

# Disaster Risk Reduction through Managing Risk Perception and Adaptation of Community Livelihood Assets In Turgo Hamlet, Purwobinangun, Pakem, Sleman

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# Disaster Risk Reduction through Managing Risk Perception and Adaptation of Community Livelihood Assets In Turgo Hamlet, Purwobinangun, Pakem, Sleman.

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<sup>1</sup> **Abstract:** Within decade of 1994 until 2010, Mt. Merapi erupted, which occurred in 1994, 2006, and 2010. In 1994, the hot cloud of Mt. Merapi went to northernwest area, precisely to Boyong River. Then, in 2006, the threat changed the direction, to the southern part, precisely to Gendol River. Then, it escalated quickly in 2010, in which the hot cloud went 15 kilometers along with Gendol River. By examining the directional change of threat, the risk perception and adaptation strategy within community can be influenced. This research aimed to assess the perception, character change of Mt. Merapi and adaptation strategy to build resiliency in community and change in terms of disaster awareness. Participative data collection was utilised in this research, with qualitative method also used, by involving residents of Turgo hamlet within disaster-prone area III of Mt. Merapi as data resource. Primary data collection was assessed through Participatory Rural Appraisal (PRA) or participative rural condition assessment. The instruments were: interview, tendency and change, diversion, village history, mobility map, and Focused-Group Discussion. The results were descriptive-qualitatively analysed. The research was located in Turgo hamlet, Purwobinangun village, b-district of Pakem. The results were that the residents of Turgo understood the model of risk perception, in form of directional change of threat and its character of Mt. Merapi eruption. The residents' resiliency can be seen through their ability in implementing the strategy of adaptation while also analysing and assessing to build community resilience.

**Keywords:** Mt. Merapi, perception, adaptation strategy, disaster-prone area, residents of Turgo hamlet

## <sup>3</sup> INTRODUCTION

Mt. Merapi is one of the most active volcanoes that still exist in Indonesia. Their high volcanic activities, gained nationwide and worldwide acknowledgement. Mt. Merapi administratively located within four regencies: Sleman regency (Special Province of Yogyakarta), Magelang regency, Boyolali regency, and Klaten regency of Central Java province. According to history of the activities of Mt. Merapi, there were 28 eruptions at minimum, during 20<sup>th</sup> century, with the biggest eruption was occurred in 1931. There was no massive eruption within third-quarter century after that [1]

It was claimed that the eruption of Mt. Merapi from 1872-1931 were went to the west-northwest. However, after big escalation in 1930-1931, the direction was dominantly seen to the southwest until eruption in 2001, except the 1994 eruption, which diverged to western part area to the upper section of Boyong River. Then, there was threat diversion from southwest to south, creating crater which went to Gendol River [2]

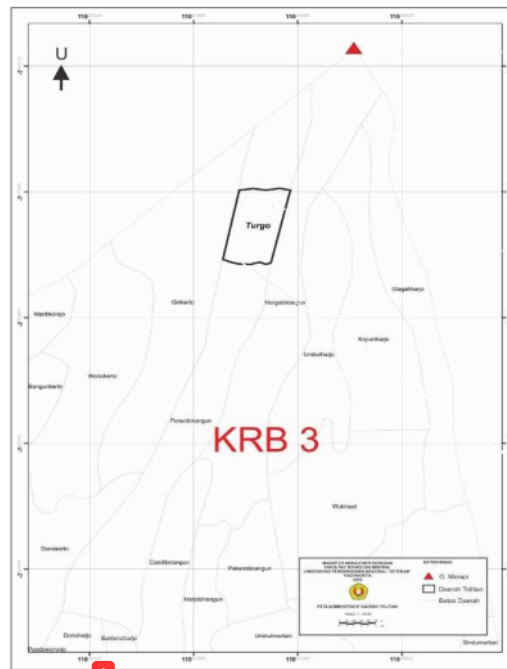
There were 66 victims in Turgo hamlet, which caused by direct impact of hot cloud during Mt. Merapi eruption on November 22<sup>nd</sup>, 1994. It was a great experience, as most of residents did not receive and understand the information related to activities of Mt. Merapi and disaster that it can create. These lacks of information were acknowledged by residents of Turgo hamlet [3].

The important event during 2006 eruption was that the dominant change of hot cloud direction, which was occurred from southwest to south. It was never occurred since 1961, which later could bring consequences related to the change of disaster area, such as around Gendol, Kuning, and Boyong River [4].

**Character of Eruption from Year to Year:** There are types of eruptions of Mt. Merapi, based from its activities. There are explosive eruption and effusive eruption. Explosive eruption is an eruption caused by high-pressure of gas within magma. Meanwhile, effusive eruption is an eruption caused by low-pressure of gas within magma. Generally, basalt-composed magma has little component. Whereas, magma that possesses great amount of gas may create high pressure [5]

## STUDY AREA DESCRIPTION

<sup>1</sup> The research was located in Turgo hamlet, Purwobinangun village, Subdistrict of Pakem, Sleman regency. The hot cloud of Mt. Merapi struck Turgo hamlet in 1994, with 187.502 households within it. It located within + 5kilometres of Mt. Merapi peak, and located within disaster-prone area III



<sup>1</sup> FIGURE 1: Study Area Research Turgo hamlet, Purwobinangun village, Sub-district of Pakem, Sleman regency

## METHODOLOGY

This research was a-qualitative-descriptive research, in which the words and action were the main data sources, supported by other documents and literature data. Primary and secondary data were used <sup>1</sup> in this research [6]. Participative data collection was utilised in this research, by involving residents through Participatory Rural Appra<sup>3</sup>1 (PRA) or participative rural condition assessment. It is a research methodology that emphasises residents' involvement in the research process and its results [7]

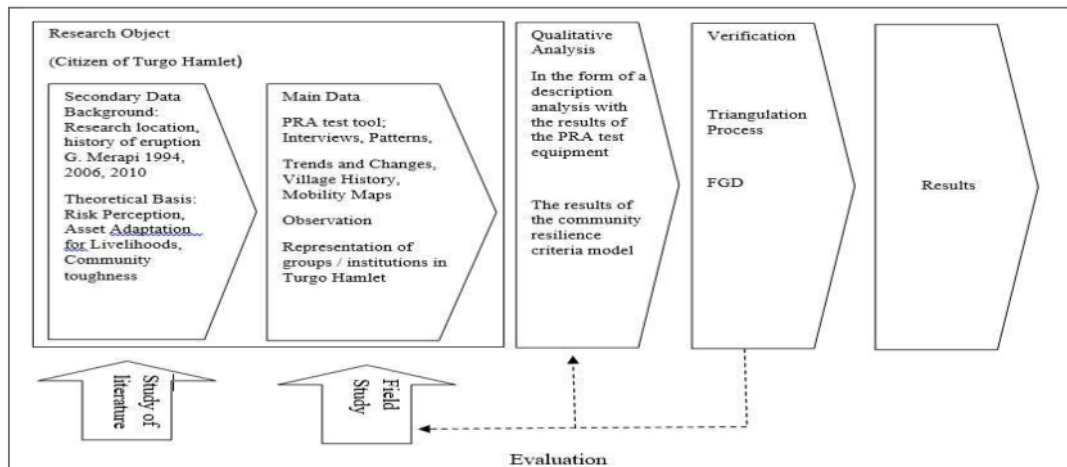


FIGURE 2 : Research Process Flowchart

## REVIEW OF LITERATURE

**Perception:** Community perception on disaster threat can be gained through experience in facing the threat itself and education related to the disaster. In the future, it can increase community awareness in facing the disaster of Mt. Merapi while also change their perception, as directly impacted community [8]. Community experience in facing disaster may influence their perception and reaction on eruption disaster [9]

After 1994 eruption, some residents of Turgo hamlet went back to their house, although they got a relocation house in Sudimoro. It was mainly caused by their occupations and their resources that they previously possessed. For example, the farmers felt reluctant to be relocated than residents who had other occupations, as the farmers depend heavily on fertile land [10]

## ADAPTATION STRATEGY OF PREPAREDNESS

From Mt. Merapi disaster that repeatedly erupted, community can implement adaptation strategy through critical thinking, supported by approach on disaster mitigation effort, through preparedness and awareness that focuses on community and do adaptation in order to realise their position within disaster-prone area, until the point where community may initiate preparedness on Mt. Merapi eruption. Meanwhile, community may defend and protect themselves both individually or in group towards the threat of Mt. Merapi eruption.[11]

Disaster preparedness in form of practice of Community-based disaster risk management (CBDRM), is an approach to encourage grassroots community to manage disaster risk within local level, through series of action that can be done in action priority or disaster risk reduction, reducing and monitoring and evaluating their own performance to reduce the risk. Preparedness can be done through series of activities and steps to ensure that the response can effectively overcome the impact and disaster, supported by timely and effective early warning system by moving the residents and their assets temporarily from the threatened area [12]

## COMMUNITY RESILIENCE

Community means "various, characterized, not-homogenous". The meaning of it was proposed in social study for long time, and in some research, it turns out that the meaning of "community" are really varied. Furthermore, the meaning of community can be seen as collective similarities, structure, that can be mentioned as 'paguyuban' with values within such as togetherness, commitment, reciprocity, and trustworthiness. Another meaning, which is "bonded-community" as "social aspect" depicted by Putnam, 2000, is a bonded relationship within individuals, such as social networks and reciprocity, and trustworthiness. For example, community within a village in same geographical condition, exposed in same threat and risk repeatedly, exposed in same crisis, enable them to increase their bond relationship [12]

## RESULTS AND DISCUSSIONS

**Knowledge On Mt. Merapi Disaster :** Mt. Merapi eruption in 1994, which damaged Turgo hamlet, with 68 victims within the event, were the results of lack of knowledge on character and pattern of hot cloud disaster of Mt. Merapi. There was no socialisation from CVGHM to residents of Turgo hamlet at that time. There was also no early warning system as the gate to understand the incoming disaster.



FIGURE 3. A house during the 1994 Mt. Merapi Eruption Disaster

Based on that experience, residents of Turgo hamlet followed and participated actively in 2006 to understand the character of Mt. Merapi disaster and information from CVGHM. Turgo hamlet also held activities to strengthen their capacity by implementing independent community-based disaster management. These done in order to build agreement related to point of evacuation at Tritis field and when to evacuate.

According to the residents of Turgo hamlet, there were some differences. Before 2010 eruption, there were lava dome and fire static on the mountain peak. However, it turned that the 2010 eruption showed no signs of these. Instead, the status of activity was escalated rapidly. By monitoring activities of Mt. Merapi and information gathered by CVGHM related to status change, Turgo hamlet were finally able to evacuate themselves independently to refuge in Purwobinangun village by using 4 trucks, motorbikes, 5 cars, by following instructions and recommendations from local government and village of Purwobinangun.

**Monitoring the Disaster Of Mt. Merapi:** During the 1994 eruption of Mt. Merapi, residents of Turgo hamlet realised that the peak of the mountain cannot be seen anywhere. It only can be seen in monitoring post at Tritis, thus made the residents did evacuation response halfheartedly. Turgo hamlet has information as guidance to evacuate. Their main information for them is monitoring post before the 1994 eruption occurred, which located on the top of Plawangan Hill. It still had role to build safe feeling among the residents, although there is doubt about the validity of the information source. Before the 1994 eruption occurred, they had high dependence on that monitoring post. As time goes on, the residents of Turgo hamlet can access information collectively and personally, related to sign of Mt. Merapi eruption. It all started in 2006, when early socialisation on Mt. Merapi activity development shown by CVGHM. During that socialisation, the residents got understanding on status change or level change of Mt. Merapi and their recommendations.



(a)

(b)

FIGURE 4. Monitoring Post of Mt. Merapi in Turgo Hamlet 1997 (a) Monitoring Post of Mt. Merapi in Turgo Hamlet 2013 (b)

In 2008, residents of Turgo hamlet received their Disaster Management Obligatory Training (WPLB), which based on volcanic disaster. The target was to encourage the residents to understand status of Mt. Merapi and their recommendations in form of permanent program of disaster management [13]

Before the 2010 eruption, residents of Turgo hamlet gained information from CVGHM related to early sign, activities, and status development of Mt. Merapi. The information can be used to monitor Mt. Merapi disaster through status of Mt. Merapi from Normal to Alert. Beside the information from CVGHM, the residents of Turgo hamlet created neighbourhood watch (*ronda*) schedule, which located in the monitoring post at Tritis. The target was to see visualisation of Mt. Merapi. Then, HT/RPU was already set at Tritis to catch seismic which connected through certain frequency to know seismic of Mt. Merapi. The *ronda* schedule enabled all the residents to be involved.

**Dissemination and Communication:** Ideally, communication should be done simultaneously in terms of disaster management (pre-disaster, whilst-disaster, and post-disaster). In its process, community or agency will disseminate or receive information to make these information guidance for decision that must be taken in uncertain situation. Warning becomes easier to do for the residents of Turgo hamlet, through HT and socialisation during meetings. These meetings are important to reach greater community and also to monitor the current status of Mt. Merapi. Besides that, Purwobinangun village supports the hamlet to invite CVGHM to explain the current condition of Mt. Merapi scientifically. The residents believe that, in this era, valid and countable monitoring tools can be used for greater community. Poster of Mt. Merapi status and HT or hand phone can be used to disseminate the information.

**Ability to Respond: It** is an important point to decide which way to evacuate and who to give command to evacuate. From the residents of Turgo themselves, they evacuated themselves individually.



**FIGURE 5.** The residents of Turgo hamlet in assembly point to evacuate during phreatic eruption of Mt. Merapi

Since 20 September 2010, that the status of Mt. Merapi was raised from Normal to Alert, the information disseminated from monitoring post of Kaliurang to the HT that the residents possessed. Upon receiving the information, they invited CVGHM to deliver socialisation on the current condition related to Mt. Merapi.

During Mt. Merapi eruption, on 26 October 2010, majority of the residents used their motorbikes and five units of trucks to barracks in Purwobinangun village. Vulnerable and infant groups were the first to be evacuated, and then continued with all residents of Turgo hamlet and their important documents and clothes as well. For the livestock, there were not evacuated, as at that time, the personal and community safety were more important. On 26 October 2010, the residents still stayed in the barracks.

The 2010 eruption was occurred at 00.05 Western Indonesia Time, which the refugees at Purwobinangun village can hear it. The eruption was occurred together with ash rain and pebbles. The residents were evacuated using truck prepared by National Soldier of Indonesia/Police of Republic Indonesia from Purwobinangun village to Maguwoharjo stadium, in accordance with the regent of Sleman regency and the leader of Purwobinangun village.

**Adaptation Strategy:** There was correlation of development plan with the preparedness post-2010 eruption of Mt. Merapi. Sand mining contributed enough in improving and repairing evacuation way to the assembly point at Tritis, therefore, the access to evacuate will be easier to reach. A positive learning can be seen through infrastructure management, in form of residents' initiation to reassess and improve the evacuation route, which previously cannot be passed. Such event can be implemented as the result of strong togetherness/social modal among Turgo residents. Besides that, the residents built monitoring post in RT 04, to see the direction of hot cloud to the eastern part of Mt. Merapi. The post can also be used as assembly point and meeting hall. The

3  
monitoring post was supported by Local Agency for Disaster Management of Sleman regency in 2018, which it was built by Turgo hamlet residents.

Communication was also built through HT with local frequency of 15920, between the security guard with the sand miners in Boyong River. Therefore, imminent danger can be known, and evacuation process can be done.



FIGURE 6. Evacuation route sign as a tool of preparedness adaptation strategy during evacuation

### CHANGE OF PREPAREDNESS BEHAVIOR



FIGURE 7. The poster of the flow of the increase in the status of Mt. Merapi as a reference for changes in the behavior of the residents of Turgo Hamlet



**TABLE 1** : National Standard of Indonesia of volcanic status, recommendation, and change of preparedness behavior of Turgo hamlet [14]

Status	Recommendation	Community Activities	Behavior change of Turgo hamlet residents	Evaluation
Normal	Residents within DPA I,II can do their daily routines Residents within DPA III can do their daily activities by obeying local rules and government based on technical recommendation from geological agency and ministry of energy, mineral resources	<ol style="list-style-type: none"> <li>1. Socialisation on DPA mapping</li> <li>2. character understanding on volcanic disaster</li> <li>3. community understanding on residence within DPA</li> <li>4. Residents data collection within DPA</li> <li>5. Resources data collection within DPA</li> <li>6. Arranging permanent/standard operational procedures</li> <li>7. Preparation of evacuation route and signs</li> <li>8. Preparedness training</li> </ol>	<ol style="list-style-type: none"> <li>1. Preparation of evacuation route signs</li> <li>2. Monitoring the activities through accessing information to monitoring post in Kaliurang hamlet</li> <li>3. Residents of Turgo hamlet can do their daily activities</li> <li>4. Improving evacuation route from RT 04 to the assembly point at Tritis</li> </ol>	<ol style="list-style-type: none"> <li>1. Character understanding on Mt. Merapi disaster needs to be implemented</li> <li>2. Disaster risk understanding needs to be deepen</li> <li>3. Increasing human resources as a whole needs to be increased, related to threat and character change of Mt. Merapi</li> </ol>
Alert	Residents within DPA I can do their daily routines by raising their awareness Residents within DPA II can do their daily routines by raising awareness on disaster; Residents within DPA III are not recommended to do activities around the crater	<ol style="list-style-type: none"> <li>1. Dissemination of status change information from geological agency</li> <li>2. Data renewal of the residents who live around DPA</li> <li>3. Data renewal of vulnerable residents who live around DPA</li> <li>4. data intensify of the resources who live around DPA</li> <li>5. system and equipment preparation</li> <li>6. evacuation plan preparation</li> <li>7. transportation preparation</li> <li>8. refuge preparation</li> <li>9. kitchen preparation within the refuge</li> </ol>	<ol style="list-style-type: none"> <li>1. through socialisation, community wants to know about the real condition and the possibility of eruption in the future</li> <li>2. data renewal of the residents within every RT</li> <li>3. In this status, neighborhood watch and monitoring post needs to be implemented actively, 24 hours</li> <li>4. Schedule distribution within Mt. Merapi monitoring at Tritis</li> </ol>	<ol style="list-style-type: none"> <li>1. Data renewal can be done in Normal status</li> <li>2. Some residents have minimum understanding on what to do</li> <li>3. Do not look down on the residents who do preparedness</li> <li>4. The existence of individual and collective awareness to prepare preparedness bag and to obey the recommendations from village government related to status development from CVGHM Yogyakarta.</li> </ol>

(continued)

Status	Recommendation	Community Activities	Behavior change of Turgo hamlet residents	Evaluation
High Alert	Residents within DPA I raise their awareness by avoiding activity near the river; Residents within DPA II prepare themselves, while waiting instruction from local government, based on technical recommendation from geological agency and ministry of energy, mineral resources; Residents within DPA III should avoid having activity and prepare themselves to evacuate	<ol style="list-style-type: none"><li>1. Dissemination of information related to status change from geological agency</li><li>2. Early warning is ready to be operated</li><li>3. Transportation mode is ready to be operated</li><li>4. Refuge is ready to be operated</li><li>5. Security is ready to be operated</li><li>6. Permanent procedure is ready to be operated</li><li>7. Communication system and equipment are ready to be operated</li><li>8. Emergency command is ready to be operated</li></ol>	<ol style="list-style-type: none"><li>1. There is an independent, collective awareness among the residents to buy fuel, do checking for transportation</li><li>2. Residents aware the current situation and condition of Mt. Merapi</li><li>3. Residents able to remind people to avoid the threat</li><li>4. Vulnerable groups are already in the barracks (independently evacuated)</li><li>5. Do livestock evacuation</li></ol>	<ol style="list-style-type: none"><li>1. Transportation is ready</li><li>2. More unity communication chain between the coordinator of information and CVGHM related to current condition of Mt. Merapi</li><li>3. Accountable information related to Mt. Merapi that can be disseminated to Turgo hamlet residents.</li><li>4. <b>one-gate-information related to the status of Mt. Merapi, Mr. Gimin, the man who has high integrity and capacity to disseminate information</b></li></ol>
Warning	Residents within DPA I, II, III should prepare themselves to evacuate based on technical recommendation from geological agency and ministry of energy, mineral resources;	<ol style="list-style-type: none"><li>1. Dissemination of information related to status change from geological agency</li><li>2. Early warning signs are activated</li><li>3. Written and oral command on evacuation from the commander are implemented</li><li>4. Permanent procedure is activated</li><li>5. Evacuation is being implemented</li><li>6. Kitchen is operated</li><li>7. Security is operated</li><li>8. Crisis center is operated</li></ol>	<ol style="list-style-type: none"><li>1. The early warning signs are activated, as signs of eruption</li><li>2. All within Turgo hamlet is empty, as all residents are in the barracks</li><li>3. Finding information related to Mt. Merapi</li><li>4. Every individual should monitor the current condition of Mt. Merapi through HT or television</li></ol>	<ol style="list-style-type: none"><li>1. The condition is dangerous, that recommendation from CVGHM should be obeyed</li><li>2. Community can be involved in logistic and basic needs fulfillment</li><li>3. Involvement of Turgo hamlet residents into emergency management</li><li>4. Structured activation of Disaster risk reduction forum within Purwobinangun village</li></ol>

## CONCLUSION

1. Character change of Mt. Merapi disaster from 1994 until now, can be understood. Thus, the information related to its status change can be received easily and quickly by residents of Turgo hamlet. Then, the correct decision can be made.
2. Adaptation strategy of preparedness within residents of Turgo hamlet can be seen by monitoring and viewing the status/ level of Mt. Merapi according to recommendation from CVGHM, which already agreed by analysing behaviour change of Turgo hamlet residents.
3. Introducing component of early warning system that help them to understand disaster until enable them to respond, can be combined with Mt. Merapi status with its recommendation to know the behaviour change within the residents preparedness to build resilience within DPA III of Mt. Merapi

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