

Revitalization of Coastal Area Pasie Nan Tigo Padang City for Hazard Mitigation

¹ HARYANI, ² LUSI UTAMA

Faculty of Civil and Planning Engineering University of Bung Hatta Padang Jl. Sumatera Ulakkarang Padang
email: irharyanimtp@yahoo.co.id

Abstract. The coastal neighborhood of Pasie Nan Tigo, city of Padang after the earthquake of 2007 and 2009 is threatened by various disasters. Therefore, the efforts should be made in comprehensive way to reduce the risk of the disasters through community participation. The study conducted by Haryani (2013) on the mitigation efforts in coastal areas shows that the environmental revitalization with active disaster mitigation model needed to be done before the disaster occurred. The method used in the revitalization of disaster mitigation in coastal areas is the Active Hazard Mitigation Model (non-physical) with community participation and Passive Mitigation Models (physical) with community empowerment. The results of the study are that the communities of the coastal areas, Pasir Nan Tiga have a better knowledge and understanding on the threat of coastal disasters and on the disaster mitigation. In addition, the communities also have a better knowledge on the importance of revitalizing the market place and settlements after the earthquake. The results of the implementation of passive mitigation models to the community empowerment are: (a) basic map / forum administration, (b) a map of evacuation routes, (c) a map of problems mainly related to the disaster, (d) a disaster vulnerability map of Pasie Nan Tigo Village, and (e) trees-barriers to avoid erosion / abrasion in the coastal neighborhood of Pasie Nan Tigo, city of Padang.

Keywords: revitalization, coastal, mitigation disaster

Introduction

Since 2006, a number of research and community service activities have been carried out in Padang Pasie Nan Tigo - Padang, particularly in response to the various issues such as disaster and its impacts, social, economic, and even the environmental issues which have been identified before. These research and activities have been funded by Directorate of Higher Education of Bung Hatta University, Government of Padang, and NGOs. The disasters potentially threaten the villages in coastal areas, most inhabited by fishermen, are indentified as; a) tidal wave. On Thursday 17 and 18 May 2007, the tidal wave hit the coastal areas of West Sumatra. According to BMKG, this condition was caused by the symmetrical position of the sun, moon, and the earth. Moreover, the distance of them were relatively closer than usual so that the

wave became higher. Besides, there were also some regions encountered this tidal wave, they were Bengkulu, southern coast of Java, Bali and NTB.

Haryani (2007) said that the 2-days tidal wave created sandbanks which piled up public facilities and infrastrucuter as high as 1,20 m. The road along the coastal side as long as 700 m, the only access to the coastal villages, was covered by the thick sand after stricken by the 3 – 4 m high wave. In addition, the wavelength was recorded as long as 65 to 80 m when it crept into the land.

It was recorded in Padang, that 474 houses were damaged, which were 73 badly damaged, 34 moderately damaged, and 367 lightly damaged. Meanwhile, according to the data recorded by Kimpraswil – city of Padang, in 6 subdistricts and 15 *kelurahan* of coastal areas, there were 201 buildings

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badly damaged, 148 lightly damaged, and 140 moderately damaged.

In response to this disaster, the government of Padang has planned to relocate the houses in the hazard zones. In this case, BPN has prepared a land area of 2,7 hectares in Juruai Bungus, Bay of Kabung from 4 hectares needed.

From this fact, it is concluded that the coastal settlement of Pasie Nan Tigo is the disaster hazard zone particularly by tidal wave.

If we see more general, the geographical location sets Pasie Nan Tigo into the hazardous area of tidal wave. Pasie Nan Tigo is directly adjacent to the deep sea of Indian Ocean, moreover it has open shape of coastlines. These geographical and oceanographical characteristics potentially induce natural disaster such as high tidal wave.

Tsunami wave; another kind of natural disaster that threaten Pasie Nan Tigo is tsunami. According to experts that the high potential tsunami disaster is mainly because the Indonesian territory is part of the geological process located on three tectonic plates, namely Indo-Australian, Eurasian and Pacific.

The history has written that tsunami has been recorded 3 times that happened in West Sumatra, they were in 1797, 1833 and 1861 (Source: Indonesia's tsunami region in Earthquake & Tsunami).

A researcher, Prof. Kerry Sieh (2006), from the California Institute of Technology has conducted a simulation based on the amount of slip of Eurasian and Australian Slab on the ocean floor of northwestern Mentawai Islands and coastal bathymetry of West Sumatra. The slip of the slab as high as 10 m with a magnitude of 7 on the Richter scale caused a tsunami as high as 4 m above mean sea level infiltrated to the land as far as 1 km. If the plates slip reaches 20 m high and a magnitude of 8.5 on the Richter scale, the tsunami wave increases as high as 6 meters above mean sea level with the infiltration to the land as far as 3 km.

In response to the research above, that the ideal tsunami safe zone in the coastal areas of West Sumatra should exceed the size of the tsunami height. However, the settlements of Pasie Nan Tigo are located at a height of 0-2 m above mean sea level, so they are highly vulnerable to disasters. Therefore, efforts should be made to minimize the impact

caused by the tsunami.

Referring to the Law of living environment, of which states that 200 m of the coastline should be designated as a green zone. It is implicitly stated in the law, presidential decrees, and ministerial decrees that the green zone in the coastal region is very important as a conservation area. It can be understood because the buffer areas are necessary at border area of land and sea.

Furthermore, in RUTR of Padang in 2004, it was assigned some policies that the beach area, in the average distance of 100 m from the highest tide, functions as following: (a) Protecting the city environment against seawater intrusion; (b) Controlling flood due to tides; (c) Securing coastal ecosystems; (d) Abrasion and coastal erosion; the changes of beach slope (beach gradient) becoming steeper than before is one of the indicators that the coastal areas are experiencing abrasion. Regional breaker zone (waves break), which was far from the coastline have now changed to be close to the beach. It shows that the coastal area Pasie Nan Tigo is undergoing destructive changes.

Establishing coastal structures such as sea wall, groyne, and wave breaker is one of the solutions to the problem of coastal erosion. A wise and environment-friendly way such as reconstructing the coastal ecosystem is quite appropriate in solving this problem. For example, reforestation of coastal areas with mangroves to create a green belt around the coastal region, which is accompanied by rules, and sanctions for disregarding the rules are needed to be enforced.

Coastal dynamics changes in time and space. Wave breaking, tidal stream, river, coastal vegetation, and human activities are among the factors that can lead to the changes of the beach dynamics to form a new balance. Coastal area can not respond very well to all changed processes, it depends on several factors such as the type of sediment, morphology, geological conditions of shores. The shifting forward of coastline can be caused by the growth of delta.

Human activities can directly or indirectly affect the changes of coastal dynamics. Moreover, they can lead to the new sedimentation order which ultimately change the natural coastal environment. In consequence, it gives rise to erosion and degradation.

Some of the actual problems, that

occurred in the coastal region of Nan Tigo Pasie and must be solved immediately, are:

(a) The abrasion is undergoing intensively, especially in places that have no stone breakwater, as a consequence, the settlements are continuously experiencing abrasion; (b) Three bridges have collapsed and buried in the sand as a result from the high and sand-carrying tidal wave; (c) Some fishermen residential facilities such as gas stations, warehouse storage of fishing equipments, fish processing building, fish cooler and the morning market are threatened by the sea wave and even some buildings have collapsed; (d) Religious facility (musollah) is out of order because it was damaged, hit by tidal wave; (e) A total of 1000 households (> 50%) of the population in Pasie Nan Tigo are fishermen who live in a conservation zone. They are in danger because of living in the area 100 m from the highest tide, especially by tsunamis, tidal waves, coastal erosion, hurricanes, earthquakes, and erosion; (f) Not all coastal areas of Pasie Nan Tigo are equipped with soft or hard protection to minimize the impact of threatening natural disasters; (g) The distance of fishermen settlements is very close to the beach, approximately 5 m, and therefore they are highly vulnerable to natural disasters; (h) The environment of fishermen settlements (houses and social facilities) is not well managed, dirty and gradually increasingly close to the beach because of coastal erosion; (i) There are no alternative jobs because the land can not be cultivated optimally as well as home fish-processing industries that are not well managed and developed; (j) Fishing facilities and settlements are very close to the highest tide of about 5 m, so that in the case of disaster, the facilities will be badly damaged such as the tidal wave in 2007 which piled up the facilities and settlement nearly 2 meters tall; (k) Sedimentation occur at the mouth of the rivers, cause the river to die, to be dirty because of rubbish gathering. As a result, it can not be used for fishing boat landing; (l) Horizontal evacuation line and shelter (vertical evacuation) are still not as expected so that in case of the tsunami, they will not be able to function optimally; (m) Marine resources have not been exploited optimally as a tourism resort.

From the identified actual problems occurred in Pasie Nan Tigo above, then the issue of fishermen residential neighborhood which is vulnerable to the disasters should be the priority because it provides a gloomy atmosphere to the people around. Therefore, it must be settled immediately.

Efforts to revitalize the coastal areas of Pasie Nan Tigo which are vulnerable to disasters will be handled integrately referring to *Bengen* in ecosystem and coastal-marine resources and its management, and *Dahuri* in the management of coastal-marine resources integrately, among of them are to

provide knowledge, increase communities' thinking skills about how to overcome the disaster or pre-disaster both active, passive and physically to create a conducive environment, so that it provides a good life quality, comfortable and productive for the communities in carrying out their activities.

Methods offered in solving the priority issues in the coastal areas of Pasie Nan Tigo are Active Hazard Mitigation Model (non-physical) and Passive Mitigation Model by empowering the community.

Identification of Coastal Zone Administration

IbM activity of Environmental Revitalization, in the coastal areas of Pasie Tengah Koto Nan Tigo region - Padang, began by creating the latest administrative map (2015). This was done by considering that the administrative map is the main spatial information that needs to be created in the administration of villages because a thematic map then can be made from it. Thematic map will provide information and actual data of coastal areas of Pasie Nan Tigo.

Based on the research (in Haryani) conducted since 2007, the region development has been carried out four times (*Rukun Warga/ RW*). In 2007, *Kelurahan* of Pasie Nan Tigo consisted of only 7 *RW*, and then in 2010 it developed into 10 *RW* and in 2015 to 14 *RW*.

Regional Proliferation of Pasie Nan Tigo was implemented by consideration of *RW* area and the high population density. Map making of regional Pasie Nan Tigo was done by public participation. As a result, the base map (administration) of Pasie Nan Tigo region was obtained after proliferation in 2015.

Then thematic maps of land use after earthquake was created based on actual data. In making of the land use map, the whole area were identified, among of them were a) Housing zone of BSD I, BSD II, Wisma Indah 10, Cendana, Nyiur Melambai, Kamela I, Kamela II, Harka, PPI, Harmony, Kuala Nyiur I and Kuala Nyiur II, b) Region of fishermen original inhabitants (indigenous) were located in coastal *RW* namely: *RW* VII, VIII, XI, XII and XIV; and migrant population were found in *RW* III, XIV, IV, II and VIII. Most fishermen settlements (90%) were in *RW* IV.

Evacuation map is a reference of evacuation route used in case of tsunami. This evacuation route determination needs to be done by participation of the society, so that

Table 1
Identification of Problems Occured in the coastal areas of Pasie Nan Tigo

No	RW	Problems
1	III	1. Physical Problems: <ol style="list-style-type: none"> a. Primiere problem is flood b. Many houses are still not reconstructed after the earthquake c. No waste disposal d. Poor drainage system e. Toilets (MCK) are necessary 2. Economic Problems. Disadvantage is faced by many <i>Teri</i> -processing home industries due to lack of facilities and infrastructures such as drying tools of boiled fishes and the reduction of fish production of catching. 3. Social Problem. A lot of children have no education.
2	IV	1. Physical problem. Lack of information of government to the community. 2. Facilities and Infrastructure: <ol style="list-style-type: none"> a. Poor roads such as potholes b. Gutters are clogged. c. Wells are brackish d. No toilets (MCK) so that the people use beaches to defecate. 3. Socio-cultural: <ol style="list-style-type: none"> a. Lack of skills to process the cathed fishes. b. No organization or institution for young men to learn and do some creativities.
3	V	1. Physical Problems: <ol style="list-style-type: none"> a. Vulnerable to floods especially RT 04. b. Many roads in RT 04 are not yet paved. c. Poor waste disposals d. The aid from government was not well distributed after earthquake. 2. Socio-cultural: <ol style="list-style-type: none"> a. Social jealously because of uneven distribution of government aids after earthquake.
4	VI	1. Physical Problems: <ol style="list-style-type: none"> a. Wells are brackish b. Lack of clean water c. Poor drainage systems d. No waste disposals 2. Economics problem. Low income of traditional fishermen.
5	VII	1. Physical Problems: <ol style="list-style-type: none"> a. Floods due to lack of drainage systems. b. Poor roads c. No waste disposal d. Some still have no electricity 2. Economic problem. Low income so that the community needs sidejobs to have a decent life. 3. Socio-cultural: <ol style="list-style-type: none"> a. Plenty of unschooled childrens b. Many unemployed youngmen c. Gambling spreads rapidly d. Drugs e. Poor educational access f. Many people keep awaken untill late at night
6	IX	1. Physical Problems: <ol style="list-style-type: none"> a. No gutters b. Poor roads c. No waste disposal d. No road lighting at night 2. Economic problem. Low income of fishermen which causes difficulties in community's economy. 3. Socio-cultural: <ol style="list-style-type: none"> a. Too many unemployed youngmen b. Lack of cultural activity and no communication on that c. Aid distribution is not well managed and does not achieve the targeton target.

7	X	<ol style="list-style-type: none"> 1. Physical Problems: <ol style="list-style-type: none"> a. Flooding frequently due to heavy rain and tidal wave. b. Poor roads c. Unfinished drainage system as long as 80± meters 2. Economic, Low income of fishermen which causes difficulties in community's economy. 3. Socio-cultural. Many unschooled children
8	XII	<ol style="list-style-type: none"> 1. Physical Problems: <ol style="list-style-type: none"> a. Flooding frequently due to the clogged gutters b. Lack of clean water, especially in the dry season 2. Economic problems: <ol style="list-style-type: none"> a. Low income of fishermen which causes difficulties in community's economy. b. Decrease of fishes production or catch causes the income of fishermen. 3. Socio-cultural. Many children play around with no meaning, unschooled, and waste time in cafeterias. In addition, there are many teenagers who can not read al-Quran well.
9	XIV	<ol style="list-style-type: none"> 1. Physical Problems: <ol style="list-style-type: none"> a. Poor roads b. No waste disposal c. Some road lighting do not work properly. 2. Economic problems: <ol style="list-style-type: none"> a. Having difficulties in fish catching b. Lack of catching equipments 3. Cultural. Many teenagers are already influenced by global or foreign culture.

Source: Pasie Nan Tigo 2015

the path will be understood and approved by the people as disaster mitigation efforts that threaten the society of Pasie Village Nan Tigo.

After meeting and consultation with citizens about the evacuation path in Pasie Nan Tigo, it was achieved that there are 4 four routes of evacuation line and two buildings that serve as shelter, 1) evacuation route I is through RW XIII, 2) evacuation route II is through RW VIII, 3) evacuation route III is through RW VI and 4) Evacuation route IV is through RW VII. While two buildings are in RW VIII (furniture shop of Mekar Perabot) and in the building of Muhammadiyah University in RW II.

Map of Coastal Potential Resource and Actual Problems

The study of the problems occurred in coastal areas of Pasie Nan Tigo shows the results as follows.

The market is one of vital places for the community. In villages of Pasie Nan Tigo, there is a morning market called "Pasar Banda Aie" which is visited by people around even from outside the villages.

There are 12 kinds of merchandise and as many as 83 traders in the market. The market building consists of several shops and shanties where wares can be sold openly but temporarily, so that the market environment

is in bad condition. While the permanently existing market facilities (managed by the community) is a parking place for cars and motorcycles.

Tabel 2
Type of Marchandise at Pasar Banda Aie In Pasie Nan Tigo

No	Type of Marchandise	Amount
1	Fish, shrimp, crab	30
2	Salted fish	3
3	Vegetables	11
4	Fruits	7
5	Coconuts	2
6	Chicken	1
7	Tradisional Food	6
8	Spices	4
9	Glassware	3
10	Daily Appliances	10
11	Stores	1
12	Warung	5
	Jumlah	83

Source: Pasie Nan Tigo 2015

Revitalization of the environment as one of the efforts to improve the fishermen settlement environmental is carried out by the community's participation, in accordance with Dusseldorp, "Pembangunan Masyarakat Berwawasan Partisipasi," the decree of Minister of Marine and Fisheries No.Kep. 34 /

Men / 2002 on general guidelines for Spatial Planning of Coastal and Small Islands, Minister of Maritime Affairs and Fisheries (Department of Marine and Fisheries, 2002) and the Implementation Guidelines for Improvement of Fishermen Settlement Environment, PLP-KIP Fishermen, Ministry of Settlement and Regional Infrastructure, Directorate General of Housing and Settlement (Jakarta Ministry of Settlement and Regional Infrastructure, 2001). The information and data collection was done as one effort to create a site plan of Market Banda Aie to be more organized. Organizing the Market Banda Aie in Pasie Nan Tigo is carried out by using environmentally friendly traditional concept, because the market is later than as economic zones which may also support Pasie Nan Tigo as a tourist attraction for instance "Fisherman Village".

Revitalization of the Market Banda Aie in Pasie Nan Tigo consists of wet and dry markets. Dry the market is provided for selling merchandise of non-marine products in so that the building will be designed permanent and dry, while for the wet market, it is provided to trade marine-products, and this will be designed semi-permanent and wet.

The involved components of the market that will be disegned are; a) permanent, dry shops or market; and semi-permanent, wet market, b) the parking place for cars and motorcycles, c) drainage facilities, d) trash facilities, e) road pavements/circulation, f) RTH and g) breakwater.

By revitalizing the Market Banda Aie, it is expected that the communities especially in Pasie Nan Tigo can do shoping more comfortable, which in turn can improve the local economy. The concept of traditional markets of Pasie Nan Tigo is expected to be implemented even its location very close to the beach in order to support Market Banda Aie" Pasie Nan Tigo to be a new tourism resort and model of "Fishermen Villages". The location of the market is very close to the beach, only within 5 m, so that the disaster potentially threaten anytime. For that reason, it is planned to create a wall / stone breakwaters along the coastline.

Promoting and disseminating disaster mitigation in coastal areas was held on May 23, 2015 at the Village Office of Pasie Nan Tigo. This event was attended by people of Pasie Nan Tigo representing 14 citizens association where only 1 member each citizens association.

After that, counseling and stimulus, that aims to provide an insight to the public about the importance of revitalizing the environment around the residence, is conducted. This allows the environment clean and more resilient to disasters, especially to earthquakes and coastal erosion.

Each household must understand how mitigation efforts initiated by the self-understanding of each individual and family. It is very important to reduce the risk of damage to property or lives at once.

Another program in term of environmental revitalization in Nan Tigo Pasie has been implemented two times. The activities in program are counseling and planting trees by participation of the community.

Table 3
Beach Reforestation of Pasie Nan Tigo

No	Day/Date	Location	Number of trees
1	Saturday, 23 May 2015	Muaro Ujung Batu	50
2	Sunday, 14 June 2015	Pasie Jambak	50

Source: Pasie Nan Tigo 2015

Besides for beach reforestation, planting trees is executed with the intention of disaster mitigation which often threaten coastal abrasion in Pasie Nan Tigo. Ujung Batu Muaro is an area of muaro where the coastline is widening due to the silting, so it is suitable to be planted pine trees. Muaro Ujung Batu is a potential new tourism resort where many people enjoy the sea and other tourism activities in the morning and afternoon. The visitor of this beach enjoy the time by sitting around, playing beach volleyball, playing sand beach, swimming, surfing, etc. While Pasie Jambak is the area, where is still threaten by coastal erosion. Therefore, reforestation is required to avoid further damages.

Publishing TTG (*Teknologi Tepat Guna*)

One of disaster mitigation efforts is by publishing TTG where by which is expected that the society have knowledge and understand about pre-disaster preparedness.

A program on TVRI - West Sumatra on 1 February 2015 with the theme "Fisherman Villages Pasie Nan Tigo"

A program on TVRI - West Sumatra on 18 March 2015 with the title "The Participation of Fisherwomen in Pasie Nan Tigo"

A program on TVRI - West Sumatra with the theme of "New Tourism Destination of Pasie Nan Tigo" on 18 May 2015

A program in accordance of *Rakorda Badan Koordinasi Penataan Ruang* of West Sumatra province on Thursday, 4 June 2015 in Bappeda - West Sumatra Province with the theme: "Development Dynamics in Coastal Areas of West Sumatra"

A program on National TVRI on 16 June 2015 at the beach of Pasie Nan Tigo with the theme "Environmental Revitalization of Pasie Nan Tigo in order to improve the community economy."

Evaluation of Activities

Revitalization activity of Coastal Environment of Pasie Nan Tigo for disaster mitigation has been implemented according to the plan. Finally, the last evaluation was done to ensure how far this program gives benefit to the community.

The community were asked of their

knowledge about environmental revitalization before promotion and dissemination, but only 8 RW understood the issue from 10 invited RW. However, after the promotion and dissemination, all participants understood the issue.

Further questions were addressed to the participants, how far they know about the meaning of environmental revitalization. From the table below, it shows that each of them had a different perception. From 9 answers, 6 (66.7%) of them answered correctly which is the reviving / reorganizing the post-disaster environment. This condition is quite encouraging because people have started to understand about the need to revitalize the post-earthquake environment.

In the table below, it can also be seen the perception of each RW representative about environmental revitalization and what needs to be revitalized in their neighborhood.

Conclusions

Active mitigation activities such as socialization, counseling, mentoring and hearings should be implemented in order to

Table 4
The Perception of Pasie Nan Tigo Community about the Environmental Revitalisasi

No	Explanation about Environmental Revitalization as an effort to Disaster Mitigation	What Need to be Revitalized in your RT/ RW ?
1	Prevention of coastal erosion and the reduction of disaster risk	a. planting of trees as coastal safeguards b. flood preventing c. drynage systems/sidewalks
2	Reduction of pre-disaster hazard such as abrasion by planting trees for instance Cemaras, manggroves or other kind of trees. In addition, the most important action is physical construction such as breakwater and <i>seawall</i>	a. Water gutters/drynage systems b. The opening of river at Bt. Kandeh will be opened immediately c. Organizing fishermen settlement d. Culinary market will be opened immediately to trigger the community economy
3	Rehabilitation and reconstruction of the disaster-damaged areas	a. reviving the community economy b. establishing drynage system particularly in housing areas c. Reconstruction of disaster-damaged roads d. trees planting along the RT area
4	Determining the map of region from a certain position in terms of disaster : coastal abrasion, breakwater, seawall, wind, trees planting	a. coastal abrasion b. ocean breeze c. tidal waves d. flood
5	Reforestation, creation of disaster-based map of coastal areas	a. building rubbish bins b. keeping the environment clean and comfort

6	The way to stimulus the community's activities in the RW 07 in order to give rise to tourism activities	a.to raise the participation of community
		b.reforestation
		c.reforestation of tourism resort
		d.counseling to upgrade the community economy
7	Preventing the coastal abrasion	a.planting trees
		b.preventing flood
		c.establishing drynage system
		d.reconstructing roads
8	The reviving of community's activities in terms of physical construction, and economics s post-earthquake	a.planting trees
		b.repairing disaster-damaged roads and bridges
		c.promoting to the society
		d.improving the disaster-damaged fascilities and infrastructures
9	The reviving of community's activities in terms of physical construction, and economics s post-earthquake and other types of disater	a. planting trees
		b. repairing roads
		c. promoting to the society
		d. improving fascilities and infrastructures

Source: Pasie Nan Tigo 2015

provide knowledge, a sense of security and comfort in the coastal community which is potentially threaten by disaster.

Public hearing activiyy suggested some results, among of them is proposing the evacuation routes construction. The availability of evacuation routes and evacuation buildings (shelters) as decided before, then the community is expected to be prepared or aware of the coming tsunami disaster as mitigation efforts. Beside the contructing of evacuation rutes and shelter, the environmental revitalization was also conducted by making the arrangement/drafting disaster-based market and fishermen settelments site plan together with the community and by planting trees in two locations of beach and muaro.

While, in the frame of Passive mitigation (physical activity), the activity was conducted by creating a map of vulnerability to disasters in Pasie Nan Tigo and a map of problems in the coastal region. After the map-making with the participation of the community, then proceed to providing appropriate technology that can later be used by public community particularly in Pasie Nan Tigo, as well as the government of Padang and related SKPD. In addition, the inovation of appropriate technology (TTG) has also been broadcasted locally on TVRI West Sumatra Province and even on national

television (National TVRI).

The efforts to revitalize the coastal environment are expected to be a continuous program of the Government of Padang. It is then expected that this program are able to minimize damages caused by threatening disaster anytime.

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