

Sharing Experiences and Lessons Learned in Disaster Management System in Indonesia

Mochamad Teguh

Abstract—Indonesia has unique geography and geology affecting its prone to natural disasters such as earthquakes, tsunamis, floods, landslides, cyclones and volcanic eruptions. With a large and dense population, human-induced disasters such as fires, forest fires, pollution and environmental degradation also pose large threats. Consequently, most part of the country is seismically active and the geomorphology is very fragile. Urban areas are highly vulnerable to earthquake disaster and it is one of the biggest obstacles for sustainable development. This paper reviews the disaster management system in Indonesia to share experiences and lessons learned from natural disasters. Hence, Indonesian government has provided a systematic guidance of disaster management system in order to minimize huge losses of lives and properties due to major disasters. Pre- and post-disaster assessments require effective recovery processes and successful assessments which are simple, flexible, adoptable, and adjustable for further recovery process. National action plans for the post-disaster recovery process towards a better and effective execution of rehabilitation and reconstruction, and an efficient funding disbursement for the activities should be well managed. The outcome of disaster risk reduction activities should be the substantial reduction of disaster losses, in lives and social, economic and environmental assets of communities and countries.

Index Terms—lesson learned, response, preparedness, mitigation, Disaster Management System, Indonesia

Manuscript was received on September 30, 2011 and it was accepted on October 30, 2011. This work was supported in part by the Directorate of Research and Community Services, Directorate General of Higher Education, Ministry of National Education of Indonesia under Grant 108/SP2H/PL/Dit.Litabmas/IV/2011.

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I. INTRODUCTION

Indonesia is geologically situated at the juncture of four major world tectonic plates; i.e., the Asian plate, Indian Ocean plate, Australian plate, and Pacific Ocean plate. It is located on crossing three-mountain system: Alpine Sundae, Circum Pacific, and Circum Australia [9, 10]. This condition affects directly to seismotectonic in Indonesia resulting most regions prone to earthquakes (Table 1). More than 500 volcanoes in which 128 volcanoes are still actively erupted, it is so-called ring of fire. It has been observed that 383 out of 456 districts/cities considered as prone areas because of high number of population, or high density areas with uneven population distribution, high income disparity, and decrease of building coverage. Most of the river banks are used as low-income squatter area with high population density.

These disasters may have been probably caused by natural and man-made hazard, social and physical vulnerabilities, low capacity in government bureaucracies as well as in community as a whole. Within the last six years, Indonesia experienced major disasters as shown in Table 1, which have caused loss and fatalities accounting for.

A. Earthquake and Tsunami Disasters

It is about five earthquakes occur daily in Indonesia because it is located at the intersection of three crustal plates: the Eurasia Plate, the Ancient Australia-Indian Continent and the Pacific Ocean Floor. As a result, the country has to challenge with frequent and powerful seismic activity (Figure 1). It was observed that the May 2006 Java earthquake occurred at 05:54 local time on 27 May 2006 (22:54 GMT 26 May), in the Indian Ocean around 25 km (16 mi) south-southwest of the Indonesian city of Yogyakarta, near Galur, on the southern side of the island of Java (7.962°S 110.458°E), 10 km below the seabed, with a magnitude of 6.2, according to the U.S. Geological Survey. Two aftershocks, measured at 4.8 and 4.6, occurred between 4 and 6 hours later [11]. In addition, the 6th March 2007 and 30th September 2009 Sumatra earthquake occurred just off the southern coast of Sumatra, Indonesia. The major shock hit at 17:16:10

local time on September 30, 2009 (10:16:10 UTC) [8] and had a moment magnitude of 7.6. The epicenter was 45 kilometers west-northwest of Padang, Sumatra, and 220 kilometers southwest of Pekanbaru, Sumatra. When earthquakes occur at sea, there is the added danger of a tsunami (Figure 2). The devastating tsunami of 26 December 2004 in Aceh, for instance, was caused by an earthquake with a magnitude of 9.0 on the Richter scale producing the fourth largest earthquake in the world since 1900 [12].

The whole of Indonesia except Borneo, Bangka Belitung, Riau Islands and Timor is situated within a zone of high seismic activity known as the "Pacific Ring of Fire". Along the Sunda megathrust, the Indo-Australian Plate is being subducted beneath the Eurasian plate [7]. The subduction creates regular earthquakes, many of them of megathrust type. Specifically the Sumatra segment is currently experiencing a period of increased activity that began with the catastrophic 2004 Indian Ocean Earthquake. Each earthquake of the sequence adds additional stresses to segments of the plate boundary that have not moved recently.

B. Flood and Landslide Disasters

Almost every year, flood disaster occurs in some areas of Indonesia. Flood disaster has affected more than 25,000 people have been displaced by widespread flooding across Sumatra Provinces, parts of Kalimantan, Sulawesi, Irian, and Java Islands (Figure 3), caused by weeks of torrential rains through much of December. Numerous rivers have overflowed such as the Batanghari River in Jambi Province, the Kapuas River in Kalimantan Province which resulted in the flooding of nine districts at its peak with five districts still severely affected.

National Institution on Disaster Management of Indonesia was established in 2008 with its main task is to provide guidance and direction as efforts on disaster management includes prevention, handling of emergency response, rehabilitation, and reconstruction with fair and equal. The institution has an extension until village level and focused on saving essences.

According to the joint assessment as carried out by SATGANA Team (Indonesian Red Cross Rapid Response Team, at field level) and SATKORLAK (Provincial Disaster Management and Coordination Committee), the most affected districts in Jambi province were Muraro, Jambi, TanjabTimur and Batanghari. During the disaster over 20,000 displaced people from these areas were living on roadsides in makeshift shelters as well as in schools and mosques in a distressed condition. The flood waters killed six people, and submerged over 20,000 houses, some 200 schools, and 70 health centers, hundreds of thousands of hectares of paddy fields, 45 mosques and seven

bridges. The waters damaged 75 flood gates and killed farm animals.

With a tropical climate, Indonesia is often subjected to massive amounts of rain within a short time. There are over 5000 rivers throughout Indonesia, of which at least 30% pass through major population centers. The western areas of Indonesia are particularly susceptible to floods, due to heavy rainfall and shallow rivers. Although natural ecosystems serve as a buffer, in areas of heavy logging, the effects are exacerbated. Along with floods, heavy rains frequently cause deadly landslides (Figure 4) due to the porous volcanic soil that is so common throughout many parts of Indonesia.

C. Volcano Eruption Disaster

At least 128 active volcanoes have been identified among more than 500 young volcanoes. This represents 15% of all the active volcanoes in the world. The eruption of Krakatao in 1883, which killed tens of thousands of people, destroyed the island and affected global climate for several years. It remains one of the most cataclysmic natural disasters in recorded history. Eruptions on a much smaller scale occur with relative frequency in this volcanic hot spot. Mount Merapi in Jogjakarta, perhaps the most active volcano in Indonesia in recent years, has had over a dozen known deadly eruptions (Table 1).

In the last 10 years, Merapi Mountain frequently spews clouds of hot ash and huge magma every 4 years. Merapi Volcano Eruption was occurred in October 2010 producing clouds of hot ash and huge debris and killed hundreds of people living in surrounding hills. It can be concluded that probability of exposure to high disasters in particular areas of Indonesia varies significantly as presented in Figure 5. Given this condition, better preparedness in attempt to reduce vulnerability and losses is essential [14].

II. LESSON LEARNED FROM DISASTER MANAGERMENTS

A. Disaster Management System

Several issues in disaster management systems have been discussed in an attempt to reduce risk disasters particularly due to natural hazards such as earthquake and volcano eruption [6]. In practice, however, lacks of management and personal qualification (management capacity), and lack of understanding in disaster risk reduction have been found. For instance, delay in the management of emergency response, lack of coordination in planning and programming for post-disaster recovery, institutional framework focusing on emergency response only, ra-

ther than post-disaster recovery, and funding emphasizes emergency response are categorized as lack of management capacity on disaster response. Whilst lack of understanding in disaster risk reduction (DRR) has not been perfectly improved such as the preparation of disaster preparedness and risk reduction, institutional performance in the management of risk reduction, planning and programming for risk reduction, and incorporating risk disaster mitigation into spatial plans. Figure 6 shows a disaster management cycle.

The International Strategy for Disaster Reduction 2006-2009, World Disaster Reduction Campaign, UNESCO has ranked Indonesia as the 7th among countries most hit by natural disaster in 2005 [5]. Indonesia remains vulnerable to disasters with high risks and high costs. A result of government leadership and broad partnerships, Indonesian has developed successful responses in disaster risk management. There are many lessons learned from the Indonesia experience in managing disasters to save life and reduce vulnerability and losses. The effective models used in any regions in Indonesia, therefore, can be replicated globally, and challenges remain unavoidable.

Preventive action/mitigation and preparedness as parts of pre-disaster action should be well prepared by the government and private communities before any disasters occurred in order to save human lives and significantly reduce loss of properties. In line with the pre-disaster action, emergency response, rehabilitation, and reconstruction should be well managed to assure that infrastructure is well done and operated in order to support the emergency activities.

B. New Paradigm on Disaster Management

A new paradigm on disaster management (Figure 7) has been recently introduced recognizing the right for dignified life and livelihood. The government should be responsible to ensure the manageable disaster casualty, which is essence, avoidable, and with no risks creation in recovery process [3]. Reducing disaster risk factors from unsustainable development practices will be worsened by the impacts of climate changes, natural and man-made hazards. Being accountable to the risk community and/or disaster-affected community and sensitivity to gender, participatory, equity and justice is an essential issue.

Various management arrangements for the post-disaster recovery process, such as emergency response, rehabilitation and reconstruction, and long term sustainable, should be carried out. Whilst in the recovery stage, the approach and management system maybe different with the emergency response stage, however an integration effort should be made to make sustainable development in the future possible. Therefore, the aims of emergency response after the disaster break out, and about the last three months should be directed to minimize the dead toll, to provide basic needs for a temporary period and to assure that infra-

structure is well done and operated in order to support the emergency activities.

Once the emergency response has been function, the next step of rehabilitation and reconstruction should be well prepared for the period of approximately three years. The aims of rehabilitation and reconstruction steps are to provide infrastructure and economic development and to assure that communities, the private sector and the government are able to recover from the disaster and be able to conduct their daily activities at least at a minimum standard of living.

It is observed that several different management schemes have been adopted by the Indonesian government for the rehabilitation and reconstruction stages, depending on the type of disaster as well as casualties involved. However, the central government still plays an important role to provide main policies and strategies for rehabilitation and reconstruction stages, including financial support. The experiences and approaches used in this stage will become a solid foundation for the implementation of a long term sustainable recovery strategy for the purpose of integrating sustainable economic development in the future.

III. DISCUSSION ON IMPLEMENTATION OF DPRR MODELS IN INDONESIA

A. National Action Plan (NAP) of Indonesia for Disaster Preparedness and Risk Reduction (DPRR)

Indonesia is well known as the largest archipelago country in the world which is highly prone to disasters. The high frequencies of natural disasters (Figure 5) have occurred frequently with immeasurable damages to the society and economy (Table 1). Table 2 shows death toll and number of people injured during the 2006 Yogyakarta. Earthquake Ministry of National Development Planning/National Development Planning Agency published Project and Technical Assistance Proposal 2006-2009 in order to achieve the effectiveness and efficiency of the utilization of external loans and grants (PHLN) for supporting disaster risk reduction and other government's programs. Indonesian Government has issued Government Regulation (PP) No.2/2006 on Procedure for the Provision of External Loans and Grants and the Forwarding of External Loans and Grants (to Local Government and State Owned Enterprise). To implement the regulation, several ministry decrees have been issued such as Decree of the State Ministry of National Development Planning/Bappenas No. 5/2006 on Procedure for Planning and Submitting Proposals and Assessing Projects that are funded by External Loans and Grants [13].

The National Action Plan for Disaster Risk Reduction (NAP-DRR) 2010-2012 formulation has been through sequential process, several consultative and

participatory phases based on coordination, consultation and consolidation among stakeholders at the central as well as the regional level over the past six months. The results of this process have been stipulated in the form of the Decision of the Head of National Agency for Disaster Management (BNPB) No. 5 Year 2010 [1]. It is expected that the NAP-DRR 2010-2012 document will serve as a basis and reference for stakeholders in implementing disaster risk reduction measures as expected. Furthermore, from the Government's point of view, particularly of State Ministry for National Development Planning iv NAP-DRR 2010-2012 ministries/agencies, the NAP-DRR 2010-2012 document can be referenced in the formulation of the Government's and the Ministries'/Agencies' Annual Work Plan. In addition, the respective regional governments will be able to follow up on this NAP-DRR in the Regional Action Plan for Disaster Risk Reduction (RAP-DRR), both at the Provincial and the Regency/ Municipality levels.

The Government of Indonesia has made efforts to conduct structural and nonstructural measures for the disaster management. However, an application of structural measures has limitations due to the financial difficulties of the government. Therefore, nonstructural measures need to be strengthened for the disaster management. Since 1979, coordinating boards of disaster management consisting of agencies concerned have functioned from the national level to village level. Based on the national disaster management policies/strategies, the coordinating boards at different levels are mandated to coordinate the implementation of disaster management before, during and after disaster. However, there are still many obstacles in disaster management (Figure 6), such as insufficient coordination among agencies concerned, lack of information sharing, delaying in warning and evacuation, institutional issues, lack of awareness and participation, no reflection of disasters to land-use/development plan and so on.

The Community-based Settlement Rehabilitation and Reconstruction (REKOMPAK) is one of the Government of Indonesia's program in post-disaster housing and settlement reconstruction which include disaster mitigation, using community empowerment approach. REKOMPAK in Yogyakarta has two components: housing and community DRR infrastructure, both are part of community settlement/DRR planning process. In this program women were also involved in formulation of the Community Settlement Plan (CSP) and implementation housing and community infrastructure reconstruction projects. The REKOMPAK is an example of the community-based settlements available among Indonesian people who involves in the community empowerment in the disaster risk reduction cycles coordinated by the government of Indonesia.

It is urgently required to formulate the disaster management plan considering local wisdom in order

to secure the society against disasters. This consists of a master plan and feasibility study phases. Three model areas have been selected for the master plan study to identify issues in past disaster management and formulate disaster management plan [13]. It should be noted that the local wisdom in Indonesia from hundred years ago can be easily replaced by modern technologies which are assumed, often erroneously, to be more sophisticated and effective. For example in some cases of Yogyakarta, Padang, Aceh, and Nias Earthquakes, the traditional timber constructions were proven to be earthquake resistant. Most of the damaged and collapsed houses from the earthquake (Table 3) were in fact modern concrete ones. When traditional timber houses were damaged, this was by degradation due to their old age, weak construction methods used, and lack of maintenance rather than by the earthquake itself. However, many building designers have abandoned local wisdom, ignored traditional construction, and designed new earthquake-resistant technologies using steel and concrete. All housing aid programs for rehabilitation and reconstruction in the aftermath of the disaster had to implement this mass produced standard. Some infill design had even to be inserted among rows of traditional houses leading to a disharmonious, if not ugly result. This arrogant development has been improved without deeper consultations and respect for a harmonious living heritage.

According to the Indonesian Law (UU) Number 24/2007 regarding the disaster management regulates in the following items, such as roles and responsibilities of government, roles and responsibilities of stakeholders, establishment board for disaster risk reduction, community participation, and funding for disaster risk reduction [3]. Referring to the law, the National Action Plan (NAP) of Indonesia for Disaster Preparedness and Risk Reduction (DPRR) has been launched early 2007. The NAP specifies platforms, priorities, action plans and mechanisms pertaining to the implementation and institutional basis of disaster management in Indonesia. The NAP elaborates interests and responsibilities of all stakeholders where identified through a participatory coordination process and in line with the Hyogo Framework for Action. This plan provides guidelines and information that will facilitate decision makers to pledge commitment to cross-sector and jurisdictional priority programs based on a strong and systematic foundations.

B. Platform for Disaster Risk Reduction

National platform of Indonesia for DRR [2] is categorized into two parts consisting of National Middle-term Development Plan (RPJM) and Government's Work Plan (RKP). In the first platform, programs and activities related to DRR are generally developed independently by different sectors. Whilst in the second platform states that the Law No 13/2005

on State Revenue and Expenditure Budget for fiscal year 2006 allocates budget for implementing Natural Disaster Management Policy through (a) enhancement of natural disaster mitigation and climate forecasting, (b) spatial planning and natural resource protection zoning, including disaster-prone areas in coastal and sea areas, and (c) development of a natural disaster management system and early warning system (EWS). In RKP for 2007 (through Presidential Regulation No.19/2006) two key targets; (a) continue and completion post-disaster in Aceh, Nias, Yogyakarta etc, and (b) completion of emergency response, rehabilitation and reconstruction affected by disasters in other regions.

Based on the national platform, the Government's Annual Work Plan is to satisfy three targets comprising: (a) enhancement of natural disaster mitigation and climate forecasting, (b) spatial planning and natural resource protection zoning, including disaster-prone areas in coastal and sea areas, and (c) development of natural disaster management system and early warning system (EWS). Since 2006, the following five priority activities in NAP - DRR have been introduced to:

1. Ensure that DRR is a national and local priority with a strong institutional basis for implementation.
2. Identify, assess and monitor disaster risks and enhance early warning system.
3. Use knowledge, innovation and education to build a culture of safety and resilience at all level.
4. Reduce underlying risk factors; and
5. Strengthen disaster preparedness for effective response at all level.

In the implementation, the institutional arrangement such as building a network among government institutions, local governments, private sectors, civil society and other relevant stakeholders, as well as civil society will be involved in the institutional arrangement and disaster risk reduction mechanism at all levels of the government should be monitored consistently. Besides, the funding availability to support the implementation, for instance, state budget, local budget, private sectors and/or community, and regional and international donors is sufficiently taken into account

IV. CONCLUDING REMARKS

Based on aforementioned description, it can be drawn concluding remarks as follows.

1. Post-disaster assessment essentially requires an effective recovery process and successful assessment should be directly instrumented by recovery plans which are simple, flexible, adoptable, and adjustable for further recovery process.
2. Important national action plans for recovery process towards a better and effective execution of rehabilitation and reconstruction, and an efficient funding disbursement for the activities should be essentially well managed. This action plans include the development and implementation on monitoring and evaluation system for the post-disaster recovery process.
3. DRR in each country has a uniqueness approach and therefore it requires a holistic approach that includes all sectors and actors of society and the outcome of DRR activities should be the substantial reduction of disaster losses, in lives and social, economic and environmental assets of communities and countries.
4. These initiatives need to be long-term, address some of the underlying causes of vulnerability and access, improve livelihood conditions and build various forms of resilience.
5. The conceptual framework of elements considering the possibilities to minimize vulnerabilities and disaster risks throughout a society is mainly to prevent the mitigation and preparedness programs from the unfavourable impacts of hazards within the broad context of sustainable development.

ACKNOWLEDGEMENT

The author would like to extend a special gratitude to the Directorate of Research and Community Services, Directorate General of Higher Education, Ministry of National Education of Indonesia who has supported this research under the multi-year grants (reference number 108/SP2H/PL/Dit.Litabmas/IV/2011).

APPENDIX

TABLE 1. Indonesia's Major Disasters

No.	Description	Date	Location
1	Earthquake and tsunami	December 2004	Aceh and Nias
2	Massive earthquake	May 2006	Yogyakarta & Central Java
3	Flood disaster	February 2007	JABODETABEK (Jakarta)
4	Earthquake and possible tsunami	September 2007	Bengkulu & West Sumatera
5	Ongoing mud flow (Lapindo)	2008	Sidoarjo, East Java
6	Earthquake	September 2009	Padang, West Sumatera
7	Earthquake and tsunami	October 2010	Mentawai Island, Sumatera
8	Merapi Volcano Eruption	October 2010	Yogyakarta, Central Java

TABLE 2. Death toll and number of people injured during the 2006 Yogyakarta Earthquake

Province and District	Death Toll	Number Injured
Yogyakarta	4659	19401
Bantul	4121	12026
Sleman	240	3792
Yogyakarta City	195	318
Kulonprogo	22	2179
GunungKidul	81	1086
Central Java	1057	18526
Klaten	1041	18127
Magelang	10	24
Boyolali	4	300
Sukoharjo	1	67
Wonogiri	-	4
Purworejo	1	4
Total	5716	37927

Source: Yogyakarta Media Center, June 7, 2006

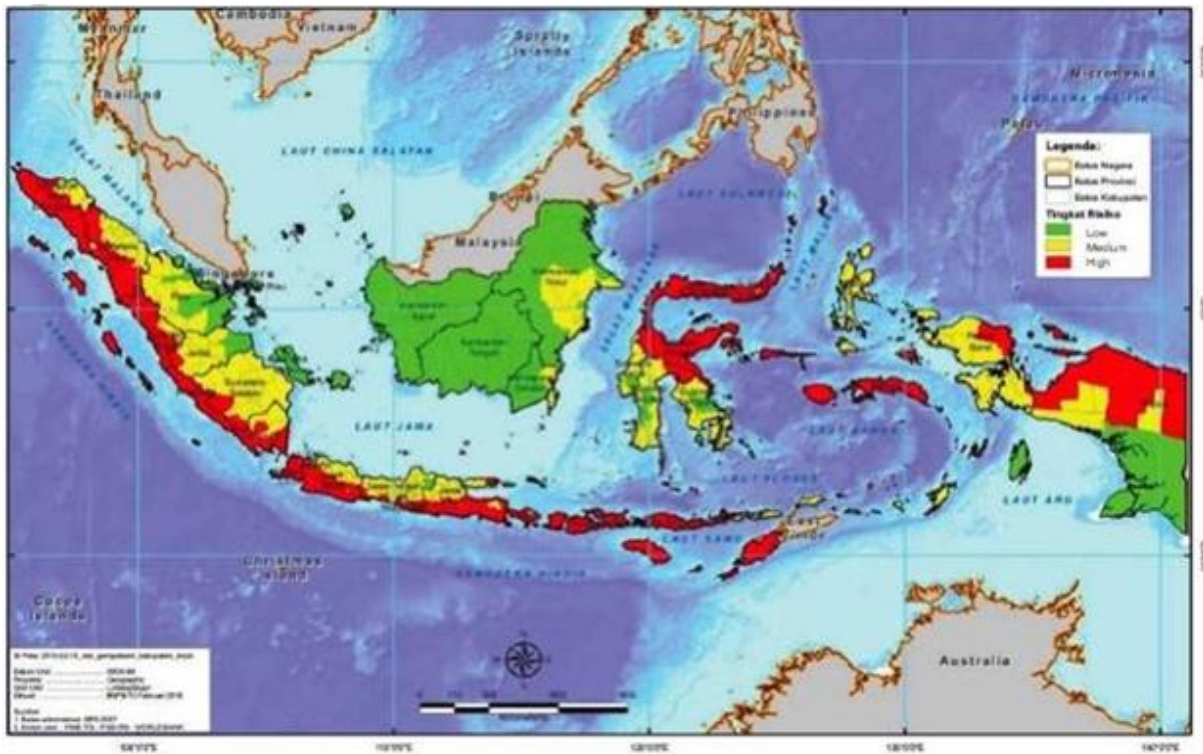


Fig. 1. Map of Indonesia's earthquake risk

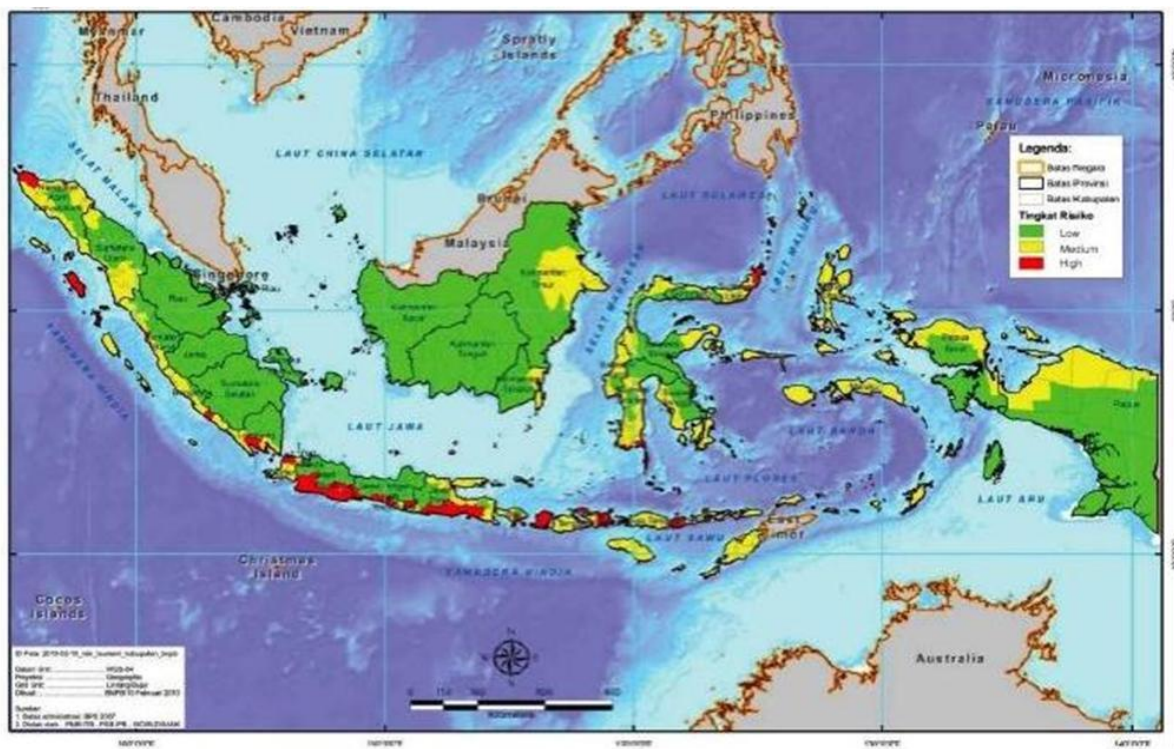


Fig. 2. Map of Indonesia's tsunami risk

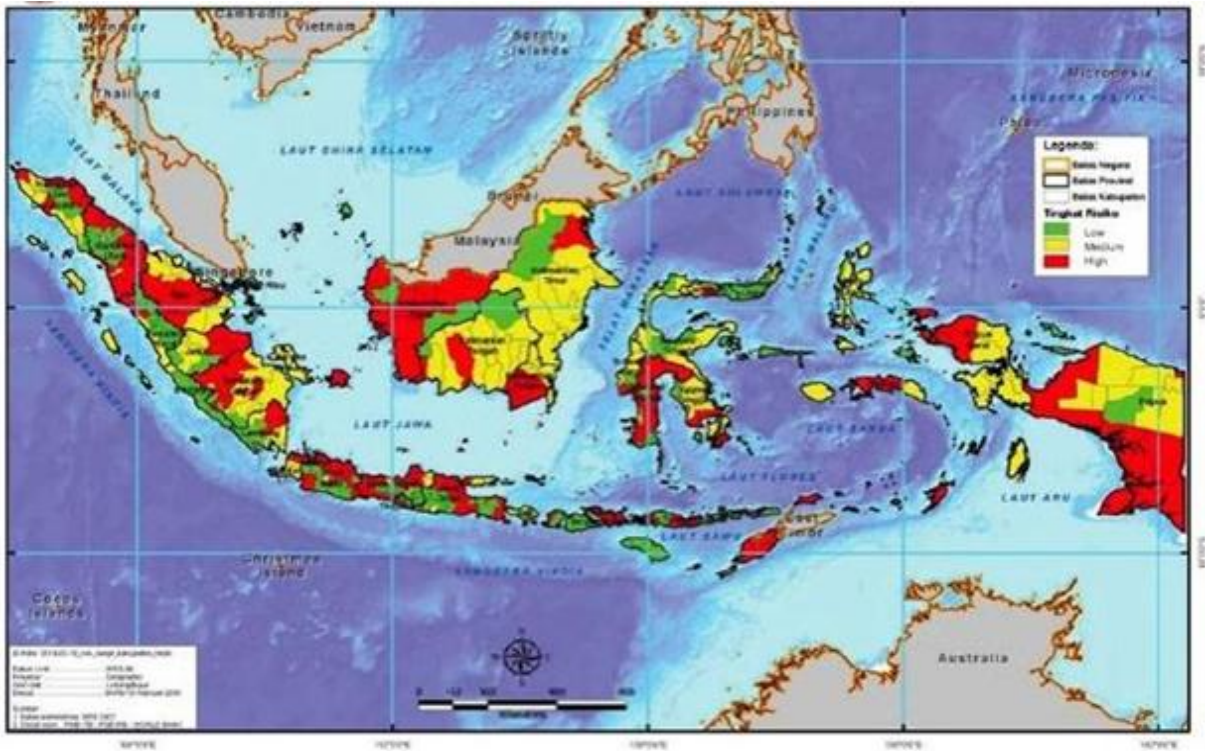


Fig. 3. Map of Indonesia flood risk

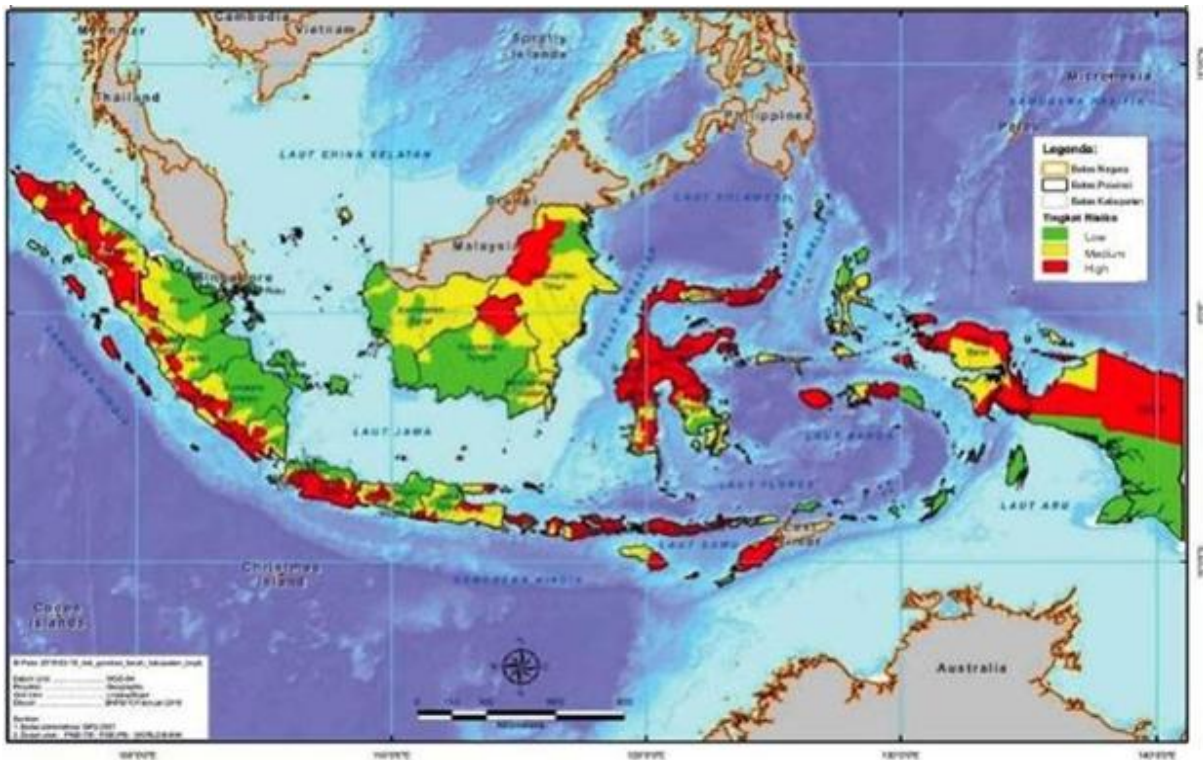


Fig. 4. Map of Indonesia's landslide risk

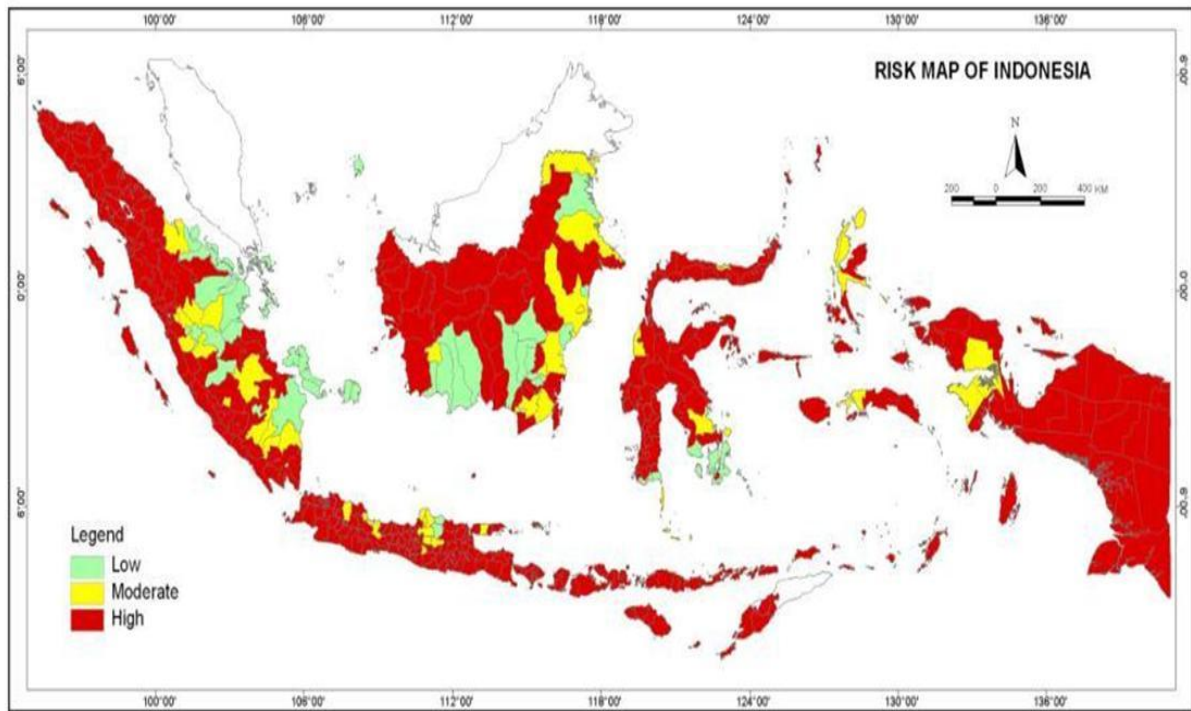


Fig. 5. Map of Indonesia's exposure to high disaster



Fig. 6. Disaster management cycle

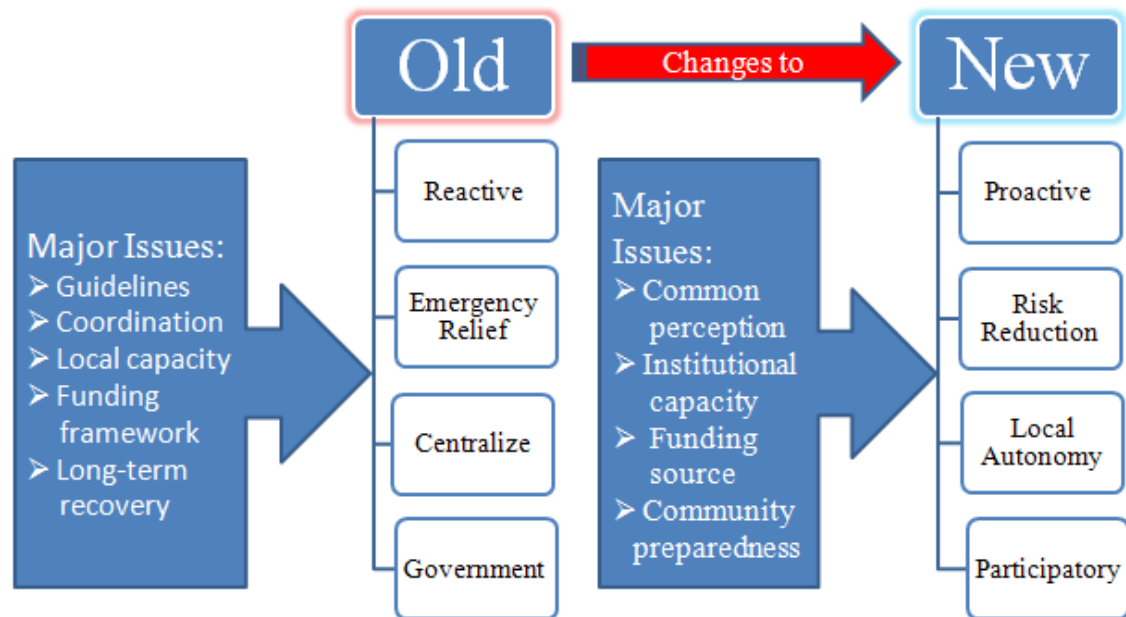


Fig. 7. Paradigm on disaster management

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