

SI10_Identifying factors for assessing regional readiness level to manage natural disaster in emergency response periods

by Naniek Utami Handayani

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Naniek Utami Handayani, Diana Puspita Sari, M. Mujiya Ulkhaq, Adi Setyo Nugroho, and Ajeng Hanifah



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Identifying Factors for Assessing Regional Readiness Level to Manage Natural Disaster in Emergency Response Periods

² Naniek Utami Handayani^{1,a)}, Diana Puspita Sari¹, M. Mujiya Ulkhaq¹, Adi Setyo Nugroho¹, Ajeng Hanifah¹

¹ Department of Industrial Engineering, Faculty of Engineering, Diponegoro University
Jl. Prof. Soedarto, SH, Kampus Undip Tembalang, Semarang, Indonesia 50275

^{a)} Corresponding author: naniekh@ft.undip.ac.id

Abstract. Disaster preparedness is an effective, realistic and coordinated planning program with risk reduction measures, reducing the impact of disasters, saving lives optimally, and returning the community to normal conditions in the shortest possible time. Sleman Regency has a volcanic eruption of Mount Merapi potential. The agency of the emergency response should manage the emergency response period effectively and efficiently both concerning victim handling, and disaster logistics management. This study aims to identify factors for assessing regional readiness in disaster management. The analytic hierarchy process was employed to accomplish the objective of this research. There are 11 factors for assessing regional readiness in natural disaster management, namely: strengthening the legal framework for disaster management, mainstreaming disaster risk reduction in development, enhancing multi-party partnerships in disaster management, implementing Good Governance in disaster management, increasing the effectiveness of disaster prevention and mitigation, improving preparedness and handling disaster emergencies, increasing disaster recovery capacity, understanding disaster risk, strengthening risk governance, DRR investment for resilience, and improving risk management.

INTRODUCTION

³ Mount Merapi is one of the most active mountains in the world with high intensity and relatively short eruption periods of around 3-7 years [1]. The biggest eruption of Mount Merapi occurred in 2010 with the power of the eruption 3 times greater than before with the launch of an incandescent cloud with a radius of 14.5 km. According to the National Disaster Management Agency (BNPB), at that time the emergency response period for the eruption of Mount Merapi was carried out for 14 days since October 26, 2010. The eruption resulted in 277 deaths and missing, 186 injured and 159,977 people were evacuated.

According to PVMBG, the type of Mount Merapi eruption was cyclical and it would reoccur in a certain period of time, so that Mount Merapi has a periodic potential disaster. Therefore, the local government must be ready in handling the eruption [2-6]. The local emergency response (BPBD) Sleman area, Special Region of Yogyakarta is a government institution that has the duty to deal with the disasters occur within the province of the Special Region of Yogyakarta. According to [7], 2011 about BPBD, one of the duties of BPBD is to mitigate the disaster defined as a set of efforts to minimize the disaster risks through organizing as well as through effective and efficient steps. In its implementation, however, from the interview with the Chief of Prevention and Preparedness - Unit of Prevention and Readiness - of BPBD Sleman as well as the Head of Executor in facing the disaster, the disaster handling implemented by BPBD is still responsive and not preventive. In its implementation, BPBD tries to improve its preventive readiness in various executing programs aimed to anticipate the disasters. However, the lack of knowledge and understanding from the people about the disaster especially the risk of Mount Merapi eruption often made the preventive steps taken by BPBD could not run as it should. As the consequence, the handling and the prevention went back to responsive and the readiness of BPBD has become critical to be concerned. The readiness of many aspects of risk needs to be improved by BPBD to minimize the disaster effects.

The regional readiness of the disaster affected area to reduce the level of damage and disaster victims must refer to the National Disaster Prevention System written on [8] about the Prevention of Disaster and its derivative regulations. Besides, the readiness of the area must also be seen on its international scale. Sendai Framework for Disaster Risk 2015-2030 Reduction is a Framework for Disaster Risk Reduction post 2015 which has been adopted in the third World Conference on Disaster Risk Reduction, conducted on March 14-18, 2015 in Sendai, Miyagi, Japan. This framework represented unique opportunities for all nations to be made as one of the basic reference in capacity building or readiness [9]. The Sendai Framework is in the continuation of Hyogo Framework for Disaster Risk Reduction 2005-2015. This study aims to identify factors for assessing regional readiness in disaster management. The analytic hierarchy process was employed to accomplish the objective of this research. Factors to assess regional readiness for handling the period emergency response referring to the Sendai Framework and the Act No. 24, 2017 which then was ratified into the National Disaster Management Plan (RENAS) - the National Plan of Disaster Management - 2015-2019. This action planning and Sendai framework are used by BNPB and BPBD as the achievement indicator reference in disaster management [10]. The study of local readiness must also be able to map the local general capacity for the existing threat of disaster within an area and it could recognize the level of readiness of each existing parameter [11].

RESEARCH METHODS

System Characteristics

The Alert system must be taken into account in disaster management. In international level, within 15 years, there must be a conference among the countries related to the framework that would be used in managing the risk of disaster. The framework produced was a 15 years' period of agreement, which admit that the country plays important role in disaster risk management. The role could be shared among the local government, private institutions, etc. In national level, BNPB has been an institution that has the authority to arrange the framework of national scaled disaster management system. In the arrangement of the national scaled framework, it should always refer to the framework of international scaled disaster management where it would be adjusted with the condition or the need of each area through BPBD which directly related to the rural location or local people. To support the need of handling mechanism or the disaster management, there would be formed an indicator of readiness for each area. On such system, BPBD carries a task to execute the indicators of readiness that have been set. The implementation of readiness in risk disaster management and handling has become an important factor for a region for to have better anticipation steps in emergency response [12-14].

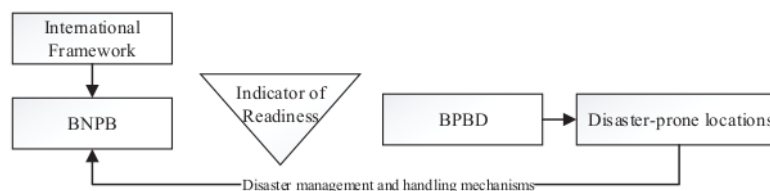


FIGURE1. System Characteristics

The method used in this study is the Nominal Group Technique (NGT) and Analytic Hierarchy Process (AHP) methods. The criteria and sub-criteria used in this study refer to the Sendai Framework and the National Disaster Management Plan (RENAS PB). The criteria and sub-criteria are then validated using the NGT method through a questionnaire to respondents who have competence in the matter. The respondents were disaster researchers, Head of Disaster Prevention and Preparedness, Head of Emergency and Logistics, Head of Disaster Mitigation and Head of Disaster Preparedness. After validating the criteria and sub-criteria, the next step is to determine the importance of the criteria and sub-criteria by using the AHP method through a pairwise comparison questionnaire.

Analytic Hierarchy Process (AHP)

The steps in weighting using AHP are as follows [15-18]:

- Building a Hierarchical Structure
The compilation of the problem hierarchy is a step to identify complex problems into sub-systems, elements, sub-elements, and so on which eventually become clearer and more detailed.
- Priority Determination
AHP conducts element priority analysis using the pairwise comparison method between two elements, until all the elements that are included. This matrix form is usually called a square matrix. This priority is determined based on the views of experts and interested parties in the decision, both directly through discussion, interview and indirectly through questionnaire. To determine priorities, it is necessary to make a pairwise comparison between criteria.
Priority determination is obtained from the results of filling in the pairwise comparison questionnaire by respondents. Questionnaire respondents in this case are those who are considered experts / experts in the field of Human Resources, namely Supervisors and Senior Supervisors in each division. The results of the questionnaire are then processed using the help of expert choice software.
- Measuring Logical Consistency
AHP process includes measurement of consistency, namely whether the provision of values in comparison between objects has been done consistently. Consistency Ratio is a parameter used to check whether a pairwise comparison has been done consequently or not. If the evaluation of criteria and alternatives has been carried out consistently, the CR value should be < 0.10. If there are inconsistencies in carrying out the assessment, it is still necessary to revise the assessment.

The Development of Research Variable

The variable of this research refers to RENAS 2015-2019 and Sendai Framework for Disaster Risk Reduction 2015-2030. This framework represents unique opportunities for all countries where this framework is could made as one of the basic references in capacity building or readiness [9]. The criteria and sub-criteria of the research are presented in Table 1.

TABLE 1 Research Variable

No	Priority Focus	Indicator	Reference
1	Strengthening the legal framework of disaster management	The Revision of Act No 24, 2007 about Disaster Management	[10]
		Harmonization of other rules that have been applied under the act of disaster management.	
		The Improvement of Technical Rules in Disaster Management	
		The Improvement of the implementation of legal framework for conducting disaster management	
2	Prioritize the disaster risk reduction in development	Prioritizing the disaster risk reduction and the adaptation of climate change related to the disaster in terms of development	[10]
		Monitoring, evaluation, and update of RENAS PB integrated with the related sectors	
		Developing information system for RENAS PB implementation	
3	The improvement of multi-party partnership in disaster management	Strategy development of the human resource and the implementation for the disaster management concerning the local wisdom and adaptive towards climate change, gender, and vulnerable group.	[10]
		Strengthening independence and sustainable partnership in conducting disaster management.	
		Strengthening PRB forum nationally, locally and thematically as a media to share information in the execution of disaster management	
		Strengthening and empowering education institutions and association of expertise in the field of disaster as an education media and safety culture development.	
		Strengthening and improving the role of volunteers in management disaster.	

TABLE 1. continued

No	Priority Focus	Indicator	Reference
4	Good Governance in the field of disaster management	Meeting the Minimal Service Standard related to disaster management	[10]
		Improving the capacity of human resources within the related institutions conducting disaster management	
		Improving the facilities that support the institutions for disaster management	
		Management support and the accountability of technical implementation of disaster management	
5	The Improvement of preventing activities and disaster mitigation	Improving the building capacity and community in preventing and mitigating disaster.	[10]
		Strengthening research and technology and the application of its results for the effectiveness of prevention and mitigation of disaster as well as knowledge and understanding sharing in the level of local, national and international	
		Updating the Study of Disaster Risk by strengthening its information system in national scale.	
		Optimizing the maintenance of resources as well as spatial plan in order to prevent and mitigate disaster.	
6	The improvement of readiness and the emergency response for disaster	Maintaining disaster mitigation in synergy with the adaptation of climate change as well as considering the vulnerable group and local wisdom	[10]
		The combination of effort in disaster risk reduction with the emergency response	
		The establishment of early warning system for multi danger disaster	
		The expansion of the scope area of the early warning system for disaster	
		The establishment of the national and local disaster readiness capacity	
		The acceleration of the establishment of facilities and logistics as well as distribution in emergency response..	
		Strengthening <i>Satuan Reaksi Cepat</i> (SRC) - Quick Response Unit of Indonesia's disaster management	
7	Increasing the capacity of post-disaster recovery	Strengthening and local guidance to strengthen the mechanism of emergency response towards disaster based on the priority of operation target (rescuing the people, localization of the area exposed and rescuing the vital assets)	[10]
		Increasing the capacity of emergency response	
		Strengthening the mechanism of recovery support at the scale of international and national	
		Combining the conduction of post-disaster recovery by reducing the disaster risks	
8	Understanding the disaster risks	Optimizing Rehabilitation and Reconstruction in all aspects	[9]
		Building the character and the sustainability of the people to aware of disaster	
		Encouraging the collection, management and access to the information of risks.	
		Utilization of location based-data	
		Optimizing statistic in handling the damage and loss	
		Increasing the people's awareness about the understanding of PRB	

TABLE 1. continued

No	Priority Focus	Indicator	Reference
9	Strengthening the risk management	Prioritizing & integrating PRB in all sectors	[9]
		Adopting strategy and applying the strategy to reduce disaster risks and its planning based on the target set	
		Empowering the local area through regulation and financial to coordinate with the civilian, community as well as the citizens to maintain the risks.	
		Formulating the applicable public policy which aims to overcome the issue of preventing or relocating the people's housing in the high risk area.	
10	PRB Investment for Resilience	Allocating the resources needed, including financial and logistic in all level government to develop and to execute the strategic policy of disaster risk reduction, planning and the rules in all relevant sector.	[9]
		Increasing the critical infrastructure	
		Integrating PRB within fiscal instrument & risk sharing as well as transfer.	
		Increasing business sustainability, either from the people's professions or the efforts from many parties.	
11	Increasing risk management	Protecting and supporting the conservation of cultural institutions and the objects collected as well as other historical sites, cultural heritage and religious related matters	[9]
		Readiness and policy, planning, as well as programs within the disaster risk handling	
		Increasing the people's sustainability, and infrastructure services.	
		The support and the recovery of funding, coordinating as well as procedure in handling disaster risk.	
		Developing the legal, guidance, procedure, and mechanism from the disaster risk handling	

RESULT AND ANALYSIS

Validation of criteria and sub-criteria is done to get expert consensus using the Nominal Group Technique method. The experts were asked to rank the suitability of each criterion and sub-criteria on a scale of 1 to 5, where scale 5 shows a high value of conformity, while scale 1 shows a low value of conformity. In addition, each expert is given the opportunity to discuss with other experts and given the opportunity to add criteria and sub-criteria that need to be added [19]. Expert respondents in this study were the Head of Prevention and Preparedness, the Head of the Disaster Mitigation Section, and the Head of the Disaster Preparedness Section. The results of the validation of the criteria and sub-criteria of the study are presented in Table 2.

TABLE 2. Criteria and Sub criteria

No	Criteria	Code	Sub criteria	Code
1	Strengthening the legal framework of disaster management	A	Completion of Disaster Management Technical Regulations	A1
			Increasing the implementation of the legal framework for disaster management	A2
2	Prioritize the disaster risk reduction in development	B	Prioritizing the disaster risk reduction and the adaptation of climate change related to the disaster in terms of development	B1
3	The improvement of multi-party partnership in disaster management	C	Strategy development of the human resource and the implementation for the disaster management concerning the local wisdom and adaptive towards climate change, gender, and vulnerable group.	C1

TABLE 2. continued

No	Criteria	Code	Sub criteria	Code
			Strengthening independence and sustainable partnership in conducting disaster management.	C2
			Strengthening PRB forum nationally, locally and thematically as a media to share information in the execution of disaster management	C3
			Strengthening and empowering education institutions and association of expertise in the field of disaster as an education media and safety culture development.	C4
			Strengthening and improving the role of volunteers in management disaster.	C5
4	Good Governance in the field of disaster management	D	Meeting the Minimal Service Standard related to disaster management	D1
			Improving the capacity of human resources within the related institutions conducting disaster management	D2
			Improving the facilities that support the institutions for disaster management	D3
			Management support and the accountability of technical implementation of disaster management	D4
5	The Improvement of preventing activities and disaster mitigation	E	Improving the building capacity and community in preventing and mitigating disaster.	E1
			Optimizing the maintenance of resources as well as spatial plan in order to prevent and mitigate disaster.	E2
			Maintaining disaster mitigation in synergy with the adaptation of climate change as well as considering the vulnerable group and local wisdom	E3
6	The improvement of readiness and the emergency response for disaster	F	The combination of effort in disaster risk reduction with the emergency response	F1
			The establishment of early warning system for multi danger disaster	F2
			The expansion of the scope area of the early warning system for disaster	F3
			The establishment of the national and local disaster readiness capacity	F4
			The acceleration of the establishment of facilities and logistics as well as distribution in emergency response..	F5
			Strengthening <i>Satuan Reaksi Cepat</i> (SRC) - Quick Response Unit of Indonesia's disaster management	F6
			Strengthening and local guidance to strengthen the mechanism of emergency response towards disaster based on the priority of operation target (rescuing the people, localization of the area exposed and rescuing the vital assets)	F7
			Increasing the capacity of emergency response	F8
7	Increasing the capacity of post-disaster recovery	G	Strengthening the mechanism of recovery support at the scale of international and national	G1
			Optimizing Rehabilitation and Reconstruction in all aspects	G2
			Building the character and the sustainability of the people to aware of disaster	G3
8	Understanding the disaster risks	H	Encouraging the collection, management and access to the information of risks.	H1
			Utilization of location based-data	H2
			Optimizing statistic in handling the damage and loss	H3

TABLE 2. continued

No	Criteria	Code	Sub criteria	Code
9	Strengthening the risk management	I	Increasing the people's awareness about the understanding of PRB	H4
			Prioritizing & integrating PRB in all sectors	I1
			Adopting strategy and applying the strategy to reduce disaster risks and its planning based on the target set	I2
			Empowering the local area through regulation and financial to coordinate with the civilian, community as well as the citizens to maintain the risks.	I3
			Formulating the applicable public policy which aims to overcome the issue of preventing or relocating the people's housing in the high risk area.	I4
10	PRB Investment for Resilience	J	Allocating the resources needed, including financial and logistic in all level government to develop and to execute the strategic policy of disaster risk reduction, planning and the rules in all relevant sector.	J1
			Increasing the critical infrastructure	J2
			Integrating PRB within fiscal instrument & risk sharing as well as transfer.	J3
			Increasing business sustainability, either from the people's professions or the efforts from many parties.	J4
			Protecting and supporting the conservation of cultural institutions and the objects collected as well as other historical sites, cultural heritage and religious related matters	J5
11	Increasing risk management	K	Readiness and policy, planning, as well as programs within the disaster risk handling	K1
			Increasing the people's sustainability, and infrastructure services.	K2
			The support and the recovery of funding, coordinating as well as procedure in handling disaster risk.	K3
			Developing the legal, guidance, procedure, and mechanism from the disaster risk handling	K4

In this study, the AHP method is used to determine the weight of each criterion and sub-criteria that are indicators of the assessment of the BPBD Sleman's readiness in managing the emergency response period of the eruption of Mount Merapi. The stages of data processing by AHP consist of distributing pairwise comparison questionnaires to specified respondents, checking the consistency ratio of <0.1, estimating relative weights, and calculating global weights using Expert Choice software. The results of weighting criteria and sub-criteria are presented in Table 3.

9

3

TABLE 3. Results of Weighting Criteria and Sub Criteria

Criteria	Local Weight	Sub criteria	Local Weight	Global Weight
A	0.022	A1	0.694	0.015
		A2	0.306	0.007
B	0.04	B1	0.040	0.040
		C1	0.163	0.008
C	0.05	C2	0.067	0.003
		C3	0.360	0.018
		C4	0.192	0.010
		C5	0.218	0.011
		D1	0.168	0.014
D	0.084	D2	0.324	0.027
		D3	0.432	0.036
		D4	0.076	0.006

9

TABLE 3. continued

Criteria	Local Weight	Sub criteria	Local Weight	Global Weight
E	0.163	E1	0.133	0.022
		E2	0.525	0.086
		E3	0.342	0.056
		F1	0.084	0.013
		F2	0.088	0.013
F	0.151	F3	0.130	0.020
		F4	0.045	0.007
		F5	0.222	0.034
		F6	0.100	0.015
		F7	0.106	0.016
G	0.135	F8	0.225	0.034
		G1	0.346	0.047
		G2	0.134	0.018
		G3	0.519	0.070
		H1	0.200	0.024
H	0.118	H2	0.102	0.012
		H3	0.282	0.033
		H4	0.416	0.049
		I1	0.187	0.017
		I2	0.558	0.051
I	0.092	I3	0.139	0.013
		I4	0.116	0.011
		J1	0.531	0.044
		J2	0.163	0.014
		J3	0.093	0.008
J	0.083	J4	0.120	0.010
		J5	0.093	0.008
		K1	0.182	0.011
		K2	0.213	0.013
		K3	0.302	0.019
K	0.063	K4	0.302	0.019

Criterion 5 (The Improvement of preventing activities and disaster mitigation) is the criterion that has the greatest weight of 0.163 or 16.3%. Next is criterion 6 (The improvement of readiness and the emergency response for disaster) with a weight of 0.151 or 15.1%; criterion 7 (Increasing the capacity of post-disaster recovery) with a weight of 0.135 or 13.5%, criterion 8 (Understanding the disaster risks) with a weight of 0.118 or 11.8%; criterion 9 (strengthening the risk management) with a weight of 0.092 or 9.2%; criterion 4 (Good Governance in the field of disaster management) with a weight of 0.084 or 8.4%; criterion 10 (PRB Investment for Resilience) with a weight of 0.083 or 8.3%; criterion 11 (increasing risk management) with a weight of 0.063 or 6.3%; criterion 3 (The improvement of multi-party partnership in disaster management) with a weight of 0.05 or 5%; criterion 2 (Prioritize the disaster risk reduction in development) with a weight of 0.04 or 4%; and finally, criterion 1 (Strengthening the legal framework of disaster management) with a weight of 0.022 or 2.2%.

The criteria with the highest weight are increasing the effectiveness of disaster prevention and mitigation due to disaster management efforts. Effective and efficient prevention and mitigation are expected to reduce the occurrence of casualties, economic losses, and environmental damage due to disasters. Increasing the effectiveness of disaster prevention and mitigation is focused on (a) optimizing public awareness strategies to develop community participation in implementing disaster prevention and mitigation, (b) spatial planning and land use in most areas based on water, land and forest resource management plans in accordance with the results of the Study Disaster Risk and Regional Strategic Environmental Assessment.

The criterion with the second highest weight is increasing disaster preparedness and handling. Increased preparedness capacity is expected to increase the effectiveness and efficiency of disaster emergency response operations. Preparedness in dealing with disasters is one of the preventive measures so that stakeholders are able to manage the emergency response period quickly and on target. Preparedness is a series of activities carried out to anticipate disasters through organizing appropriate and effective actions. Disaster emergency management is a

series of activities that are carried out immediately at the time of a disaster event to deal with the adverse impacts caused by including the rescue and evacuation of victims, property, fulfillment of basic needs, protection of refugee management, rescue, and restoration of infrastructure and facilities.

The criterion with the third highest weight is increasing disaster recovery capacity. Strengthening regional disaster recovery support mechanisms and infrastructure supply chains in each service sector are the basic perspectives used to increase disaster recovery capacity.

The criterion with the fourth highest weight is understanding disaster risk. Policies and practices in disaster risk management must be based on an understanding of disaster risk in all dimensions of vulnerability, capacity, people and assets affected, hazard characteristics and the environment. Knowledge about understanding risks can be utilized for the purpose of risk assessment before a disaster occurs, for prevention and mitigation as well as for the development and implementation of adequate preparedness and effective response to disasters.

The criterion with the fifth highest weight is about strengthening risk governance. Disaster risk management needs to be considered in order to improve effective and efficient management of the risks posed. Cross-sectoral vision, plans, competencies, guidelines and coordination as well as stakeholder participation need to be strengthened. This is necessary so that prevention, mitigation, preparedness, response, recovery and rehabilitation need to encourage collaboration and partnership mechanisms across institutions and for the use of instruments relevant to disaster risk reduction and sustainable development.

The criterion with the sixth largest weight is good governance in the field of disaster management. This is directed to ensure transparency, accountability and the availability of infrastructure for disaster management at all levels of government.

The criterion with the seventh largest weight is investment in disaster risk management to reduce disaster risk, resilience in public and private investment through structural and non-structural measures to increase economic, social, health and cultural resilience of individuals, communities and the environment. Investment is needed in the rehabilitation process specifically to encourage innovation, growth and job creation.

The criterion with the eighth largest weight is improving risk management. It focuses on increasing effective responses in disaster preparedness in the context of recovery, rehabilitation and reconstruction due to disasters.

The criterion with the ninth largest weight is increasing multi-stakeholder partnerships in disaster management. One of the paradigm changes in disaster management mandated in Law Number 24 of 2007 is a shift in the implementation and responsibility of disaster management which initially only rested with the Government into a matter that must be jointly addressed by all stakeholders. Thus, increasing community participation, promoting partnerships with non-governmental institutions, educational institutions, and the National DRR Forum are among the focuses that need to be developed to achieve effective disaster management.

The criterion with the tenth largest weight is the mainstreaming of disaster risk reduction in development. Disaster management is a cross-sectoral and cross-sectoral effort and is integrated or mainstreamed in overall and holistic development planning. Disaster management mainstreaming must be in the work plans of non-governmental organizations, so that they can be integrated with one another.

The criterion with the eleventh largest weight is strengthening the legal framework for disaster management. The effectiveness of the implementation of disaster management requires strengthening commitment by aligning the authority, duties and functions between institutions and local governments in the implementation of disaster management. Strengthening this commitment is implemented by strengthening the legal framework [9][10].

CONCLUSION

Based on the results of the identification of criteria and sub-criteria obtained 11 indicators for the assessment of regional preparedness in natural disaster management. Regional preparedness is needed in order to reduce fatalities and other losses. Disaster management is the responsibility of the Government and stakeholders with the division of responsibilities for effective and efficient implementation. Further research will develop a regional readiness assessment model that is a composite index formulation and model validation developed. The model is expected to be an input for the government through BPBD in improving natural disaster management preparedness.

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