

59^J Problems of Spatial Plans for Disaster Risk Reduction in Padang City, West Sumatera, Indonesia

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Abstract

Padang City, the capital city of West Sumatera in Indonesia, is prone to earthquakes frequently. In light of the geographic condition, spatial planning is a crucial aspect of long-term development planning for Padang City. Therefore, national and local governments have issued and improved spatial plans for natural disaster areas in Padang City. For example, Provincial General Spatial Plan of West Sumatera 2004–2019 (RTRWP West Sumatera), Municipal General Spatial Plan of Padang 2008–2028 (RTRW Padang City), Detailed Development of Evacuation Shelter Building of Padang City 2008 (ESB 2008), and Strategic Disaster Mitigation Plan of Padang City 2008–2012, have been issued as improvements.

This paper discusses the current situation concerning disaster risk reduction in order to evaluate the effectiveness and implementation of the spatial plans in Padang City from the viewpoint of disaster risk reduction. This descriptive analysis is based on a review of the relevant literature, the spatial plan documents, and field observations. The analysis revealed that: 1) the impact of the West Sumatera Earthquake in 2009 was exacerbated by weak building structures in the affected areas, 2) Padang City's spatial plans still lack an effective disaster risk reduction approach, and 3) gaps exist among the stakeholders involved in disaster risk reduction.

Keywords: spatial plan, implementation process, West Sumatera earthquake, disaster risk reduction.

1. Introduction

Indonesia has experienced many large-scale catastrophes in recent years, with the most recent great disaster, being the West Sumatera earthquake on September 30, 2009. Padang City, the capital city of West Sumatera, is an area most frequently stricken by earthquakes in Indonesia. In light of these circumstances, national and local governments have issued and improved the spatial plans for disaster risk reduction. However, most local governments and societies lack both disaster risk reduction capacity and recognition¹⁾. As Table-1 shows, the last earthquake killed more than 1,114 people and injured another 2,902. In addition, more than 124,000 houses, shops, and offices were destroyed, while more than 125,000 other structures were damaged. Damage and losses have been estimated at US\$ 2.3 billion²⁾. These data indicate that the spatial plans (RTRWP West Sumatera, RTRW Padang City, ESB, etc) were not sufficient in terms of preparing for natural disasters as the number of casualties and the amount of damages were high. Here, Padang City is taken up as a case study to identify problems related to the effectiveness of the spatial plans due to 1) its geographical location in the most disaster

prone area, 2) its' having experienced the most earthquake damage and fatalities in the area, and 3) its many spatial plans related to disaster risk reduction.

Spatial planning is a common method in land use allocation and important for disaster risk reduction efforts. For natural disaster mitigation, spatial planning has to support specific essential functions: risk assessment and mapping, prevention and reduction, risk management and reconstruction. The spatial plan is document enables relevant governmental and administrative bodies to play a decisive role in the protection of humans and resources against natural disasters. It is used to guide what is type of appropriate land use for hazard prone areas while developing approaches to hazard modification, such as the control of population density and expansion, and the establishment of service routes for transportation, power, water, and other critical facilities.

Fig. 1 shows the Indonesian planning system, which consists of two types of spatial plans: 1) general spatial plan issued by legislative board (*Dewan Perwakilan Rakyat*) and 2) detail spatial plan issued by ministry. The general spatial plan requires approval of the local legislative body and provincial government; it is released in the form of government regulation. Indonesian spatial plans should be published as a law, thereby binding the practical spatial planning and land uses. At the national level, it is published as a national law while published as a local law at the provincial and municipal authorities, respectively.

This paper is organized into four parts. First, it discusses the related hazards and the impact of the last earthquake in Padang City, as well as the major land use problems facing disaster risk reduction in Padang City. Second, the local spatial plans are reviewed according to Spatial Planning Law 26/2007 (SP 26/2007) and Disaster Management Law 24/2007 (DM 24/2007). Third, the damage and losses in Padang City are evaluated based on field surveys and the spatial plan documents. Finally, section four provides a summary of the discussion and offers postulation concerning prospects for the future.

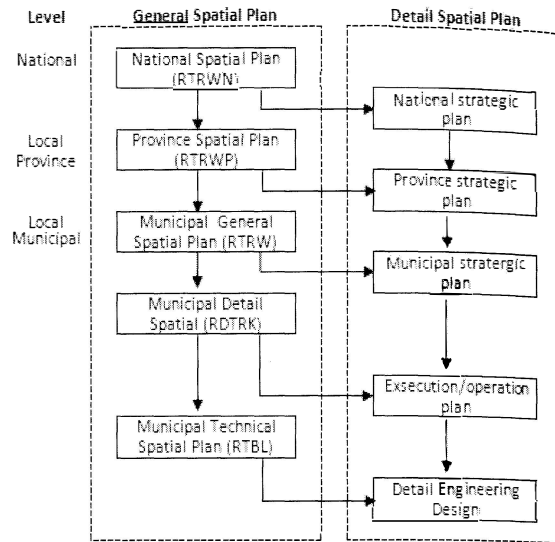


Fig. 1 Indonesian spatial planning system

Table 1. Number of deaths, injuries, and damaged houses: West Sumatera earthquake in 2009²⁾

Districts	Number of dead and injured			Number of damaged houses		
	Mortal	Serious	Moderate	Heavy	Moderate	Light
Padang City	313	431	771	35.927	36.340	38.953
Kota Priaman	32	148	278	8.619	1.633	2.073
Kota Bukit Tinggi	-	-	-	180	7	740
Kab. Padang Panjang	-	6	14	183	617	2.142
Kab. Padang Pariaman	675	527	528	61.765	12.047	3.503
Kab. Agam	80	90	47	12.634	3.457	3.719
Kab. Solok	-	-	5	145	234	357
Kab. Pasaman	-	-	-	192	7	740
Kab. Pasaman Barat	5	5	25	3.021	2.976	2.747
Kab. Pesisir Selatan	9	7	20	1.740	3.775	9.295
Kab. Tanah Datar	-	-	-	24	44	418

2. Natural hazards and disasters in Padang City

2.1. Natural hazards

Historical data on seismic activity over the past 200 years show that West Sumatera is particularly prone to earthquakes due to its location at the convergence zone of four major tectonic plates. Fig. 2 shows the location of Padang City, which is well-known for its high population growth rates, especially in the coastal areas. The city also lies along one of the world's most active fault lines, making it vulnerable to earthquakes and tsunamis³⁾.

2.2. West Sumatera earthquake in 2009

Indonesia had already enacted the Building Law 28/2002 and a standard of earthquake planning for Building Structures (SNI-1726, 2002) for West Sumatera Province. However, local regulations in the area's more than 320 municipalities, including Padang City, were quite poor in terms of their technical guidelines⁴⁾. Fig. 3 shows the extensive damage to houses, buildings, and infrastructures caused by the last earthquake, which also triggered landslides. Weak building structure was a primary cause of the damage, with improper building design and land use contributing to the problem as well. As evident in the photographs, the most common type of building damage was the collapse of soft first-story constructions (see Figure 3).

The most severe casualties and damages occurred in Padang Pariaman District, where three villages were completely leveled and most inhabitants buried. The second hardest-hit area was Padang City, as shown in Table 1. The victims killed in Padang City died primarily due to building collapse, such as the collapse of the Ambacang Hotel (see Figure 3), where the rubble trapped approximately 200 people.

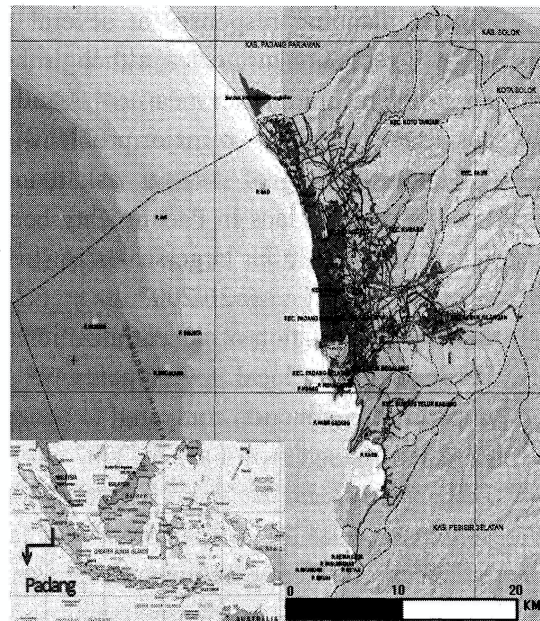


Fig. 2 The location of Padang City, West Sumatera, in Indonesia

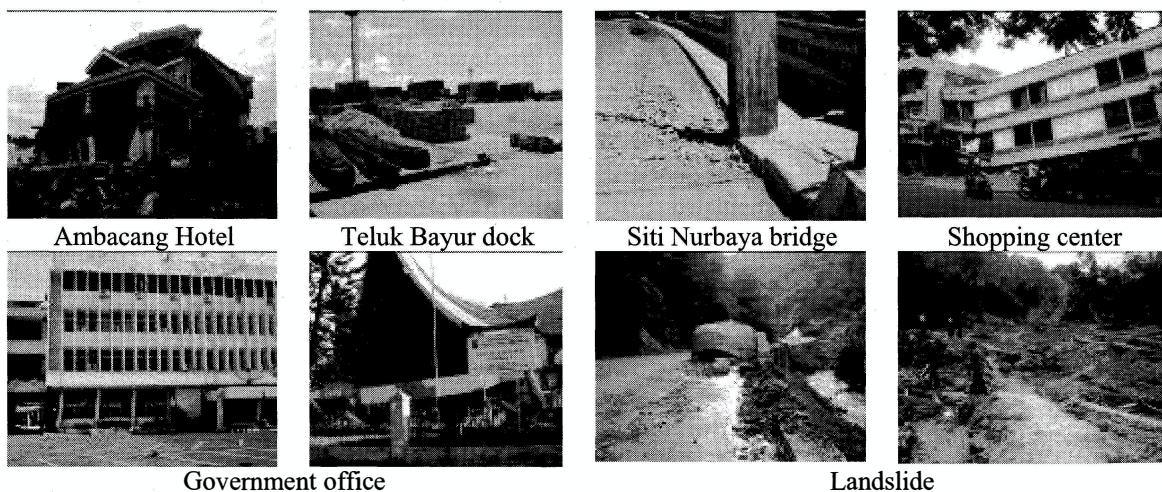


Fig. 3 Damage of West Sumatera Earthquake 2009

3. Spatial planning and disaster management (DM)

3.1. Land use and disaster risk reduction in Indonesia

Spatial planning responses at several planning levels can be applied to the respective disaster risk reduction strategies, although the spatial plan responses are concentrated primarily on non-structural mitigation measures. Land use is an important key to disaster risk reduction. Indonesia faces at least two major problems⁵⁾: lack of management and qualified personnel and lack of understanding of disaster risk reduction. SP 26/2007 and DM 24/2007 are used to evaluate the spatial plans in Padang City because they reflect new laws related to land use and disaster management after large-scale disasters in Indonesia.

A. Spatial Planning Law 26/2007

The implementation of decentralization has created greater flexibility and responsibility in land use among local governments. SP 26/2007 provides new conventions for land use in disaster risk reduction compared to Spatial Planning Law 24/1992 (SP 24/1992).

B. Disaster Management Law 24/2007

DM 24/2007 is the main reference regarding how disaster risk reduction should be conducted. DM 24/2007 ultimately created three paradigm shifts in disaster management practices⁶⁾: 1) from emergency response to risk management, 2) to a centering of protection of the people as a governmental responsibility and a basic right, and 3) from the responsibility of the government to the responsibility of the community.

DM 24/2007 provides detailed information and implementation of spatial planning from SP 26/2007 both prior to and following a disaster. Although the spatial planning concept of DM 24/2007 has generally been accepted, the translation into institutional and societal behavior remains a matter of contention. In addition, institutional reluctance and hesitancy exist with regard to abiding by the changes prescribed by the new laws (i.e., SP 26/2007 and DM 24/2007)⁹⁾ because the new laws lack technical guidelines for implementation of spatial planning at the local level. By the end of 2009, new technical guidelines still had not been issued.

Table 2. Comparison of land use in SP 24/1992 and SP 26/2007 related to disaster mitigation ^{7),8)}

Comparison	Spatial Planning Law 24/1992	Spatial Planning Law 26/2007
Disaster issues	<ul style="list-style-type: none"> • Land use differentiated by two main functions: conservation and cultivation areas • Conservation areas focus primarily on protecting sensitive areas; activities allowed in these areas are quite limited. 	<ul style="list-style-type: none"> • Land use differentiated by two main functions: conservation and cultivation areas • Enhanced safety standards, including strengthening of the regulatory and planning framework for disaster risk reduction
Density of population	Not stipulated	<ul style="list-style-type: none"> • The minimal standard of services to be provided in the spatial plan to ensure a good quality of basic services for the people. • At least 30% of urban areas are set aside as open spaces. • Forest areas must account for at least 30% of river stream areas.
Land ownership	Not stipulated	Not stipulated

3.2. Land use problems in Padang City

Many coastal communities are facing severe pressure resulting from growth in coastal areas, human induced vulnerability, increases in the frequency and magnitude of coastal hazards, and

the impact of global climate change¹⁰). Padang City has the same conditions. Indeed, land use conditions of coastal regions in Padang City have faced the following major issues in the associated disaster risk reduction:

- 1) High-risk areas are characterized by their short distance from the coastline and low elevation as well as their high density, improper infrastructure, and low-income groups.
- 2) Stakeholders have inconsistently implemented land use planning (see Figures 5 and 6).
- 3) The insufficient number and quality of infrastructure for disaster countermeasures exist in rural areas.
- 4) Communal land (*tanah ulayat*) is still practiced in rural areas of West Sumatera. This system has frequently come into conflict with modern administrative regulations²).

Table 2 shows that the application of SP 26/2007 creates an interesting issue, especially in light of the land use implications of disaster risk reduction in Padang City. Definitive land ownership is important for minimizing potential disputes in the rehabilitation and reconstruction process¹¹). Indonesia has two systems of land titles: the western titles introduced by the Dutch colonizers and the Indonesian “*Adat*” indigenous land titles. This circumstance further increases conflict in the land use arrangement. Unfortunately, SP 26/2007 excludes land ownership issues from the spatial planning process (Table 2). Most land ownership in Padang City is communal land (*tanah ulayat*), obtained through inheritance or certified by the local authority (village) or sales certificates. Reconstruction has been complicated by Indonesian law, which only recognizes land registered with the National Land Agencies (*Badan Pertanahan Nasional*). It further exacerbates problems for land acquisition during the process of reconstruction and rehabilitation.

3.3. Disaster risk reduction problems in Padang City

Padang City is a benchmark for disaster mitigation in Indonesia, and many plans and programs for disaster risk reduction have been issued by the government in this area. In order to describe the actual conditions and identify the problems of disaster risk reduction in Padang City prior to the last earthquake, a SWOT analysis is used to evaluate strengths (S), weaknesses (W), opportunities (O), and threats (T). Table 3 shows the SWOT analysis results of disaster risk reduction problems. Limited government capacity, insufficient infrastructures for disaster response, and lax enforcement policies and regulations are problems that must be solved through the empowerment of local government capacity. The implementation of decentralization through SP 26/2007 and DM 24/2007 have provided opportunities to improve disaster risk reduction in Padang city

Table 3. SWOT analysis of DRR problems in Padang City ^{2),12),13)}

Strengths	Weaknesses	Opportunities	Threats
<ul style="list-style-type: none"> • Awareness and spirit of local government • Existence of disaster management agencies such as KOGAMI • Infrastructure elements for disaster management are ready for use • Existence of disaster management network 	<ul style="list-style-type: none"> • Limited government capacity to protect the population from natural disasters • Insufficient infrastructure for disaster response • Inadequate rules and mechanisms for DRR • Lack of the enforcement of policies and regulations 	<ul style="list-style-type: none"> • Padang City is a benchmark for DRR in Indonesia • Technological developments in DRR are promising • Curiosity and awareness among Padang people concerning DRR are high 	<ul style="list-style-type: none"> • Disaster is unpredictable • Disaster-prone areas are relatively large and densely populated • Lack of the implementation of building codes • Continued external support is not guaranteed

4. Overview of spatial plans in Padang City

4.1. Provincial General Spatial Plan of West Sumatera 2004–2019 (RTRWP West Sumatera)

Padang City and Padang Pariaman District have been identified as disaster-prone areas, subject to earthquakes, floods, tsunamis, and tidal waves. Padang City has functioned as a national activity center¹⁴⁾, which is vital as it includes the provision of such infrastructures and services as international airports and the main port (i.e., elements of the main national transportation network); overseas marketing, for which it serves as a collecting center of export-oriented national commodities; and governmental functions including its function as a center of national economic development¹⁴⁾. Its designation as a national activity center should be taken under careful consideration, given that Padang City is one of the most disaster-prone areas.

Table 4. Land use problems related to disaster risk reduction in RTRW Padang City 2008-2029¹⁵⁾

Problems	Problems-solving in RTRW Padang City 2008-2029
Padang is a disaster-prone area	Determination of disaster-prone areas for each disaster type Land use utilization of disaster-prone areas is directed by: <ul style="list-style-type: none"> • Application of prohibitions and disincentives for the utilization of certain zones as cultivation areas • Determination of technical regulations through zoning regulations and restrictions on development of activities in disaster-prone areas • Development of multi-layer spaces that can be used as evacuation spaces if disasters occur. In normal conditions, these would be used for public/open spaces • Directives in disaster-prone areas with regard to open spaces and conservatory areas
Population density	<ul style="list-style-type: none"> • Development of forest city • New developments occupying more than 5 ha are required to have open space of 30% • Updated building codes and zoning regulations
Land ownership	Unstated

4.2. Municipal General Spatial Plan of Padang 2008–2028 (RTRW Padang City)

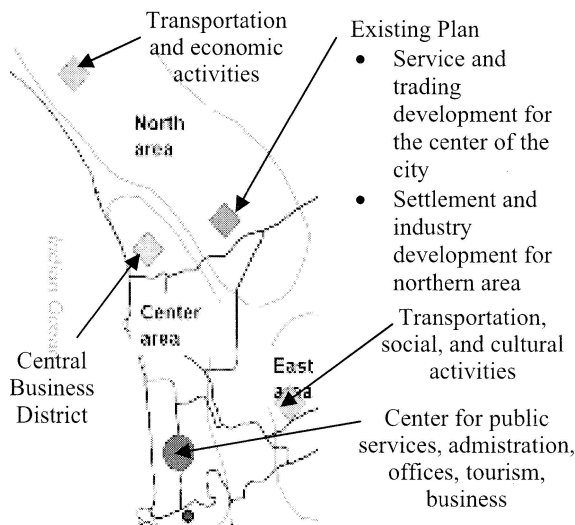


Fig. 4 Location of important functions in RTRW Padang City 2008-2028 ^{12),15)}

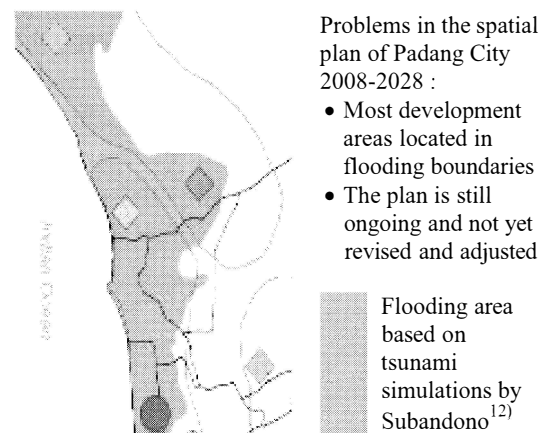


Fig. 5 Problems related to locations' important functions in RTRW Padang City 2008-2028 ^{12),15)}

Table 4 explains the contents of the RTRW Padang City related to disaster risk reduction from the perspective of spatial planning problems under the frame of SP 26/2007. Fig 4 and 5 indicate that spatial planning in RTRW Padang City does not take into account coastal

conditions. Many important facilities and infrastructures are located in disaster-prone areas. During the last earthquake, improper building design and weak city hazard zoning contributed to the underlying causes of high damage and casualties²⁾.

4.3. Strategic Disaster Mitigation Plan of Padang City 2008-2012

The Strategic Disaster Mitigation Plan of Padang City was issued by the Ministry of Marine Affairs and Fisheries. This plan consists of steps for disaster mitigation in Padang City, including strategic issues related to disaster mitigation plans and action plans. Floods, earthquakes, tsunamis, abrasions, landslides, and sea-level rises are types of disasters covered in detail in this document based on the condition and history of disasters discussed for each sub-district. The Strategic Disaster Mitigation Plan of Padang City 2008-2012 articulated a vision and mission. The vision of Padang City related to disaster risk reduction is “Padang City is ready for disasters.” The missions are 1) enforcement of disaster management laws and empowerment of disaster management agencies, 2) development of a disaster preparedness culture, and 3) the fostering of disaster resilience¹³⁾. Regarding the last earthquake, this spatial plan should be improved based on the local community in Padang City and local capacity related to disaster risk reduction.

4.4. Detailed development of evacuation shelter building plan in Padang City 2008

The evacuation shelter building (ESB) design focuses on preparation for tsunamis and earthquakes. The ESB Plan for Padang City considered the potential group zoning for the region in the event of a tsunami, its benefits and secondary functions if the disaster does not occur, travel time to access the ESB, and the capacity of the ESB. Fig. 6 shows that Padang City’s ESB is divided into four sectors, and the ESB document consists of detailed directions concerning: 1) the location of the ESB (see Figure 7), 2) evacuation roads (see Figure 8), 3) secondary functions of ESB when a tsunami does not occur, and 4) maintenance of ESB.



Fig. 6 Distribution sector for vertical evacuation¹⁶⁾

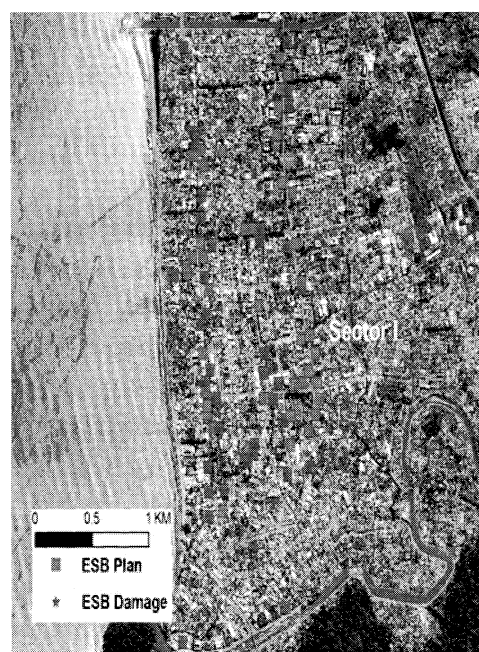


Fig. 7 Direction of ESB in sector I¹⁶⁾

After the last earthquake, ESBs were damaged in some areas as a result of lack of enforcement of building code provisions for design and construction quality assurance. In fact, 48.2% ESBs were damaged in sector I. In addition, the evacuation route designed for the ESB was immediately subjected to severe traffic congestion. This scenario demonstrated that horizontal evacuation alone is insufficient to safely evacuate Padang City residents to higher level areas. Therefore, vertical evacuation must be utilized, and the local community must be educated concerning such a possibility. Additional ESBs have been located on private lands, which will raise problems for implementing the plan related to the land acquisition process as the spatial plans in Padang City exclude land ownership issues from the spatial planning.

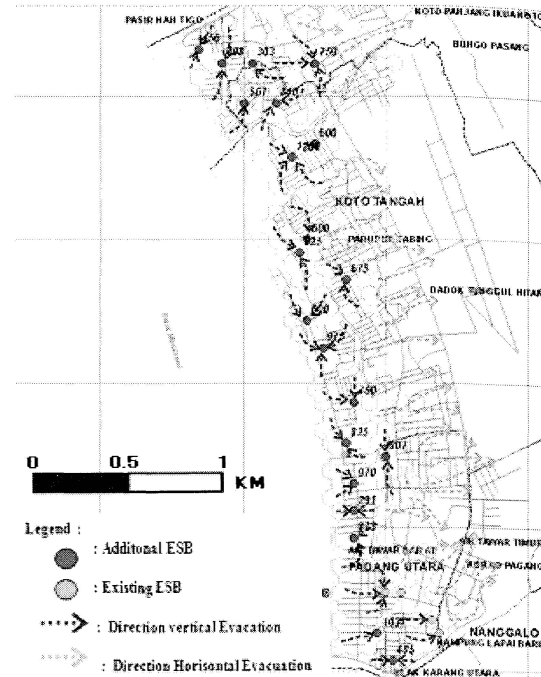


Fig. 8 Direction of evacuation road in sector III¹⁶

5. Problems with the spatial plans for earthquake disasters in Padang City

This chapter discusses the problems that are present concerning the spatial plans in Padang City that relate to disaster risk reduction. The quality and appropriateness of the data gathered will affect the quality of the spatial plans. Table 5 shows the type of data and the analysis methods for arranging the spatial plans in Padang City. It demonstrates that the processes for plans formulation are adequate because of the complete data collection and the analysis methods used. The spatial plans in Padang City are made in consultation with the public, and the process includes interviews with the community, the private sector, and relevant agencies. Table 5 demonstrates that the plan was drawn in detailed scale (ESB Plan 2008). It was easy for the stakeholders to understand and apply this plan at the local level. When the last earthquake occurred, however, some problems with the spatial plans related to disaster risk reduction were discovered.

Countermeasures to address the spatial plan problems are listed in the right column of Table 5, and the following improvement of spatial plans should also be discussed:

[Province level]: Improve local building code of West Sumatera because many important facilities and activities are in this area. These facilities need to be able to resist major disasters.

[Regency level]: Improve land use and population control especially along the coastal line.

- Strategic DM plan: Give certain incentives and disincentives for development in disaster prone areas and provide a strategic plan for the infrastructure that relates to disaster risk reduction.
- ESB Plan: Regular public education related to evacuation route, certification of public buildings for evacuation shelter building, and socialization of land acquisition for providing public facilities.

The problems with the spatial plans in Padang City (Table 5) shows that disaster risk reduction in Padang City has focused strictly on disaster relief and prevention, but neglected to

study emergency contingency measures for the rapid evacuation of the general populace to disaster shelters. Vertical evacuation must be utilized, and the local community must be educated concerning another type of shelter. High casualties and damage from the last earthquake has led to national government and local government decision to improve the spatial plan in Padang City. SP 26/2007 suggest a change for improving the spatial plan more than once every five years in case of a large disaster, such as the last earthquake. The Ministry of Marine Affairs and Fisheries is improving the ESB Plan of Padang City based on the actual problems mentioned in Table 5.

Table 5. The process and problems related to the spatial plans in Padang City ^{12),13),14),15),16)}

Spatial plans	Data collections	Analysis methods	Problems	Effective countermeasure
RTRWP West Sumatera 2004-2019 Map scale (1:250,000)	<ul style="list-style-type: none"> Land use Demography Topography Socioeconomics 	<ul style="list-style-type: none"> Evaluation RTRW West Sumatera 1989-1990 Regional Analysis Economic Analysis 	<ul style="list-style-type: none"> Padang City is a national activity center within the national constellation West Sumatera is one of the most disaster-prone areas in the world 	Strengthen building local code of West Sumatera
RTRW Padang City 2008-2028 Map Scale (100,000-50,000)	<ul style="list-style-type: none"> Land use Demography Topography Socioeconomics 	<ul style="list-style-type: none"> Evaluation of RTRW 2004-2013 Demography and social culture analysis Topography analysis Land use analysis 	<ul style="list-style-type: none"> Central business district located along coastal areas Coastal area in Padang City is a high-risk area because of high population and a high low-income population 	<ul style="list-style-type: none"> Rearrangement of land use Limited development allowed in coastal line area. Strict control of population density in coastal line area.
Strategic DM Plan of Padang City 2008-2012	<ul style="list-style-type: none"> Assessments of previous disasters Disaster assessment for each sub-district 	SWOT analysis	<ul style="list-style-type: none"> Inadequate infrastructure for disaster response Low enforcement of existing law/regulations 	<ul style="list-style-type: none"> Improving infrastructure plan for each type of disaster Certainty of disincentive and incentive in disaster prone area.
ESB Plan 2008 (1:5,000)	<ul style="list-style-type: none"> Historical data: Tsunami in Padang Socioeconomic data Demography Topography Building codes 	<ul style="list-style-type: none"> Tsunami modeling Vulnerability and risk analysis of tsunami Location analysis and models developed for ESB vertical evacuation 	<ul style="list-style-type: none"> Lack of implementation of building codes; some ESBs were found to have collapsed Additional EBS located on private land Lack of public education concerning vertical evacuation 	<ul style="list-style-type: none"> Multi-layer space used for evacuation space when disasters occur. In normal conditions, these are used for open space Strengthen application of building and environment codes Regulate land acquisition for public facilities Have regular evacuation drills

6. Summary

The results of this paper are summarized as follows:

- 1) The new spatial plans for Padang City respond to disaster risk reduction were presented. Issues related to land use and disaster mitigation were also addressed since 2008 after the promulgation of SP 26/2007 and DM 24/2007. The spatial plans excluding the land ownership issue, however, remain one of the crucial problems spatial planning in Padang City.
- 2) The number of casualties and damage were still high in the West Sumatera earthquake in 2009, showing that the spatial plans in Padang City had problems to address and improve to meet natural disasters. Weak application of the building code was a primary cause of the damage, and weak land use contributed to the problem as well, both related to the institutional capacity, awareness, and political will of the local government.

- 3) Generally, the new spatial plans for Padang City have made considerable progress in addressing disaster management. Land use is still lacking certain benefits that might accrue from an effective disaster risk reduction approach. Performance environment standards and building and structure standards should be implemented by using building permissions as an instrument for land use control. Building codes should also include both the technical and functional standards for building.
- 4) As traffic congestions occurred on the evacuation routes and many ESB damaged in the last earthquake, traffic performance plan and the capacity and multilayer structure of ESB should be taken account in to the new ESB Plan of The Ministry of Marine Affairs and Fisheries, and the regulations to acquire private lands is needed for additional ESB.

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