certified hotels (Bali Province BPBD, 2019).


Figure 1 and 2. Evacuation Hotels in the Hotel Building and Lobby



Figures 3 and 4. Gathering points at the Hotel Open Field

Other activities that support disaster mitigation and preparedness programs in Bali have also been carried out by the Badung Regency BPBD, where the Badung Regency has quite a lot of tourist attractions, allowing tourists to consider. Programs such as socialization at tourist sites must be carried out regularly with support from participants for information about residential areas (BPBD Badung Regency, 2019).

Balinese cultural tourism that has developed since the 1920s has attracted the arrival of tourists, including foreign and domestic tourists. The development of tourists both foreign (domestic tourists) and domestic tourists to Bali in the past 5 years has increased spending quite quickly, based on data from the Bali Provincial Tourism Office, specifically opening foreign tourists as follows:

Table 1. The Number Foreign Tours Arrival Bali By Month

Year	Cat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot
2014	Tourist	279.26	275.80	276.57	280.10	286.03	330.40	361.07	336.76	354.76	341.65	296.88	347.37	3.766.638
	-/ + (%)	19.89	14.03	9.33	15.57	15.35	19.85	21.21	8.91	16.08	28.17	-3.38	16.17	14.89
2015	Tourist	301.75	338.99	305.27	313.76	295.27	359.70	382.68	303.62	389.06	369.45	270.94	370.64	4.001.835
	-/ + (%)	8.05	22.91	10.38	12.02	3.48	8.87	5.99	-9.84	9.67	8.14	-8.74	6.70	6.24
2016	Tourist	350.59	375.74	364.11	380.77	394.56	405.84	484.23	438.14	445.72	432.22	413.23	442.80	4.927.937
	-/ + (%)	16.19	10.84	19.27	21.35	33.31	12.83	26.54	44.30	14.58	16.99	52.52	19.47	23.14
2017	Tourist	460.82	453.99	425.50	477.46	489.38	504.14	592.05	601.88	550.52	465.09	361.01	315.91	5.697.739
	-/ + (%)	31.44	20.82	16.86	25.40	24.03	24.22	22.27	37.37	23.51	7.61	-12.60	-28.70	15.62
2018	Tourist	358.06	452.42	492.68	516.78	528.51	544.55	624.37	573.77	555.90	517.89	406.73	498.82	6.070.473
	-/ + (%)	-22.30	20.41	35.31	35.72	33.95	34.18	28.94	30.96	24.72	19.82	-1.57	12.65	23.18

In recent years, tourism visits to Bali have continued to increase. Along with the increasing number of potential tourist attractions that have been well explored. Ranging from natural tourism, cultural tourism, religious tourism to culinary and shopping tourism. All components of society that exist in Bali starts from the community, traditional villages, the government to the business world capable of concocting Bali into the center of world tourism. Bali is able to contribute 70% of revenue from the tourism sector in Indonesia (Bali Province Tourism Office, 2018). So that the Government targets 8 million foreign tourist visits. But the target of eight million foreign tourists is affected by the effects of natural disasters in Bali. Mount Agung Eruption in Bali in 2017 caused a decline in the number of tourist arrivals by 1 million, the reduced target resulted in declining foreign exchange earnings in the tourism sector. The cause of the decline in the number of foreign tourists who came to Bali, not due to the emergence of fear of the eruption of Mount Agung, but the number of foreign tourist arrivals declined more due to the closure of the international airport I Gusti Ngurah Rai by the PT. Angkasa Pura I as an effort to anticipate the distribution radius of volcanic ash from Mount Agung. As a result of the airport closure, not only has it caused a drastic decline in foreign tourists to Bali, but tourists who are already in Bali have become restless, because of uncertainty when the Bali I Gusti Ngurah Rai airport will be re-opened or closed, this will certainly bring restlessness to foreign tourists the scheduled vacation schedule. In the end, many foreign tourists who divert tourist destinations to Bali to other ASEAN countries, as well as tourists who are already in Bali, accelerate their travel time in Bali. This incident directly caused a decline in the target of tourist arrivals, especially foreign tourists to Bali, where the government's target in 2017 is eight million tourists.

Seeing this incident, the regional government of Bali does not remain silent, there are many ways and real efforts in attracting foreign tourists to keep coming to Bali and "holding" foreign tourists who still live in Bali not to leave Bali because they want to speed up their visiting time. One way that has been done by the Provincial Government of Province Bali is implementing the "one night free" rule for hotel managers in Bali to be given to tourists, especially on the first night of the Mount Agung eruption, as well as providing free transportation services for tourists who will move to a safer hotel than an eruption radius Holy mountain. The steps taken will be implemented not only on the Mount Agung eruption, but will also be applied when extraordinary events occur, especially natural disasters, to save tourists and tourism businesses that become the mainstay of Bali and tourism in Indonesia.

In the digital era like now, in every event natural disaster are always followed by the emergence of false news or hoaxes who always follow the event. When Mount Agung is still on alert level three, but the news circulating on social media, has circulated that Mount Agung has erupted with terrible images, but after tracing the truth, the news of the eruption of Mount Agung is a hoax. The government through the BMKG has provided clarification on the wrong reporting. However, most foreign tourists are more careful and aware of all kinds of news, foreign tourists understand better and know how to get the right and correct information on the events of Mount Agung. They are not easily provoked by the circulation of hoax news on social media. In fact, foreign tourists are more worried because the closure of the airport of I Gusti Ngurah Rai by PT. Angkasa Pura I. They argue that the closure of the airport will change the schedule of visits and their return schedule to return to their country. From the Mount Agung Bali eruption above, that the role of information and certainty from competent officials in the world of tourism, especially in Bali, has become very important role to provide certainty of calm and security that is needed by tourists in carrying out their holidays. Interconnection across government agencies in supporting the improvement of the tourism world in Bali, especially in anticipation in the event of a special natural disaster due to the Gunung Agung eruption, the government through the Bali Provincial Tourism Office on Thursday 22 November 2017 held FGD (Focus Group Discussion) and Tactical Floor Tourist Service SOP Mitigation Game If the Ngurah Rai Airport Is Closed. Related agencies involved are: Indonesian Ministry of Tourism Experts, Head of Bali Tourism Office, Chair of GIPI, PT Angkasa Pura I, BPBD, OTBAN Ngurah Rai, Basarnas, Department of Transportation, TNI, Police and Provincial Health Offices. Bali. In the FGD an understanding was reached in acting all authorities in the event of an emergency caused by natural disasters so that the airport closure occurred. This effort is included in disaster mitigation, where the vulnerability of the community, especially tourists both domestic and foreign, will be reduced. So that the security and comfort of tourists is guaranteed thanks to the preparedness of government officials and the business community in facing the risk of disasters that will come at any time.

The challenge faced by the tourism sector in Bali in particular is to provide a sense of comfort and security to the tourists who come. All kinds of threats must be anticipated by related parties. The tragedy of Bali I and II bombs cannot be repeated again by reducing the movement of terrorists to terrorize Bali again. But now the real and factual threat is natural disasters, both in the form of volcanic eruptions where in Bali there are two active mountains, namely Gunung Agung and Gunung Batur, as well as the threat of a large earthquake followed by a tsunami, this is possible because of the Indo Australia and the Eurasian plate are very active and potentially cause a large earthquake. The question is ... is Bali ready with all its natural beauty that has become a world tourist destination facing the threat of the disaster. The answer must be ready.

4. Conclusion

The tourism industry in Indonesia, especially in Bali Island, is increasingly becoming the idol of foreign tourists. The foreign exchange generated shows a graph of increase every year and is able to contribute 70% of foreign exchange tourism in Indonesia. However, the tourism business in Bali is not without obstacles and threats, one of the real and factual threats are natural disasters. Preparedness of the Government of Bali Province in facing the threat of natural disasters is carried out seriously and integratedly. This can be seen from the collaboration between government agencies, the business world and harmoniously intertwined communities. Through the Government Tourism Office, Bali government has been able to become the leading sector guarding Bali tourism to remain a world tourist destination. Real efforts in providing certainty of security and comfort of tourists from threats, one of them is disaster mitigation towards tourist destinations. The Group Discussion Forum was intended to anticipate and implement the actions of the relevant authorities if the threat of a disaster occurred. The Regional Government of Bali has installed nine Early Warning System points and will install as many as ten units as mitigation efforts in areas prone to earthquakes accompanied by tsunamis. Regular training every month and earthquake-safe hotel buildings along with evacuation instructions and evacuation gathering points are standards that must be implemented. Providing understanding of the disaster through the provision of disaster brochures and exercises involving tourists is one of the real action of Bali regional government in protecting tourists and tourism.

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Civil and Military Sinergity in Preparedness for Natural Disaster Threats (Case Study in Bali Province)

Fani Aprilia Perdani, Nurul Safitry, and Yohannes Ari
Indonesia Defense University
IPSC Complex, Bogor 16810, Indonesia

Email: faniapriliap@gmail.com

Abstract. Disaster management is not only a civil matter, but is a shared responsibility, including military involvement. Civil-military coordination proved to be able to accelerate disaster management so that victims could be minimized. This study will explore information from informants that are relevant to the purpose of research related to the forms of civil and military synergy in preparedness to face the potential threat of natural disasters in Bali Province. The research design applied is qualitative research through collecting data with in-depth interviews. Bali Provincial Government preparedness efforts that are supported by military elements can be viewed from the scope of preparedness consisting of disaster risk reduction, institutions, plans in emergencies, information systems, supporting resources, early warning systems, emergency response mechanisms, education and training, and rehearsal.

***Keywords*:** Civil, military, preparedness

1. Introduction

Indonesia is traversed by two major mountain ranges in the world, namely the Pacific and Mediterranean Circums. Indonesia is also at the confluence of the lithosphere, namely Indo-Australia, Eurasia, and the Pacific. The Indo-Australian plate collides with the Eurasian plate off the coast of Sumatra, Java and Nusa Tenggara. While the Indo-Australian Plate collides with the Pacific plate in the north of Irian and North Maluku. This position makes Indonesia prone to natural disasters, ranging from droughts, floods, earthquakes, volcanic eruptions, to tsunamis. The island of Bali which is in the ranks of the islands of Java and Nusa Tenggara has the potential threat of natural disasters, especially earthquakes, tsunamis and volcanic eruptions.

Disaster management is not only a civil matter, but is a shared responsibility, including military (TNI) involvement. Civil-military coordination proved to be able to accelerate disaster management so that victims could be minimized. It cannot be denied that in the large deployment of troops, the TNI is faster than civilians [1]. The TNI as part of the state based on Law Number 3 of 2002 concerning National Defense and Law Number 34 of 2004 concerning the TNI has the task of Military Operations Other Than War (OMSP), one of which regulates the TNI's tasks in Disaster Management.

BNPB was formed based on Presidential Regulation Number 8 of 2008, has the duty to coordinate the implementation of disaster management activities in a planned, integrated and comprehensive manner. Disaster management is multi-stakeholder, multi-disciplinary, multi-sector and multi-phase. The form of BNPB's collaboration with the military is manifested in the

Ministry of Defense's Memorandum of Understanding with BNPB Number 66 / BNPB / 03/2016 and KB / 3 / M / III / 2016 which includes the implementation of disaster management which includes operational activities and administrative activities. The Ministry of Defense will assist BNPB in achieving government policy objectives at the national, regional and international levels for disaster risk reduction through coordination and communication with the TNI and other agencies, while BNPB will submit requests for support for personnel, facilities, equipment and equipment for disaster management to Kemhan and TNI. Besides that, a Memorandum of Understanding was made by the TNI Headquarters with BNPB Number 47 / BNPB / III / 2016 and KERMA / 6 / III / 2016 to improve the cooperation of the parties in the field of disaster management with the aim of guiding the implementation of rapid, planned, organized and integrated disaster management .

This study will explore information from informants that are relevant to the research objectives related to the form of synergy between TNI and civilians in preparedness in the face of the potential threat of natural disasters in Bali Province.

2. Research Methods

The research design applied is qualitative research, which is a method for exploring and understanding the meanings considered from social or humanitarian problems of a number of individuals or groups of people. [2]

Methods of data collection and analysis in qualitative methods based on observations at the study site. To strengthen the results of the study, researchers conducted a test of the validity of the data and provided an interview guide containing the questions that will be explored from the research subjects. The research was conducted for four days, 25-28-28 2019 in Bali Province.

The research consisted of several stages to find out and analyze the form of synergy between TNI and civilians in preparedness in the face of the potential threat of natural disasters in Bali Province. The first stage was identifying the forms of synergy between TNI and civilians that had been established so far, then analyzing the forms of synergy by collecting data usingmethods *participatory inquiry* and *in-depth interview* as primary data. Secondary data is taken from open sources such as books, journals, the internet, and various literary sources from the agencies studied.

3. Results and Discussion

Disaster threats can cause casualties and property damage [3]. In the general lecture of the Minister of Defense at the Defense University, it was conveyed that the threat of national defense is now shifting from gunfighting to a threat other than war, one of which is natural disasters, so that recalibration is needed in preparing future national defense policies including disaster management [4].

Indonesia is a country that has natural wealth with tourism potential but on the other hand is also prone to disasters. One province that has high population and economic activity in tourism is Bali Province. Relief of Bali Island is a chain of mountains and hills that extends from west to east. Among the mountains are active volcanoes, namely Mount Agung (3,142 m) and Mount Batur (1,717 m). This mountain chain causes the geographical area of Bali to be divided into 2 (two) unequal parts, namely North Bali with a narrow lowland and less sloping while South Bali with a broad low and gentle slope. The province of Bali has the potential for several types of disasters, especially earthquakes, tsunamis and volcanic eruptions. Bali is located in the collision zone between the Indo-Australian Plate and the Eurasian Plate. Subduction zone which is the main source of earthquake and potential tsunami especially in the southern part of Bali Island. The threat of a tsunami wave estimated from this area only takes 30 to 60 minutes to reach the coast. The history of disasters that have occurred in Bali Province is a historical summary of all disaster events including natural, non-natural and social disasters which are divided into geological, hydrometeorological, biological, and social conflict disasters.

The charming potential of cultural and natural tourism on the island of Bali is a magnet for local and international tourists. The population density on the island of Bali is not only local residents but also tourists who are on vacation. Tourism is a major driver of the economic sector in Bali Province. Bali Province as a favorite destination for tourists, both local and foreign countries, requires extra security against the threat of crime and natural disasters.
In disaster management in the region, the BPBD is the *focal point* and coordinating center in carrying out disaster management phases at the provincial and district / city levels. Support and participation of elements of the TNI on the island of Bali (Kodam, Lanal, and Lanud) in the implementation of disaster management is an implementation of the CSO in maintaining the state (within the province). The role of the TNI in disaster management on the island of Bali has been proven in the Mount Agung eruption where the Dandim 1623 / Karangasem was appointed as the Commander of the Mount Agung Eruption Eradication Task Force. Good cooperation from all *stakeholders* in handling the disaster of the Mount Agung eruption throughout 2016 until 2018 did not cause direct casualties, but caused considerable losses in the tourism sector due to a drastic reduction in the number of tourists.
In addition to volcanic eruptions, there is the potential threat of a huge disaster on the island of Bali, the tsunami. Geographically, Bali Island is an area that has a high potential for tsunami threat. Vulnerability in the face of a tsunami threat can be reduced so as not to cause casualties and damage considering the density of coastal tourism in Bali, especially in the southern part. Preparedness is needed to reduce or eliminate the risk of the threat. The implementation of disaster management, especially in the implementation of disaster preparedness (tsunami) in Bali Province is not only the responsibility of the government, in this case the Regional Government of Bali with regional apparatus organizations, but there is active participation from military elements namely Kodam, Lanal, and Lanud and Regional Police. To examine more deeply the role of the government (Regional Government and the involvement of the TNI), community and business world preparedness theory is used by discussing the scope of preparedness.

3.1 Definition of Disaster Preparedness

Preparedness defined as a form of action or activities undertaken before a disaster occurs or override the victim. Preparedness according to Pinkowski (2008) is an act of avoiding disaster threats and reducing the impact caused by disasters through the process of planning, preparedness and mitigation [5]. Preparedness for disaster threats are actions taken to ensure that at the time of a disaster an appropriate response will be carried out in the face of the impacts caused by the disaster in an appropriate manner so that it can be carried out effectively.

In the opinion of Carter in Fauzi, responsibility for preparedness is not only certain people, but all components in the region with the hope of victims caused by disasters that may occur at a minimum can be reduced [6]. Preparedness aims to minimize the side effects of hazards through effective, timely, adequate preventive measures, efficiency for emergency response and assistance during disasters. This explains that preparedness is needed in order to anticipate the disaster that will occur, with the hope that if at any time there is a disaster, the victim can be minimized because it is ready in advance. Preparedness of each individual in the face of a disaster that will occur can prevent the emergence of panic and ineffective actions.

3.2 Civil and Military Cooperation In The Scope of Preparedness

Research conducted by LIPI and ISDR (2006) on community preparedness in the face of disasters has scope as follows [7]:

1. Disaster Risk Reduction

The scope of disaster risk reduction includes knowledge and attitudes about disasters. Indicators regarding knowledge and attitudes about disaster are an understanding of natural disasters, environmental vulnerabilities, and the vulnerability of physical buildings and important facilities for disaster emergencies [8]. In the variable knowledge and attitude, the local government in this case the Regional Disaster Management Agency in collaboration with the relevant regional apparatus organizations has conducted disaster risk studies and vulnerabilities found in the coastal environment. The provincial government of Bali has carried out certification of hotels and buildings in accordance with security requirements and standards from the threat of a tsunami disaster. This is a manifestation of the implementation of disaster risk reduction efforts.

2. Institutional

Indicator of institutional namely the existence of relevant policies, regulations and guidelines. BPBD as the *focal point* of government agencies at the provincial and district / city levels, in carrying out their main tasks and functions as moving institutions in each phase of disaster management. BPBD has preparedness policies to anticipate disasters (natural and non-natural), such as organizing disaster management, action reactions for emergency response, disaster warning systems, community education, and allocation of funds. The role of the military in institutions in the Province of Bali is to support every policy of the local government and play an active role in organizing and responding to the emergency.

3. Plans in Emergency Situations

Plans in an emergency, commonly referred to as contingency plans, can be reviewed with the following indicators:

- Disaster management organizations, including disaster preparedness.
- Evacuation plans, including locations and evacuation sites, maps, routes and evacuation signs.
- Disaster posts and implementation procedures.
- First aid plan, rescue, safety and security in the event of a disaster.
- Plans for meeting basic needs, including food and beverages, clothing, refugee camps, clean water, sanitation and environmental sanitation, health and information about disasters and victims.
- Evacuation equipment and equipment.
- Important facilities for emergencies (hospital / health post, fire department, PDAM, Telkom, PLN, port, airport).
- Exercise and evacuation simulation.

Military elements play a role in almost all indicators of contingency plans. In organizing in general TNI personnel are appointed as Task Force Commander, such as Dandim 1623 / Karangasem appointed as Commander of the Mount Agung Eruption Eradication Task Force. Military personnel play an active role in evacuation planning, establishment of disasterposts, *Search and Rescue* relief(SAR), establishment of refugee camps / places, sanitation, health support, public kitchens, security assistance, and participating in every exercise and simulation held, both in the face of natural disasters, social disasters or both. The last joint exercise carried out was an election security simulation which at the same time occurred an earthquake.

4. Information Systems

According to Blaike in Permana (2015), the information system aims to:

- Improve the capacity of disaster management planning for all disaster management mechanisms, both at the central and regional levels.

- support the implementation of reporting disaster events quickly and precisely, including the process of monitoring and development of disaster events.
- provide complete and actual information to all parties related to disaster management elements both in Indonesia and foreign countries through global network facilities [9].

In preparedness activities, communication will include accurate information, coordination and aspects of cooperation, especially for people who are vulnerable to disaster events [10]. Through communication, organizations can improve their ability to take effective actions to deal with disasters. In disaster management efforts in the province of Bali, the local government along with Indonesian National Armed Forces personnel from Kodam IX / Udayana, Lanal Denpasar, and Ngurah Rai Airport had a communication forum through the Whatsapp group application which became the fastest access to disaster information exchanges every day.

5. Supporting Resources

Suporting resources are needed to support disaster response activities, which come from internal and external sources. Disaster conditions result in limited resources so effective and efficient planning and administration are needed. Before a disaster has occurred, it must be prepared and planned for the existence of an *Incident Command System* (ICS), a complete organization of personnel, rules, budget planning and SOPs. Every personnel must know so that the personnel can understand their respective roles and duties in the event of a disaster so that there is no confusion about what actions should be taken when the disaster comes. In the case of the Mount Agung eruption disaster relief, the Regional Disaster Management Agency as the *leading sector* coordinated several other relevant agencies including the military in terms of personnel and logistics deployments.

6. Early Warning System

The early warning system (EWS) includes warning signs and distribution of information in case of disaster. EWS is a tool that requires people's understanding of information about warning signs and what to do if one day the warning signals sound. Bali Province has 9 EWS units located along the southern coast of Bali. EWS ignition test activities are carried out routinely on the 26th of every month.

7. Emergency Response Mechanisms

According to Hediarto (2016), the handling of emergency response by civilian and military associations has made the public more trusting the government, thus creating conditions where they will not be affected by other ideas that conflict with the government, because they feel very government [11]. According to LIPI-UNESCO / ISDR (2006), emergency response plans or planning emergencies are an important part of a preparedness process, especially those related to evacuation, relief and rescue, so that disaster victims can be minimized. Based on the direction of the President at the Opening of the BNPB National Working Meeting on February 2, 2019 in Surabaya, at the time of the disaster the governor as the regional head automatically became the commander of the emergency task force with the Regional Military Commander and the Regional Police Chief as his deputy. These directives reinforce military involvement in disaster management, especially at the regional level.

8. Education and Training

Education and emergency training to provide specific knowledge and information for skills improvement in disaster preparedness. During a visit to Kodam IX / Udayana, Lanal Denpasar, and Lanud I Gusti Ngurah Rai, some TNI personnel have attended emergency disaster preparedness education and training, both independently and in combination with other elements including the local BPBD.

9. Rehearsal

Rehearsal or simulation is intended to actualize the knowledge and skills of officers or the community in responding to threats. In Bali Province, regular disaster management simulations at the provincial level are coordinated by the BPBD of Bali Province and at the district / city level coordinated by the district / city BPBD. During a visit to BPBD, Badung Regency routine simulation activities were carried out and received full support from local military elements, even carried out at the village / banjar level involving Babinsa.

5. Conclusions

Involvement of civilians and the military in the implementation of disaster management in the Province of Bali is very effective, proven in the disaster management of the Mount Agung eruption throughout 2016 to 2018 and mitigation activities in the face of the potential threat of earthquake and tsunami disasters. This form of synergy starts from the institutional level of the Regional Government of Bali Province with elements of the TNI in the area of Bali Island (Kodam, Lanal, and Lanud) to the level of village government and the smallest military unit in each village. Preparedness of the Regional Government of Bali which is supported by elements of the TNI, the community, and business actors is an important point in the pre-disaster phase. The Regional Government of Bali as the main person in charge of the implementation of disaster management is fully supported by the TNI, so that it can be concluded that the synergy between civilians and the military in the Province of Bali has been well established.

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Effectivity Analysis of The Use of Telemetry 433 Mhz to Deliver of Sensors Data As Early Warning System Das Jeneberang

Iris Sumariyanto[1], Ramanta Pinem[1] and Andry Anzhari[2]

[1]Indonesia Defense University, Bogor 16810, Indonesia
[2]State University of Makassar, Makassar 90222, Indonesia

E-mail: iris.sumariyanto@tp.idu.ac.id

Abstract.Jeneberang River is the largest river in Gowa regency with 75 km length, the river flow is accommodated in Bili-bili DAM located 40 km from upstream with 73 m high DAM and 750 m long with a capacity of 375 million m3. If the DAM bili-bili collapsed can increase sodden flood with high Damage to the area through which Jeneberang river. Aims to know the effectivity of telemetry with yagi antenna and the effectivity of sending data with a certain distance. Design of Telemetry Device, Analysis of Telemetry Module, RSSI Analysis (Receiver Signal Strenght Indicator). Based on the results of the test research consists of three stages: 1). Pretest 1 Standard tx telemetry antenna - standard rx telemetry antenna with range 252 meters with RSSI dbm 40 dbm. 2). Pretest 2 Telemetry antenna yagi - telemetry antenna rx yagi state los. The data transmission capability of telemetry data is 5.7 km. 3). Field testing (Bili-bili DAS), This test is done by telemetry device switching from transmit power 100 mW to 500 mW. Effective data delivery is done within 8.9 km with RSSI doses of 35 dBm and still possible to transmit data. To be necessary to compare back telemetry devices and yagi antennas used.

Keywords: Effectivity; Telemetry; EWS.

1. Introductions

Use Flash floods is the transporting flood water and mud. Flash floods are very dangerous compared to regular water flooding, it is because it would be difficult to escape. Flash floods can wash away objects and has a high destructive power. Flash floods usually occur in mountainous areas such as the mountainous land to landslides because of the rain water to the water carried on the lower mainland. Usually such flooding can wash away the trees that are large and can damage the residential area affected by the flood.

Jeneberang River is one of the largest river in Gowa. Upstream from Mount Bawakaraeng, flowing through the District. Gowa and empties between Barombong and Tanjung Bayang, from upstream to downstream length of 75 km. Jeneberang pass through eight districts in Gowa (Tinggimoncong, Parigi, Parangloe, Manuju, Bontomarannu, Pallangga, Sombaopu, Barombong) and three districts in Makassar (Tamalate, Barombong, and Mariso)[1].

Jeneberang River Dammed stream in Giant Bili-Bili dam, located 40 km upstream. The results of this dam into raw materials of drinking water, irrigation and power generation. Some devices such as sabo dam, dam consolidation, and there is a pocket of sand along the river, especially before floodplains. Dams built with stone backfill type, main dam 73 m high and 750 m long. Catchment area of 384.40 km2 reservoir with storage capacity of 375 million m3 and the effective storage capacity 346 million m3 [2]. With the capacity for it, if Bili-Bili dam could burst, causing widespread flooding with high destructive force against areas traversed Jeneberang river. So that the Bili-Bili dam and river watershed Jeneberang need to be equipped with early warning system against possible disasters that can occur.

Early Warning System (EWS) is a series of systems to inform would be natural occurrences, can be a disaster or other natural signs. Early warning community for the disaster was an act of providing information in an easily digestible by the public. In critical circumstances, the general warning that the delivery of such information is embodied in the form of a siren, gong and others. However, sirens are part of forms of information delivery needs to be done because there is no other way faster to deliver information to the public. The hope is that the information society can respond quickly and appropriately. Alertness and public reaction speed required for a narrow time of the time of the release of information by the time of (alleged) the coming disaster. Critical condition, while narrow, major disasters and rescue the population are all factors that require an early warning. The earlier information given, the more loose the time for people to respond.

In the system of disaster early warning (EWS) detector disasters of sensors detecting cracks and telemetry (transmitter) mounted on the body of the dam Bili-bili which serves to detect cracks in the dam and then sends the data in the form of a warning through the media of radio waves by using a frequency of 433 MHz to the tool receiver which has been installed at some point that is expected to be a disaster-affected area. However, use of the transmission medium using radio waves have several problems such as network capacity to face keterbatas spectrum and radio propagation issues eg obstructed, reflected and many sources of interference. Bad weather also has the impact on the transmission process using the medium of radio waves.

Therefore, we need an assessment of the effectiveness of the use of telemetry with 433MHz frequency for sending sensor data to the Early Warning System DAS Jeneberang.

The rest of this paper is organized as follow: Section 2 describes proposed methodology of this work. Section 3 presents the obtained result and following by discussion. Finally, section 5 concludes this work.

2. Methodology

2.1. Research procedure

The procedure in this research are:

2.1.1. Telemetry Device assembly

Tools and materials that have been collected are assembled into 2 parts, parts Transmitter and Receiver section.

2.1.2. Analysis Telemetry Modules

Telemetry is used in this study was 3DR Radio Telemetry Module 433MHz kit, with a small size and light weight [3]. 433-434.79MHz frequencies, -121dBm receiver sensitivity. Transmit power up to 20dBm (100mW). Transparent serial link. Rating data on the air until 250kbps. MAVlink framing protocol and status reporting. Hoping Frequency Spread Spectrum (FHSS). Adaptive team division multiplexing (TDM). Support for LBT and AFA

2.1.3. Analysis RSSI (Receiver Signal Strength Indicator) telemetry module

RSSI is a technology that is used to measure the signal strength indicator received by a wireless device. However, a direct mapping of the RSSI value based on the distance has a lot of limitations, because basically, RSSI susceptible to noise, multi-pat fading, and other disturbances that cause large fluctuations in the received power.

1) $$P_r = P_t G_r G_t \left(\frac{\lambda}{4\pi d}\right) \qquad (1)$$

Where:

P_r = Power received by the antenna

P_t = Number of known transmission power

G_r = Receiver antenna gain

G_t = Transmitter antenna gain

The tools used in this measurement is the SWR meter. Research analysis method like this has been done by Sahu et al in 2013.

2.1.4. Analysis of the data transmission at a certain distance

Distance is the range between the transmitter and receiver. Analysis and testing of the distance is done by continuously sending transmitter broadcasting signal received by the receiver on a 4 point distance is 2.5 km, 5 km, 7.5 km and 10 km to the case lost between transmitter and receiver. So that it can be seen that the maximum distance is still effective for delivery of sensor data.

2.2. Data collection technique

Data collection instrument in this study is the SWR meter used to measure the value of RSSI and transmitter-receiver module which is used for testing the effective range of the sensor data transmission then the value and the data is entered in a table of data analysis. The methods used in data collection for this study is the method of testing. Based on the method of data collection conducted by researchers, this research is an experimental research, which is a special form of investigation or research that is used to specify any variables as well as how to form relationships with each other.

In the activity conducted by researchers of the object study, researchers determined that the variables used in this research is the distance and RSSI (Receiver Signal Strength Indicator).

2.3. Data analysis

Analysis of the data used in this study is a descriptive analysis of quantitative data, therefore it takes a table to document the data collected, the following table the required data:

Table 1. Table RSSI measurement data

o.	Distanc e (km)	Value RSSI (dBm)	Data transmission (sent / no)	Info rmation
	2.5			
	5			
	7.5			
	10			

Drawing conclusions in this study based on the value of RSSI measurement table, where the use of telemetry with 433MHz frequencies for sensor data transmission on the Early Warning System DAS Jeneberang said to be effective if it meets the parameters at a distance of how the data can still be sent to the value of RSSI (dBm) the highest.

3. Results and Discussion

3.1. Telemetry device assembly

At this stage, the first thing to do is to design a device telemetry and yagi antennas will be deployed using several applications such as Yagi Calculator and MMANA-GAL and using a VSWR meter to test yagi antennas have been made.

Yagi antenna is made of aluminum with a total length of 2 meters, the size of the antenna along the antenna elements based on the measurement Yagi Calculator application, yagi antennas connected by telemetry with SMA connectors and connector N installed coaxial cable MG58.

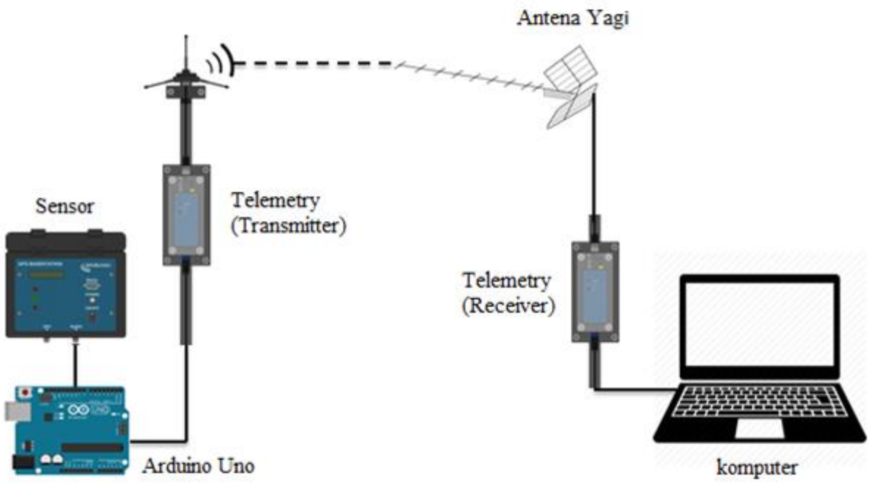


Figure 1. Schematic design tools [4]

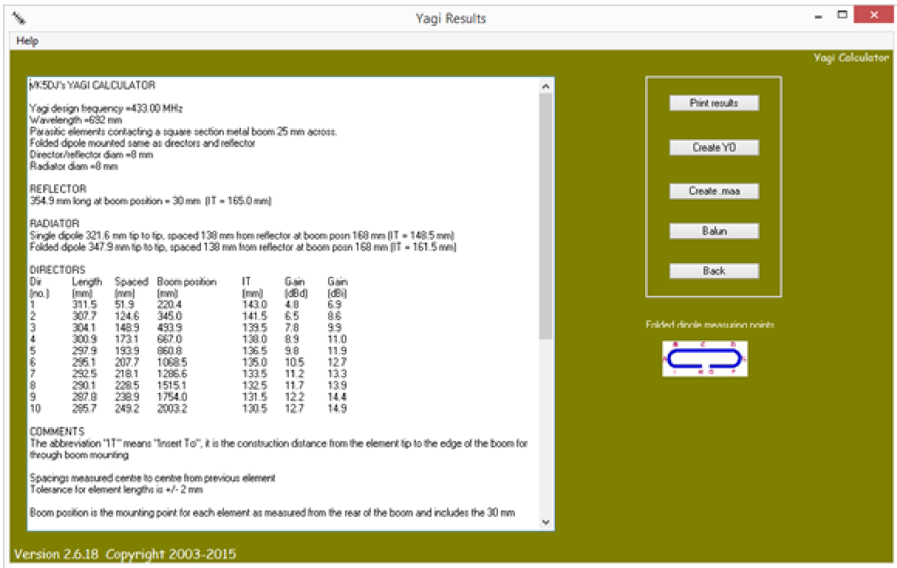


Figure 1. Application Calculator to formulate Yagi antenna size [5].

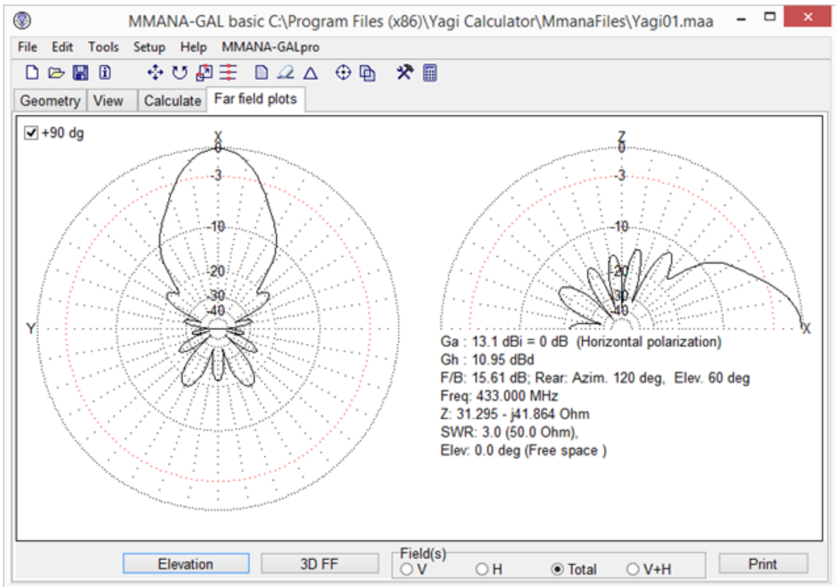


Figure 3. Application-GAL MMANA designed to analyze antenna [6]

3.2. *Analysis Telemetry and Yagi*

Analysis of telemetry devices use i-SIK Radio application for displaying telemetry settings and specifications that are used while to analyze yagi antennas that have been made to use tool VSWR meter, where the smaller the value, the better SWR obtained an antenna that has been assembled.

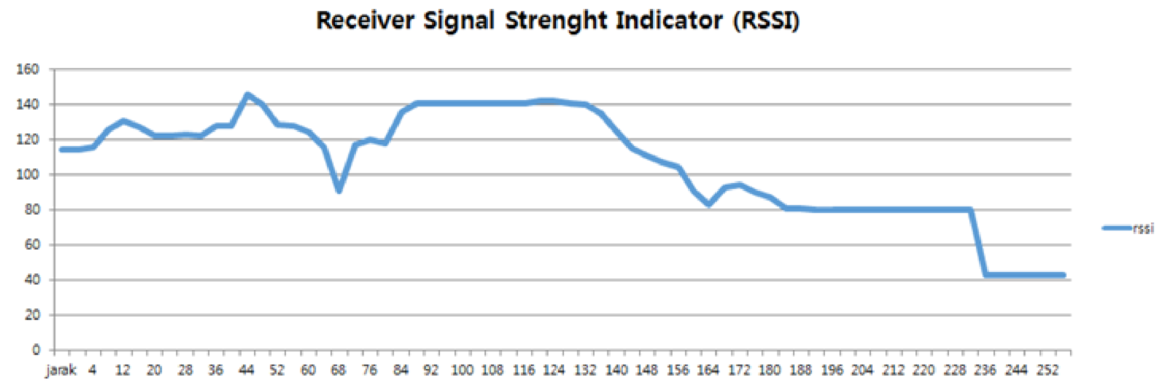
Figure 4. The application i-SIK Radio

Figure 5. VSWR Meter

3.3. Testing data transmission at a certain distance

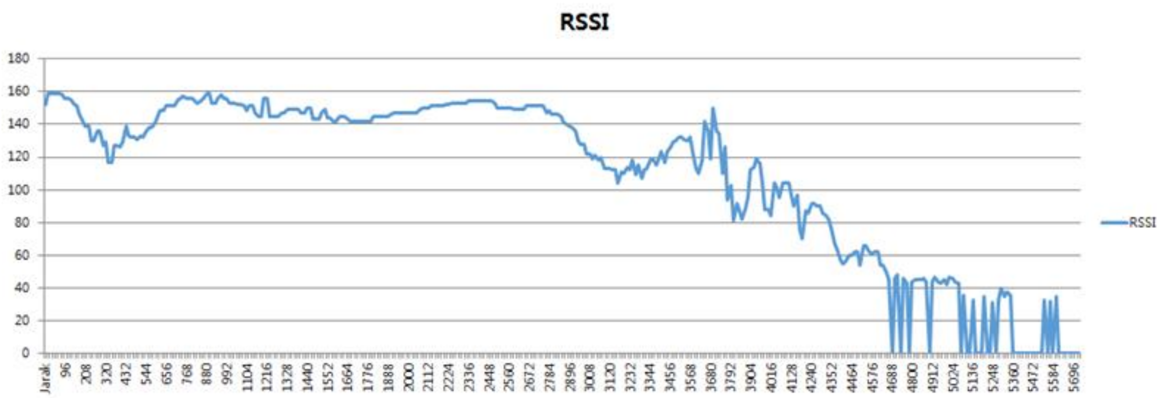
This testing is done in three phases:

3.3.1. Pre test 1. Antenna telemetry standard tx - rx telemetry antenna standard



From the results obtained, it can be seen that the data transmission capacity telemetry using a standard antenna is only able to reach a distance of 252 meters with 40 dbm RSSI value

3.3.2. Pre-test 2. telemetry yagi antennas - yagi antenna telemetry rx los state.



The test is performed using a Yagi antenna with state LOS (length of sight) without hindrance by crossing the island. From these data it can be seen the data transmission capacity telemetry with yagi antenna is only able to reach a distance of 5.7 km that is considered necessary to re-analyze the telemetry device and yagi antennas are used.

3.3.3. Field testing (Bili-Bili DAM)

Field trials were conducted with the procedure laid transmitter device in Bili-Bili DAM and down the river Jeneberang to get a spot and start transmitting data at a certain distance. The test is performed after replacing the telemetry devices that have previously been used to transmit power of 100 mW to 500 mW.

Table 2. Field testing (Bili-Bili DAM)

o.	Dis tance (km)	Val ue RSSI (dBm)	Data transmission (sent / no)	Information
	0	221	sent	
	1.5	195	sent	
	3.5	110	sent	

6.2	76	sent	
7.4	70	sent	
8.9	35	sent	
9.5	13	Not sent	Hindered by the hill, and the orientation of the antenna is not known

From these results, the effective data transfer is done within 8.9 km with 35 dBm RSSI value is still possible to transmit data. Yagi antenna is a directional antenna, which means that this antenna is an antenna directive so that when the orientation of the antenna is not known ability of an antenna to receive the signal decreases

4. Conclusion

Based on the results of testing consisted of three phases:

1). Pre telemetry antenna test 1 standard tx - rx telemetry antenna standard. Telemetry data transmission capabilities able to reach a distance of 252 meters with 40 dbm RSSI value. 2). Pre-test 2 yagi antennas Telemetry - telemetry antenna yagi rx los circumstances. Testing in an LOS (length of sight) without hindrance by crossing the island. The results of the data transmission capacity telemetry reach a distance of 5.7 km. 3). Field testing, field testing with the procedure laid transmitter device in Bili-Bili dam and down the river Jeneberang to get a spot and start transmitting data at a certain distance. The test is performed after replacing the telemetry devices that have previously been used to transmit power of 100 mW to 500 mW. effective data transfer is done within 8 9 km to the RSSI value of 35 dBm and still allows it to transmit data. so it is necessary to re-analyse the telemetry device and yagi antennas are used.

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Mitigation of landslides through erosion rate reduction in pine stands in BKPH Kebasen, KPH East Banyumas, Central Java

Oktavia P Rahmawati[1] and Sugeng Triutomo[2]

[1]First affiliation, Indonesia Defense University, Bogor Wesr Java 16810, Indonesia
[2]Second affiliation, Indonesia Defense University, Bogor Wesr Java 16810, Indonesia

E-mail: oktaviapr@gmail.com, striutomo@gmail.com

Abstract, Pine forests have been developed in Java by Perum Perhutani to land rehabilitation that determined by the canopy closure of the tree, and the presence of understorey vegetation. The ability of pine forest to rehabilitate land is the caused by its ability in reducing water runoff and soil erosion. In contrast, the less extensive the canopy and understorey vegetation are rare, the higher the rate of surface runoff and erosion, roomates Eventually causes a Decrease in soil fertility and loss of soil biota such as *Collembola*. The objectives were to Determine the relationship between the rate of pine tree canopy closure, with understorey vegetation structure and the level of erosion as well as *Collembola* community, to Investigate the relationship between rates of erosion and *Collembola* composition. The results Showed the value of the cumulative variance of 84.9%. MANOVA test revealed significant differences (Wilks's Lambda = 0.017) among erosion rates, understorey vegetation, and *Collembola* community According to canopy closure. The result of multiple regression analysis between precipitation (X1), surface flow (X2), and erosion produced an erosion function as (Y) = 19.36 - 9,79X1 + 1,25X2. Erosion was Considered very low to low (7-37 ton.ha-1.day-1).

Keywords: Pine forest, understorey vegetation, erosion, mitigation

1. Introduction

Pine (Pinus) is a tree native to Indonesia are widely used in reforestation as a pine tree can grow in a variety of soil conditions including critical land (Suhaendi, 2007). Pine has the potential to be developed as production forests can reduce the rate of erosion because it has deep roots, the tree is not too heavy or light, and produce a latex as a main product. In addition, the pine stands are much lower tolerant plants, so it can grow with the diversity and abundance of relatively high (Indrajaya and Wuri, 2008).

The existence of undergrowth in pine stands can help address the critical land. This is because the undergrowth in the forest ecosystem plays a role in binding soil particles so that the soil becomes stable and able to strengthen the slopes, as well as withstand blows rain and runoff water so as to minimize the danger of erosion (Hilwan et al., 2013). Erosion is the displacement events of land or portions of land from one place to another by a natural medium (Arsyad, 1989). Problems caused by erosion is the decline in land productivity. The decline in land productivity due to decreased soil fertility and loss of soil biota. Soil biota will not grow well on land that is not fertile. One soil biota is *Collembola*.

Undergrowth vegetation management under pine stands is one way to reduce the rate of erosion, especially in areas with steep slopes. This includes efforts to mitigate disasters, especially landslides. According to Law No. 24 of 2007, is a series of mitigation efforts to reduce disaster risk, either through physical development as well as awareness raising and capacity building facing the threat of disaster. Avalanche is a process of soil or rock mass transfer with the obliquity of the original position, so that apart from a solid mass, due to the influence of gravity to the type of rotational and translational motion form (PU Candy. 22, 2007). The principle of avalanche prevention can be done by preventing the water is not concentrated on the glide plane, binding the soil mass in order to get into the soil layers deeper layers of the glide plane. Landslides can be prevented by maintaining the stability of pepohoan on the slopes. Plants will absorb water, the roots will bind the soil, and the soil barren areas need greening (Riyanto, 2016).

On the basis that it is necessary to search the causes of the high rate of attrition in the pine forest. The problem of research that needs to be addressed is how the relationship between the area of the closure of stands of pine and vegetation structure below the level of erosion and *Collembola* community, and how the relationship between the rate of erosion and composition of *Collembola* in pine stands.

Based on the formulation of the issues mentioned above, this research aims as follows:

a. Knowing the relationship between the rate of closure of the stand of pines and undergrowth vegetation structure with erosion and *Collembola* community.
b. Knowing the relationship between the rate of erosion and composition of *Collembola*
c. Knowing the role of vegetation structure down to decrease the attrition rate in the landslide disaster mitigation efforts

2. Research Method

This study uses survey carried out in a pine forest protected areas swath 44 C in the area RPH Kalirajut BKPH KPH Banyumas Kebasen East. The dependent variable in this study include erosion and *Collembola* community. The independent variables include the canopy and understorey vegetation structure. The main parameter is the amount of sediment, vegetation diversity undergrowth, and abundance of *Collembola*. Parameters such support consists of precipitation, soil porosity, soil moisture, slope, soil temperature, soil pH, organic carbon, and soil organic matter.

To determine the relationship between the rate of closure of the stand of pines and undergrowth vegetation structure with erosion and measurement closure *Collembola* community with tree cover measurement methods in all three different plots by making plots aide size of 10 mx 10 m. Comprehensive measurement tree canopy on each plot of erosion performed on the outermost and innermost header, then the data that has been obtained is calculated using the formula:

$$\text{Crown diameter (d)} = d1 + d2 / 2 \quad (1)$$

$$\text{Roomy crown cover (CP)} = 0.25 \text{ x } d2 \quad (2)$$

$$\text{Spacious percentage crown cover (CP\%)} = \Sigma\text{luas header / spacious plot x } 100\% \quad (3)$$

Information:
d1: the diameter of the outer canopy
d2: the diameter of the inner header

The erosion rate was measured by measuring sedimentation water sampling sediments deposited by a different tree cover on erosion plots for 10 times the rainfall event. Rainfall measurement is calculated using the formula:

$$Pg = X / B \times 10 \quad (4)$$

Information:
Pg: Rainfall (mm)
X: Precipitation that accommodated
B: Cross-sectional area ombrometer

As for the measurement of sediment, erosion, and runoff is calculated with the following formula:

- The rate of erosion in basin B is calculated using the formula:

Heavy soil in bath B (kg.petak-1) =
(The dry weight of the sample B / weight of wet sample B) x (weight of wet soil like B) (5)
Daily Erosion (ton.ha-1.hari-1) = weight of the ground like B x 0,001 x swath bathtub A) (6)

Big sedimentation on the vessel C is calculated using the formula:
Sedimentation basin C (gram.petak-1) =
(Dry weight of sediment samples / sample volume) x volume of water of the C (7)
Heavy sediment basin C per day (ton.ha-1.hari-1) =
(Sedimentation basin C x number of holes / broad swath tubs A) x 0.000001 (8)
Large erosion total is calculated by the formula:
Erosion total (ton.ha-1.hari-1) = B + Sedimentation Erosion bath tub C (9)
Large surface flow is calculated using the formula:
Flow surface of a body B (mm) = Volume of water tub B / A roomy tub (10)
C bath surface runoff (mm) = Volume of water bath C x number of holes / A roomy tub (11)
Total runoff (mm) = Flow Flow surface of a body surface of a body B + C (12)

Measurement of vegetation under done by creating a 1x1 m2 sample plots of 10 repetitions under the observation of plants on a plot area of erosion, then the results already obtained for the formula:

Density = Σ individuals of a species / area of entire swath made (13)
Relative density =
The density of a species / Σ density of all species x 100% (14)
frequency =
Σ swath discovery of a species / Total plot created (15)
Relative frequency =
The frequency of a species / Σ frequency of all species x 100% (16)
Important Value Index (%) = relative density + relative frequency (17)

Collembola community is measured by observing the abundance of each familia by way mengesktrak soil samples with methods Barlese Tullgren three rain events on the ground eroded and 1 time sampling on land not eroded. *Collembola* extraction result is then observed using a digital microscope. Correlations were analyzed by CCA (Conical corespondence Analysis) between the rate of erosion, vegetation structure below, and *Collembola* community. While to find a significant difference between the rate of erosion, vegetation structure below, and *Collembola* community on all three plots with different canopy closure were analyzed using MANOVA (Multivariate Analysis of Variance).

3. Result and Discussion

Pinus crown cover for each plot of erosion have different values of 0%, 12.75%, and 24.22% (hereinafter referred to PT0, PT1 and PT2). There is a significant difference between the rate of erosion, vegetation structure below, and community *Collembola* (Wilks's Lambda = 0.017). The discrepancies in crown cover, precipitation, and runoff each of the plots followed by difference in value erosion, plant vegetation below, *Collembola* and Acari (Figure 1). The average value erosion PT0, PT1, PT2 is 22.60; 20.13; 18.17 ton.ha-1.hari-1 while *Collembola* is 0.41; 0.23; Individu.100 0.43 gr-1 soil and Acari 0.77; 1.06; Individu.100 1.45 gr-1 soil. PT0 has an average value of 2.47% erosion (4:43% higher than PT1 and PT2). Number of *Collembola* PT0 higher (0.18%) than PT1, but lower (0.02%) than PT2.

The number of plant species between the three plots are not too big PT0 6 types, 7 types PT1 and PT2 9 types. The average value of 28.5 PT0 undergrowth vegetation, erosion score of 22.60 individu.m2 with ton.ha^{-1}.hari-1, the value of vegetation PT1 33.8 individu.m2 with erosion-1.hari 20.13 ton.ha-1, and the value of 36.6 individu.m2 vegetation PT2 with a value erosion of 18.17 ton.ha- 1.hari-1. PT0 value lower vegetation and erosion higher than PT1 and PT2. The highest vegetation value contained in PT2 (36.6 individu.m2) with a value of 4.43% than PT0 erosion.

The vegetation is needed to minimize erosion. The more dense undergrowth, the more effective the influence of vegetation in protecting the soil surface against erosion threat because it will reduce the speed of rain water, so that the rain water droplets to the surface of the lower ground (Asdak, 2002).

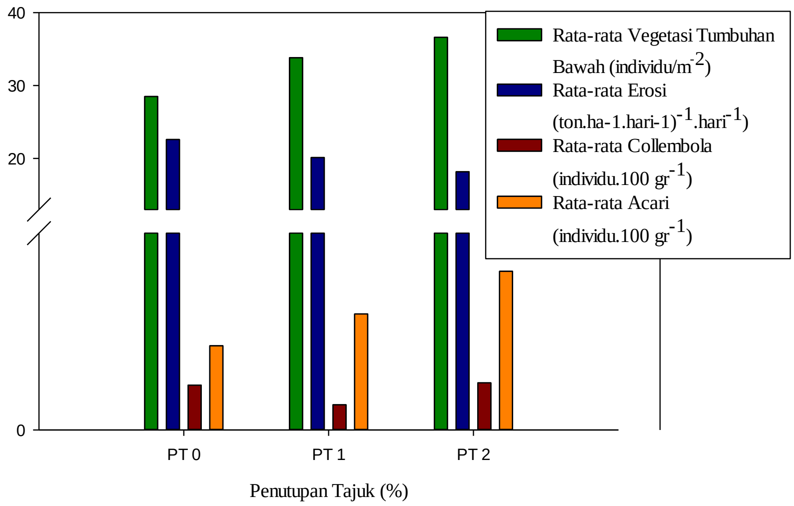

Figure 1. Relationship Between Vegetation Plant Down, Erosion, Abundance *Collembola* and Acari in Pine Forest with Different Heading Closure

From biplot Figure 2a there is a correlation between all the parameters used. The results of CCA analysis showed a correlation between all the parameters used with eigenvalues value axis 1 (0.48); axis 2 (0.26), r axis 1 (1.00); axis 2 (0.98), and 84.9% cumulative variance. Besides PT0, PT1 and PT2, the study also taken the data PT3 which is a plot of soil sampling were not eroded by crown cover of 90% is used to compare the number of *Collembola* and Acari with eroded plots.

Parameter data supporting this study include rainfall ranging between 6.37 to 47.77 mm, soil moisture between 90-100%, ≤45o land slope, soil temperature between 25-30oC, soil pH between 5.7-6,5. The texture of the soil samples in this study manifold dusty clay with sand percentage of 4.22%, 51.31% of dust and clay 44.56%. Porosity of the soil all the same samples is 50.75%. PT0 and organic carbon content of 1.47%; 2.53%, 1.92% PT1; 3.31% and 2.02% PT2; 3.48%, and the plot is not eroded (PT3) of 2.47%; 4.25%. The existence of soil organic matter is very important in determining soil fertility. Fertile soil provides sufficient energy source for plants and soil organisms. Land conditions in open and closed affecting nutrients in the soil.

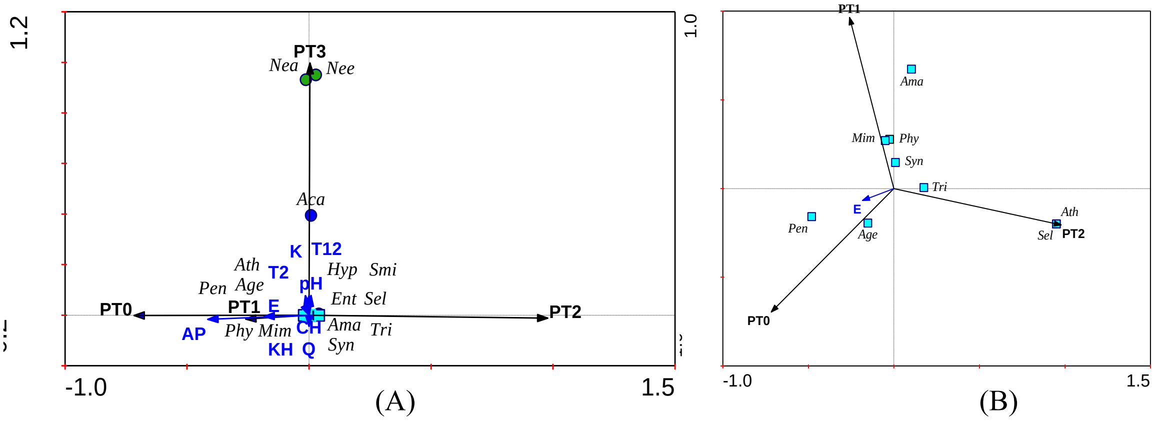

Figure 2. Biplot CCA a) Linking Environmental Factors (Closing Headers, Rainfall, Erosion, Flow Surface, Soil Temperature, Humidity, Soil pH) and Vegetation Plant Down, Community *Collembola* and Acari, b) between the Closing Title, Vegetation Plant bottom, and erosion at the Closing Heading Different

Value greatest erosion and runoff contained in PT0. *Collembola* Composition showed no difference between the three plots erosion. However, when compared with PT3, familia Neelidae, Neanuridae, and Acari more numerous in the PT3. In addition, under the komposisis vegetation also showed no difference from the three plots were observed. Plants on the third plot is Pennisetum purpureum erosion, Selaginella doederleinii, Amaranthus spinosus, Synedrella nodiflora, Tridax procumbens, Ageratum conyzoides, Phyllanthus niruri, Mimosa pudica, and Athyrium esculentum (Figure 2b). Under the existence of vegetation is one of the variables used in this study. The function of vegetation in pine stands can reduce the amount of erosion.

However, if only to compare erosion and undergrowth on all three plots, it appears that a greater erosion occurs in PT0 by the number of plant species under as many as 6 different types of plants followed by the dominance of P. purpureum and A. conyzoides with a number of important value index P. purpureum 58, A. conyzoides 20% and 39.05%. The highest vegetation type bottom on PT1 namely A. spinous with a number of important value index of 46.40%, while the highest type of vegetation on PT2 is S. doederleinii with an index number of important value of 40.34%.

The test results of multiple regression analysis between precipitation, runoff, and erosion provide erosion function as follows.

$$Y = 19.36 - 9{,}79X1 + 1{,}25X2,$$

X1 is rainfall, and X2 is a runoff. Values of rainfall and runoff greatly affect how much erosion will occur surface ($r = 0.5$ and $r\ 2 = 0.25$).

The result of the calculation of the relationship between vegetation below, erosion, abundance of *Collembola* and Acari in the pine forests with different canopy closure has an influence on the attrition rate value for the existence of plant vegetation in stands of pine. This is one of landslide disaster mitigation efforts that can be done in areas that have a high degree of slope. The role of vegetation to maintain the stability of the slope seen from the vegetation canopy and roots have an important role in preventing or eliminating the landslide. Vegetation with wide distribution, with a diverse structure and composition is expected to provide great benefits for human life, among others as controlling land landslides. On the other hand, the choice of plants is no less important in the success of the landslide control engineering vegetative land. In addition to the role of vegetation based on the three crops (trees) and Zone Potential landslide, selection is also based on a height where the plants grow from sea level (elevation). Elevation is an ecological range to grow crops where there are plants that have narrow ecological range and width (Riyanto, 2016).

4. Conclusion

Based on the analysis and discussion can be concluded that:

1. Pine tree crown cover showed a significant difference and the strong correlation of the structure below the vegetation, erosion and *Collembola* community.
2. The erosion rate has a weak positive correlation to the composition of *Collembola*.
3. Role undergrowth vegetation structure has a crucial link in a decrease in the rate of erosion. This is one way to mitigate landslides in areas with steep slopes.

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The Importance of Disaster Mitigation Education for Early Childhood to Reducing Impacts of Disasters

Muhammad Eric F R [1], Vania K F Navalina [2] and Wildan Akbar H R [3]

[1]Indonesia Defense University (Peace and Conflict Resolution), Indonesia Peace Security Center, Bogor 16810, Indonesia
[2] Indonesia Defense University (Peace and Conflict Resolution), Indonesia Peace Security Center, Bogor 16810, Indonesia
[3]Indonesia Defense University (Peace and Conflict Resolution), Indonesia Peace Security Center, Bogor 16810, Indonesia

E-mail: eric.fazlur@gmail.com

Abstract. This research is based on Indonesia as a red zone country due to its geographic location vulnerability in the Pasific's Ring of Fire. In that condition, the people of Indonesia are still ignorant with danger and impact of disaster. Prevention and education of disaster still appear unthinkable. The purpose of this research is to educate and develop the awareness of the people towards disaster mitigation by reaching complete comprehension. The main object is the mitigation education for children in their basic survival due to its enormous impact related to main survival while disaster occurs. Myth and Folklore are our local wisdom and apply as a media to educate. We can analyze Japan as an example due to its similiar geographic location. This qualitative descriptive reasearch is based on fact and observation with literation as adjunct. The results of this research are expected to obtain insights to the goverment in establishing efficient policy related to disaster mitigation in advance, both in prevention and additioning lesson in school.

1. Introduction

It is time for Indonesia to seriously think about the problem of education and the development of disaster mitigation technology and training to deal with earthquakes. Therefore, seeing Japan as a role model is necessary. Indonesia and Japan are both located in the red area. Both stand in the Pacific Ring of Fire zone, which is the location of 90 percent of the earthquakes in the world.

According to the United States Geological Survey (USGS), Indonesia which is in a very active seismic zone is the country with the highest frequency of earthquakes in the world. Indonesia appears only inferior to Japan if compared to the land area that often produces earthquakes. Because of the large territory of Indonesia, not all earthquakes have a direct impact or can be felt on land. Approximately 1,500 earthquakes hit Sakura this year. Being along the Pacific Ring of Fire zone, the lan of Japan becomes unstable. The expanse of the Ring of Fire of

Japan is a meeting place for four thrusting plates, namely North America, the Pacific, Eurasia and the Philippines. Small tremors occur almost every day.

Aware of the destructive effects of the earthquake, Japan immediately conducted a large-scale evaluation. There is no technology that can stop the shifting of the earth's plate but technology can still be maximized to carry out early warning functions, so that disaster risk can be reduced. Reporting from The Telegraph, a generation of Japanese children after the Kobe earthquake in 1995 was familiar with earthquake disaster mitigation exercises. When the warning alarm activates, it is imperative that the children at the school search for shelter under the table to protect themselves from the debris of goods and building materials.

The exercise is simulated every month. If they are outdoors, they are taught to immediately run to an open space to avoid debris from buildings and other city facilities. The Japanese fire department also possesses an earthquake simulation tool. The goal is to familiarize school children to experience the earthquake sensation so that they are more sensitive to taking steps to save themselves. There are also rules that require schools with two floors or more equipped with evacuation routes that can be used by children to go to a safe place. Schools can also be an emergency shelter when students' homes are damaged by the earthquake. This earthquake mitigation program in Japan produced a great level of tranquility among children and adults every time the earth began to vibrate.

Tsunami mitigation is as structured as earthquake mitigation. In Japan, school children are taught how to organize themselves when a tsunami warning signal activates. Older students also help the younger ones to higher ground to avoid waves. Reporting from Japan Times, Toshitaka Katada, professor of civil engineering at Gunma University who oversees the disaster education program in Kamakura, said that repeated training when there is no disaster has successfully made students act quickly and orderly in an emergency situation. In Addition, children are taught not to rely on locations that are merely mapped, considering disasters can come from outside the predicted location.

The value of helping each other is also taught in disaster mitigation education,. Children are prioritized during the evacuation process, so that they can transfer knowledge to those around them if the disaster returns. According to Katada, this habit eventually spread and managed to save many lives. In Indonesia, this must be regulated in a standard protocol in order to start disaster mitigation education for early childhood. This is because at an early age, the child's brain development system is still in its infancy and has an easy memory system. In order to keep minimum casualty in the future, the comprehension of survival from disasters is the fundamental phase that must be taught and implemented into the national goals of Indonesia as based in the opening of the UUD.

Indonesia has a way to survive from disaster by reviewing products of literature, namely legends, fairy tales, and poems. This was developed during the tsunami in Simeulue Island, Aceh. The community there has a fairy tale or poem called "*Smong*" and is told down from generations to generations to run to the mountain when seeing low tides in the ocean. This was implemented by the people of Simeulue Island during the tsunami, having the least number of victims compared to other regions.

2. From Lingustic Prespective

Simuelue, one of the regions in Indonesia, possesses a traditional piece of literature that has been proven to save thousands of lives from the devastation of tsunami back in November 2004. The literature that has been preserved is called *smong*. Based on the tsunami devastation occurring in Simuelue back in 1907, the people since then has increased their tsunami alert system amplified into a hundred. Smog appears as a legendary local song about how pivotal and prominent it is to flee towards the mountain when an earthquake occurs. Despite the tsunami resulting in thousands of casualties around Aceh, Simuelue only had six. This local song appears as their salvation and also as a product of their local wisdom.

One important question pertaining to language maintenance is what measures should be taken to revitalize or revive interest in small endangered languages (Kaswanti Purwo, 2009). This proves of how fruitful and important the essence of endangered languages or can be defined as local languages in Indonesia towards the safety and self-awareness of Tsunami appearance in advance. This also proves of how Semantic expressions impact the people in believing the true meaning of the local song.. Semantic is the study of meaning of the word purely on the conceptual level. Linguistic semantics is the studies of languages organizes and expresses languages (Adisutrino Wagiman, 2008).

The whole understanding of languages are based upon the umbrella of semantics. Pragmatics is generally about how to ascend messages and expressions throughout the second speaker or hearer with different ways. The general study of how context influences the way we interpret sentences is called pragmatic. The theory of speech acts is part of pragmatics, and pragmatics itself is part of what we have been calling linguistic performance. They are just what they are, and we learn them naturally as we learn our own native language.

Indonesia is famous by its genuinely colourful cultures with the precious values of local wisdom. The wisdom has been passed through by generations to generations. The local wisdom in Asia has its philosophy for the society and possesses local knowledge where it can be understood as local ideas or perception. These perceptions are thoughtful, full of wisdom, valued and kept safe by its predecessors. In the aspect of anthropology, local wisdom is also a local knowledge or local genius that is used as a fundamental cultural identity. The core values of local cultural policies can be applied as guidance in how to live. This type of understanding has transformed into a local rule in living. Indonesia, as a part of Asia, has values underlying such wisdom produced and generated from almost thousands of years ago.

The local wisdom of Simuelue is produced as a legacy from the ancestors long before the construction of nations. The *smong* is told to generations by generations together with cultural forklore, art performances, and literatures (Ayat S Karokaro, 2014). The existence of *smong* successfully created a semantic understanding of how urgent it is to establish an escape route towards higher ground. It is also emphasized that the men who are warned by the word *smong* must prioritize children, senior citizens, females and siblings towards safety before their own selves. The lyric of *smong* greatly selects strong semantics in order to amplify self-awareness. *Smong* appears in the beginning of the song

"listen to a story long time ago, there was a village that sunk to the ocean, that is how it was told. It started with an earthquake, followed by a gigantic wave, so it sank the whole country, …."

The chosen words displayed at the first sentence of the song appear to be strong and factual. This is to directly generate fear and self-awareness towards the people of Simuelue. The semantic essence that appears in the song is deliberately expressed by design, in a rather focused and specific pattern intended only for the people who understand the melodic local wisdom.

There are also several other examples of this life saving phenomenon towards survival in earthquakes scenarios. One of them is the oarfish mythology all over the world. The myth includes the basic knowledge of the fish which live a thousand meters under the ocean. Whenever an oarfish surfaces the ocean, it holds a strong belief that the inner layer of the sea bottom experiences a transformation. Therefore, this is believed that an earthquake occurs after the they surface the ocean. An oarfish is a legendary fish with a length of 11 meters. Based on the earthquake occurrence in Japan on March 11th 2011, a school of oarfish was detected near the shore and this appeared as an ultimate sign of an upcoming earthquake. This local belief saved thousands of lives. The fact that the oarfish appears as a legendary tale of disaster which immediately brings caution towards the people of japan prominently increases the alert system of the region and country towards the disaster occurring on March 11.

Such simple tale that is brought from ancestors saved hundreds of families and chances of survival. It can be seen that such tale or old story must be respected through generations in order to maximize the survival rate in any upcoming disasters. All sectors in education, defense, and government must collaborate in achieving the safety of its people. One of those efforts is to amplify the awareness of any disaster signs, symptoms, and precautions. Therefore, in order to establish a better opportunity in the future to survive next waves of tsunami, the existence of local wisdom is definitely not something to be ignored easily.

3. Cognitive Development of Children and Disaster Mitigation Education

Figures In relation to the future and progress of a nation, early childhood is an important asset that must be applied by educational needs in all aspects, especially in terms of education about disasters. generally, Indonesia is in a geographical condition that is prone to disasters, such as earthquakes and tsunamis. Children, in addition to disabled people, the elderly and pregnant women, are invitable victims and often neglected in the evacuation process. Those who survived experience disruption in the process of psychological development and social health. This should be prevented by early education about disaster preparedness and the ability of independent survival.

Early childhood is in the golden age. It is called the golden age because of its rapid physical and psychological development, ranging from the growth of brain cells to the development of gross motor skills such as walking, running, jumping, and fine motor skills such as grasping, writing, reaching, and so on. Santrock states that early childhood development includes aspects of physical, cognitive, social-emotional development, social context, moral, language, self-identity, and gender (John W Satrock, 2011). Whereas Piaget, in the theory of children's cognitive development explains that children's thinking ability consists of four stages, namely sensory-motoric, pre-operational, concrete operational, to develop into formal operations (John W Satrock, 1995).

The sensory-motoric stage lasts from the child born into the age of two. At this stage, the child builds an understanding of the world by developing his or her sensory experiences through physical actions such as seeing and hearing. On the other hand, the pre-operational stage is in the age range of 2-7 years. At this stage, children begin to use language and represent objects with stories and words, but children still have egocentric thoughts that produce difficulty in comprehending the perspective of others. Next is the concrete operational stage which is in the age range of 7-11 years, in which children can think logically about objects and events. The last formal operational stage that lasts from the age of 11 and above, the child has reached logical thinking about abstracts so that they can test hypotheses systematically.

We can identify that mitigation or education about disasters can be started since in the pre-operational stage of a child, because at that stage the child has begun to interact with people and learn to think critically. The focus of the child is still in the playing stage and imitating sensory actions, such as playing role-plays. That way, disaster education can be included through fun games or exciting disaster simulations for children. Due to the lack of memory capability at this stage, their attention is easily switched into newest objects and passions, so the process of habituation in education becomes important. In this condition they need to be accustomed to certain behaviors, skills, talents and mindsets.

The age of basic education (the age of 7 to 11) according to Piaget is a group of children with a level of cognition in solid operational stages. In this stage, the child is best given education about disasters because children are considered capable of understanding disaster that is quite complex starting from the understanding of disasters and causes of disasters to what is done during a disaster. Children at this age also begin to think logically and organized for an event (Kendra Cherry, 2019), so they can begin to imagine how to respond to a disaster through real simulations.

Disaster education in early childhood is expected to reduce disaster risk and contribute to individual and community preparedness towards disasters, so a safe culture and form a resilient community can be established (Suharwoto, 2015). Disaster mitigation in the form of early childhood education can be done at the level of education in schools in the form of adding curricula regarding disasters in subjects or continuous basic simulation training. The step is based on the aim of early education which is a long-term activity and part of sustainable development.

4. Legal Reference for the Introduction of Disaster Mitigation Education by the Government

The objective of the Indonesian State is stated in the opening of the 1945 Constitution in paragraph 4 which is the goal of the Indonesian state, namely to protect the entire Indonesian nation and all of Indonesia's sovereignty, promote public welfare, educate the nation's life, and participate in carrying out world order.

Protecting all Indonesian people and sovereignty also means to identify domestic and foreign threats. One of the types of domestic threat is natural disasters. Indonesia is not unprepared in the face of disasters, as evidenced by the establishment of Law No. 24 of 2007 concerning Disaster Management to reduce disaster risk.

The types of disasters according to Law No. 24 of 2007 concerning Disaster Management, can be in the form of natural disasters, non-natural disasters, and social disasters. Disasters caused by events or a series of events caused by nature include earthquakes, tsunamis, volcanic eruptions, floods, droughts, hurricanes, and direct land. Non-natural disasters include human-caused forest fires, transportation accidents, construction failures, industrial impacts, nuclear explosions, environmental pollution and space activities. Social disasters include social unrest and social conflicts in the community that often occur.

Furthermore, according to the level of danger, disasters can be categorized into three levels, namely hazardous, disastrous, and catastrophic (Edward A. Keller, 2006). It is said hazardous if the disaster process is only a threat to mankind, such as earthquakes, floods, landslides, volcanic eruptions, storms, but not or have not caused casualties. If it has taken a lot of casualties and property then it is referred to as a disaster, and if it is worse than the prior, for example resulting in the destruction of the building and the source of life and the number of human casualties covering a large area, it can be identified as a catastrophic level. Therefore, the tsunami in Aceh, the Yogyakarta Earthquake, and the Fukushima Tsunami are more accurately identified as a catastrophic level.

Disaster Risk Reduction (DRR) must be implemented if a disaster occurs in advance. Efforts to reduce risk are disaster mitigation measures. The Republic of Indonesia Law Number 24 of 2007 concerning Disaster Management has caused a very basic paradigm change in disaster management.

Disaster management activities are carried out through the establishment of development policies that are at risk of disasters, disaster prevention activities, emergency response and rehabilitation. Development is carried out in line with efforts to reduce disaster risk. An important component of disaster management is mitigation. Article 1 number 9 of Act No. 24 of 2007 concerning Disaster Management defines mitigation as a series of efforts to reduce disaster risk, both through physical development and awareness and capacity building in the face of disaster threats. Disasters that often occur in Indonesia need the support of various parties, from the government, society, and non-governmental organizations (NGOs) in an effort to reduce disaster risk.

By the fact that Indonesia is prone to disasters and the government's responsibility to protect its people, education on disaster mitigation should start early. Children must begin to be introduced to how to independently survive when a disaster strikes. Actions such as taking shelter under a table during an earthquake, running to an evacuation point or to an open space, are fundamental reflexes of self-defense that should be taught early. Matters related to disaster management can then be carried out quickly and are useful to reduce the risk of the disaster itself. Inevitably, the problem of disasters is not only a problem for the government, but also ours.

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Forecasting of CO2 Emissions from Energy – Environment in Blending Biodiesel Regulacy using Modified Fuzzy Density Approach

Wisnu Ramadhan[1,2], Danur Lambang Pristiandaru[1], and Yanif Dwi Kuntjoro[1]

[1] Energy Security Master Program, Indonesian Defense University, IPSC Sentul Bogor 16810, Indonesia
[2] Departement of Mathematics, Diponegoro University, Prof Sudarto Street Tembalang Semarang, Indonesia

wisnurama7@gmail.com

Abstract. Energy security is a condition of energy availability, public access to energy at an affordable price in the long run while paying attention to the protection of the environment called the Quantiple Helix Model. Indonesia is still very dependent on fossil energy, especially petroleum. The way to reduce dependence is by developing EBT one of them is biodiesel. Through ESDM Permen No. 12 of 2015, the biodiesel mandatory policy accelerated from B-10 (Biodiesel 10% + Solar 90%) in 2014, increased to B-20 in 2016, even B-30 began in 2020 so that early on prepared a variety of policies needed in the provision biodiesel or related to changes in energy consumption. Indonesia develops biodiesel dominated by palm oil (CPO) commodities. In some countries bioenergy development is a trigger for environmental damage. The expansion of land through logging activities (deforestation) has an influence on biodiversity (biodiversity), as well as an increase in the effects of greenhouse gases which cause an increase in the earth's surface temperature. This study aims to analyze the demand for biodiesel demand due to the mandatory policy and analyze the impact of the implementation of mandatory policies on the needs of plantation land and its impact on the level of CO2 emissions. Existing problems are brought into the fuzzy linguistic model. Projection analysis is carried out through the construction of a fuzzy forecasting model by modifying the fuzzy time series method. The results of the projection of the implementation of the mandatory policy show that the demand for biodiesel has a monotonous trend going up, the level of land use experiences a linear trend rising slowly, and the level of CO2 emissions has decreased but not significantly. Mandatory policy analysis results show that B-30 policy alternatives are the best choice of the level of solar dependence, land expansion and the level of CO2 emissions produced.

Keywords: Biodiesel, CO2 Emissions, Fuzzy, Land Area, Mandatory Policy

1. Introduction

The level of energy security in Indonesia according to [1], [2] is said to be good but in fact there are still problems with Indonesia's energy security, namely the matter of fossil energy dependence, especially the need for fuel oil. Indonesia's Energy Mix in 2016 the portion of petroleum still dominated with 33.19%. [3]. Petroleum production in Indonesia since 1995 has continued to decline from 1.6 million barrels / day to only 786 thousand barrels / day in 2015 coupled with no discovery of new reserves in the last 6 years. The highest type of petroleum used in Indonesia is solar. While the consumption of petroleum according to the user sector is dominated by the transportation sector [4].

The use of EBT energy in this case non-fossil energy is believed to be the right solution in overcoming the problem of reserves and availability of fossil energy. Presidential Regulation No. 22 of 2017 concerning the General Plan for National Energy (RUEN) is to prioritize the use of EBT in 2025 at least 23% and in 2050 a minimum of 31% of the total national energy mix and reduce the portion of petroleum to a maximum of 25% in 2025 and 20% in 2050 [5]. One of the uses of non-fossil energy in meeting fuel needs is by using bioenergy.

The Indonesian government is serious in managing bioenergy, this seriousness is demonstrated by the issuance of Minister of Energy and Mineral Resources Regulation No. 25 of 2013 in the regulation there was an increase in the portion of utilization of biofuels (BBN) in fulfilling 10% fuel oil (BBM) in biodiesel fuel in the form of blending (mixing biodiesel with diesel fuel called biosolar) had a positive impact on the national economy [6]. Based on data from the Directorate of ESDM Bioenergy, in 2013 the implementation of B10 policy, was able to save foreign exchange (especially from biodiesel utilization) of US $ 831 Million [7]. In 2014, the government revised the previous regulation, through Minister of Energy and Mineral Resources Regulation No. 12 of 2015, the mandatory biodiesel policy accelerated from B-10 in 2014, to B-15 in 2015 and increased to B-20 in the coming year. [8]. With the implementation of this policy, the government economically expects a savings of US $ 3 billion [9].

Indonesia develops biodiesel made from vegetable oils which are dominated by palm oil commodities because palm oil commodities have great potential in terms of land area and productivity. In 2015, the area of oil palm plantations nationwide reached 11.3 million hectares, up about 25% from the previous five years. An area of 6 million hectares of oil palm plantations is large-scale private plantations, 4.6 million hectares of smallholder plantations and the remaining 0.7 million hectares in the form of large oil palm plantations belonging to state companies [10]. National production of crude palm oil (CPO) in 2010 amounted to 22 million tons, and increased to 31.1 million tons in 2015 [11]. About 75% of total CPO production was exported, generating Rp275 trillion in contributions to national income. in 2014 [12]. Oil palm exports accounted for around 29.5% of industrial product exports, or 4.9% of total exports in 2016 [13].

The main objective of Indonesian CPO exports is the European Union (EU). But exports have declined since 2014 after the European Union imposed anti-dumping in November 2013 [14]. In addition to the European Union, in October 2017 the United States government also imposed anti-dumping on biodiesel produced by Indonesia [15]. The reason is that Indonesia's biodiesel prices are considered to be cheaper than world prices because biodiesel in Indonesia receives subsidies and concerns about global environmental impacts [15]

Some of the positive impacts of bioenergy utilization on palm oil agroindustry include increasing production, consumption and prices of palm oil (CPO). However, efforts to develop bioenergy through the use of potential agricultural commodities have the potential to decrease value (depletion) from other natural resources which must also be calculated. Land expansion through deforestation activities has an effect on biodiversity (biodiversity), loss of content of organic matter in the soil as well as an increase in the effect of greenhouse gases which results in increased surface temperature of the earth [18]. These environmental impacts not only affect a country, but will have a global impact such as global warming caused by increasing greenhouse gas emissions in the atmosphere. The use of fuel (fuel use) accounts for the largest greenhouse gas emissions in the world in 2017, namely in the form of carbon dioxide (CO2) emissions from the energy sector by 72% [19].

Policy alternatives in the development and management of biodiesel energy resources can be planned as a whole but there are flexibility for uncertainty due to vague information and subjective preference elements used in evaluating existing factors. Existing problems will be brought into the fuzzy linguistic model [20]. The advantage of this model is that the error generated from forecasting is smaller than other existing methods. Classic forecasting is only limited to linear, exponential, seasonal and other patterned data, if used on fluctuating data it will produce a large error [22]. In fact most real estate data is high fluctuating data

2. Problem Statement and Research Goals

2.1 Problem Statement

Indonesia has the potential for the availability of raw materials, especially palm oil, which is high enough to be developed into biodiesel products, but the condition of the biodiesel industry in Indonesia is currently not optimal. There is a considerable disparity between production capacity and real production utilized which can be a challenge for the development of the national biodiesel industry going forward. In terms of CPO production, the use of palm oil as the main raw material for biodiesel should still be fulfilled. Nevertheless, there are a number of challenges that hinder the development of biodiesel in Indonesia.

Biodiesel production does not grow consistently because the existing policy framework is in opposition. The government encourages the use of biodiesel as a renewable energy source on the other hand the government provides subsidies for fossil-based fuel products, plus the challenge of an anti-dumping policy from the EU and America making CPO exports experience a downward trend.

Biodiesel in addition to having potential economic value, of course, must pay attention to its environmental and social values. The use of palm oil as biodiesel will directly increase the occurrence of land expansion. Land expansion through deforestation activities has an effect on biodiversity. Environmental sustainability is one of the negative impacts caused by this mandatory policy. The evaluation of the previous policy, namely the Indonesian Minister of Energy and Mineral Resources Regulation No. 25 of 2013 also resulted in the planned utilization of the planned biodiesel. Complex problems are not effective enough to be solved by classical methods, it is necessary to do fuzzy inference or change the problem into a fuzzy linguistic form.

2.2 Research Goals

Based on the problems described above, the general objective of the research is to analyze the mandatory policy of biodiesel according to Indonesian Minister of Energy and Mineral Resources Regulation No. 12 of 2015 in the target of developing palm oil biodiesel (CPO). The specific objectives of the study include. (a) Estimating the demand for palm oil (CPO) biodiesel for domestic use in Indonesia with the modified Fuzzy Time Series method, (b) Formulating and estimating the impact of oil palm land requirements and CO2 emissions resulting from the mandatory policy of blending, (c) Analyze the mandatory biodiesel blending policy that has been set by the government, (d) Formulate appropriate alternatives in encouraging the development of palm oil (CPO) based biodiesel in Indonesia.

3. Methodology

This research is a case study and literature review carried out in the territory of Indonesia. Data retrieval is done by literature studies related to institutions that have secondary data needed in this study. Data collection is conducted from September to October 2018

This research requires data in the form of monthly time series data, namely January 2017 - September 2018. Secondary data needed are data on prices and amount of absorption of biodiesel from CPO in Indonesia, Indonesian diesel prices, oil palm area and emission levels from the energy sector. These data are obtained from relevant agencies, namely the Ministry of Energy and Mineral Resources of the Director General of EBTKE, and the Central Statistics Agency, as well as the USDA and APROBI websites.

The data obtained are then analyzed in a mix of qualitative and quantitative methods. Projections use fuzzy time series calculations and approaches. Biodiesel demand data is approached using biodiesel absorption data in Indonesia.

Qualitative data refer to the Executive Summary data Focus Group Discussion (FGD) on the Policy of Increasing the CPO Portion of Biodiesel by IRESS in 2017 which was then analyzed descriptively

4. Results and Discussion

4.1 Data Pattern Identification

The purpose of making a graph of biodiesel demand in Indonesia over time is to look at the patterns in available time series data. Based on the pattern of biodiesel demand in Indonesia, it can be seen by the diversity of fluctuations in the pattern of biodiesel demand in the selection of quantitative forecasting methods in the next processing stage.

4.2 Modified Fuzzy Time Series with Density Approach Algorithm

Fuzzy forecasting steps with intervals according to modification [23] fuzzy metric method fuzzy time series with average-based fuzzy time series using symmetrical triangle membership functions:

1. Step 1 Define the universe *U*
2. Step 2 Determine fuzzy linguistics
   Determine the fuzzy linguistic set (A_i) based on *U* speaking universe which has been divided again and fuzzy the discrete data.
3. Step 3 Divide into sub-intervals
   Re-division of the base base interval according to each frequency.
4. Step 4 Fuzzyfy according to fuzzy triangle rules (t-norm)
   Fuzzyfication of each discrete data with a triangle rule and find the value of its membership
5. Step 5 Establish FLR and build FLRG
   Set FLR and build FLRG from fuzzy rules (linguistic fuzzy) fuzzy logic relationships (FLR) defined by $A_i, A_j, A_k \rightarrow A_j$
6. Step 6 Defuzzyfication
   Use the centroid method to get crips
7. Step 7 Measure the suitability of forecasting
   Calculate MSE and AFER then analyze AFER results

4. 3 Numerical Simulation

Table 1 - Monthly data on domestic biodiesel demand

Years	Month	Demand (kL)	Years	Month	Demand (kL)
	January	381388		January	250489
	February	291002		February	221579
	March	360131		March	276189
	April	233169		April	325856
	May	199038		May	344068
2017	June	178012	2018	June	217844
	July	240199		July	301009
	August	249810		August	333385
	September	279134		September	462479
	October	258913		October	-
	November	279103		November	-
	December	257910		December	-

From table 1, the value of $Xmin = 178012$ and the value of $Xmax = 462479$. The range of the data above is defined as

$$J = |Xmax - Xmin|$$

found $J = 284467$

Formation of the universe set of maximum and minimum values defined

$$U = [Xmin - D1, Xmax + D2]$$

with selected $D1 = 12$ and $D2 = 521$so that the universe set is $U = [178000, 463000]$.

The average absolute value is the absolute difference from the month *i* and *i + 1* data divided by *n*-months, symbolized by $|X_i|$. From the above data obtained

$$|X_i| = 51701,95$$

Determination of the number of intervals is defined as follows

$$I = \frac{J}{Basis}$$

where Base is rounding $\frac{|X_i|}{2}$ [23]. Obtained $I = 9,482$ which means there are 9 sub-intervals.

From the sub-intervals, then the frequency of each sub-sub interval will be searched for to find the degree of membership.

Suppose that in sub interval $U_1 = [17800, 193834]$ with the middle value 185917, a fuzzy triangle rule is formed.

$$\mu(x) = \begin{cases} \dfrac{x - 17800}{185917 - 17800} \; for\ 17800 \leq x < 185917 \\ \dfrac{193834 - x}{193834 - 185917} \; for\ x\ 185917 \leq x \leq 193834 \\ 0\ for\ other\ x \end{cases}$$

in the same way for each Ai with $i = 1,2,..15$
where *ai* is the middle value of Ai linguistics

The final step with trend prediction testing in the centroid method [22] is represented as follows:

$$Fi = \begin{cases} \dfrac{1,5}{\dfrac{0,5}{ai-1} + \dfrac{1}{ai}} \; for\, i = 1 \\ \dfrac{2}{\dfrac{0,5}{ai-1} + \dfrac{1}{ai} + \dfrac{0,5}{ai+1}} \; for\; 2 \leq i \leq n-2 \\ \dfrac{1,5}{\dfrac{1}{ai} + \dfrac{10,5}{ai+1}} \; for\, i = n \end{cases}$$

Furthermore, with the linguistic association, FLRG was formed

$$Ai = \begin{cases} Ai - 1 \\ Ai \\ Ai + 1 \end{cases}$$

The error results using MSE and AFER are defined as:

$$AFER = \frac{\dfrac{|Xi - Fi|}{Xi}}{n} \times 100\%$$

from the calculation of the AFER value obtained

$$\overline{AFER} = 0{,}1137\%$$

where $\overline{AFER} < 10\%$ the projected demand for biodiesel has very good criteria because the resulting error is low compared to other methods [23].
and

$$MSE = \sum_{i=1}^{n} \frac{(Xi - Fi)^2}{n} = 123450306$$

From the numerical simulation we plots the graph result :

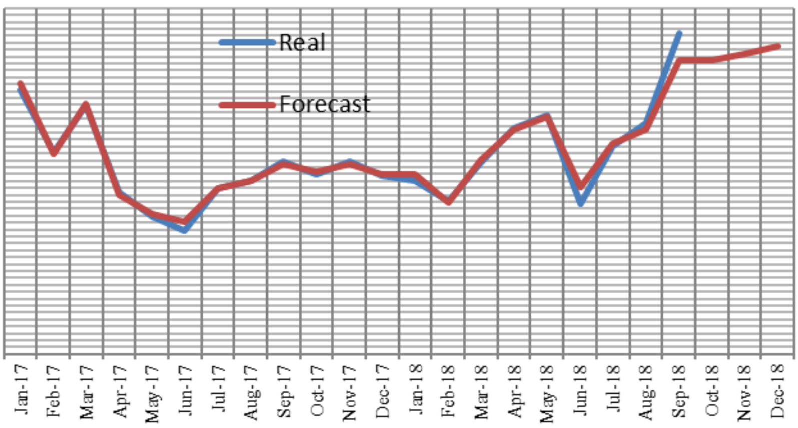
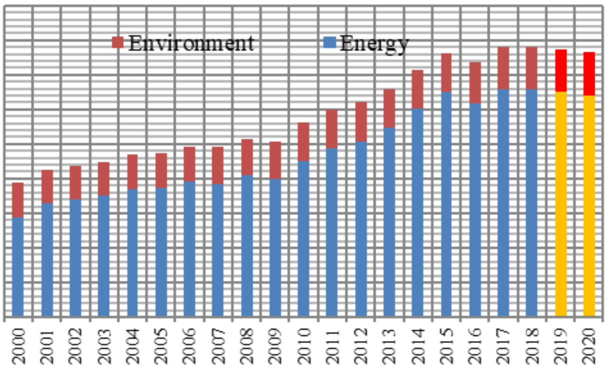


Figure 2 – Total Graph and Fuzzy Forecast Approach

From the graph (Figure 2) the comparison of the real number and the forecast of biodiesel demand is obtained a prediction that tends to be monotonically up.

In the same way for the projected CO2 Emissions beetween Energy and Environment as follows:



5. Conclusions

Based on the projection results with the fuzzy inference approach above with modified fuzzy LTM algorithms, biodiesel demand will tend to increase due to B20 policy setting, the number of oil palm land in Indonesia will also increase but based on FGD President Jokowi will establish a Palm Oil Moratorium policy in Indonesia, and for GHG emissions generated from the energy sector will decrease as the use of B20 is more environmentally friendly, but from the environmental sector itself will slowly rise even though not significantly due to reduced land and plants as CO2 absorbers.

We estimate that the situation of "*turn around*" will occur in 2019 along with the government's commitment to continue to boost domestic CPO consumption through the B20 scheme. Meanwhile, CPO prices will strengthen again due to the limited amount of inventories accompanied by a consistent increase in demand for palm oil.

In general, for the implementation of B30 policy there is an increase in the need for diesel fuel in this case, meaning that the demand for biodiesel is 6.5% with the total demand in 2020 amounting to 34.56 million kl. In an effort to achieve the biodiesel production target by 2020, an area of 15.2 million ha of oil palm plantations will be needed.

6. Acknowledgements

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Strengthening Women in Facing the Threat of Post-Disaster Conflict

Nailuttaris Indriane[1], Ira Guslina Sufa[2] and I Gede Sumertha KY[3]

[1]Peace and Conflict Resolution Studies, Indonesia Defense University, Bogor, Indonesia
[2]Peace and Conflict Resolution Studies, Indonesia Defense University, Bogor, Indonesia
[3]Peace and Conflict Resolution Studies, Indonesia Defense University, Bogor, Indonesia

E-mail: nellaindri999@gmail.com

Abstract. Indonesia as a nation that is located in a disaster-prone area has an environmental threat. This threat needs a serious attention. Preparation of human resource capacity is needed to reduce the impact of disaster risk. The tsunami disaster that occurred in Banten, West Java brought a huge damage to infrastructure and psychological damage to individuals. In addition, the large amount of logistical assistance that goes in without good managing distribution raises the threat of social conflict among refugee residents. Women as vulnerable groups need to be involved in education and training throughout the disaster management cycle starting from prevention, disaster mitigation until the rehabilitation process. In the peace and conflict resolution study, the threat of post-disaster conflict is seen by the approach of human needs compliance because of basic needs that have not been fulfilled. Through this research, the author analyzes how disasters and post-disaster recovery programs affect women's lives in social and economic activities. This paper aims to see the extent to which the involvement of female volunteers in strengthening faces disaster emergency situations and the threat of social conflict that occurred after the tsunami in Pandeglang, Banten, West Java.

1. Disaster and Woman, an Introduction

Indonesian country is experiencing a shift in threats at this time. From what was originally conventional or military to a non-military threat in various aspects of the state such as economics, social, political, cultural, and ecological. Along with the changing threats that occur, the security sector paradigm also undergoes a revolution. The revolution changed the scope of national security which was originally State-centered to the People-centered. In this paper, the author focuses on ecological or environmental threats. One threat originating from the environment is a disaster that threatens security in the perspective of human security of the Indonesian people (Wantanas, 2010)

In these two decades, Indonesia was hit by repeated natural disasters. BNPB’s data shows that at least disaster cases in Indonesia in 2017 reached 2,372 cases which are increasing every year. The vulnerability of this disaster is due to Indonesia's geographical conditions which besides being in the Ring of Fire region, it is also at the intersection of two great oceans, the Indian Ocean and the Pacific Ocean. According to data from the Ministry of National Development Planning (KPPN) and the Ministry of Women's Empowerment and Child Protection (KPPPA), there were 293 cases of natural disasters that have occurred in these two decades and have an impact on approximately 18 million people spread throughout Indonesia. The general disaster is earthquakes and tsunamis. (KPPN & KPPPA, 2011)

Recently, the tsunami of the Sunda Strait crashed the islands of Java and Sumatra caused by the eruption of Mount Anak Krakatau. On December 22, 2018, the coastal islands of Banten and Lampung were hit by two meter high waves. Based on BNPB data, the number of victims killed and lost due to the tsunami disaster in Pandeglang district was 304 people, while the injured victims were 7,656 people. Indeed, there are 28,139 people suffered and were displaced. Meanwhile, the house suffered severe damage amounts to 942 units, slightly damaged 70 units coupled with damage to public facilities such as electrical substations, dock and vehicle.

Anak Krakatau eruption caused damage to the closest seismographic equipment, but at other stations it detected continuous vibrations. The BMKG had detected a tsunami on the west coast of Banten even though there were no tectonic events. The BMKG issued a high-wave warning for the Sunda strait waters and was recorded in the BMKG twitter account, before finally being deleted a few hours later (Detiknews 23/12). Then finally BMKG verified that the tsunami did occur at around 21.30 WIB together with high wave conditions due to the full moon on December 21-25.

The author has experience by looking at post-tsunami locations in Pandeglang District, Banten, 3 days after the tsunami on December 26, 2018. There are three affected districts visited by the authors are Carita, Labuan and Sumur. Many house debris and infrastructure damage along the coast have not been cleared yet. Meanwhile, in the volunteer post there is a lot of logistic assistance such as clothes and instant noodles. Pandeglang Regent also stated that the assistance was sufficient for the next seven days. The assistance was stacked due to remote evacuation posts were located in the homes of mountain residents.

The issue of assistance is limited by distribution to refugee areas. This condition is more severe in Sumur Subdistrict, residents who have fled not only do not get help, they are even difficult to get it. This is because the bureaucracy to take help requires an identity card, while many of them lose their identity cards along with the transfer of their homes and property. The threat of social conflicts arising from disasters is something that must be taken into account.

Furthermore, KPPPA (2017) states that when disaster strikes, the number of female victims is relatively four times greater compared to the number of male victims. Why are women, because women as victims are more often trapped while doing household activities at home during a disaster. And disaster victims are usually those who are at home. Men in general are doing activities outside the home, so when the disaster comes, their chances of saving themselves are relatively bigger than women. (UNIFEM, 2005)

Following up on the distributed logistical assistance, the author made several visits to the disaster site. In addition, the author also conducted a program to handle psychological impacts in collaboration with non-governmental organizations (NGOs), volunteers and the local women's community. The impact of the tsunami in the form of physical damage was nothing compared to the psychological impact they experienced coupled with the conflict that occurred after the disaster. Women have a considerable role in the process of psychological handling and post-disaster conflict resolution. There is a paradox, because women in disaster emergency situations are classified as vulnerable groups that must be rescued in addition to children, the elderly and the disabled. But on the other hand, women are able to strengthen themselves and their surroundings to be tough.

Disasters have changed aspects of social and economic life, and the impact of post-tsunami recovery programs itself is felt by women. This study aims to present data qualitatively, the authors will analyze how disasters and post-disaster recovery programs affect women's lives in social and economic activities. This paper aims to see the extent to which the involvement of female volunteers in strengthening faces disaster emergency situations and the threat of social conflict that occurred after the tsunami that occurred in Pandeglang, Banten, West Java.

2. Disaster Management and Human Needs

Disasters have broad meanings. According to the Laws of number 24 of 2007, the definition of disaster is an event or series of events that threatens and disrupts the lives and livelihoods of people caused by natural factors or non-natural factors and human factors resulting in human casualties, environmental damage, property losses objects and psychological effects. While the impact of a disaster is measured based on the number of casualties, damage, or losses caused.

$$Risk = \frac{Hazard \times Vulnerability}{Kapasitas}$$

Disaster risk is determined by variables such as threats / hazards, vulnerabilities and capacities. Disaster risk can be estimated from these three variables. Disaster risk is the interaction between the level of vulnerability and danger that exists. From the variable formula above, it can be interpreted as follows: if a region wants to reduce disaster risk, it must increase the ability to deal with threats by reducing the level of vulnerability. Those who survived the disaster were called *Penyintas*, which means survivors.

Handling victims of disasters appropriately is important to minimize the number of victims due to delays in saving people, especially for vulnerable groups. Bastick, et. al. (2008) revealed that the increasingly diverse threat of disasters also requires the strength of defense in the form of skills and cooperation of civil society as a reserve component. Competency diversity of human resources as a composition of defense and gender mainstreaming in a variety of disaster management operations is able to make the defense sector to carry out tasks properly, including women.

Related to disaster management, the Law number 24 of 2007, states that the implementation of disaster management is a series of efforts which include the establishment of development policies that are at risk of disasters, disaster prevention activities, emergency response and rehabilitation. The formulation of disaster management from the Law contains two basic understandings, namely:

- Disaster management as a series or cycle.
- Disaster management starts from the establishment of development policies that are based on disaster risk and are followed by the stages of disaster prevention activities, emergency response and rehabilitation.

There are community groups that need special attention in handling the psychological impact of disasters. The group is a vulnerable group. The definition of a vurnerable group is implicitly stated in Law number 39 of 1999 concerning Human Rights in Article 5 paragraph 3. “Every person belonging to a vulnerable group has the right to receive more treatment and protection with regard to their specificity”. Then further mentioned in the explanation, what is meant by vulnerable groups is the elderly, children, the poor, pregnant women and people with disabilities.

BNPB's head regulation No. 13 of 2014 stated that gender responsive disaster risk assessment is carried out by taking into account traditional women's knowledge and perceptions. Women in disaster management need to be involved starting from a series of prevention, emergency response even to the rehabilitation process. So that the impact caused by the disaster can be reduced in number by intensive education and training not only for men but also for women.

Furthermore, if the disaster management cycle can be handled properly by people who have capacity in their fields, then unexpected conflicts will not occur. Conflicts occur due to differences in interests that cannot be resolved properly. Social conflict will always occur in interactions between humans. The triggers vary. In the context of this disaster, the post-disaster situation with the large amount of assistance that came in without good distribution management, the threat of conflict was very high.

Etymologically, conflict comes from the Latin "con" which means "together" and "fligere" which means "collision". As a social symptom, conflict always exists between individuals or between groups. This is related to social relations. All this is due to the desire of individuals or groups to fulfil basic needs and improve welfare, gain social support and appreciation.

To get conflict resolution, people must think to fulfil or satisfy basic human needs. Based on Abraham Maslow's theory (Richardson, 1997) about human needs, that humans have five sequences of basic needs as individuals. This sequence is represented by a triangle with a hierarchical system. When someone has fulfilled satisfaction at a certain level, it will be able to continue to the needs of the level above. From the hierarchy of needs, the first level of the triangle is located at the bottom, namely *physiological needs*. These needs include food, drinks, toilets, beds, adequate housing, and health care. At the second level, one level above mentioned the need for security (*safety needs*). Then proceed to the third level, namely the need for love and belonging (*love-belonging needs*). At the fourth level is the need for recognition (*esteem needs*). And the top level is the need for actualization or development of self-potential (*self-actualization*).

If basic human needs have not been met, then someone will impose in all kinds of ways to fulfil them. In an emergency situation after a disaster, the main need is food. The logistical assistance that is expected to be quickly distributed then hampered is what causes the conflict. As humans who want to fulfil their basic needs, conflicts are created automatically to get their importance.

3. Results and Discussion

One community group that needs special attention is women and children. Children need more attention because they do not yet have the ability to articulate their feelings. While women need psychological support post-disaster. In the event of a disaster, the roles of women and men can quickly change. Women as survivors, learn lessons from problems faced after destruction. Women, who lost their husbands, inevitably had to replace the role of men to make a living to support their families. Here the role of women is doubled because they have to do the work of women as well as men. Protection and reinforcement that is usually done by a father must also be handled by a woman. This is where the female figure is tested for their strength to use their strengths to overcome the challenges they face.

Enarson (1998) in his book The Gendered Terrain of Disaster: Through Women 's Eyes, said the important thing to do to help women is by providing education and training that can equip them with knowledge, expertise and self development as members of the community even as community leaders. Prior to the disaster, most of the women were housewives and were not involved in social groups or community development. But after the disaster, they must be incorporated into a community that manages and develops their economy independently. These women are mutually powering each other into dynamic groups that can support the development activities that they themselves started. This is a significant change that is significant in empowering women and their own involvement in community development will have an impact on a sustainable program for stable peace

Every individual has a different experience when faced with a disaster because each individual has different degrees of vulnerability and disaster management capacity. To gain economic strength and rebuild their livelihoods, the change seen is how women work together as a resilience, resurrection and development for themselves and their families. Their increased self-confidence builds collectively once again to achieve their economic awakening by working hard and mutually reinforcing. They prefer to sell fish or fried food around in the center of the tsunami debris rather than having to rely on outside assistance which is not well distributed.

Gender considerations have been accommodated in the National Action Plan for Disaster Risk Reduction (RAN-PRB) 2010-2012, that is "integrating gender considerations in disaster risk reduction and disaster management as a whole requires government policies to expand economic, social and political opportunities for women in society" (Sunarti, 2015).

As a result of the dual role of women influencing families and communities, conflicts also arise in work and household affairs. The vulnerability and risk of women during a disaster is very different from that of men. The role of women in disaster situations has not been widely studied. Even if we see women accustomed to taking care of children and parents, this will become the strength of women to be involved in pre-disaster prevention, mitigation and post-disaster rehabilitation. Women can be agents of disaster vulnerability for the elderly and children. Moreover, the role of women can propose changes to reduce disaster risk and strengthen community resilience.

Communities that have strong organizations and / or pre-existing women's groups can respond quickly and reduce the amount of damage in the event of a disaster (Julia, et.al, 2018). Furthermore, by Fatimah and Agustin (2008) in her study "Engagement of Women in Disaster Management" revealed that basically, women who choose to volunteer in their communities have become active subjects to know and anticipate information about changing natural and social situations. Women who are community volunteers are easier to adapt, so their vulnerability to the impact of disasters decreases. Women who become community volunteers can help themselves and help their groups even in conditions of crisis such as disasters.

The above statement proved that when the author came to the location two weeks after the disaster, a number of volunteers joined in the Volunteer School (SR), Sahabat Indonesia Berbagi (SIGI), Unhan Volunteer Corps, and the Ojek Online community accompanied the post-disaster recovery process. The head of the tsunami disaster emergency response of Pandeglang provided data that the number of volunteers was 1,501 volunteers from community organizations, youth organizations and individuals. Most volunteers are women. From the community, it was present to help the process of psychological recovery of children affected by the tsunami. Especially Early Childhood Education Programs (PAUD) teachers in Carita sub-distric at that time enthusiastically paid attention to the ways volunteers entertained children with games and fairy tales. They said that later they will actively and continuously assist children especially those who experience trauma so deeply. Some of the children we met were even traumatized by the crowds. Every time a crowd arrived, they would indicate the arrival of danger or disaster. Some of them were cried, some chose to run.

The stories about child assistance by women do not stop there. 3 locations in the Carita sub-district prove that women are active in helping to restore psychological impact both for themselves and their families and their surroundings. These female volunteers are not reluctant to ask for help if there is something unknown, such as stress coping for children who hear the sound of the waves or are traumatized by the crowd. A number of outside volunteers with the help of psychologists will provide counselling and assistance for women in need.

In this case women can empower the community after the disaster because of their experience and ability to take care of the household. They can contribute to the risk management of disasters and conflicts that occur after a disaster. The role of women in disaster mitigation is still very lacking because there are still many inequalities in social structure in the context of gender among Indonesian society. Many victims of disasters are among children and women. Therefore the involvement of women who are minimal in disaster mitigation efforts results in problems that arise among women becoming less manageable.

The refugee camp that has been in a disaster situation does not pay attention to and provide special facilities for women and child-friendly environments. A lot of cases were the lack of public toilets, a lack of lighting and a lack of basic needs for women such as sanitary napkins and underwear. Women's participation in pre-disaster socialization is important so that women participate in conceptualizing facilities for post-disaster needs. The phenomenon of decision making in Indonesia is related to gender issues where men are considered more capable in social interaction and community activities.

Gender issues do not only bring women to situations that are more vulnerable when disasters occur. The condition of post-disaster women also affected. Economic status, social structural conditions in society also contribute to the increasing vulnerability of women. Even the menstrual cycle can contribute to its own vulnerability to the situation they face (UN Women, 2015). The phenomenon of community marginalization in the social structure assumes that women tend to be seen as victims of various social processes that have occurred in society so far (Nugroho, 2008).

From the various problems above, it appears the threat of conflict resulting from the non-fulfilment of basic human needs, especially women and the lack of knowledge about community disaster management cycle. If the approach described by the theory of hierarchy of human needs according to Maslow, the cause conflict in Pandeglang can be mapped as follows:

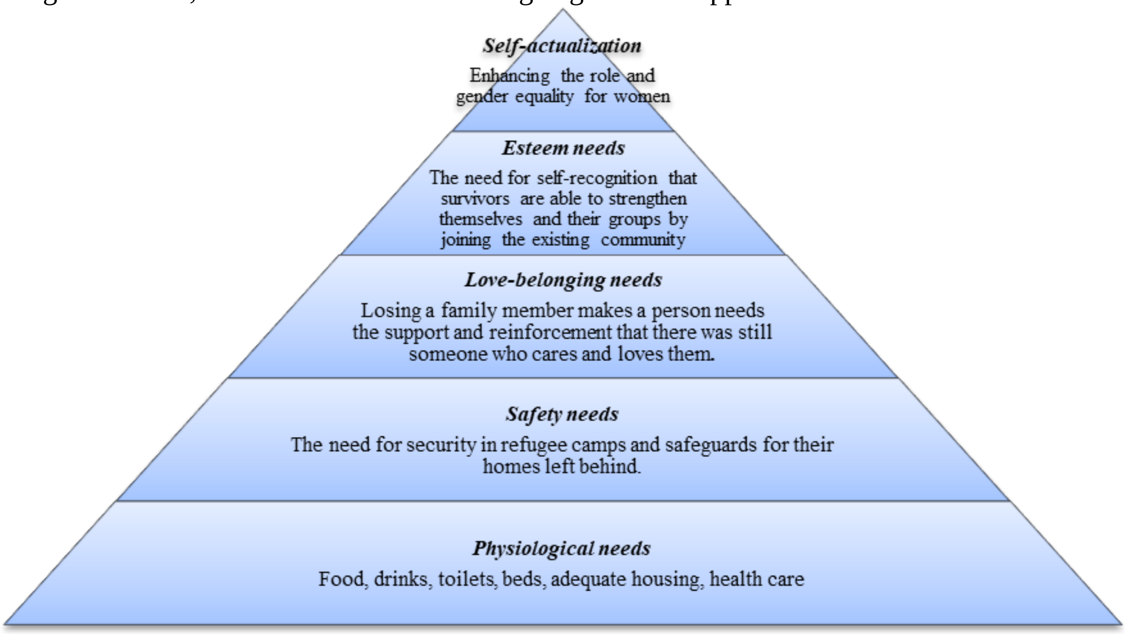

Figure 1. Hierarchy of post-disaster human needs

Based on the picture above, the basic needs of the community at the first level have not been fulfilled. The government's efforts to overcome it have not been maximized without the involvement of the people themselves. If efforts to prevent disaster mitigation are carried out thoroughly by involving the community without looking at gender, then the risk of post-disaster impacts will be reduced. In addition, the need for proper management of human resources and natural resources so that post-disaster handling can take place without conflict, both horizontally and vertically.

Women who take care of their homes in their daily lives prove that they are able to face all the rights that occur, even during a crisis such as a disaster. Tugade & Fedrikson (2004) mentions factors that influence their ability both internal (self-esteem) and external (family and children) are closely related to resilience, namely the ability to continue life after being overcome by misfortune or after experiencing heavy pressure is not luck, but it describes the existence of certain abilities in individuals.

In this case the government needs more intensive assistance for women's empowerment with a return to the community approach. Women's empowerment is defined by Nirooja et al. (2008) as a process where women can obtain the ability to make life-choice strategies that not only eliminate obstacles faced especially impacts after disasters, but also are able to increase or develop resilience in the community. In many post-disaster recovery situations like this, women are active in rebuilding the community by taking the initiative in calling for a meeting of "grassroots" communities and organizing disaster response coalitions.

4. Summary

As a disaster-prone area, Indonesia is faced with serious ecological threats that can lead to social conflicts. The impact that occurred after the disaster was not only physical damage to facilities and infrastructure owned by residents, but also a psychological impact that was prolonged. Other impacts that arise are when there is assistance from outside and then not properly distributed. So that people cannot fulfil their basic needs. This is what triggers a conflict, both horizontally and vertically. Women in disaster situations can be vulnerable groups, but on the other hand the most effective community strengthening is also carried out by women. This is because women are used to taking care of children and the elderly at home.

Tsunami in Pandeglang district provides a lot of lessons. Seeing the amount of damage and casualties can be concluded by the lack of socialization, debriefing and training for the community on knowledge of disasters, especially for women. Women's ability to manage obstacles that occur after a disaster requires them to play a dual role. In fulfilling basic needs, for example, women who have lost their husbands must also take care of their families, also make a living. In disaster emergency situations, what women survivors can do is rely on existing assistance by distributing equally to fellow refugees. If in this capacity, women are not provided with good knowledge, of course the threat of social conflict will occur.

Therefore disaster mitigation efforts are expected to be maximized by involving children and women at the planning stage so that decision making on the basis of their input can be carefully considered. The need for the involvement of women in the dissemination of the disaster management cycle starting from prevention, mitigation to rehabilitation is important to reduce the impact of the disaster risk is greater. Consideration of facilities for post-disaster needs also needs to involve women, because there are many incidents in refugee camps that are not provided by children and women. This is what triggers a conflict because of an imbalance of needs. In the future, women's empowerment is considered important by involving grassroots communities to reduce the number of casualties and damage caused by disasters.

Acknowledgment

This scientific paper can be completed well because of the help of various parties. Therefore, we would like to thank all parties, especially the entire faculty and staff of Peace Studies and Conflict Resolution which has helped us, both in the provision of infrastructure, and in the discussion and the provision of the required data.

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Readiness of Tsunami Early Warning System in Bali, Indonesia

Adib Hermawan, Saifuli Sofi'ah and Sugeng Widodo

Indonesia Defense University
IPSC Complex, Bogor 16810, Indonesia

E-mail: adib_bima@yahoo.co.id

Abstract. *The threat of a tsunami disaster for the people of Indonesia is very large, especially the people who live in the coastal areas of Bali. This study aims to find out information on how the involvement and coordination between the Regional Government or Institutions related to tsunami disaster response preparedness to several relevant stakeholders include the Bali Provincial Government, BPBD and BMKG Region III Denpasar. This research also explores information about disaster mitigation efforts, the fixed procedures implemented by BPBD in implementing disaster management and some information from BMKG in Bali province related to mitigation and preparedness efforts that have been carried out through the programs implemented. Balinese people have been provided with knowledge by local stakeholders, including the activation of the tsunami siren as an early warning, knowing the evacuation route if a tsunami occurs, even the community has several times carried out disaster management simulations. Efforts to disseminate and disseminate information on disasters that have been carried out to the community, readiness of personnel and facilities related to disaster management, update information and readiness of the early warning system. Thus it can be seen the readiness of the Provincial Government of Bali in the face of the tsunami disaster.*

Keywords: *Early Warning Systems, Tsunami Hazard, Readiness, Bali Provincial Government*

1. Introduction

Geographically, Bali is located at 8 ° 3′40 ″ - 8 ° 50′48 South Latitude and 114 ° 25′53 ″ - 115 ° 14′55 ″ East Longitude which makes it tropical like other parts of Indonesia. The Province of Bali is part of the Lesser Sunda Islands with an area of 5,636.66 km2 with a coastline length of 529 km. The Province of Bali consists of 8 regencies and 1 city with a population of 4,2227,705 people or close to 4.3 million inhabitants. The Bali region consists of 6 mainland areas, namely the island of Bali, Menjangan Island, Ulau Serangan, Nusa Penida, Nusa Lembongan, and Nusa Ceningan. The physical limits are as follows: North: Bali Sea; East: Lombok Strait (West Nusa Tenggara Province); South: Indonesian Ocean; West: Bali Strait (East Java Province). Administratively, Bali Province is divided into 9 regencies/cities, 57 districts and 716 villages. Regencies/cities include Jembrana, Tabanan, Badung, Gianyar, Karangasem, Klungkung, Bangli, Buleleng, and Denpasar Cities.

The biggest source of regional income (PAD) in Bali Province is from the tourism sector. The results of the study stated that the growth in the number of tourist visits, the level of investment, the trade sector, and hotels had a positive effect on the Regional Original Income (PAD) of the Province of Bali [1]. Therefore, the tourism industry is the most important sector and developed in the Province of Bali. Tourism as the main industry is strongly influenced by various factors, one of which is safety. Disasters as part of security have a huge influence on the tourism sector. Humans are anxious and worried about visiting destinations that are prone to disasters. Visitors' security and safety are multidimensional ideas in various components such as political security, public safety, health and sanitation, personal data security, disaster protection, and guaranteed service quality [2]. By that reason, the factor of tourist safety and security is the main thing that must be considered by the Bali Provincial Government in the development of its tourism sector.

The Mount Agung eruption disaster in 2017 that lasted until 2018 has had an impact on most Balinese people, especially those who work in the tourism sector. The impact of the eruption of Mount Agung is very influential on the income of local people from the accommodation business [3]. The reduced number of tourist visits due to travel warnings, and the closure of Ngurah Rai airport for several days due to the burst of volcanic ash had made the industry in the tourism sector experience a downturn. Media coverage related to the Mount Agung eruption also resulted in a decline in the number of tourists. The role of comprehensive media as a system of dissemination of early warning to the community can actually minimize the loss of life and the amount of losses because the community can take attitudes and anticipatory actions. The involvement of the media in providing education and the system of dissemination of early warning to the community as part of disaster mitigation [4].

In general, coastal areas in Indonesia are prone to tsunami disasters, including coastal areas in Bali. The western region of Sumatra, Sunda Strait, South Java Island, and East Nusa Tenggara are tsunami hazard zones. The four points of the seismic gap area (earthquake zone has never been shaken by a massive earthquake between 50 - 100 years) in Indonesia are in the Sunda Strait, the southern coast of Java, the Bali Strait, and the area near Alor Island has the potential to cause a tsunami [5]. The coastal area of Bali is one of the coastal areas that is on a seismic gap so it is very vulnerable to the threat of a tsunami disaster. The cause of the tsunami is largely due to the tectonic earthquake, which is usually shallow, large magnitude, and has a rising or falling fault. Table 1. is the data of the 2018 disaster events in Bali Province.

Table 1. Disaster Events in Bali Province in 2018

No.	Disaster Events	Numbers of Event
1	Earthquake	902
2	Tsunami	0
3	Kebakaran	442
4	Fire	151
5	Landslide	250
6	Tornado winds	23
7	Volcanic Eruption	3
8	Drought	11

Based on the data in Table 1. it can be concluded that an earthquake is a disaster with the highest incidence of disasters throughout the year. In fact, in the previous explanation tectonic earthquakes were the cause of most tsunamis. Therefore, it is necessary to pursue disaster mitigation activities to reduce the impact that caused in the event of a tsunami. One of the disaster mitigation activities that can be carried out is the existence of a tsunami early warning system.

The early warning system according to UN-ISDR (United Nations - International Strategy for Disaster Reduction) is the provision of timely and effective information through identified institutions, which enables people exposed to hazards to take action to avoid or reduce their risk and prepare for an effective response . An effective and complete early warning system consists of four interacting elements namely risk knowledge, monitoring and warning services, dissemination and communication, and response capabilities [6]. An effective early warning system is not only concerned with technical matters, but also focuses on people who are exposed to risks both arising from natural hazards or social vulnerabilities. The system approach that combines all relevant factors in risk is needed to realize an effective early warning system.

With the description above, the researcher takes the theme of the Preparedness of the Early Warning System (Early Warning System) of the Bali Provincial Government in facing the Tsunami Disaster, on the grounds that it knows the ability and readiness of Bali in maintaining safe and comfortable tourism conditions in order to find out how the government local and office holders and the role of the community in creating Bali security and comfort as one of Indonesia's mainstay tourist attractions. readiness is key to dealing with tsunamis, developing local preparedness strategies is key. The development of preparedness strategies requires a good understanding of hazards.

2. Research Methods

The research method is used is a qualitative research method that applies a pragmatic approach in the practice of disaster management in terms of readiness to face the threat of tsunami disasters in coastal areas of Bali. Data collection is carried out through interviews and documentation studies related to the development of preparedness for the tsunami Tsunami disaster in Bali. Interviews are one way to get information by asking directly [7]. Interviews were conducted with those who made efforts to increase readiness to face the threat of a tsunami in Bali, among others, the Provincial Government of Bali, BPBD Bali, and BMKG region III Denpasar. Documentation study is one method of collecting qualitative data by looking at or analyzing documents made by the subject itself or by others about the subject of study documentation such as notes, photos, video recordings or sounds [8]. Documentation studies were carried out by reviewing documents related to tsunami preparedness in tsunami prevention in Bali such as contingency plans and disaster management planning documents.

3. Result and Discussion

3.1 BPBD/Pusdalops Readiness of the Bali Provincial Government

The early warning system is only effective when the arrival (intensity, time, etc.) of an event in a place can be predicted in advance, therefore information or tools are needed to detect the occurrence of an event. The release of information about hazard conditions is the estuary of a process of analyzing data about disaster sources and synthesis of various considerations. The accuracy of information can only be achieved if the quality of analysis and synthesis that triggers the release of information has high accuracy. Thus there are two main parts of the early warning system, namely the upstream part in the form of efforts to package the data into the right information and the downstream in the form of efforts so that information quickly reaches the community.

The existence of the BPBD (Regional Disaster Management Agency) / Pusdalops (Government of Bali Province aims to integrate disaster management in the regions, which has four functions, namely: disaster data and information center, early warning system, emergency response control operations, emergency services. Pusdalops functions include: a) providing early warning to the community so as to avoid any disaster / security threats; b) centers controlling people's mobility to avoid disasters; c) monitoring disaster-prone points. Early warning system (BPBD Early Warning System) / Bali Provincial Emergency Center has supporting facilities and human resources (HR), among others: BMKG / INA TEWS and CCTV servers, monitoring towers, CCTV cameras, BMKG workstations and tsunami siren activation, early warning sirens , CCTV & LCD TV projector screens, digital information terminals, radio communications, tel / facsimile / internet, CCTV workstations, SOPs and HR (D3 IT).

The readiness of the Bali Provincial Government in facing the threat of a tsunami from the southern coast region of Bali Province, namely:

• Collaborating with the French Red Cross to establish the Crisis Center

• Establish cooperation with the German Indonesia Tsunami Early Warning System (GITEWS)

• Installing early warning sirens at nine points throughout the Province of Bali

• Establish cooperation with the regency / city government to install evacuation signs

• Disseminating tsunami hazards

Readiness made by the Bali Provincial Government is appropriate in realizing an effective tsunami early warning system. Government cooperation with the French Red Cross and the German Indonesia Tsunami Early Warning System (GITEWS) is a commitment made by the government to produce disaster risk observation and analysis as a component of the early warning system. The government has also socialized tsunami hazards to the community through disaster resilient village programs, socialization of tsunami siren activation and disaster safe schools. Making evacuation routes throughout Bali is also carried out in order to facilitate the evacuation process if necessary.

The activation of tsunami sirens in Bali is carried out on the 26th of every month in order to check the sirens that are available throughout the Bali Province. Placement of siren distribution in Bali Province is shown in Figure 1.

Figure 1. Placement of Sirens in the Province of Bali

The placement of sirens in Bali Province as shown in Figure 1. Has not yet reached all of the coastal areas in Bali so that it requires an additional ten tsunami sirens to be able to reach all coastal areas in Bali. The tsunami siren activation activity besides being used for checking tsunami early warning tools is also used as a means of socialization to the community regarding tsunami disaster mitigation efforts.

In addition, the Pusdalops has a fleet and devices that support it with roles and functions including:

- Radio Communication Systems,
- KOMODO (Multi Moda Operation Control Communication),
- Car Communication, DVB (Digital Video Broadcasting),
- Disaster Information System, Monitoring CCTV and LED Display and other communication devices. And PB BPBG Pusdalops Device Desimination
- DVB (Digital Video Broadcasting) with the function of Digital Video Broadcasting (DVB) to receive and disseminate information on earthquakes and potential tsunamis. PB Pusdalops provide tsunami early warning to registered cellphones in the form of SMS.

The use of the radio communication system as a supporting tool in the implementation of disaster management in Bali works if in the event of an internet network system suddenly down. Bali Province BPBD conducted a round table using radio communication three times a day with BMKG (Meteorology, Climatology and Geophysics Agency) to update information related to disaster.

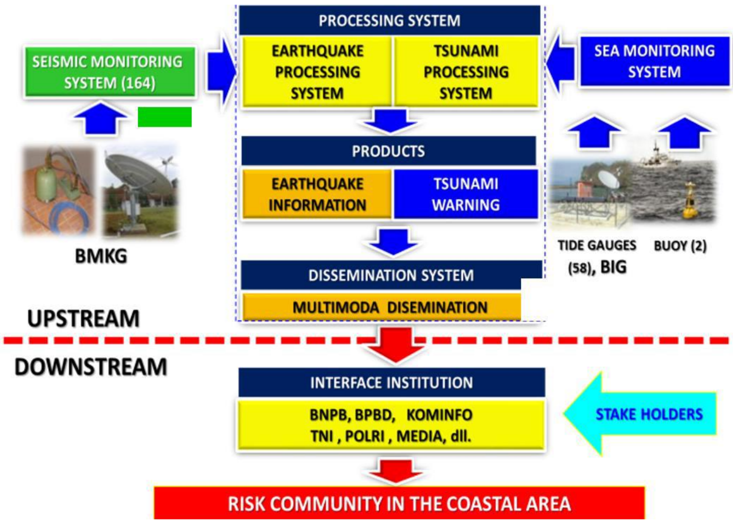
3.2 Readiness of BMKG Region III Denpasar

The Center for Meteorology, Climatology and Geophysics in Region III Denpasar has the task of carrying out observation, data management, forecasting, research, collaboration, calibration, and meteorological, climatology, air quality and geophysical services in the Bali Province. Regulation of the Head of BMKG Kep. 015 of 2014 states that the Center for Meteorology, Climatology and Geophysics has the task of carrying out observations, data management, forecasts, research, cooperation, calibration, and services for meteorology, climatology, air quality and geophysics. Based on these regulations the mitigation and preparedness efforts carried out by BMKG are to provide early warning.

In accordance with the mandate of Law 31/2009 concerning Meteorology, Climatology and Geofiika, BMKG conducts tsunami early warning services. Therefore, Indonesia, through the BMKG and related institutions under the coordination of the Ministry of Research and Technology has developed tsunami early warning technology, equipment, systems and governance since 2005, called the Indonesian Tsunami Early Warning System abbreviated as InaTEWS .

InaTEWS was built by implementing several integrated systems such as tight and sensitive seismograph networks, the construction of a Deep-ocean Assessment and Reporting of Tsunamis system along with devices such as buoys, satellite systems, tide gauges placed in ports to observe wave characters, and cameras by visually monitoring places with a certain height. Another device used by InaTEWS is DSS (Decision Support System). The DSS collects all information from the sensor group to decide whether a tsunami has occurred or not.

Figure 2. Desain InaTEWS



Desain InaTEWS design produces products in the form of earthquake information and tsunami early warning as in Figure 2. Inatews uses a land monitoring system and a marine monitoring system. A land monitoring system consisting of a network of broadband and GPS seismometers. Sea monitoring system consists of tide gauges, buoys, and CCTV. Observational data is sent to BMKG to be processed and analyzed to produce tsunami early warning information related to areas that may be affected, warning levels, and tsunami arrival times.

The BMKG's work area in the tsunami early warning system is in the upstream domain, which means that the BMKG carries out its function as an institution that provides information services through analysis of monitoring data related to tsunami early warning. Whereas downstream institutions or stakeholders function to disseminate information (function of dissemination) early warning to the public such as BPBD, TNI, Media, KOMINFO to the public exposed to coastal areas. The readiness of BMKG region III Denpasar Bali includes the readiness of personnel by collaborating with universities both at home and abroad in developing Ina TEWS. BMKG personnel were also given training at the BMKG Training Center and there was also an internal assessment (certification) for each personnel. Readiness of facilities and infrastructure in the face of the tsunami disaster is quite good according to the SOP (Standard Operating Procedure) in Inatews. Maintenance activities of facilities and infrastructure include several activities, namely preventive (tool checking), corrective (damaged tool correction), tool calibration, replacement of equipment that is not feasible.

Conclusion And Recommendation

Readiness of the tsunami early warning system in Bali involves various sectors, such as BPBD, the Government of Bali, and BMKG. The role of BPBD is as a disaster data and information center, early warning system, controlling emergency response operations and emergency services, the role of the Bali Provincial Government includes cooperation with various international disaster agencies, installing sirens in Bali in collaboration with the district government, and conducting socialization disaster mitigation to the community. The role of the BMKG with regard to the threat of a Tsunami is to produce information related to seismic and Tsunami early warning. The three institutions have had basic tasks, functions and good synergy in the face of the tsunami threat in Bali.

BPBD has plans for the addition of Tsunami sirens in coastal areas that are still unreached by existing sirens. Recommendations for the BMKG are to increase cooperation in the development of tsunami early warning detection sensors in order to produce faster and more accurate tsunami early warning information. With the existence of concrete efforts and actions before, when and after a disaster, it is expected to be able to create a positive image of Bali so that sustainable tourism can be created without concern for natural disasters.

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Coordination in Disaster Communication in Bali Province

Deny Widi Anggoro[1], Dian Efrianti[2] and Novita Berhitu[3]
[123]Disaster Management, Faculty of National Security, Indonesia Defense University, Kawasan IPSC Sentul, Kabupaten Bogor 16810, Indonesia

E-mail: deny.widianggoro2007@gmail.com,dian.efrianti@gmail.com vittaberhitu1884@gmail.com

Abstract. Historically increasing statistical data on disaster events occurring in Indonesia shows that the importance of disaster management in disaster management. This needs to be used as a mainstream in development by the government, so as to be able to realize national security and human security. As a manifestation of one of the disaster management efforts carried out with disaster coordination to elements of government, business, academia, communities and communities. Based on research in Bali Province, all of these elements are very cooperative in joint efforts to overcome disasters, assisted by the media community that cares about the field of disaster that helps disseminate information on disasters in Bali Province to be effective and efficient to be accessed by the wider community. This good coordination in disaster management has made the Balinese community formed into a community that understands disasters and hopes to be able to face the potential for disasters that threaten the region.
Keywords: Coordination, Disaster, Bali

1. Introduction

Use this The national defense effort to be prepared early by both central and local government with the involvement of all citizens, regions and all of their national resources in a total, integrated, directed and sustainable manner. In addition to the military's national defense efforts, it is no less important now that non-military national defense efforts are being sought to reduce the impact of real non-military threats such as disasters that have recently occurred in almost all regions in Indonesia. One area that also has a considerable potential for disaster threats is Bali, which is better known as the Island of the Gods. Bali Island is not only known in the national arena but is very well known internationally because of its artistic and cultural characteristics which are the selling points and attractiveness of foreign tourists.

The island of Bali is located very close to the subduction zone between the Indo-Australian Plate and the Eurasian Plate. The meeting zone of these two plates is an area where the main source for earthquakes and tsunamis which can have an impact to thes people on the island of Bali. Bali Province is one of the most popular tourist attractions for international tourists by offering all the attractive natural beauty and wide spread, culture and life of local people who are still very strong guarded and preserved by the local community. However, behind this beauty, the Province of Bali also has a huge vulnerability to potential disasters. Historically, various disasters have occurred in the Province of Bali such as earthquakes, volcanic eruptions, floods, landslides, droughts and strong winds. Bali Province has two active volcanoes, namely Mount Agung and Mount Batur, and does not rule out the possibility that Mount Batukaru will potentially become active.

Based on observations of various disaster reports in Indonesia, it still shows some problems in the field, as stated by Budi (2011) that after going through various strengthening of legal, institutional and disaster management experiences, it still leaves many problems both conceptually and in the field. The main problem is "KIKK", namely Communication, Information, Coordination and Cooperation. From the aspects of speed, accuracy, accuracy - reliability, aspects of communication and information are still problematic, especially when talking about information confusion, various inaccurate actions such as uneven logistics, integration between sectors in handling disasters or overlapping are still a lot. [1]. On one side this shows that sectoral egocentric aspects are still visible, on the other hand an understanding of the aspects of policy and integrated implementation regarding aspects of disasters has not been the main agenda. These problems certainly need to be corrected, and become an opportunity to implement disaster management policies, strategies and operations as an integrated and systemic movement. In other problem, considering the province of Bali as a large foreign tourist destination and its various diversity of society.

The problem which stands out at this time is the occurrence of refraction of the news or more often we are familiar with hoaxes. Hoax news whose nature still cannot be assessed is a very serious problem, because it can lead to misinformation of information and communication given to the wider community. Moreover, faced with a disaster situation, misinformation provided will have a fatal impact on the community and foreign tourists. Therefore the government must focus on dealing with this problem. The Head of the Center for Data, Information and Public Relations of the National Disaster Management Agency (BNPB) Sutopo Purwo Nugroho said that it was actually easy to determine a disaster information that was a hoax. If the news says when or a prediction time of a disaster will occurs, so clearly concluded that the news is a hoax, because until now there has been no technology or experts who are able to predict when a disaster will occur.

Hoax pattern by distributing videos or photos about the occurrence of disasters that have occurred but are redistributed by making the video or photo as if the incident from the disaster is happening. Or another pattern by utilizing expert statements that have been submitted based on research and observation, but are re-loaded by changing the context as if it was a threat. Besides spreading fear, the hoax perpetrators sometimes have criminal motives. For example, when the issue of aftershocks appears, then the community is asked to evacuate, after which the house is left empty and thieves enter. Based on the statement from the Kapusdatin and Public Relations of BNPB, the hoax news has circulated to the national level. The widespread hoax threat must be immediately follow up by the government. Especially the local government, in this case the Regional Disaster Management Agency (BPBD) of Bali Province as the leading sector in disaster management at the regional level must be active in providing opinion counters and providing information updates continuously so that information can be delivered correctly without any news refusal and abuse news and information that can be harmful. Considering the Province of Bali has the potential for earthquake, tsunami, landslides, floods, and potential social disasters, the government, community institutions, indigenous communities and the business world have the role to disseminate disaster information to the public.

2. Methodology

The method used in this study is a qualitative method, using observation and interviews as the main tool in retrieving data. This research uses purposive sampling method. Sampling is done intentionally and researchers determine their own samples to be taken with a variety of specific considerations. According to Creswel (2006) the procedure for retrieving data through purposive sampling is the most appropriate data retrieval procedure in qualitative research [2] because this method will be able to answer research questions well and on target, this is caused by selected informants has considered certain aspects in accordance to the field under study.

The selected informants are the Communication and Information Service, the Regional Disaster Management Agency, and the Disaster Care Journalists.

3. Discussion and Research Results

Basically humans need communication in their live to meet the information needs needed to support their activities. The pattern of communication can be done by a face-to-face manner, through writing, telephone, or social media, which is now increasingly developing along with the development of advances in information and communication technology to create convenience, speed, cheap and practical so as to enable the public to know the latest information developments. In general, government apparatuses use magazines, newsletters, newspapers, television, social media, and exhibitions to socialize activities that aim to improve their performance through programs and activities that are informed to the community and lead to the welfare of the community.

Various information are broadcasted from mass media and print media, can affect the knowledge and attitudes of the community towards an event that occurs including the preparedness of the community in facing the threat of disaster. Lately, information about natural disasters such as tsunamis, flash floods, landslides, volcanic eruptions, earthquakes and liquefaction have fulfilled all mass media and print media, even more popular ones, on social media. Because nowadays people are more interested in reading and hearing various information through social media than in mass media, so that it is possible to deviate from reporting such events that make the public a misperception or panic and worry. This study will discuss the form of coordination in disseminating disaster information in Bali Province by the local government through the Information and Communication Service in collaboration with the Regional Disaster Management Agency and Disaster Care Journalists and other relevant agencies.

Communication in the field of disaster especially communication and dissemination of disaster information is very important for the community. Disaster management efforts will involve various stakeholders, each of whom has duties and responsibilities in a well-coordinated command. Information and communication greatly influence the knowledge and attitudes of the local community where if the information cannot be communicated well to the community it will have a negative impact on the pattern and behavior of the community in the face of disasters. The original paradigm of disaster management is the conventional view that the community is a weak source and cannot cope with the threat of disaster itself and must wait for help from the government has now turned into a resilient and prepared community where the community is the main resource in overcoming the disaster own. Therefore, one form of community preparedness in dealing with disasters is through hate information and communication in the form of knowledge and attitudes of the community.

Learning from the events of the disasters that took place in Lombok, Palu, the Sunda Strait, and even what just recently happened in Sentani shows that the community is still not ready to face the disaster itself even though the efforts of the Government and the community have reached the stage of preparedness. This is proven by still causing a lot of casualties and property which quite a lot even paralyzes all government activities and the economy of the community which requires a long period of rehabilitation and reconstruction such as those that occur in the hammer and its surroundings. In this case who should be blamed and what is wrong so that the disaster can occur and destroy all aspects of people's lives. Of course, it can be said that the government and society are the ones who are very responsible in this event, namely the weak information system that must be conveyed to the community first called the early warning system and the attitude of the people who are not sensitive to the threat of the disaster itself. So that when the disaster occurs the community is unable to face and only surrender to receive threats that lead to disaster.

Disasters which happened in some regions in Indonesia surely it will certainly be a lesson to other regions that have the potential threat of disaster itself, so is the case with the Bali Provincial Government which has a very high potential for disaster because the positon of Bali is at the meeting of two large plates of the world. As a tourist area the government of Bali is very concerned about its area in dealing with disasters, namely reducing the risk of disaster threats through community preparedness in the field of information and communication. Bali has many beaches and volcanoes, which has the potential to disaster risk. But it does not reduce the interest and attractiveness of tourists who come from various countries in the world and even many foreign tourists who have settled on the island of Bali. Even the beaches and volcanoes are the source of the disaster have turned into a tourism selling value for domestic and foreign tourists who have now become the leading sectors and the highest regional income per capita found in the tourism sector. Of course this is a hard work from the Bali Provincial Government which is fully responsible for protecting and protecting its people from military threats and non-military threats that come from outside and from within the country.

Disaster problems are not only the responsibility of the National Disaster Management Agency (BNPB) or the Regional Disaster Management Agency (BPBD) but are a joint responsibility starting from the elements of government, media, private parties, industry, communities, and the community itself. In order for the community to have preparedness and resilience in dealing with disasters, it must improve knowledge and attitudes in the field of disaster information and communication that are good. And in this case those who have the task and function of informing and communicating disaster information, namely the Information and Communication Service so that the community will be sensitive and resilient and can eliminate the sense of panic and worry that always occurs at the beginning before the occurrence of the disaster. Especially for tourists who often come and visit or even who have settled in Bali , they must have a good image of Bali. Moreover, Bali is often the place for international events to take place as it has just happened in 2018, namely the International IMF Meeting.

The Department of Communication, Information and Statistics of Bali Province was established in 2017, which was previously one of the fields in the Department of Transportation. But before being merged and included in the Department of Transportation, all information and communication was in the Central Bureau of Statistics. Because there is no link between the Department of Transportation and Communication Information, the field is separated and stands alone into the Office of Communication, Information and Statistics under the Ministry of Communication and Information, based on PP 18 of 2014. In accordance with Bali Provincial Governor Regulation Number 102 of 2016 states that the Bali Province Communication, Informatics and Statistics Office has the task of helping the Governor carry out government affairs in the fields of Communication, Information, Statistics and Coding which are the authority of the region, and carry out deconcentrated tasks, led by a Service Head, who is under and responsible to the Governor through the Regional Secretary.

In carrying out these basic tasks, the Communication and Information Agency of Bali Province [3] has the following functions:

a. As the formulation of technical policies in the field of Communication, Informatics, Statistics and Coding which are the authority of the Province;
b. Implementation of policies in the fields of Communication, Information, Statistics and Coding which are the authority of the Province;
c. Administration of the Office of the field of communication, informatics and Statistics and coding;
d. Implementation of Service evaluation and reporting;
e. The implementation of other functions provided by the Governor relates to their duties and functions

The service performance of the Province of Bali's Information and Communication Services and Statistics includes: (1) Telecencer, is an information center for ICT-based communities in order to empower communities managed by the community, this facility is provided to facilitate the community in accessing information quickly and cheaply. (2) Implementation of ICT (Information and Communication Technology) governance in this case e-Gov ranking is an activity held in order to see a map of the conditions of use of Information and Communication Technology (ICT) by national government agencies, (3) Letter electronic correspondence (E-Office), (4) Colocation Utility and Hosting which is a technical service to the zProvincial and District / City SKPD by placing the server and its application to obtain internet access facilities in supporting public information services, (5) ICT network infrastructure (6) Empowering community information groups (KIM), (7) Bali Province Bakohumas forums, (8) Online Media, (9) Potential Magazines, (10) Facilitation of Provincial Information Commission (KIP) and (11) Regional Indonesian Broadcasting Commission (KPI) Facilities Bali.

The strategy that has been carried out is the installation of wifi in every area in Bali Province, which has been installed in Adat Village, government agencies, public facilities such as health centers and schools, to the Banjar Hall. This is done with the aim that the dissemination of information to the public and government agencies can be received quickly, and appropriately and to facilitate dissemination of information, especially disaster information. This Wifi installation is also intended to increase knowledge and skills in accessing various news and information which includes disaster news and information. In addition, it can support the economic activities of the community with the support of media and technology to facilitate market surveys, marketing and transactions so that the community can carry out many communication activities seeking information, communicating with other parties, and obtaining social and economic services. In relation to the response regarding the amount of information that contains elements of hoax, the Office of Communication, Information and Statistics has a technical team to analyze and validate information by going directly to the field.

The Office of Communication, Information and Statistics has collaborated and coordinated with all regional equipment related to information and data encountered in the field to be analyzed and followed up to be information that will be disseminated to the public. To support broadcasting information to the Diskominfo community and Statistics, it always collaborates with all journalists, media centers, and related electronic media in broadcasting and public information data. So that the news that will be delivered to the public is valid and accurate news and has integration between various parties both government and private. Diskominfo and Statistics Bali do not have the authority to take action if found in the news of a disaster hoax, which has the authority to follow up is the Ministry of Communication and Information.

Based on Government Regulation (PP) No. 50 of 2005, private broadcasters are required to disseminate early warning information from official government sources about the possibility of disasters that could threaten life safety and cause damage to property belonging to residents. Broadcasting and dissemination institutions through communication media have the role to disseminate disaster management information, starting from the pre-disaster phase with the form of disaster education, during disasters or emergency response periods, and post-disaster during the rehabilitation and reconstruction phase [4].

At a glance discussing the role of media as a form of information dissemination in disaster events in Indonesia, there is a dual role carried out by the media according to Masduki on Hasibuan (2011), namely an informative role by disseminating (disseminating) information on intensive disasters and charitable social roles through donation / collection activities and disaster relief distribution. However, the portion in disaster reporting between disaster events and disaster mitigation efforts is still not balanced [5]. Disaster mitigation efforts should get a greater share of coverage to increase community capacity in the face of disasters and as an effort to reduce disaster risk. The role of the media is not only limited to disseminating disaster information but also educating the public to be able to deal with disasters.

Juni Wati Rizki (2016) stated that the news must prioritize absolute truth because it will affect the credibility of the media [6]. The news preparation process must be able to see important things become interesting and relevant information, not to the contrary make interesting information (even though it is actually news that is not so urgent and important) forced into important news. In relation to disaster reporting, as much as possible try to load news with interesting headlines but not terror for the people who read it, so that the media with its publication can lead public opinion to remain positive about disasters, and as much as possible the media is used for educational media community as a real effort to reduce disaster risk by increasing community capacity.

In reporting disaster information must contain fact elements that are packaged in elegant language but still interesting to read and not meaningful. According to Soehoet (2003) in Western literature a formula of 5 W + 1 H has been found as news building elements namely What, Who Where, When, Why, How [7]. The news contained contains reports on factual events that are published in a relatively fast time but by ensuring news confirmation with the authorities related to the occurrence of the current disaster. So that the news which is disseminated not news contains elements of lies and fiction. The role of the media in reporting this disaster is really important, according to UNISDR's United Nations International Strategy for Disaster Reduction (2011) information from the media is able to influence political decisions, change behavior, and be able to save human lives [8]. Communication is at the core of successful disaster mitigation, preparedness, response and disaster rehabilitation activities. According to Ibnu Hamad (2004) mass media do construction of reality, the basic element of all mass media [9]. Mass media such as coverage such as news, field reports, or the results of analysis in the form of articles, opinions, is language (verbal and non-verbal). The content of print media is a written language that is represented by words, numbers, images, and graphically radio media using speech and sound, TV media combines language, writing, images, and sounds (audiovisual).

Shaw and Gupta (2009) in his research specifically highlighting the issue of communication in disaster management see the relationship between the disaster management cycle and the communication aspects, namely the dimensions of information, coordination and cooperation [10]. In the stage before the disaster, the aspect that needs to be strengthened is communication that is engaged in accurate information collection, coordination and cooperation with agencies, institutions and communities about disaster mitigation and disaster socialization efforts to the community, especially for the community, especially for communities in the region disaster-prone. This is the key to success as an effort to reduce disaster risk and avoid falling casualties and losses. At the stage of disaster emergency response conditions, the four aspects: communication, information, cooperation and coordination work together to handle disasters and evacuate disaster victims and manage disaster relief. In the post-disaster / rehabilitation and reconstruction phase, recovery and rebuilding measures are pursued by taking into account security and disaster risk aspects in the development area to avoid similar events in the future.

Disaster problems are not only the responsibility of the National Disaster Management Agency (BNPB) or the Regional Disaster Management Agency (BPBD) but are a joint responsibility starting from the elements of government, media, private parties, industry, communities, and the community itself. BNPB has formed a community of journalists with the name of the Disaster Care Journalists forum Wartawan Peduli Bencana (WAPENA) which has become a driving force in disseminating disaster disaster education and information for the community by carrying out a humanitarian care mission and supporting disaster management. Volunteer communities that have a high spirit of humanity voluntarily help in disaster management activities in Bali Province. The people of Bali province also have some local wisdom that is very adhered to by the community so that it facilitates disaster education.

WAPENA is a forum for caring about disasters established by BNPB, currently WAPENA is a partner of BPBD and the Regional Government / Institution in disseminating disaster information and education to the public. The WAPENA community synergizes between journalists who have a soul of volunteers, BNPB, Provincial and District / City BPBDs, establish collaboration with disaster communities such as Disaster Care Scouts, and so on. All WAPENA members have conducted Disaster training with BNPB and Provincial BPBD and District BPBD. The training that obtained was very detailed starting from how to deliver and write responsible and positive news to incidental capabilities for soup kitchens, first aid, and water rescue. The target of the WAPENA organization is that all media in Bali have at least one special reporter trained to cover disaster events in the Bali Province, especially. WAPENA conducts disaster education and mitigation through print and electronic media that are positively and responsibly involved. WAPENA informs the facts by being processed so as not to scare the reader.

The content of news by WAPENA is obtained directly from the community then it is confirmed by the BPBD and other relevant agencies for the truth and validity of the news before disseminating disaster news. Disaster report is done by utilizing electronic media such as TV and radio, print media, and mainstream media such as social media. WAPENA conducts field observations, but still coordinates with the relevant government, for example with BPBD as a body that has authority in decision making related to the field of disaster.

Communication aspects in the field of disaster in Bali Province have been well coordinated and implemented. Information and communication related to disaster in Bali Province can be well disseminated to the community. But there are some things that need to be improved in order to support the performance of the Office of Communication, Information and Statistics. Such information globalization has an impact on public information disclosure so that it can make people easily reach and receive any information on the internet through social media, information gaps in society, rapid development of ICTs, availability of uneven ICT infrastructure and limited understanding of apparatus and society towards ICT.

All government agencies, community institutions, indigenous communities, and communities themselves work together to create a resilient community of disasters. Not only from the side of the local community, Bali as a world tourist destination that brings many foreigners to the region has also tried as much as possible to educate tourists regarding disaster well. WAPENA is tasked with finding and disseminating the broadest news while still coordinating with Diskominfo and BPBD as the biggest responsible person in disaster management. However, overall government agencies in Bali Province work hand in hand in realizing resilience to disaster by utilizing various opportunities that exist in the field of communication and information, namely the concern of the leadership in the field of communication and information, the availability of information and communication media to be utilized, the need to improve the quality of public services development of the content of e-Government, public awareness of the importance of information, the development needs of ICT in the administration of government and the availability of legislation underlying the regulation of the Ministry of Communication and Information and Statistics.

4. Conclusion

In disaster management efforts, communication and coordination are needed by government agencies, private parties, academics, communities, the media and the community. This proves that the disaster management activities are not the responsibility of BNPB and BPBD alone, the disaster problem is a shared problem that needs the support of many parties in its implementation to achieve good results and minimize the number of victims and losses that will be experienced by the community in the event of a disaster. The Province of Bali is one of the provinces in Indonesia which has a very high tourist attraction and is a source of foreign exchange for the State. Aside from the natural beauty of the Province of Bali, this region has the potential to pose an equally important disaster threat that must be a concern. All disaster management efforts in Bali Province are strongly supported by various elements, ranging from the government, the private sector, academics, communities, the media, to the very cooperative indigenous peoples. In addition to programs launched by the government, indigenous communities in Bali Province have local wisdom in terms of disasters that are highly believed and adhered to by their communities so that it is very effective to be used as a vehicle for disaster education. The role of the media is well implemented especially in disaster reporting, with the formation of a Disaster Care Journalist forum (WAPENA) which has been equipped with journalistic skills and has a high humanitarian spirit in the field of disaster.

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Implementation of Sister Village as an Alternative for Handling Refugees in the Mount Agung Eruption: Case Study in Semarapurakangin Village, Bali

F A Kharis[1], B D Priambodo[2], M P Rizayati[3], IDK Kerta Widana[4]
[1,2,3,4] Indonesia Defense University, IPSC Sentul, Bogor 16810, Indonesia

Email: faisol.kharis@kn.idu.ac.id, putririzayati@gmail.com

Abstract. This research aims to find out and analyze the implementation of the sister village concept between Duda Utara Village, Selat District, Karangasem Regency, Bali with Semarapurakangin Village, Klungkung District, Klungkung Regency, Bali in September 2017. This research is important to reduce the risk eruption of Mount Agung. This study uses a qualitative approach with descriptive methods. The sample selection technique uses *purposive* and *snowball sampling* based on certain criteria including competent officials and directly involved in disaster management, especially handling refugees due to the eruption of Mount Agung. Data collection uses deep interviews, observation and literature studies. Data were analyzed using data collection, data reduction, data presentation and conclusion. The technique of checking the validity of the data uses a triangulation technique that utilizes the use of sources. This research shows that there are 28 villages in the high vulnerability area of the Mount Agung eruption. The radius is safe at the 4th level situation within 6 km, there are 10 villages around Mount Agung which are vulnerable areas. The 18 other villages have status of buffer village. If the safe radius is increased to 10 km, the buffer villages recommended by Regional Disaster Management Agency (BPBD) of Karangasem are spread in three districts, namely Bangli, Singaraja and Klungkung. Sister village as a model for empowering Balinese people in facing the eruption of Mount Agung between the village of Duda Utara and the village of Semarapurakangin has gone well. Sister village grew based on the high social solidarity of the Semarapurakangin Village community in providing evacuation, relief and rescue assistance to minimize casualties. This model is one of the procedures for community empowerment in helping victims of Mount Agung eruption to provide disaster emergency facilities. Sister village between Duda Utara Village and Semarapurakangin Village is combined with indigenous Balinese local wisdom, namely *Nguopin* or the application of mutual cooperation with a sincere heart without receiving compensation.
Keyword : Sister Village, Local Wisdom, The Eruption of Mount Agung

1. Introduction

Bali is one of the regions in Indonesia with local traditions and modernization in tandem. The development of modern civilization in Bali is increasingly massive due to the demands of the era and the flow of immigration does not necessarily erode the indigenous culture of Bali. This was inseparable from the interference of the Balinese people who formed various village groups. The village groups then developed and created a culture that made different characteristics of each village. Traditional arts, traditional dances, community houses, traditional ceremonies and prayers are still well preserved. Bali Aga community or Balinese mountain community is the oldest traditional village community in Bali. The Bali Aga people are the ancestors of the Balinese originating from Austronesian descendants from the Megalithic era who lived in groups in a certain area and still held fast to their traditions (Purwadi and Aliffiati, 2015:5).

In addition to well-preserved traditional values and local traditions, Bali has the potential of natural resources such as rice and coffee farming, coral reef, beaches and seaweed. Bali's leading tourism sector featured the beaches, cultural ceremonies and religious rituals as well as rural tourism revenue accounted for the most in running the government and the economy of Bali. This of course can invite both domestic and foreign tourists to make Bali a top choice destination for travel and vacation.

In the other side of the progress of the Province of Bali in the field of economy and tourism, there are various threats that can disrupt the stability and security of the Balinese and tourists. The threats are the potential disasters such as tsunamis, floods, landslides and the of eruption of Mount Agung and Mount Batur.

The geographical position of Bali is in a disaster-prone areas, namely the "ring of fire" that stretches along the islands of Sumatra, Java, Bali, Nusa Tenggara to Sulawesi which at times has the potential of volcanic eruptions, earthquakes, tsunamis and other natural phenomenon (National Disaster Management Agency/BNPB, 2017). In the topography and reliefs of Bali Island lies an active mountains, namely Mount Agung and Mount Batur. Gunung Agung is the highest mountain in Bali, located in Karangasem Regency with a peak height of 3,142 masl. The Mount Batur, which is 1,717 masl is located in Bangli Regency.

In September 2017, Mount Agung erupted due to increased tectonic earthquake activity that caused a change in status from 3rd level to 4th level (Bhaskara, 2017:32). The affected people (radius 6 km) around Agung must evacuate to safe areas based on recommendations from the Regional Disaster Management Agency (BPBD) of Karangasem Regency. One of the handling of refugees due to the eruption of Mount Agung in September 2017 is through the local wisdom that is the concept of sister village. The implementation of the sister village concept in handling refugees from Duda Utara Village, Selat District, Karangasem Regency was held in Banjar Lebah Hall, Semarapurakangin Village, Klungkung District, Klungkung Regency, Bali Province. In general, the arrival of refugees from one area to another can disrupt the stability of security in refugee areas, but the people of Semarapurakangin Village, Klungkung Regency are able to carry out refugee handling properly. The sister village implementation was proven to help the residents of Duda Utara Village. Based on this case, the Government of Bali must be a bureaucratic actor that handling disaster by using an alternative model of the sister village cooperation.

2. Method

This research was conducted in Semarapurakangin Village, Klungkung District, Klungkung Regency, Bali Province. The method used in the form of qualitative research by using descriptive data. This research aims to analyze the implementation of the sister village as a solution to the problems caused by the eruption of Mount Agung in 2017.

2.1 Data Collecting

The data is collected using several techniques, namely through deep interview, observation and literature study. The research subjects are those who are directly involved as resource persons and understand the topic of the research. The sample selection technique uses purposive and snowball sampling. Purposive sampling is taking samples from a population based on certain criteria. The snowball sampling is the selected resource person who meets the specified criteria, including competent officials and directly involved in disaster management, especially handling refugees due to Mount Agung eruption (Sugiyono, 2013:125). The intended sources include the following:

- The Regional Disaster Management Agency (BPBD) of Bali
- The Regional Disaster Management Agency (BPBD) of Karangasem Regency
- The Regional Disaster Management Agency (BPBD) of Klungkung Regency
- Volcanology Center and Geological Disaster Mitigation (PVMBG), Mount Agung Observation Post
- Pecalang community leaders or Bali Customary Police

2.2 Analysis

The data was analyzed using qualitative methods by using descriptive data. The data analysis technique used in this research is an interactive model as stated by Miles and Hubberman (2014), which is an analysis technique that is carried out continuously during data collection in the field until data collection is complete so that the data obtained is saturated. The interactive model data analysis technique as stated by Miles and Hubberman (2014:33) consists of data collection, data condentation, data presentation and the final step is drawing conclusions. The steps in data analysis are as follows:

2.2.1 Data Collecting

Data analysis of this research has been carried out from the moment the research data collection took place until the data collection was completed.

2.2.2 Data Condentation

Data condentation is a simplification that is done through selection, focusing and the validity of raw data, notes, interview transcripts, and other empirical findings into meaningful information, thus facilitating conclusion drawing.

2.2.3 Data Presentation

The presentation of data that is often used in qualitative data is narrative. Data presentations in the form of a collection of information arranged systematically and easily understood.

2.2.4 Conclusion

Conclusion is the final step in data analysis is done to see the results of data reduction still refers to the formulation of the problem are the objectives to be achieved. Data that has been compiled is compared with another one to describe conclusions in response to existing problems.

Primary data, secondary data and field survey results obtained were analyzed by description of the results of in-depth interviews and tabulations of sociometric data. Data reduction is done by coding techniques. It should be noted that the codes specified in answering each question form can interact with each other according to the results observed in the field. The validity test of the data is done using the source triangulation technique. The researcher compared the opinions of BPBD Bali, BPBD Karangasem, BPBD Klungkung, PVMBG, community leaders in the form of the Chief of the Pecalang community, as well as the results of observations of the researchers.

3. Results and Discussion

The change in the paradigm of handling disasters by the government that wants to give a greater role to the community is designed as an approach to handling community-based disasters. It aims to encourage and invite more active participation from the community in order to convey the ideas of planning, implementing, and evaluating programs, preparedness, emergency preparedness, response, and recovery in the stages of disaster management.

Mount Agung is the highest point on the island of Bali with a height of 3,142 masl. This volcano with stratovolcano type erupted in 1963, 2017, 2018 and last in March 2019. The impact of the Mount Agung eruption resulted in people living around the slopes have to evacuate. In addition, the Mount Agung eruption also caused losses in the form of material damage and loss of community livelihood resources.

3.1 Establishment of Sister Village in Semarapurakangin Village, Klungkung

In September 2017, the tectonic activity of Mount Agung has increased. Volcanology Center and Geological Disaster Mitigation (PVMBG) raises the status of Mount Agung from level III (standby) to level IV (alert). The intensity of the burst of smoke and volcanic ash from Mount Agung continues to increase with a boom that can be heard up to 12 kilometers. Communities, tourists and climbers are prohibited from doing activities at a 9 km radius from the crater of Mount Agung. The area in the radius must be sterile and empty of activity. This caused a wave of refugees to come to safe areas that had been recommended by the BPBD Karangasem. The following figure depicts disaster-prone areas in the alert condition of the Mount Agung which is mapped at a radius of 6 km from the summit.

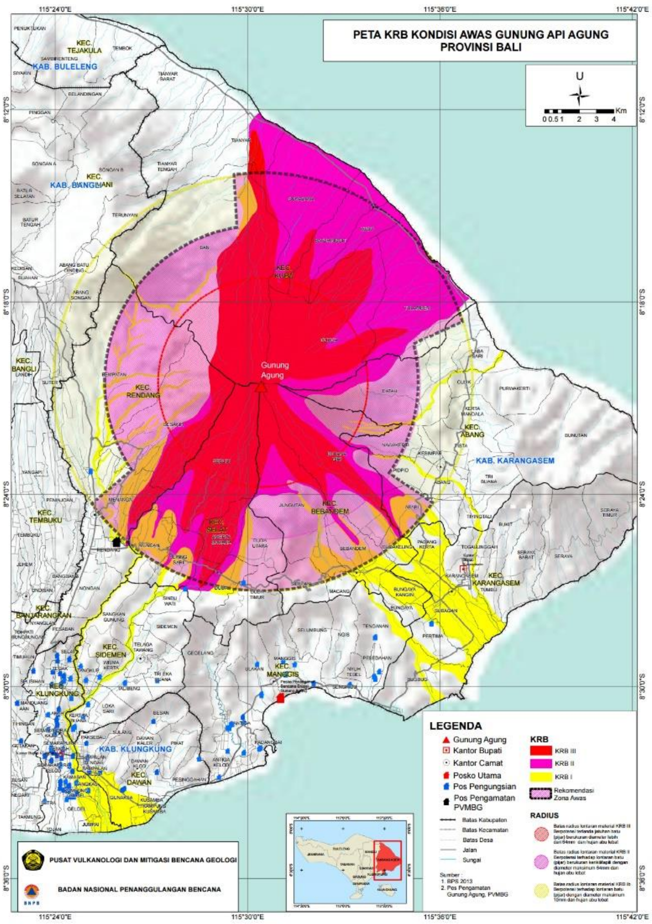

Figure 1. Map of disaster prone areas of the Mount Agung. The picture shows that there are 28 villages in the high vulnerability region of Mount Agung eruption. A safe radius at the level of the 4th level situation within 6 km there are 18 villages around Mount Agung which are vulnerable areas. The other 10 villages have the status of buffer villages.

Source: Volcanology Center and Geological Disaster Mitigation (PVMBG), 2018

The government of Karangasem through the Decree of the Regent of Karangasem No. 14/HK/2018 has determined villages that are included in the dangerous radius of Mount Agung eruption. The government determined 28 villages affected by the eruption of Mount Agung. The list of 28 villages can be seen in the following table.

Table 1. List of villages affected by Mount Agung eruption

Sub-District	Affected Village	
	Village List	Total
Kubu	Tulamben, Kubu, Dukuh, Baturinggit, Sukadana, Ban dan Tianyar (kecuali Tianyar Tengah dan Barat)	7
Sub-District	Affected Village	
	Village List	Total
Abang	Pidpid Atas, Nawa Kerti, Kesimpar Atas (perbatasan dengan Wates Datah), Datah Atas (Kedampal, Karangsari, Wates) dan Ababi Atas (Umanyar, Besang dan sekitarnya)	5
Bebandem	Bhuana Giri, Budakeling (dekat sungai Embah Api), Bebandem Atas (Tihing Sekaa, Tihingan) dan Jungutan	4
Selat	Duda Utara, Amertha Buana, Sebudi, Peringsari Atas (Lusuh, Padangaji), Muncan Atas (Pejeng dan sekitarnya)	5
Rendang	Besakih, Menanga Atas (Batusesa, Tegenan dan sekitarnya), Pempatan Atas (Pemuteran, Gunung Lebah, Keladian) dan Puragae	4
Karangasem	Padangkerta (kecuali Desa Adat Peladung dan Temega), Subagan (kecuali Desa Adat Jasri), dan Karangasem yang dekat dengan Tukad Janga	3

Source: BPBD Karangasem, 2018

When Mount Agung is 4th level status "alert", the safe radius set by PVMBG is 6 km. This is in accordance with the Decree of the Regent of Karangasem No. 14/HK/2018 concerning the establishment of villages and hamlets that are included in a dangerous radius of 6 km from the summit of Mount Agung in Karangasem Regency. Based on these provisions, 10 villages in 5 sub-districts in Karangasem Regency were included in the category of high vulnerability. The 10 villages include the following:

Table 2. List of villages and hamlets that enter within a 6 km radius from the summit of Mount Agung

Sub-District	Danger Area	
	Village	Hamlet
Rendang	Besakih	Temukus, Angsoka, Kidulingkreteg, Br.Kesimpar
Kubu	Ban	Bunga, Daya, Cegi, Pengalusan, Belong, Pucang, Bonyoh, Cucut
	Dukuh	Dukuh, Batu Giling, Buana Kusuma, Pandan Sari
	Kubu	Juntal Kaja
	Baturinggit	Bantas
Abang	Datah	Kedampal, Karangsari, Juwuk, Wates
	Nawakerti	Batukawan, Baukangin, Laga
Bebandem	Buana Giri	Ttanah Aron, Nangka, Kemoning, Bhuana Kerta
	Jungutan	Yeh Kori, Kubu Pangi, Untalan, Galih
Selat	Sebudi	Lebih, Telung Buana, Badeg Dukuh, Sogra, Pura, Badeg Tengah, Desa Adat Sebun

Source: Decree of Karangasem Regent No. 14/HK/2018, 2018

One of the implementation of the sister village as an alternative to handling Mount Agung eruption refugees was held in Semarapurakangin Village, Klungkung Regency which accommodates refugees from Duda Utara Village, Karangasem Regency. Previously, BPBD Karangasem had coordinated with safe areas around Karangasem Regency to serve as buffer villages. The buffer villages are spread in three districts, including Bangli Regency, Singaraja Regency and Klungkung Regency. Villages identified as being exposed to the Mount Agung eruption were given information and mitigation from the BPBD Karangasem through traditional village leaders and Pecalang. The appeal of the BPBD Karangasem during the Mount Agung eruption was to immediately evacuate to one of the villages that had been registered as a refugee camp. This concept is called the sister village. The practice of implementing the sister village model between the Duda Utara Village and the Semarapurakangin village was used as one of the bases for determining the local wisdom of the sister village in other regions as a form of anticipation and solution for handling refugees during the Mount Agung eruption.

The sister village model is an attempt to unite two or more pairs of villages is a planned cooperative relationship with refugee management when a disaster occurs. The sister village model is implemented to reduce disaster risk in the form of injuries, loss of property to death. This is supported by the buffer village as a location for refugee placement both in residents homes and public facilities (Avianti, 2015:117). Sister village is a form of cooperation between disaster-affected villages and safe villages.

The implementation of disaster management is a series of efforts which include the establishment of development policies that are at risk of disasters, disaster prevention activities, emergency response and rehabilitation (Government Regulation of the Indonesian Republic Number 21 of 2008 concerning the implementation of disaster management). The implementation of disaster management involves multiple parties, including the implementation of the sister village model. The government in this case through the Regional Disaster Management Agency cannot carry out the implementation itself. Regional Disaster Management Agency requires assistance and coordination from various parties such as the community and business or private non-government. Parties involved in implementing the sister village model of Mount Agung eruption handling refugees are between the Duda Utara Village and Semarapurakangin Village.

3.2 Procedures of Sister Village Implementation

The implementation of the sister village model between affected villages and buffer villages runs systematically. If there are signs of an eruption of Gunung Agung, residents of the mountainside community, in this case, the people of Duda Utara Village, are heading towards a buffer village, in this case Semarapurakangin Village to flee. This implementation took place after an agreement between the two villages. Synergis and the coordination of the inter-village sister village involving Pasebaya (Pasemetonan Jaga Baya, brotherhood carried out jointly in the face of risk) which is the values of local wisdom that shows the resilience of the community in the face of disasters.

The people of Duda Utara Village while taking refuge in the Semarapurakangin Village have various activities to revive the economy independently without continuing to expect help from others. One of them is making Canangsari handicrafts to be used as Hindu offerings. Besides being able to sell Canangsari handicrafts, the results are used to add food ingredients everyday in the refuge.

3.3 Benefits of Implementing Sister Village

The advantages of implementing the sister village include the following:

- The people of Duda Utara Village who were victims of the Mount Agung eruption were facilitated to get a place of refuge because it was arranged with

good and clear agreement and coordination, so that in the event of the Mount Agung eruption the evacuation routes of affected victims could proceed in an orderly manner.
- Make it easy to calculate of the amount of assistance, health, education and logistics needs.
- The rehabilitation and recovery of victims has become more coordinated.
- The economy of the residents of Dadu Utara Village is still able to run even though it is being affected by the disaster.
- Refugees in Banjar Lebah Hall Semarapurakangin Village feels comfortable because of the ease of access to refugee camps, health facilities and clean water.

3.4 Constraints of Sister Village Implementation
Constraints in the implementation of sister village include some people are not willing to live in refuge camps and prefer to live in a family homes. This has made it difficult to identify the full strength of affected village communities who have taken refuge in the buffer village through the sister village model. In addition, the fulfillment of basic needs of refugees has not run optimally. Although a lot of assistance has come for refugees, not all of the assistance can be utilized to the maximum because the assistance sent is not in accordance with the needs of refugees.

4. Conclusion
The implementation of the sister village policy as part of community-based disaster management independently so as to reduce dependence on government and other people. Implementation in Bali is based on the local wisdom of the lives of people who work together, namely Nguopin (supporting neighbors/close relatives and Pasebaya). The sister village can be an alternative solution in handling victims of the Mount Agung eruption affected in September 2017. The implementation of a well-organized sister village facilitates refugees. The affected people already know the location of the evacuation. The government (especially BPBD of Bali and Karangasem), the sister village model can be used as one of the effective models of community-based disaster management. The government through the BPBD is also facilitated in carrying out quick responses to data collection and distribution of aid. Each affected village and buffer village must have a clear Memorandum of Understanding (MoU) facilitated by each Pasebayan representative and the government through BPBD to minimize misunderstandings and potential conflicts.

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