Towards an Effective Disaster Management in Indonesia: A Meta-Analysis Approach

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地震や津波から豪雨、山火事まで、インドネシアは毎年のように自然災害で大きな損失をこうむっているが、国の災害対策はどうあるべきか。さまざまな既存の理論を比較検討し、有効な災害対策の望ましい姿を探った。

Abstract

Indonesia is prone to natural disasters. Flood, tornado, landslide, fire, earthquake, drought, abrasion, and volcanic eruptions are the most frequent natural disasters that are prevalent in Indonesia. In 2007, the Indonesian government issued a disaster management act for the basis of disaster management. However, the current rule considered being revised because the current practice has not run effectively. Therefore, this study aims to propose a useful framework for disaster management in Indonesia using existing disaster management models. The methodology used in this research is qualitative literature and document analysis. Based on document analysis, the current disaster management act is examined to depict disaster management in Indonesia. Furthermore, disaster models: the traditional model, the expand-contract model, the disaster crunch model, and Kimberly's model are observed to suggest the most suitable disaster management model in Indonesia. The result of this study suggests that models are useful for decision-making support tools in disaster management. The four basic steps in the models are mitigation, preparedness, response, and recovery. These are addressed in the current Indonesia regulation of disaster management. However, the current disaster management practice in Indonesia has not considered disaster insurance as a tool for risk transfer.

Keywords disaster management, meta-analysis, insurance risk, natural disaster

Introduction

As a country located along the Pacific Ring of Fire, Indonesia faces abundant of natural threats. Earthquakes, volcanic eruptions, floods, and tsunamis are the most regular natural disaster occurs in Indonesia. According to the Indonesia National Agency Disaster Management (BNPB), over the past ten years, Indonesia has suffered 20,500 natural disasters with a total fatality of 11,489 people and 1,386,980 destroyed houses (details in Table 1). The most notable disaster was the 2004 Indian Ocean earthquake and tsunami, which affected over half a million people. The earthquake also struck other countries nearby Indonesia. Last year, another earthquake and tsunami occurred in Palu and it was followed by liquefaction.

Table 1. Indonesia Disaster Statistic

Years	Events	Fatalities	Destroyed Houses
2018	3,405	4,719	359,967
2017	2,868	378	49,731
2016	2,308	578	47,798
2015	1,694	276	25,532
2014	1,963	604	55,469
2013	1,666	512	89,718
2012	1,781	320	54,060
2011	1,622	428	73,643
2010	1,947	1,907	59,501
2009	1,246	1,767	571,534

Generally, the number of disaster victims is proportional to the number of disasters that occurred. However, each type of disaster has its characteristics. As shown in Figure 1, Indonesia categorizes disaster into nine types: floods, landslide, tidal and abrasion, tornado, drought, forest and land fire, earthquakes, tsunami, and volcano eruptions. The highest number of fatalities comes from the least occurrence, which is the tsunami. In seven times tsunamis occurred in Indonesia, the number of victims approximately 4,269 people.

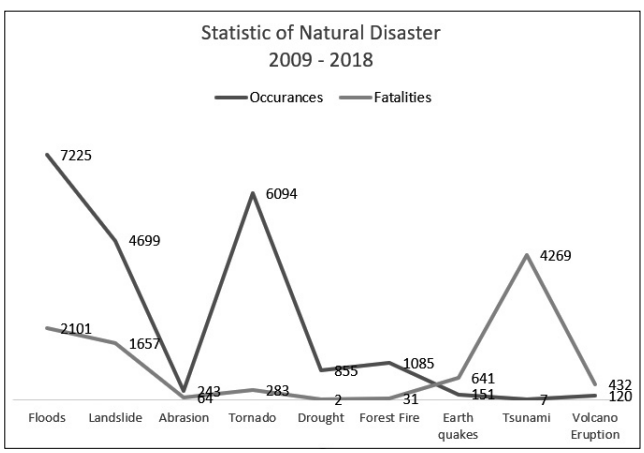

Figure 1. Statistics of Natural Disaster

Floods and tornados are the most numerous disasters occurred in Indonesia. This phenomenon is reasonable because Indonesia is an archipelago and lies at the equator, which is vulnerable to tornados. Therefore, the Government should have an extensive understanding and proper planning to mitigate potential threats of natural disasters.

The problem with disaster is not only related to reducing the victims and mitigating the potential threats, but also all activities in the recovery phase after the calamity occurs. This process usually the most extended process and the most fund needed. In Indonesia, to handle the impacts of the disaster, the government must provide approximately USD 1, 5 million every year. This amount of money allocated in the state budget. However, the total losses incurred by the natural disaster is estimated four times than the government budget allocation because it considers all material and non-material losses.

The purpose of disaster management is to decrease potential loss from threats, to guarantees appropriate support for victims, and to attain effective recovery (Othman & Beydoun, 2012). The process then simplified using model, and later it is utilized to explain the intricacy of the disaster management process (Kelly, 1998). The reason using a model is to investigate the most effective disaster management. Therefore, this research aims to evaluate the current disaster management policy in Indonesia. Using existing disaster management models, this paper describes the characteristics of each model: common types, differences, relationships. Furthermore, the paper investigates how the model contributes to disaster management in Indonesia.

Theoretical Review

Based on the literature, at least four categories of disaster models are used to describe the disaster management theory. The logical models, the integrated models, the cause models, and other models. The logical models provide a simple definition of disaster stages and emphasize the primary events and actions of a disaster. One of the most common logical models is the traditional model. This model emphasizes disaster management into two phases: pre-disaster and post-disaster.

Traditional model

This model is the earliest in the field of disaster management. The main feature is the suggestion of sequences of activities in the disaster management process. Thus, ADPC (2000) explains that the model emphasizes disaster management into two phases: pre-disaster and post-disaster (Figure 2)

Expected activities to reduce the harmful effects of the potential disaster are carried out during the first stage of the model: preparedness, mitigation, and prevention. Manitoba (2000) argues that the pre-disaster stage is the most critical stage, and so proper management should be conducted in disaster management.

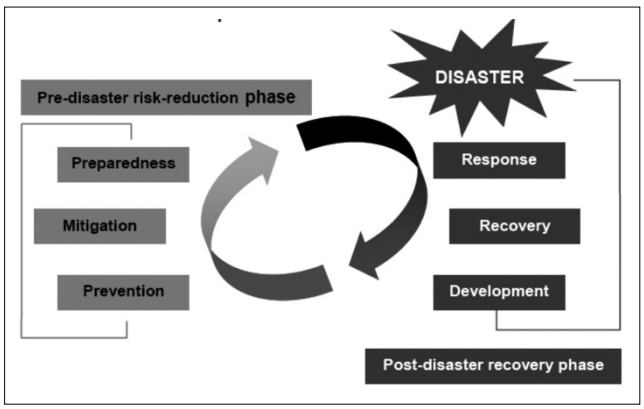

Figure 2. Traditional Model

Source: Coburn, et. al. (1994)

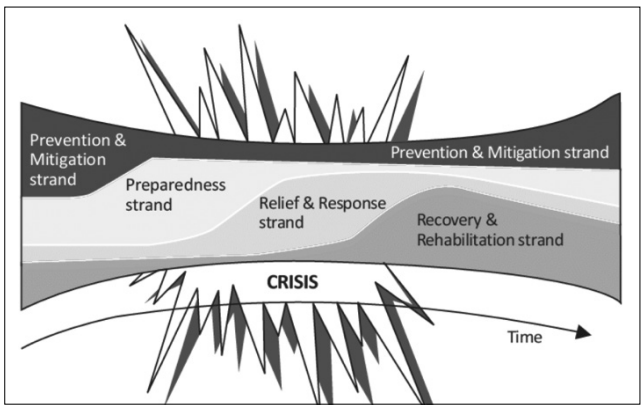

Figure 3. Expand-Contract Model

Source: Atmanand (2003)

The post-disaster stage includes a response which is carried out after the moment of catastrophe. The goals of this stage are to reduce the number of fatalities by search and rescue, medication, and food distribution. Moreover, the recovery and development process involve a long-term period of action because it includes all the infrastructure construction and community resilience after the disaster occurs.

The traditional model can be seen in a sequential process and might become the simplest model to be adapted by disaster management practice.

The expand-contract model

The expand-contract model also categorized in the logical model, which aims to improve the traditional model. This model suggests four strands which almost like the stages of the traditional model. Prevention & mitigation, preparedness, relief and response, recovery, and rehabilitation (Figure 3).

The difference between the two models is that the traditional model proposes a static sequential stage. However, the expand-contract model suggests a more dynamic stage. Thus, as shown in figure 2, the disaster management activities can be performed throughout the whole process, simultaneously, and expanding or contracting as needed depends on the calamity (DPLG-2, 1998).

Dube (2018) argues that although the activities have a dynamic relationship, the lack of cause and effect relationship among strands becomes its weakness. The cause and effect perspective is critical to clarify the relationships among strands. Moreover, the model also determines the proportion of strands while expanding or contracting.

The disaster crunch model

This model categorized as the caused model because it adopts a cause and effect perspective. While the logical model focuses on stages or strands, this model explains the relationship between vulnerability and hazards.

Hazards occur either in the form of natural hazards, social conflict, and technological accidents collide the vulnerability. The vulnerability can be seen as the progression of three stages: underlying causes, dynamic pressures, and unsafe conditions. The first stage is related to the deep-rooted set of factors that causes vulnerability to exist. Poverty, limited access to resources, ideologies, or economic systems are typical pre-conditioning factors as underlying causes (Blaikie, et al., 1994).

Dynamic pressure is the link between the root of the problem and unsafe conditions. Lack of education, training, local institutions participation, appropriate skills combine with macro-forces such as population growth, environmental degradation, and urbanization

are then become the channels to the third stage.

The last stage in this model is the unsafe conditions where people and property are directly exposed to the risk of disaster. Buildings and infrastructure that do not meet earthquakes resistance standards and construction of buildings in locations prone to natural disasters are physical environments that create unsafe conditions. Moreover, dangerous habits such as littering and other adverse public behavior will amend the level of vulnerability (Figure 4).

This model focus on establishing cause and effect in disaster. The most important contribution of this model is its focus on elaborating the causes of disasters. Therefore, it helps practitioners to understand the root of the problem, prepare and mitigate the potential threats, and react to disaster vulnerabilities facing people (Hai and Smyth, 2012).

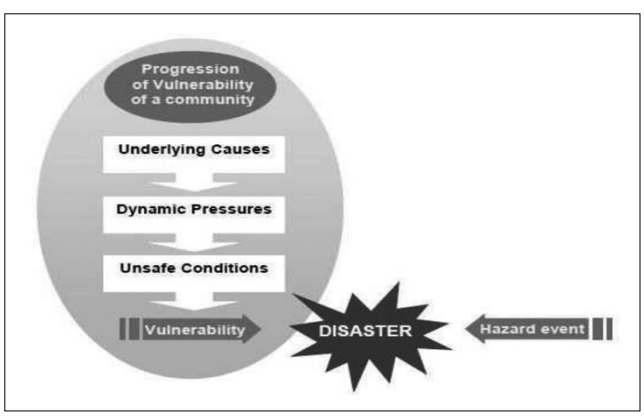

Figure 4. Disaster Crunch Model

Source: Blaikie (1994)

The Kimberly's model

The Kimberly's model is one of the integrated models' categories of disaster management model. Kimberly (2003) argues that mitigation, preparation, response, and recovery are phases of disaster management (Figure 5). Preparation and mitigation are located at the base of the model to suggest that those stages are the foundation of disaster management to minimalize losses. The Response phase is the most visible phase of disaster management (Albtoush et al., 2011). This stage is essential; therefore, it is located in the middle of the diagram, different shapes, and becomes connector among stages.

The recovery stage illustrates the process carried out after the response stage. This stage is the longest and the most extensive phase in disaster management, according to Kimberly (2003), because getting recover from a disaster is costly and needs a long-term period.

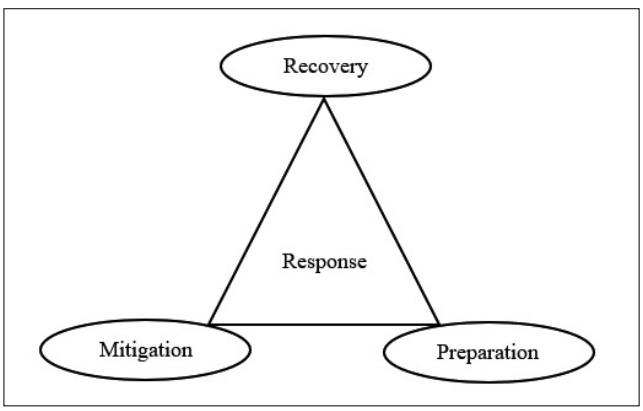

Figure 5. Kimberly's Model

Source: Kimberly (2003)

However, Dube (2018) argues that this model can be used only in a specific disaster situation. The reason for this claim, because it requires appropriately trained employees to handle each stage of disaster phases, which cannot be implemented in all disasters. Also, Alboush, et al. (2011) pointed out that this model is best implemented in the health sector.

Research Methodology

Meta-analysis is one technique in quantitative research that compares multiple previous studies. Glass (1976) explains meta-analysis as a statistical analysis of an extensive collection of analysis results from individual studies to integrate the findings.

In the meta-analysis, there is no single correct approach exists (Shelby & Vaske, 2008). However, researchers mention four basic steps to conduct meta-analysis: problem conceptualization and operationalization, data collection and processing, analysis, and reporting.

The problem conceptualization and

operationalization suppose that meta-analysis research should include a specification of the relevant research literature. Then it followed by data collection and processing, analysis, and reporting to perform appropriate research.

This study utilizes a meta-analysis approach to compares various disaster management models. The chosen research models are research models that have been published academically included journal articles, books, conference proceedings, or working papers. The models are evaluated, compared, and then associated with the results of the document analysis regarding the current disaster management implemented in Indonesia.

Furthermore, findings of the study are expected to describe the differences among disaster models, common features in all models, and how those models contribute to Indonesia's disaster management.

Discussion

This section elaborates on the Indonesian act of disaster management, which was released in 2007, to describe the current practice of disaster management in Indonesia. On the other hand, disaster models are discussed to find the main feature, differences, and how each model impacts on disaster management practice.

Indonesian Act of Disaster Management

Indonesia government released the law of the Republic of Indonesia number 24 concerning Disaster Management in 2007. The act divides disaster management into three phases: pre-disaster, emergency response, and post-disaster.

1. Pre-disaster
   Disaster at the pre-disaster stage includes situation without disaster and situations with potential disaster. Situation without disaster consists of planning, risk reduction, prevention, integration into development planning, risk analysis requirements, spatial structure plan implementation and enforcement, education and training, and technical standard requirements.
2. Emergency response
   The Emergency response phase consists of the quick and appropriate study, emergency status, rescue and evacuation, the fulfillment of necessities, protection for a vulnerable group, and immediate recovery. This phase is a critical phase to reduce the number of victims, decrease the amount of loss, and improve mental and psychological victims.
3. Post-disaster
   This phase divided into two sections: rehabilitation and reconstruction. Rehabilitation emphasizes the environmental improvement and repairment, socio-psychological recovery, healthcare, and conflict resolution. Then, it followed by reconstruction, which focuses on rebuilding the infrastructure and community.

The regulation also regulates disaster aid financing and management of the funds. The central government and the regional government shall jointly responsible for disaster management funds, encourage community participation in the provision of funds. Moreover, the government also must allocate sufficient disaster management budget, especially to recover the government's primary duties and functions.

The government does not only have to build infrastructure and buildings but also has to provide disaster aid to disaster victims. Disaster aid shall comprise donation to the relative of a ceased person, compensation money for disability, soft loan for productive business, and aid for necessities.

Influence of Disaster Management Models

Disaster management models are useful to simplify the disaster management process. Models are also can become a framework guideline for disaster management. Indonesia's act for disaster management was issued after the 2004 earthquake and tsunami in Aceh. The tragedy has prompted serious attention from the Government and the international community in disaster management. Therefore, the government established the Indonesia National Agency Disaster Management (BNPB) to replace the National Disaster Coordinating Board (Bakornas PB). The new agent has a broader function, not only emergency response but also disaster

risk reduction.

The Indonesia disaster management act has resemblances to existing models. The phases in the traditional model are applied to the rules. The cause and effect model also become Government concerns when formulating the mitigation procedures. Moreover, in practice, it is factual that the response phase becomes one of the crucial phases because it has a direct effect on the victims. Incident response, the fulfillment of necessities, rescue and evacuation are the earliest activities after the disaster. Then, the process of recovery also takes years to be complete, as mentioned in Kimberly's model.

Models comparison

This study discussed four disaster management models from different categories. The traditional model and expand-contract represent the logical approach; the disaster crunch model characterizes a cause and effect method, and Kimberly's model denotes the integrated approach of disaster management. The first-three models have a similar approach but different in emphasis. The expand-contract accepts simultaneous activities, while the disaster crunch model focuses on the cause and effect relationship (Table 2). The traditional model is a universal model for most practitioners and then followed by the expand-contract model. These models are simple, clear, and enough to be used as a guideline, while Kimberly's model is the least model used by scholars (Dube, 2018).

Table 2. Models Main Features

Model	Main Feature
Traditional	Sequential stages
Expand-contract	Accepts simultaneous activities
Disaster crunch	Cause and effect relationship
Kimberly	The importance of recovery stage

However, not only one single model used in the practice of disaster management. In Indonesia, all the models have a significant influence on the formulation of regulation. Each of the models assists different features in the disaster management process (Table 3).

Table 3. Major Differences

Model	Main Feature
Traditional	Phase pre-disaster plays a significant role in disaster management, recovery phase not indeed elaborated
Expand-contract	Each phase can expand, or contract depends on the situation, the most flexible model
Disaster crunch	Finding the deep-root problem, beneficial in disaster mitigation framework, as the basis for early construction of regulation
Kimberly	Focus on recovery and inattention the need of pre-disaster, preparedness and mitigation in the same level

Disaster Financing

Because of the significant economic losses as the impact of the disaster, as well as the potential risk exposure in the future, Indonesia needs to own a reasonable consideration of assessing the economic impact of disasters. This attention is crucial for ensuring the availability of resources for disaster response, recovery, and reconstruction, which can prevent financial distress (Mahul and Signer 2014).

There are two types of disaster risk financing as policy options; one is the public tools and the second is private tools (Juswanto & Nugroho, 2017). While the government has difficulties in financing all losses due to disaster, the private sector has financial resources. Therefore, the government might seek other funding sources such as disaster insurance. The state-sponsored reinsurance program will allow the government to protect the private insurance sector from the exposure of risks. This protection is recognized using special proportional and nonproportional of reinsurance arrangements. (Juswanto & Nugroho, 2017).

As an example is the Japan's earthquake insurance scheme. This insurance was introduced in 1966 by the act on earthquake insurance. This schema focus on the earthquake reinsurance for the private insurance market is solely provided by Japan Earthquake Reinsurance Co., Ltd. (JER). JER retains some portion of the liability and transfers the rest back to the private insurer and the government through reinsurance treaties. This schema also in accordance with Mita (2016) that explains the

needs of the public sector and private sector participation in disaster risk management.

Whereas in Indonesia, there is no disaster-specific insurance that can be used as a tool for risk transfer. Consequently, beside foreign grants, the government should fund all the disaster management process. Therefore, Indonesia should consider other tools for risk transfer, such as disaster insurance. At least the needs of a fund to cover immediate needs after the disaster will be fulfilled by the third party. (Ghesquiere and Mahul, 2007).

Conclusion

One of the conclusions in this study is that models have a noteworthy role in disaster management practice. As a base on formulating a framework of disaster management practices, the government can utilize various disaster models to be applied in the regulation. The traditional model and expand-contract are the most regular model for practitioners; while the disaster crunch focuses on the process of brainstorming to decide disaster management practice. Kimberly's model also beneficial in the formation of regulation; however, the implementation needs an adaptation on specific conditions.

After the earthquake and tsunami in 2004, Indonesia realized the importance of the preparation stage in disaster management. The regulation of disaster management then released and became a guideline in disaster management practice. The regulation also explains the source of funding to minimize the impact of disaster, reporting and accountability process of the fund. However, the regulation does not consider any risk-transfer method to minimize the Government's burden on disaster management.

Therefore, the Government should find the most suitable funding sources and consider the risk-transfer tools to mitigate the impact of a disaster.

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Appendix 1 Disaster Management Phases based on Indonesia Act of Disaster Management

Phases	Stages	Details	Explanations
Pre-disaster	Situation without disaster	Disaster management planning	Management planning document released periodically and include recognition and study of disaster threat, understanding on community's vulnerability, analysis of potential disaster impact, options for reducing risk disaster measures, selection of mechanism for alertness and for disaster impact management, allocation of task, authority, and available resources
		Disaster risk reduction	Activities to reduce potential negative impacts such as recognition and monitoring of disaster risk, participatory disaster management planning, promotion of disaster-awareness practices, greater commitment of disaster management team, application of physical and non-physical efforts and instruction on disaster management
		Prevention	Shall contain sure identification and recognition of sources of disaster danger or threat, check on control and management of natural resources with abrupt and/or gradual potential to become of source of disaster, monitoring the use of technology with abrupt and/or gradual potential to become a source of disaster threat or danger, spatial structuring and environmental management, strengthening of community's social resilience
		Integration into development planning	Shall include disaster management plan elements in Central and Regional development plans which require periodical reviews and coordination by the Agency
		Disaster risk analysis requirements	The document shall be shown in a document ratified by a government official
		Spatial structure plan implementation and enforcement	Shall aim to reduce disaster risk including the application of regulations on spatial structure, safety standard, and the imposition of sanction on violators. The implementation of spatial structure and the achievement of safety standard should be monitor and evaluate periodically
		Education, training and technical standard requirements	Government shall carry out and stipulate education, training, and technical standard requirements
	Situation with potential disaster	Alertness	Shall require preparation and try-out for disaster emergency plans, organization, installation, and testing of early warning system, provision and preparation of supplies for fulfillment of necessities, organization, counseling, training, and rehearsal regarding emergency response mechanism, preparation of location for evacuation, composition of accurate data, information, and update on disaster emergency response fixed procedures, provision and preparation of materials, goods, and equipment to fully recover facilities and infrastructure
		Early warning	Shall require observation of disaster signs, analysis of results from disaster signs observation, decision-making by the authorities, dissemination of disaster warning information, community actions
		Disaster mitigation	Shall require implementation of spatial structuring, regulation of development, infrastructure development, building lay-out, conventional and modern education, counseling, and training

Phases	Details	Explanations
Emergency response	Quick and appropriate study	Shall aim to identify disaster area coverage, number of victims, damage to facilities and infrastructure, disturbance to the functions of public service and government administration, capability of natural and artificial resources
	Deciding on the disaster emergency status	The agency shall have easy access to mobilization of human resources, equipment, and logistics. Acceptance on immigration, excise, quarantine, licensing, procurement of goods and services, accountability of money, rescue, and command.
	Rescue and evacuation of disaster-affected community	Shall require humanity services in disaster area through search and rescue of victims, emergency aid, and evacuation of victims.
	Fulfillment of necessities	Shall include aid for necessities of water and sanitation, food, clothing, healthcare, psychosocial service, and accommodation and dwelling place.
	Protection for vulnerable group	Shall priorities infants, preschoolers, and children, pregnant women and nursing mothers, the disabled, and the elderly in the forms of rescue, evacuation, protection, healthcare, and psychosocial services
	Immediate recovery	Shall require to and/or replacement of damages of essential facilities and infrastructure from disaster
Post-disaster	Rehabilitation	Shall require improvement to disaster area environment, repairment of public facilities and infrastructure, provision of aid for community housing repair, socio psychological recovery, healthcare, conflict resolution, socioeconomic and cultural recovery, security and order recovery, government administration function recovery, and public services function recovery
	Reconstruction	Shall include rebuilding of facilities and infrastructure, rebuilding of community's social facilities , revival of community life, use of appropriate design with disaster-resistant equipment, participation of social institutions and organization, business, and community, improvement to social, economic and cultural conditions, improvement to public service functions, and improvement to essential services in community