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TSUNAMI VULNERABILITY IN WEST PADANG, NORTH PADANG AND KOTO TANGAN SUB-DISTRICTS

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ABSTRACT: Padang City is one of the cities on the coast of West Sumatra, where coastal areas have the potential for tsunami disasters, which can cause significant losses. Therefore, it is necessary to know the level of vulnerability to tsunami disasters to mitigate disasters. According to BPBD Padang City, in 2010, Koto Tangah Subdistrict, North Padang Subdistrict, and West Padang Subdistrict are subdistricts with 28 villages in the red zone. Therefore, it is necessary to study the level of tsunami vulnerability in the red zone of Koto Tangah Subdistrict, North Padang Subdistrict, and West Padang Subdistrict. The secondary method is a data collection method in the form of population and GRDP obtained from BPS Padang City in Figures, building data received from the 2022 consultant digitization results, and land use data from the 2010-2030 RTRW of Padang City. The analysis method, namely descriptive and quantitative analysis, is also used with Perka BNPB No. 02 of 2012 standards concerning General Guidelines for Disaster Risk Assessment. Based on the results of the study of the three sub-districts, there are two classifications, namely high and medium; for West Padang Sub-district, all urban villages have a high level of vulnerability, while the other two sub-districts have a high and medium level of vulnerability.

Keywords: Vulnerability, Tsunami, Disaster, Padang

1. INTRODUCTION

Tsunami disasters have great potential to occur in Indonesia with the condition of Indonesia which is a maritime country causing a large impact if not minimized. Conditions in Indonesia that are prone to tsunami disasters are a challenge for scientists to jointly overcome and solve this problem for the sake of survival that is always side by side with disaster-prone areas [1-4]. Tsunamis have the capacity to inflict substantial economic damage on vital infrastructure, cause widespread social damage through mass casualties, and generate adverse environmental impacts such as erosion, sediment accumulation and flooding [5-7].

Tsunamis have been considered a major disaster and many types of research have been conducted to assess their vulnerability and risk to coastal areas. Tsunami risk assessments have been conducted to quantify the potential damage and loss of areas due to tsunamis. Tsunami vulnerability is analyzed after the evaluation of tsunami potential and probability. It depends on how close the community is to the source of the hazard, and the social and economic characteristics [8-10]. West Sumatra was affected by a tsunami that originated near the southern Mentawai islands on September 12, 2007. Many villages and buildings were affected by the tsunami, which reached 100 to 200 m from the Bengkulu coastline and as far as 300 m to the Mentawai coastline with a tsunami height of 2.15 to 3.6 m. Padang City is one of the cities located on the coast of West Sumatra, which has a high potential for tsunami disasters that can cause large losses. Therefore, it is necessary to know the level of vulnerability to tsunami disasters for disaster mitigation. Based on the BPBD of Padang City in 2010, Koto Tangah District, Padang Utara District and Padang Barat Districts with 28 villages included in the red zone, therefore it is necessary to study the level of tsunami vulnerability in the red zone of Koto Tangah District, Padang Utara District and Padang Barat Districts.

Vulnerability is a condition determined by physical, social, economic and environmental factors or processes that result in a reduced ability to cope with hazards. How much a community, building, service or an area will be damaged or disrupted by the impact of a particular hazard, which depends on its condition, the type of building and infrastructure materials, and its proximity to a hazardous or disaster-prone area [11-14]. The vulnerability of coastal areas to natural disasters is increasing along with the increasing concentration

of population making coastal areas the centers of economic activity and densely populated cities [15].

[16] environmental vulnerability is based on physical factors only, so it is necessary to conduct further studies on the level of environmental vulnerability based on resources that will be affected by the impact of the tsunami disaster itself, in this case in the form of building density, population density, and the percentage of fishing communities in the coastal area. All of these aspects need to be studied because based on the phenomenon of tsunami disasters that have occurred, physical factors must also be supported by resource factors that are damaged by the disaster. Because an area that is vulnerable based on physical environmental factors does not necessarily have a high level of vulnerability to tsunamis, because it is not supported by factors of high population density and building density.

The high vulnerability class raises mitigation policy recommendations such as activating family planning programs, conducting mitigation socialization, planting mangrove trees, not deforesting land allotments for protected forests and natural forests, and not building buildings in dense areas [17]. The physical vulnerability of an area has a considerable influence on the damage and losses caused by tsunamis that can occur at any time [15-18]. Buildings are at risk and must be protected against tsunamis that can occur at any time. Buildings are vulnerable to damage from tsunamis. In addition, buildings have a high economic value and added value as a place to live. Therefore, understanding the vulnerability of buildings to tsunamis is essential for developing effective mitigation strategies and improving the resilience of coastal communities.

Factors that can increase the chances of social vulnerability include family heads who do not have jobs and side income, the amount of primary income that is still relatively low, the lack of attention to vulnerability reduction for vulnerable groups, the absence of integration of disaster vulnerability reduction with toddler *posyandu* and elderly classes, the absence of detailed data on the existence of disabilities, and the small number of women who work and have additional income. Efforts made by the government to overcome social vulnerability are still, in general, not paying attention to each group of people included in vulnerable groups (toddlers, older people, those with disabilities, and women).

Tsunami hazards are natural disasters that cannot be prevented but can be mitigated. To reduce the impact of tsunami hazards in areas with a high vulnerability to tsunami disasters, efforts can be made to reduce vulnerability and increase capacity. Physical vulnerability describes the physical fragility of the tsunami-prone regions. If a disaster occurs in a vulnerable physical condition, it will cause a significant loss of impact, in this case, building damage. The higher the building density in an area, the higher the vulnerability to tsunamis because the number of objects that may be exposed to tsunami hazards is greater. The lower the building density in an area, the lower the vulnerability to tsunamis because the number of objects that may be exposed to tsunamis is small. Social vulnerability describes the level of social fragility in tsunami-prone areas. A disaster in a socially vulnerable area will result in significant losses, such as fatalities. The higher the density of each city or district, the higher its vulnerability to tsunamis. The map of economic vulnerability to tsunamis produces three vulnerability classes: low vulnerability class, medium vulnerability class, and high vulnerability class. The economic vulnerability map is another factor that exacerbates the population vulnerability in the coastal areas of West Sumatra Province to tsunamis [19-21].

The land elevation parameter is the most instrumental in analyzing an area's vulnerability to tsunami disasters because the land elevation will be related to the tsunami height. If the maximum tsunami wave height that reaches the coast ranges from 4 to 24 m, then land elevations of more than 25 meters above sea level will be safe from tsunami disasters. Therefore, the elevation of the place is very influential.

2. METHODS

The type of research used is descriptive quantitative on the tsunami vulnerability of West Padang Sub-district, North Padang Sub-district, and Koto Tangah Sub-district using numerical data, which shows the classification of areas based on the vulnerability categories of high zone, medium zone, and low zone. The first data collection method is a secondary survey, a secondary survey is a survey method carried out to agencies that aim to obtain data. The type of data to be collected is social and economic. The analysis methods are descriptive and quantitative. Quantitative techniques involve mathematical calculations using the Regulation of BNPB No. 02 standards of 2012 concerning General Guidelines for Disaster Risk Assessment, with social vulnerability variables calculated by population density, physical vulnerability, economic vulnerability, and environmental vulnerability. The following are the score and weight parameters for each aspect.

Table 1 Social Vulnerability Parameters

Parameter	Weight (%)	Class	Score		
		Low	Currently	Tall	
Population density	60	<500 people/Km2	500-1000 people/Km2	>1000 people/Km2	60%
Sex Ratio (10%)	40	< 20%	20-40%	>40%	40%
Poverty Ratio (10)%					
Disabled Person Ratio (10%)					
Age Group Ratio (10%)					

Table 2 Economic Vulnerability Parameters

Parameters	Weight (%)		Class		Score
		Low	Currently	Tall	
Productive Land	60	<50 million	50-200 million	>200 million	Class/Max Value Class
GRDP	40	<100 million	100-300 million	>300 million	

Table 3 Physical Vulnerability Parameters

Parameters	Weight (%)		Class		Score
		Low	Currently	Tall	
House	40	<400 million	400-800 million	>800 million	Class/Max Class Value
Public facilities	30	< 500 million	500 million - 1 billion	> 1 M	
Critical Facilities	30	<500 million	600 million - 1 billion	> 1 M	

Table 4 Environmental Vulnerability Parameters

Parameters	Weight (%)		Class		Score
		Low	Currently	Tall	
Protected forest	30	<20 Ha	20-50 Ha	>50 Ha	Class/Value Max Class
Natural Forest	30	< 25 Ha	25-75 Ha	>75 Ha	
Mangrove Forest	40	< 10 Ha	10-30 Ha	>30 Ha	

3. RESULT AND DISCUSSION

3.1 Social Vulnerability

Social vulnerability is a condition where social groups are vulnerable to disasters measured from several aspects. The social vulnerability index is obtained from the calculation of the overall value of the aspects of population density, sex ratio, population by age group, population by disability, and the number of poor people.

Table 5 Social vulnerability index

Subdistrict	Ward	Population density	Type Ratio Sex	Group Ratio Age	Population Ratio Poor	Ratio Disability	Total Score	Class
Koto Tangah	Dadok Tunggul Hitam	1.8	0.3	0.1	0.1	0.1	2.4	Tall
	Aie Pacah	1.8	0.3	0.1	0.1	0.1	2.4	Tall
	Bungo Pasang	1.2	0.3	0.1	0.1	0.1	1.8	Low
	Parupuk Tabing	1.8	0.3	0.1	0.1	0.1	2.4	Tall
	Batang Kabung Ganting	1.8	0.3	0.1	0.1	0.1	2.4	Tall
	Lubuk Buaya	1.8	0.3	0.1	0.1	0.1	2.4	Tall
	Padang Sarai	1.8	0.3	0.1	0.1	0.1	2.4	Tall
	Koto Panjang Ikua Koto	1.8	0.3	0.1	0.1	0.1	2.4	Tall
	Pasie Nan Tigo	1.2	0.3	0.1	0.1	0.1	1.8	Low
	Koto Pulai	1.2	0.3	0.1	0.1	0.1	1.8	Low
	Batipuh Panjang	1.8	0.3	0.1	0.1	0.1	2.4	Tall
TOTAL							2.23	Tall
North Padang	Gunung Pangilun	1.8	0.3	0.1	0.1	0.1	2.4	Tall
	Ulak Karang Selatan	1.8	0.3	0.1	0.1	0.1	2.4	Tall
	Ulak Karang Utara	1.8	0.3	0.1	0.1	0.1	2.4	Tall
	Air Tawar Timur	1.8	0.3	0.1	0.1	0.1	2.4	Tall
	Air Tawar Barat	1.8	0.3	0.1	0.1	0.1	2.4	Tall
	Alai Parak Kopi	1.8	0.3	0.1	0.1	0.1	2.4	Tall
	Lolong Belanti	1.8	0.3	0.1	0.1	0.1	2.4	Tall
TOTAL							2.4	Tall
West Padang	Belakang Tangsi	1.8	0.3	0.3	0.1	0.1	2.4	Tall
	Olo	1.8	0.3	0.3	0.1	0.1	2.4	Tall
	Ujung Gurun	1.8	0.3	0.3	0.1	0.1	2.4	Tall
	Berok Nipah	1.8	0.3	0.3	0.1	0.1	2.4	Tall
	Kampung Pondok	1.8	0.3	0.3	0.1	0.1	2.4	Tall
	Kampung Jao	1.8	0.3	0.3	0.1	0.1	2.4	Tall
	Purus	1.8	0.3	0.3	0.1	0.1	2.4	Tall
	Padang Pasir	1.8	0.3	0.3	0.1	0.1	2.4	Tall
	Rimbo Kaluang	1.8	0.3	0.3	0.1	0.1	2.4	Tall
	Flamboyan Baru	1.8	0.3	0.3	0.1	0.1	2.4	Tall
TOTAL							2.4	Tall

Based on the social vulnerability index table above, these three sub-districts have the same average score in each aspect. Where each element includes population density, sex ratio, age group ratio, poor population ratio, and disability ratio, but for population density, there are three sub-districts with a lower score of 1.2, meaning that the three sub-districts have a lower population density than other sub-districts. Sorted by the level of vulnerability from the highest, namely Padang Barat Sub-district, Padang Utara Sub-district, and Koto Tangah Sub-district, based on aspects of social vulnerability, namely population density, sex ratio, age group ratio, disabled population ratio, and poor population. There are two classes on the social vulnerability map, namely marked in red for the high vulnerability class and green for the low vulnerability class.

3.2 Physical Vulnerability

The physical vulnerability index is obtained from the calculation of losses from aspects of house buildings, public facilities and critical facilities.

Table 6. Physical Vulnerability Index

Subdistrict	Ward	Building House	Facility General	Facility Critical	Total Score	Class
Koto Tangah	Dadok Tunggul Hitam	1.2	0.9	0.9	3	Tall
	Aie Pacah	1.2	0.9	0.9	3	Tall
	Bungo Pasang	1.2	0.9	0.9	3	Tall
	Parupuk Tabing	1.2	0.9	0.9	3	Tall
	Batang Kabung Ganting	1.2	0.9	0.9	3	Tall
	Lubuk Buaya	1.2	0.9	0.9	3	Tall
	Padang Sarai	1.2	0.9	0.3	2.4	Low
	Koto Panjang Ikua Koto	1.2	0.9	0.9	3	Tall
	Pasie Nan Tigo	1.2	0.9	0.3	2.4	Low
	Koto Pulai	1.2	0.9	0.3	2.4	Low
	Batipuh Panjang	1.2	0.9	0.9	3	Tall
TOTAL					2.83	Tall

North Padang	Gunung Pangilun	1.2	0.9	0.9	3	Tall
	Ulak Karang Selatan	1.2	0.9	0.9	3	Tall
	Ulak Karang Utara	1.2	0.9	0.3	2.4	Low
	Air Tawar Timur	1.2	0.9	0.9	3	Tall
	Air Tawar Barat	1.2	0.9	0.9	3	Tall
	Alai Parak Kopi	1.2	0.9	0.9	3	Tall
	Lolong Belanti	1.2	0.9	0.9	3	Tall
TOTAL					2.48	Low
West Padang	Belakang Tangsi	1.2	0.9	0.3	2.4	Low
	Olo	1.2	0.9	0.9	3	Tall
	Ujung Gurun	1.2	0.9	0.3	2.4	Low
	Berok Nipah	1.2	0.9	0.3	2.4	Low
	Kampung Pondok	1.2	0.9	0.3	2.4	Low
	Kampung Jao	1.2	0.9	0.9	3	Tall
	Purus	1.2	0.9	0.9	3	Tall
	Padang Pasir	1.2	0.9	0.9	3	Tall
	Rimbo Kaluang	1.2	0.9	0.3	2.4	Low
	Flamboyan Baru	1.2	0.9	0.3	2.4	Low
TOTAL					2.64	Currently

Based on the physical vulnerability index table above, after calculating the loss value of residential buildings, public facilities and critical facilities, two total scores were obtained, namely a score of 3 (high) and a score of 2.4 (low)Where each of these aspects include house buildings, public facilities and critical facilities. For sub-districts that have low scores are influenced by fewer critical facilities, making their scores lower than other sub-districts. Critical facilities consisting of hospitals, health centers, and military areas. So that they are sorted from the highest level of vulnerability, namely Koto Tangah District, Padang Barat District and Padang Utara District. On the physical vulnerability map there are 3 classes, namely marked in red with high vulnerability class, yellow with moderate vulnerability and in green with low vulnerability class.

3.3 Economic Vulnerability

The economic vulnerability index results from the calculation of the value of losses from the aspects of GRDP and productive land.

Table 7. Economic Vulnerability Index

Subdistrict	Ward	Productive Land	GRDP	Total Score	Class
Koto Tangah	Dadok Tunggul Hitam	0.6	0.4	1	Low
	Aie Pacah	1.8	0.4	2.2	Currently
	Bungo Pasang	1.8	0.4	2.2	Currently
	Parupuk Tabing	1.8	0.4	2.2	Currently
	Batang Kabung Ganting	1.8	0.4	2.2	Currently
	Lubuk Buaya	1.8	0.4	2.2	Currently
	Padang Sarai	1.8	0.4	2.2	Currently
	Koto Panjang Ikua Koto	1.8	0.4	2.2	Currently
	Pasie Nan Tigo	0.6	0.4	1	Low
	Koto Pulai	1.8	0.4	2.2	Currently
	Batipuh Panjang	1.8	0.4	2.2	Currently
TOTAL				1.98	Currently
North Padang	Gunung Pangilun	0.6	0.4	1	Low
	Ulak Karang Selatan	0.6	0.4	1	Low
	Ulak Karang Utara	0.6	0.4	1	Low
	Air Tawar Timur	0.6	0.4	1	Low
	Air Tawar Barat	0.6	0.4	1	Low
	Alai Parak Kopi	1.2	0.4	1.6	Low
	Lolong Belanti	0.6	0.4	1	Low
TOTAL				1.08	Low
West Padang	Belakang Tangsi	0.4	0.6	1	Low
	Olo	0.4	0.6	1	Low
	Ujung Gurun	0.4	0.6	1	Low

	Berok Nipah	0.4	0.6	1	Low
	Kampung Pondok	0.4	0.6	1	Low
	Kampung Jao	0.4	0.6	1	Low
	Purus	0.4	0.6	1	Low
	Padang Pasir	0.4	0.6	1	Low
	Rimbo Kaluang	0.4	0.6	1	Low
	Flamboyan Baru	0.4	0.6	1	Low
TOTAL				1	Low

Based on the economic vulnerability index table above, after calculating the loss value of productive land and GRDP, two scores were obtained: a medium score of 2.2 and a low score of 1. The medium class is caused by productive land in the sub-district, and the class does not have productive land. The economic vulnerability of the tsunami is sorted from the highest level of vulnerability, namely Koto Tangah District, Padang Utara District, and Padang Barat District. There are two classes on the economic vulnerability map, namely marked in yellow with moderate vulnerability and green with low vulnerability class.

3.4 Environmental Vulnerability

The environmental vulnerability index is the result of calculating the loss value from the protected forest, natural forest and mangrove forest aspects.

Table 8 Environmentaln Vulnerability Index

Subdistrict	Ward	Forest Protect	Forest Natural	Forest Mangrove	Total Score	Class
Koto Tangah	Dadok Tunggul Hitam	0.3	0.3	0.4	1	Low
	Aie Pacah	0.3	0.3	0.4	1	Low
	Bungo Pasang	0.3	0.3	0.4	1	Low
	Parupuk Tabing	0.3	0.3	0.4	1	Low
	Batang Kabung Ganting	0.3	0.3	0.4	1	Low
	Lubuk Buaya	0.3	0.3	0.4	1	Low
	Padang Sarai	0.3	0.3	0.4	1	Low
	Koto Panjang Ikua Koto	0.6	0.3	0.4	1.3	Tall
	Pasie Nan Tigo	0.6	0.3	0.4	1.3	Tall
	Koto Pulai	0.3	0.3	0.4	1	Low
	Batipuh Panjang	0.3	0.3	0.4	1	Low
TOTAL					1.05	Low
North Padang	Gunung Pangilun	0.3	0.3	0.4	1	Low
	Ulak Karang Selatan	0.3	0.3	0.4	1	Low
	Ulak Karang Utara	0.3	0.3	0.4	1	Low
	Air Tawar Timur	0.3	0.3	0.4	1	Low
	Air Tawar Barat	0.3	0.3	0.4	1	Low
	Alai Parak Kopi	0.3	0.3	0.4	1	Low
	Lolong Belanti	0.3	0.3	0.4	1	Low
TOTAL					1	Low
West Padang	Belakang Tangsi	0.3	0.3	0.4	1	Low
	Olo	0.3	0.3	0.4	1	Low
	Ujung Gurun	0.3	0.3	0.4	1	Low
	Berok Nipah	0.3	0.3	0.4	1	Low
	Kampung Pondok	0.3	0.3	0.4	1	Low
	Kampung Jao	0.3	0.3	0.4	1	Low
	Purus	0.3	0.3	0.4	1	Low
	Padang Pasir	0.3	0.3	0.4	1	Low
	Rimbo Kaluang	0.3	0.3	0.4	1	Low
	Flamboyan Baru	0.3	0.3	0.4	1	Low
TOTAL					1	Low

Based on the environmental vulnerability index table above, after calculating the value of losses in protected forests, natural forests, and mangrove forests, two total scores were obtained, namely 1.3 (high) and 1 (low). The presence of protected forests in the high-class sub-districts is affected by the presence of protected forests, which involves the environmental vulnerability score. This means that

if a tsunami occurs, the level of ecological losses caused in the sub-district is greater. Environmental tsunami vulnerability is sorted from the highest level of vulnerability, namely Koto Tangah District, Padang Utara District, and Padang Barat District. There are two classes on the physical vulnerability map, namely marked in red for the high vulnerability class and green for the low vulnerability class.

3.5 Vulnerability Index

After analyzing the 4 vulnerability indicators, the next step is to analyze the level of disaster vulnerability. The level of disaster vulnerability is how vulnerable an area is to the impact of a tsunami disaster. Where the weight of social vulnerability is 40%, Physical Vulnerability 25%, Economic Vulnerability 25% and Environmental Vulnerability 10%.

Table 9. Tsunami Vulnerability Score

Subdistrict	Ward	Social Vulnerability (0.4)	Physical Vulnerability (0.25)	Economic Vulnerability (0.25)	Environmental Vulnerability (0.1)	Total	Class
Koto Tangah	Dadok Tunggul Hitam	0.96	0.75	0.25	0.1	2.06	Tall
	Aie Pacah	0.72	0.75	0.55	0.1	2.12	Currently
	Bungo Pasang	0.96	0.75	0.55	0.1	2.36	Tall
	Parupuk Tabing	0.96	0.75	0.55	0.1	2.36	Tall
	Batang Kabung Ganting	0.96	0.75	0.55	0.1	2.36	Tall
	Lubuk Buaya	0.96	0.75	0.55	0.1	2.36	Tall
	Padang Sarai	0.96	0.6	0.55	0.1	2.21	Currently
	Koto Panjang Ikua Koto	0.96	0.75	0.55	0.13	2.39	Tall
	Pasie Nan Tigo	0.72	0.6	0.25	0.13	1.7	Currently
	Koto Pulai	0.72	0.6	0.55	0.1	1.97	Currently
	Batipuh Panjang	0.96	0.75	0.55	0.1	2.36	Tall
TOTAL						2.20	Tall
North Padang	Gunung Pangilun	0.96	0.675	0.25	0.1	1.98	Tall
	Ulak Karang Selatan	0.96	0.6	0.25	0.1	1.91	Currently
	Ulak Karang Utara	0.96	0.6	0.25	0.1	1.91	Currently
	Air Tawar Timur	0.96	0.6	0.25	0.1	1.91	Currently
	Air Tawar Barat	0.96	0.6	0.25	0.1	1.91	Currently
	Alai Parak Kopi	0.96	0.675	0.4	0.1	2.13	Tall
	Lolong Belanti	0.96	0.6	0.25	0.1	1.91	Currently
TOTAL						1.95	Tall
West Padang	Belakang Tangsi	0.72	0.6	0.25	0.1	1.99	Tall
	Olo	0.72	0.75	0.25	0.1	2.14	Tall
	Ujung Gurun	0.72	0.6	0.25	0.1	1.99	Tall
	Berok Nipah	0.72	0.6	0.25	0.1	1.99	Tall
	Kampung Pondok	0.72	0.6	0.25	0.1	1.99	Tall
	Kampung Jao	0.72	0.75	0.25	0.1	2.14	Tall
	Purus	0.72	0.75	0.25	0.1	2.14	Tall
	Padang Pasir	0.72	0.75	0.25	0.1	2.14	Tall
	Rimbo Kaluang	0.72	0.6	0.25	0.1	1.99	Tall
	Flamboyan Baru	0.72	0.6	0.25	0.1	1.99	Tall
TOTAL						2.05	Tall

From the table above, it can be seen that the results of the weight multiplication of each vulnerability are totaled to determine the sub-district with the highest level of tsunami vulnerability. Tsunami vulnerability is sorted from the highest level of vulnerability, namely Koto Tangah Sub-district, Padang Barat Sub-district and Padang Utara Sub-district based on aspects of social vulnerability, physical vulnerability, economic vulnerability and environmental vulnerability. In Koto Tangah Sub-district, there are medium and high classes where the high class in this Sub-district is caused by social aspects and economic aspects in several sub-districts. In Padang Utara Sub-district, the high class is caused by physical aspects and economic aspects, while in Padang Barat Sub-district, it has a high class caused by physical aspects which have a greater influence on the total tsunami vulnerability score. On the physical vulnerability map, there are 2 classes, namely

marked with red for high vulnerability class and yellow for moderate vulnerability.

5. CONCULASION

Based on the results of this study, it can be concluded that the social vulnerability of tsunamis in Koto Tangah, North Padang, and West Padang sub-districts has a high class, sorted by the level of vulnerability from the highest, namely West Padang, North Padang, and Koto Tangah sub-districts based on aspects of social vulnerability, population density, sex ratio, age group ratio, disability population ratio, and poor population.

Tsunami physical vulnerability in the Koto Tangah sub-district is in the high class, the North Padang sub-district is in a low class, and the West Padang sub-district is in the medium class, so sorted by the level of vulnerability from the highest, namely Koto Tangah sub-district West Padang sub-district, and North Padang sub-district.

The economic vulnerability to a tsunami in the Koto Tangah sub-district is high, while in the North Padang and West Padang sub-districts, it is low. Therefore, the sub-districts are sorted by the level of vulnerability, from the highest to the Koto Tangah, North Padang, and West Padang sub-districts.

Tsunami environmental vulnerability in Koto Tangah, North Padang, and West Padang sub-districts has a low class, sorted by the level of vulnerability from the highest, namely Koto Tangah, North Padang, and West Padang sub-districts. Tsunami vulnerability in Koto Tangah, North Padang, and West Padang sub-districts has a high class, sorted by the level of vulnerability from the highest, namely Koto Tangah, West Padang, and North Padang sub-districts based on aspects of social vulnerability, physical vulnerability, economic vulnerability, and environmental vulnerability.

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