

Thesis

The role of cultural heritage in governing vulnerability and community resilience in the volcanic area of Karangasem, Bali, Indonesia



Tri Utami Handayaningsih

6113915

t.triutamihandayaningsih@students.uu.nl

MSc Sustainable Development – Earth System Governance

Utrecht University

Number of ECTS: 45

Supervisor: Arjan Wardekker

Co-Supervisor: Sanchayan Nath

Second reader: Carel Dieperink

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Summary

Volcanic eruption (Mt. Agung) in Karangasem Regency is a major geological source of disaster in Bali. Culturally, however, this mountain has a big influence on communities. From a geological point of view, Mt. Agung is a danger (hazard), and from a cultural perspective, an intangible cultural heritage that is manifested in people's belief systems may be the source of resilience or burden in disaster management. Prior research indicates there is potential in cultural heritage for disaster management. This research aims to address the aspect of how cultural heritage is, or can be, a source of resilience.

To manage disaster issues in Indonesia, the national government applies a holistic concept of disaster risk reduction which is seen as a function of hazard, vulnerability, and capacity. Hazard is the danger amongst communities which in this research is the Mt. Agung eruption. Vulnerability is the communities' situation that is assessed using socio-economic, institutional, disaster-related, infrastructural, educational and health factors. Capacity is the implementation of government initiative.

Two things are addressed in this research: the role of cultural heritage within communities and government intervention as a legal document for resilience strategies. To identify whether cultural heritage positively influences resilience and what aspects of cultural heritage support resilience, the social condition of the community should be identified through a vulnerability assessment.

Considering the proximity of cultural heritage and government initiative implementation, four villages have been selected for this research. Those villages are Besakih, Sebudi, Ulakan, and Tulamben which all fall under Karangasem Regency, Bali Province, Indonesia.

This research expects to answer the question of *whether* cultural heritage and government intervention relate to vulnerability and resilience and if yes, *how* they relate. A comparative case study is employed to see the variation between Besakih, Sebudi, Ulakan, and Tulamben. To support the comparative case study, several practical methods are used such as desk research, constructed interviews, and in-depth interviews.

This research results: First, the variation of vulnerability that is identified from a vulnerability assessment and different conditions from one village to the other that are analysed from a comparative case study. Second, the evidence that cultural heritage can reduce vulnerability. Third, factors related to economic of the communities, how the communities perceive disaster information, and how the communities psychologically recover from the Mt. Agung eruption disaster are aspects within vulnerability that prove the relation between cultural heritage and vulnerability. Fourth, both cultural heritage and government initiatives are aligned with each other and positively support in reducing vulnerability. And finally, present some ideas on how to link cultural heritage into current resilience strategies.

Key words: community-based disaster risk reduction, disaster management, case study for disaster vulnerability and resilience

Abbreviation

Balawista	Pemandu Keselamatan Wisata Tirta (Coastguards)
Bappeda	Badan Perencanaan Pembangunan Daerah (Agency for Regional Development)
Basarnas	Badan SAR Nasional (National Search and Rescue)
BNPB	Badan Nasional Penanggulangan Bencana (National Disaster Management Authority)
BPBD	Badan Penanggulangan Bencana Daerah (Local-level Disaster Management Authority)
BPS	Badan Pusat Statistik (National Statistical Bureau)
BSN	Badan Standardisasi Nasional (National Standardisation Board)
CBDRM	Community-based Disaster Risk Management
CH	Cultural Heritage (category)
CVGHM	Center of Volcanology and Geological Hazards Mitigation
D	Disaster-related issue (category)
Destana	Desa Tangguh Bencana (Disaster Resilience Village)
DRR	Disaster Risk Reduction
E	Education (category)
ESDM	Energi dan Sumber Daya Mineral
GI	Government Initiative
H	Health (category)
HP	Handphone
HT	Handy talkie
Inf	Infrasructure (category)
Ins	Institutional (category)
Jalin Merapi	Jaringan Informasi Lingkar Merapi (community-based radio communication in Mt. Merapi)
Kemensos	Kementerian Sosial (Ministry of Social Service)
Peta KRB	Peta Kawasan Rawan Bencana (Risk Zone Map)
KRB	Kajian Risiko Bencana (Disaster Risk Assessment)
KSB	Kampung Siapa Bencana (Prepared Village)
N/A	Not available
Pasebaya	Pasemetonan Jagabaya (community-based radio communication in Mt. Agung)
Perka	Peraturan Kepala (The Head of BNPB regulation)
Permensos	Peraturan Menteri Sosial (Minister of Social Service regulation)
PVMBG	Pusat Vulkanologi dan Mitigasi Bencana Geologi (in English CVGHM)
SE	Socio-Economic (category)
SFDRR	Sendai Framework for Disaster Risk Reduction
SQ(a)	Sub-question (a)
SQ(b)	Sub-question (b)
SQ(c)	Sub-question (c)
SQ(d)	Sub-question (d)
TV	Television
UNDRR	United Nations for Disaster Risk Reduction
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISDR	United Nations International Strategy for Disaster Reduction
UU	Undang-Undang (National Law)
VA	Vulnerability Assessment

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I. Chapter 1 (Introduction)

I.1. Background and Problem Definition

As a country located at the intersection of three continental plates that result in various geological patterns, the Earth activities cause the Indonesian archipelago to be prone to natural disasters (Katili, 1975) such as volcanic eruptions, earthquakes, tsunamis, and landslides. Twigg (2011) defines a natural disaster as a result of a certain dangerous natural phenomenon (hazard) that negatively affects the people or environment where the people live or community possession (vulnerability). The environment is a part of vulnerability because people depend on it. Without exclusion, Bali, a small island in the middle of Indonesia also faces several disaster risks coming from the natural phenomenon of Earth activities that lead to disasters when communities or environment are exposed (BNPB, 2015a).

In September 2017, Mt. Agung located in the north-east of Bali, in Karangasem Regency particularly, erupted and 150.867 people living within the danger zone were directly affected (Gertisser, Deegan, Troll, & Preece, 2018; BNPB, 2019). ESDM (2014) records several eruptions through years and the eruption in 2017 contributed to the increasing trend of disaster in Indonesia (BNPB, 2019). With two different statuses of danger within less than a week, the eruption alert (see sub-section IV.2 for a detailed explanation) was changed very fast. Shortly after the Center of Volcanology and Geological Hazards Mitigation (CVGHM) announced dangerous (from *Waspada* (advisory) to *Siaga* (watch)) alert, the Government of Karangasem Regency decided to instruct all people in Karangasem Regency to evacuate. Communities' material possessions, houses, public facilities, and even social networks may be damaged by the eruption (Adger, 2006; Donovan, Suryanto, & Utami, 2012; Wisner & Luce, 1993). Thus, people were panicking and evacuated themselves to the safer area. Some people evacuated using their vehicles; others were mobilised by the rescuers. People who refused to evacuate had to sign a letter stating that they accepted the risk of an eruption. There were several areas dedicated to temporary shelters, but some people who have relatives in other areas chose to go to their relatives.

The government of the Republic of Indonesia established Law Number 24/2007 concerning Disaster Management to govern all the national-wide efforts tackling disaster-related issues by all actors. Although the initial debates amongst disaster management scholars were inspired by the response during the crisis, that national legal document focuses on all disaster management phases, pre-, during-, and post-disaster. As disasters are a major global problem and the events can hamper sustainable development (Twigg, 2011), this law is expected to serve proper and effective disaster management (Uitto & Shaw, 2016) at all—national, provincial, municipal and community—levels in Indonesia. Based on that law, several more detailed regulations are made to support disaster management in Indonesia in more thematic cases, such as disaster management within community, disaster risk assessment, operation plan, etc.

In general, disaster managers emphasize the importance of pre-disasters activities (e.g. risk reduction and integration disaster preparedness with development plans) to avoid haphazard responses and to prepare effective rehabilitation and recovery. United Nations for Disaster Risk Reduction (UNDRR, former UNISDR) gives an analogy: investing 1\$ in pre-disaster activities can save 7\$ during the crisis and rehabilitation and reconstruction. It is expected that the paradigm will shift from responding to the disaster, to reducing the risk of disaster (Cox & Hamlen, 2015; Maarif, Damayanti, Suryanti, & Wicaksono, 2013; UNISDR, 2015) to foster sustainable development (Twigg, 2011; Uitto & Shaw, 2016).

Legal instruments at the community-level can drive communities' participation to prepare for an upcoming disaster since they are at the front line when a crisis occurs. To facilitate communities in facing disaster risk, BNPB issued an instrument with a community-based disaster risk management concept (CBDRM), namely Disaster Resilience Village Regulation (Destana) through Perka Number 1/2012. CBDRM is defined as a mechanism to build communities' resilience at the local level, by empowering communities to plan and take actions in reducing disaster risks or responding disasters with their resources. The regulation emphasizes the communities' capacity building in understanding the danger around their residential area, preparing and identifying resources for the upcoming crisis, and planning strategies for evacuation (BNPB, 2012). The regulation includes practical guidance for facilitators coming from the provincial or municipal government. Since the regulation is made for communities' capacity building, the targets are the village government and the communities within the village. Starting from communities' capacity building, the final goal of this instrument is communities' resilience. Besides that, this regulation is created to support in shifting the paradigm from merely response management to more preventive disaster risk management.

Theoretically, disaster happens when hazard meets the communities (Twigg, 2015; Weichselgartner, 2001). To prevent the disaster, it is important to build community resilience (Shaw, 2014a) through assessing their vulnerability. In the disaster risk reduction arena, vulnerability is one of the factors that hamper the existing resilience and it mainly showcases the communities' socio-economic condition (Birkmann, 2013; UNISDR, 2015). Vulnerability toward disaster means the ability of the people (or communities) to cope with the crisis caused by physical events (hazard) which is different from one group to another, based on class, ethnicity, age, gender, disability, and sub-culture (Blaikie, Cannon, Davis, & Wisner, 1994; Donovan et al., 2012; Wisner & Luce, 1993). There is also a spatial aspect that defines the magnitude of vulnerability (Blaikie et al., 1994; Cutter et al., 2008; Wisner & Luce, 1993).

To face disaster-related problems, hand in hand with the national directive, the government of Bali implements CBDRM to design resilience strategies. The implementation is done at the village level to facilitate the community's activity in managing disaster risks, including hazard understanding, disaster response strategy, and rebuilding shortly after the crisis (BNPB, 2012; Kemensos, 2011). Adjusted to the provincial and municipal budget, the implementation refers to the Destana guidelines. The strategy targets the community's vulnerability to being reduced. Reduced vulnerability is the starting point to increase communities' resilience. There are many perspectives on vulnerability and resilience, and the government acts on these, however the potential role of cultural heritage – as Bali's key characteristics and strengths – is not addressed.

Tangible (e.g. monuments, architecture, and archaeological sites) and intangible (e.g. folklore, rituals, and tradition) cultural heritage as part of communities' social life and belief systems should be taken into consideration when developing policies for disaster risk reduction, especially in Mt Agung volcanic area where Besakih Temple located and communities' rituals are held there. As the most honored¹ temple and the center of Balinese Hindus worships, Besakih Temple is the most visited temple in Bali, yet its location is in a dangerous area. Besides that, Balinese people deify Mt. Agung and this attitude shapes intangible cultural heritage of Balinese people.

¹ Besakih Temple is one of the nine *Pura Kayangan Jagat* (Hindus temples for universal worship). For more information about Pura Kayangan Jagat, please check <https://www.kintamani.id/mengenal-jenis-pura-di-bali-berdasarkan-fungsi-serta-karakteristiknya-007211.html>

According to the believers, disaster is sent by God to test the people's faith or as the sign of God to re-direct the societal attitude but also its presence can fasten disaster recovery (Gaillard & Texier, 2010a; Lavigne et al., 2008; Martha, Paramita, & Utama, 2018; Weichselgartner, 2001). Meanwhile, being in the risk zone, Besakih Temple itself is endangered as well as the communities surrounding and the believers who delivering the worship there. Misinterpretation of the volcanic eruption has brought many people into death (Lavigne et al., 2018; Stuart-Fox, 1987; Zen & Hadikusumo, 1964). Grattan (2006) emphasizes that in the danger zone both tangible and intangible cultural heritage are at risk of the potential hazards, whereas cultural heritage is also important to resilient communities for their memory and stability in place during a crisis and it preserves community identity in traumatic change (Appler & Rumbach, 2016; Donovan et al., 2012; Webb, 2018). The influence of traditions and belief systems in volcanic regions is very strong, attached on how local people act in pre-disaster management and in crisis moments (Cashman & Cronin, 2008; Swanson, 2008).

In this regard, combining socio-economic conditions and heritage within community vulnerability assessment can support disaster management in Bali to build better resilience strategies. Current government initiatives that have the objective of building community resilience has not specifically included the cultural heritage aspect. Webb (2018) hypothesizes that there must be a relation between heritage and a community's vulnerability and resilience. The necessity to consider cultural heritage in disaster management both as the source of resilience and as a vulnerability aspect to be taken care of is also emphasised by the United Nations' Sendai Framework for Disaster Risk Reduction (SFDRR). However, research that combines those two perspectives is still limited.

This research consists of six chapters. Chapter one is the introduction, followed by chapter two for the conceptual part. General and specifically related concepts will be presented there, including the operationalization of the concept. The methodology part will be showcased in Chapter three, consisting of an overview of the Comparative Case Study in four different locations, operated through desk research, interviews, and both qualitative and quantitative data processing. The following chapter presents the description of the case study. The display of the Result and Discussion is given in Chapter five. This research is finished by the Conclusion that is written in Chapter six.

1.2. Knowledge Gaps

Research that puts cultural heritage—both tangible (e.g. monuments and temples) and intangible (e.g. folklore, myth, indigenous knowledge)—as part of a community's vulnerability and resilience is still limited (Chester & Duncan, 2007; Donovan et al., 2012; Gaillard & Texier, 2010b; Mercer, Kelman, & Dekens, 2009). However, extant literature does state there must be a relation between cultural heritage and societal vulnerability (Donovan, 2010; Donovan et al., 2012; Grattan, 2006; Lavigne et al., 2008; Martha et al., 2018). Communities' social-economic conditions are widely discussed in vulnerability studies (Birkmann, 2013; Cutter, Mitchell, & Scott, 2012; Daniel & Cutter, 2013; UNISDR, 2015), while little to no attention is paid to cultural heritage embedded in society. Birkmann et al., (2013) mention that assessing vulnerability with cultural details is difficult because of its changing dynamics in space and time. However, there are studies that show that social recovery from disaster depends mainly on the perspective of the survivors' interpretation of disaster (Andreastuti, Budianto, & Pariipurno, 2018; Grattan, 2006; Lavigne et al., 2018). Thus, understanding cultural aspects within societal vulnerability in disaster management is important, especially to support conceptualising better resilience strategies.

Meanwhile, related to cultural heritage that potentially can be part of resilience strategies is not included in the current government initiative. Whereas, as mentioned in the prior paragraph, cultural heritage has the potential to reduce vulnerability (Donovan, 2010; Donovan et al., 2012; Grattan, 2006; Lavigne et al., 2008; Martha et al., 2018). Generally, in designing resilience strategies, goals, aspects of resilience, and consequences of the actions should be determined upfront, depends on the strengths of the communities, tools to design the strategies, and resources of the area (Wardekker et al., 2020). Although research is needed to identify which aspects of cultural heritage can be included in resilience strategies, it is clear that cultural heritage—as a strength—should be incorporated into disaster governance. Gabrielsen et al. (2018) found that integrating local wisdom into a national policy for resilience has been successful in New Zealand, however, to replicate this finding in other places, further research is needed (Gabrielsen et al., 2018).

1.3. Scientific and Societal Relevance

This research contributes to bottom-up approaches in governing disaster risk to achieve communities' resilience in volcanic areas. This research initially assesses communities' vulnerability with an assessment tool based on existing literature, specified to this study's particular location. Scientifically, this tool broadens the scope of vulnerability studies, especially for further research in Bali or places with cultural similarities to Bali. Positive takeaways from the relation between communities and cultural heritage could be useful as a source of resilience and therefore enhance the resilience concept. In result, grassroots cultural capital can support government initiatives in managing disaster risk in volcanic areas. Thus, this research is scientifically beneficial because the lessons learned are transferable to other cases.

This research also contributes to society, especially by introducing the role of communities' cultural background and government initiative. The vulnerability assessment in this research helps in identifying the social needs in coping potential risk. Moreover, this study provides the groundwork for cultivating communities' cultural heritage as a source of resilience in facing disaster. The acknowledgment of cultural heritage in this research puts local actions into broader recognition and opens the opportunity for other communities to utilise their culture. The way communities relate to their environments creates knowledge about those environments. It might even result in particular knowledge about how to respond to disaster without ever having been identified as a 'disaster risk management' the community itself. This study therefore helps communities in making explicit how they have been and could respond to disaster. Moreover, adding cultural heritage into resilience strategies will better prepare the communities in facing disasters and develop their sense of belonging of the strategies.

1.4. Research Objectives

Bali is prone to disaster but also has unique cultural heritages that are embedded in their belief system. Government intervention to address communities' vulnerability and build their resilience has been made by the national and regional government. Lack of research in the field of disaster risk reduction with the relation to cultural heritage triggers this research. Thus, this research aims to study the role of cultural heritage within communities' vulnerability facing possible eruption of Mt. Agung and which aspects of cultural heritage can be included in the development of government initiatives supporting communities' resilience.

1.5. Hypotheses

In theory, disaster happens when there are natural and human aspects (Birkmann, 2013; Coppola, 2007; Davis, 1994; Perry, 2007; Twigg, 2004), for example the eruption of a volcano which located in the residential area. Both in research development and practice, the human is

part of vulnerability (Cutter et al., 2012), and to reduce vulnerability, resilience strategies should be improved (Twigg, 2007). Meanwhile, human aspect is packed into their cultural heritage (Bankoff, Frerks, & Hilhorst, 2013; Chester & Duncan, 2007). Culture is dynamic from one incident to another, including a disaster event. Likelihood of the relation between disaster, vulnerability, resilience, and cultural heritage drives hypotheses as below:

“Cultural heritage reduces the communities’ vulnerability” and

“To reduce communities’ vulnerability, cultural heritage should be added to current disaster governance initiatives”.

Thus, a close examination of the relation between heritage and vulnerability and the inclusion of heritage in disaster risk governance is important.

I.6. Research Questions

The hypotheses drive to the main research question as below:

“How do cultural heritage and government initiative relate to the community vulnerability and resilience toward volcanic disaster?”

Together with the main question, there are four sub-questions (SQ) as below:

- a. Does the presence of cultural heritage reduce communities’ vulnerability? (SQa)
- b. Which aspects of vulnerability are influenced by cultural heritage? (SQb)
- c. Does the presence of cultural heritage reduce the vulnerability in different ways than the current government initiative? (SQc)
- d. Does the analysis provide insights into how cultural heritage aspects might be used to better design resilience strategies? (SQd)

I.7. Research Framework

Figure 1 shows the research framework. The research is started from the main research question and sub-research questions (a). From these questions, some concepts (b). The strategy and methods used are presented in box (c), and the analysis through vulnerability assessment and comparative case study will test the hypothesis 1 and 2 (d).

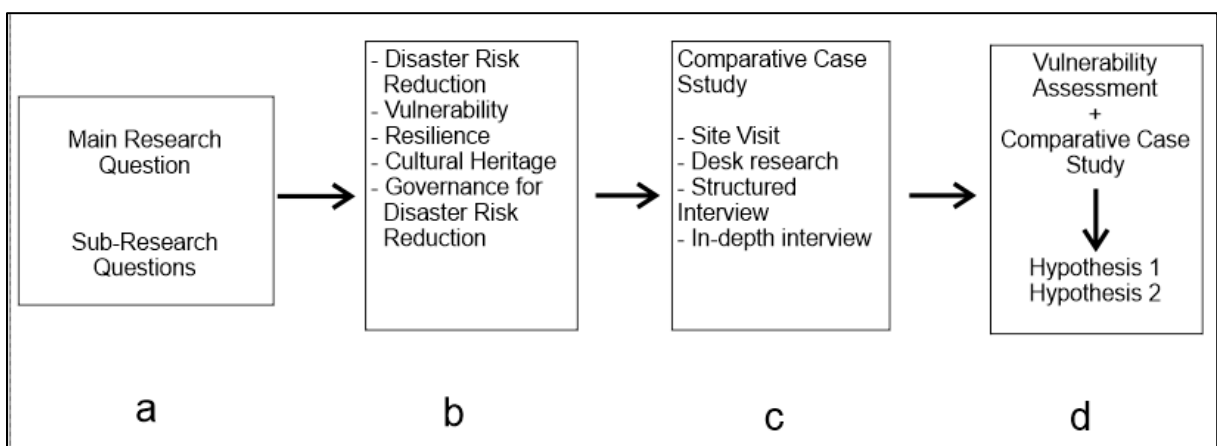


Figure 1. Research framework (Source: author’s own)

II. Chapter 2 (Concepts)

II.1. Conceptual Framework

This section will present the theories used for this research in several sub-sections. The concepts presented are disaster, disaster risk reduction, vulnerability, resilience, cultural heritage, and governance.

II.1.1. General Concept

As vulnerability studies can be approached from many perspectives, this research will use the perspective from *hazards and disaster risk reduction* scholars. This perspective covers a discussion of vulnerability and resilience. UNISDR (2009, p.18) defines a hazard as “*a process, phenomenon or human activity that may cause loss of life, injury or other health impact, property damage, social and economic disruption or environmental degradation*”. Some scholars classify disaster into two types of hazards, namely natural (e.g. volcanic eruptions, earthquakes, floods, and landslides) and manmade hazards (conflicts and technological rupture). Other scholars find that both nature and humans play a role in disaster where on the one hand Earth phenomenon becomes a disaster due to a manmade aspect (e.g. vulnerability, place of living, etc), and on the other hand people’s irresponsible behaviours may trigger actual disaster (e.g. climate change, floods, etc) (Birkmann, 2013; Davis, 1994; Perry, 2007; Twigg, 2004). Meanwhile, as defined by UNISDR disaster means “*a serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability, and capacity, leading to one or more of the following: human, material, economic, and environmental losses, and impact*” and this definition will be the starting point to discuss vulnerability and resilience (UNISDR, 2009, p.13).

Theoretically, disasters are the result of a combination of factors called hazard, vulnerability, and capacity (Davis, 1994; Twigg, 2011). Hazard has been defined in the earlier paragraph. Vulnerability is “*The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.*” (UNISDR, 2009 p.24). Capacity is “*The combination of all the strengths, attributes, and resources available within an organization, community or society to manage and reduce disaster risks and strengthen resilience.*” (UNISDR, 2009 p.12). This means that the natural phenomenon itself cannot be called a disaster as long as there is no harmful impact to the people or their assets. An example hereof is the eruption of the 2020 Anak Krakatau² eruption that occurred in the middle of the ocean. However, the eruption of Mt. Agung in 1963 was categorised as a disaster since it caused human fatalities and forced migration due to food scarcity caused by crops having been washed away after the volcanic ash (Self & Rampino, 2012). This research focuses on the disaster caused by a volcanic eruption, following Blaikie et al. (2005 p.3) who mention that disaster is not only the causation of natural phenomenon, but can be the social, political, and economic condition that define the structure of societal lives.

Definition of disaster also given by Perry (2007) within management and research scope and by The Government of Indonesia (2007) within disaster management practice. Perry, (2007) defines disaster from the perspective of social science as dependent on the causes, conditions, and consequences of a phenomenon which result in societal, organizational, institutional, or governmental uses. While the UU 27/2007 issued by the Government of Indonesia states that “*Disaster shall mean an event or a series of events threatening and disturbing the community life and livelihood, caused by natural and/or non-natural as well as human factors resulting in human*

² The eruption news is retrieved from <https://www.space.com/krakatau-volcano-eruption-satellite-photo-april-2020.html> on 16 April 2020.

fatalities, environmental damage, loss of material possessions, and psychological impact (UU 24 p.2)."

Based on those definition, the concept is developed broader involving the presence of hazards, vulnerability, and capacity. These three components result in a disaster "risk" concept which is defined as *"the potential loss of life, injury, or destroyed or damaged assets that could occur to a system, society or a community in a specific period of time, determiner probabilistically as a function of hazard, exposure, vulnerability, and capacity"*. Put simply, the product of the interaction of hazard and vulnerability is the risk itself (Birkmann, 2013). In management practice, this concept is used to formulate strategies to reduce the disaster risk (UNISDR, 2009; Twigg, 2004). The actions in the strategies are to prevent calamities from disaster events by reducing vulnerability or improving coping capacity (ibid). Birkmann (2013p.14) synthesises today's formula about risk as a function of hazards, vulnerability, and capacity. Especially in this research, the hazard is constant.

$$R = \frac{h \times v}{c}$$

'Disaster cycle' is usually used in disaster management which consists of a pre-, during the crisis, and post-disaster phase (Alexander, 2015, p.6). Each phase requires different forms of interventions such as preparedness, mitigation, response, and rehabilitation and recovery (Twigg, 2011) to reach resilience as the goal. Particularly in the pre-disaster event, designing resilience in both research and management aspects is important to prepare the system and communities in facing disasters. A resilience trajectory consists of planning/preparation, absorption, recovery, and adaptation (Linkov et al., 2013; Wardekker et al., 2020). Vulnerability study itself is part of the preparation and mitigation which is done in the pre-disaster event as the starting point in designing resilience. Figure 2 summarises this cycle.

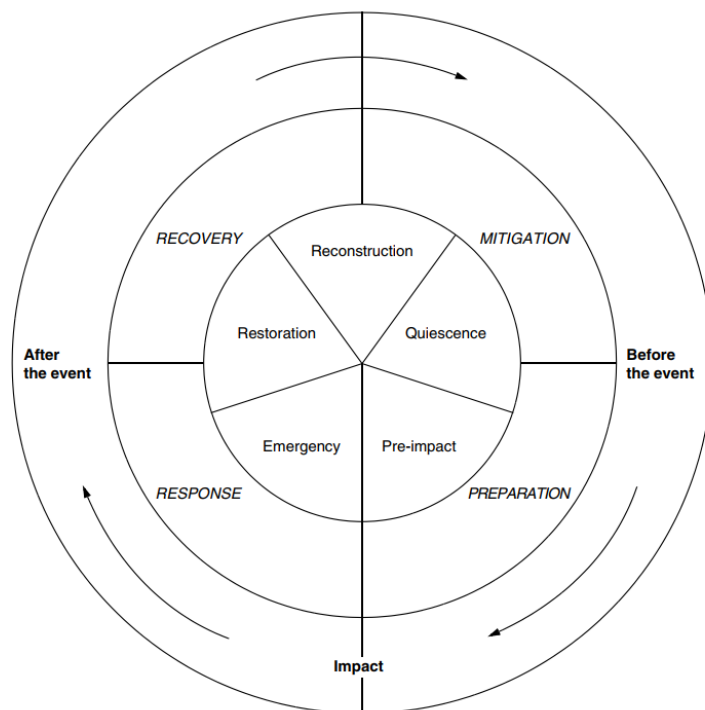


Figure 2. Disaster Management Cycle from Alexander (2012)

To implement the concept of disaster risk reduction, disaster management strategies are developed to transform the theoretical products into practices. The strategies can be used to

answer global, state, or even local disaster-related problems depending on the scale of the management. In 2015, disaster managers and scholars focusing on disaster management have agreed to the implementation of the Sendai Framework for Disaster Risk Reduction (SFDRR) to foster the shift from being responsive to being more preventive in disaster management (Aitsi-Selmi, Egawa, Sasaki, Wannous, & Murray, 2015; UNISDR, 2015). Community empowerment is highlighted in its statement in “... *While the enabling, guiding and coordinating role of national and federal State Governments remain essential, it is necessary to empower local authorities and local communities to reduce disaster risk, including through resources, incentives, and decision-making responsibilities, as appropriate.*” (UNISDR, 2015). The framework has four priorities of action: understanding risk, strengthening disaster risk governance to manage disaster risk, investing in disaster risk reduction for resilience, and enhancing disaster preparedness for effective responses and to “Build Back Better” in recovery, rehabilitation, and reconstruction. States that have agreed align their national disaster management strategies to this framework. A community-based disaster risk management (CBDRM) concept can lead to community resilience which can be realised by implement UNISDR’s priorities (Twigg, 2015).

When studying a disaster-related topic, the theoretical concepts and concrete problems require a demarcation, adjusting them to the scale of the problem. As this research focuses on vulnerability within communities, a community-based disaster risk management (CBDRM) approach is an appropriate approach to analyse the type of practices used at the grassroots level. CBDRM is an approach which led by communities facilitated by a facilitator to conduct discussions to make disaster management strategies, including the hazards maps, socio-economic data collection, resources, evacuation route, et cetera. Shaw (2014b) mentions that community-based practices are effective and useful in disaster risk reduction and are widely used by NGOs to build resilient communities in their disaster risk reduction (DRR) actions. Underlying regulations to engage communities’ practicing disaster management are also driven by CBDRM approaches, such as the Disaster Resilience Village Regulation (Perka Destana Number 1) and the Preparedness Village (Permensos Number 28).

Another issue cross-cutting the disaster debate is sustainable development. The argument that disaster events threaten the ongoing development and inappropriate development can worsen the disaster (Uitto & Shaw, 2016) drives disaster managers to govern disaster risks in a such a way that it can protect sustainable development. In practice, both issues require good governance and having detailed data of communities’ vulnerability could provide a solid basis for this.

II.1.2. Vulnerability

As an integral part of disaster (Carreño, Cardona, & Barbat, 2007; Wisner & Luce, 1993), vulnerability has widely studied (Bankoff, Frerks, & Hilhorst, 2013; Birkmann, 2013; Patterson, Weil, & Patel, 2010). Vulnerability study is usually chosen as the starting point to develop resilience strategies in disaster management or environmental science, thus different frameworks to measure vulnerability are developed in many ways (Adger, 2006; Birkmann et al., 2013; Cutter, Boruff, & Shirley, 2003; Davis, 1994; Wisner & Luce, 1993). There are some variations in vulnerability studies, depending on the goal and motives of the researchers (Adger, 2006; Birkmann et al., 2013; Birkmann, 2007; Weichselgartner, 2001). Various existing vulnerability studies apply the role of socio-economic factors (Birkmann et al., 2013; Birkmann, 2007; Cox & Hamlen, 2015; Cutter et al., 2008, 2003; Tambo & Wünscher, 2017; Twigg, 2007, 2015), geographic and hazard situations (Kumpulainen, 2006), and livelihood factors (Hahn, Riederer, & Foster, 2009). Social-based perspectives in vulnerability also touch upon the susceptibility of the exposed communities, taking into account their social, economic, and cultural capacities to cope

the distraction caused by the biophysical situation and natural hazards (Birkmann et al., 2013; Hilhorst & Bankoff, 2013; Weichselgartner, 2001).

Twigg (2011) created a map for the “progression of vulnerability” to trace back the multiple pressures and factors that can create or increase vulnerability. It started from the root causes which is intervened by the dynamic pressures. These situations turn to unsafe conditions. When there is unsafe conditions and hazards, a disaster might happen.

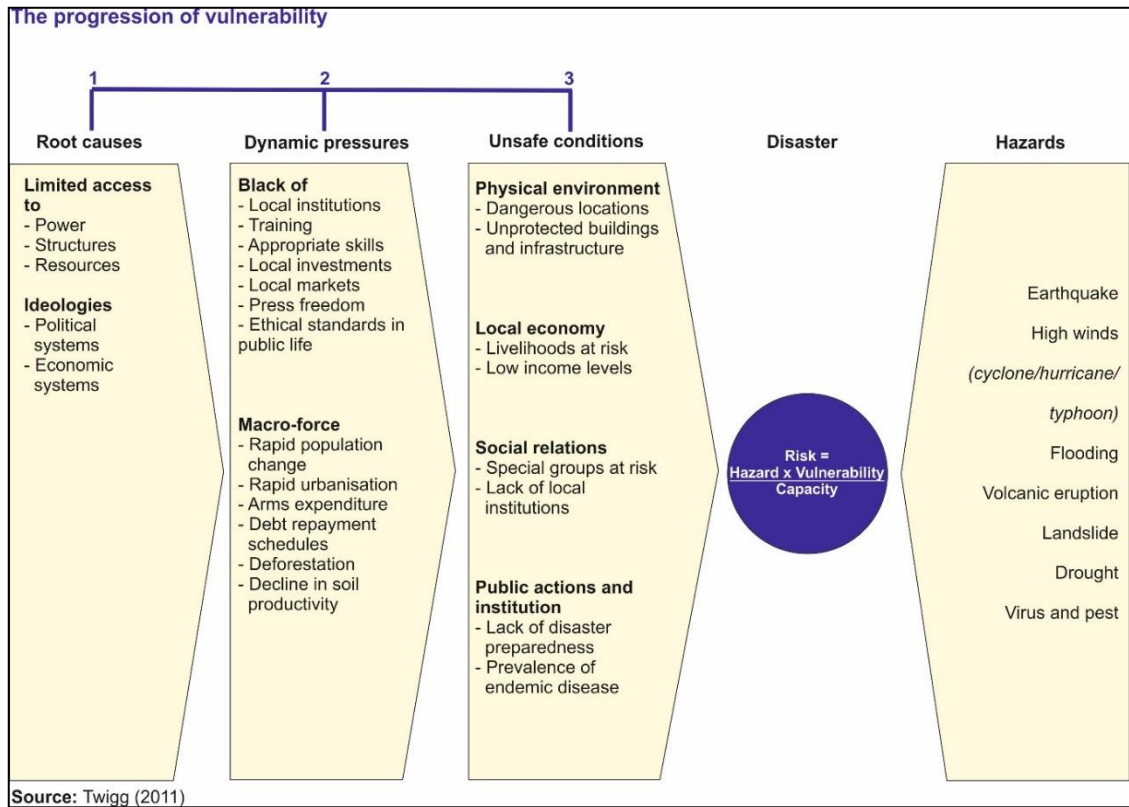


Figure 3. Progression of Vulnerability by Twigg (2011)

This research focuses on vulnerability from the perspective of disaster management scholars as defined by UNISDR (2009). According to Blaikie et al., (2005) and Donovan et al., (2012), vulnerability is related to class, gender, age, disability, and sub-culture. Vulnerability measurement is the pre-event activity, related to the characteristics or qualities of the social system that create potential harm (Cutter et al., 2008). Thus, vulnerability should be identified before the disaster event happens (e.g. disaster that is caused by volcanic activity). Vulnerability is the function of exposure that refers to the area or subject at risk and sensitivity of the system which means the magnitude of the people and places that can be harmed (ibid).

Identifying vulnerability can be done through a vulnerability assessment through an assessment tool (Weichselgartner, 2001). Vulnerability assessment is chosen as the central focus for the operationalisation of the aforementioned risk concept, as hazard and capacity are relatively stable. Using common entities within vulnerability, the assessment tool is developed by reviewing and synthesising literature that covers communities’ vulnerability. The assessment result is used as a dependent variable that determines what consequences there will be if some independent variables are involved.

II.1.3. Resilience

In disaster risk reduction and management discourses, resilience is becoming more popular (Cutter et al., 2008; Tanner et al., 2015) although there is no exact definition of it (Mayunga, 2007;

Tanner et al., 2015). Unlike vulnerability that, ideally, is identified in the pre-disaster phase, resilience emphasises how the community accepts the disruption and bounces back from it (UNISDR, 2009). UNISDR (2009) gives a working definition of this term as “*the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform, and recover from the effect of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management*”. This means that resilience has a dual function, namely that it is both inherent (function well in non-disaster period) and adaptive (ability to cope with the crisis and bounce back after the crisis) (Cutter et al., 2008). Societies, communities, individuals, and socio-ecological systems may adjust to the changing conditions due to the presence of hazards by building resilience strategies (Adger, 2000; Birkmann, 2013). Resilience occurs in many areas of research, such as environment and climate change adaptation, psychology, and disaster management (Birkmann, 2013). The concept of resilience in environmental science has similarities to disaster management. Meanwhile, there is an ongoing debate that resilience is the negation of vulnerability (Twigg, 2007). Some scholars describe resilience as the opposite of vulnerability, while others disagree and argue that the relationship is more complex than that.

This study puts resilience as the follow-up process of the vulnerability assessment. Looking back to the definition of disaster risk, there is an element that interplays with vulnerability, which is capacity. While capacity is the reverse of vulnerability—meaning how a society uses its strengths to cope with disaster (Twigg, 2015)—resilience is the integral part of adaptive capacity (Cutter et al., 2008). The assessment aims to identify what vulnerability aspects have a low index or a high index. Those aspects are the input for recommendations to improve the existing resilience. The role of cultural heritage, whether weakening or strengthening resilience, will be identified.

II.1.4. Cultural Heritage (tangible and intangible)

Since this study is one of the first to include heritage as a crucial component in vulnerability assessments, it is important to clarify what exactly is meant by ‘cultural heritage’. Already in 1972 UNESCO published a working definition of “immovable heritage” which was later renamed to “cultural heritage”. There are two types of representations of cultural heritage: tangible (the physical/material/manmade creatures) and intangible (the non-physical/non-material). Those classified as cultural heritage are monuments, groups of buildings, and sites. This research focuses on the tangible cultural heritage of groups of buildings which “...are of outstanding universal value from the point of view of history...”. As time goes by, non-material aspects such as tradition or expression of life inherited from the ancestor that goes through our descendants are still considered as cultural heritage, such as oral traditions, customs, languages, music, dance, rituals, festivities, traditional medicine and pharmacopeia, culinary arts, and all kinds of special skills connected with the material aspects such of the culture (UNESCO, 2019; Kirshenblatt-Gimblett, 2004) which later called *intangible cultural heritage*.

People’s way of living will result in cultural heritage which is flexible and evolving (Dekens, 2007; Mercer et al., 2009). Cultural heritage is also endangered by political, social, and economic changes (ibid). It is known that the natural characteristics of rural area societies and their reliance on the land for livelihood plays an important role in cultural heritage. For example, people who live on the slope of a volcano benefit from soil fertility to grow crops (Lavigne et al., 2008; Stewart et al., 2017; Wilson, Cole, Cronin, Stewart, & Johnston, 2011) so this becomes part of their belief systems in the form of rituals to protect their land from danger and to thank God for everything they can get from the land (Stern, 2007). Gabrielsen et al. (2018) found in their research that some tribes in New Zealand are attached to and familiar with the moods, signs, and language of the mountain and have local genius (knowledge) to contribute to local risk governance. Both in

disaster and environmental issues, local wisdom that is embedded in cultural heritage can be used as a medium to introduce and mitigate the risk (Hidayati, 2019; Suciani, Islami, Zainal, Sofiyani, & Bukhari, 2018). For some communities, this means building a place of worship and/or performing rituals in their surroundings such as temples or monuments.

Besakih Temple is such a representation of tangible cultural heritage. It is used as a religious centre and represents the societal trajectory from the past to the present, especially in how communities practice their beliefs through rituals (intangible heritage aspect) (Kirshenblatt-Gimblett, 2004; Martha et al., 2018). The physical condition influences how Balinese people in the past located Besakih Temple as the meeting point with their Gods, with Mt. Agung itself being a manifestation of God. For Balinese Hindus, a place of worship should be on the highest location amongst other buildings, thus the slope of Mt. Agung was chosen to build Besakih Temple in the 8th century (Interviewee number 8, personal communication, January 18, 2020). This temple is particular importance to Balinese Hindus because of its value in Balinese society as the mother temple (Martha et al., 2018). It is also one of nine *Pura Kayangan Jagat* which means the highest hierarchy of temples and can be used for universal worship. It carries ancient beliefs that are still being practiced until now (Putra & Hitchcock, 2005). The geographical location puts this temple at risk and saving the temple from disaster should be taken into consideration by disaster managers.

While intangible cultural heritage can be seen from several forms such as how Balinese Hindu in delivering their rituals and intergenerational shared indigenous knowledge. Both tangible and intangible cultural heritage are intertwined with each other, especially in the case of Besakih Temple and the rituals done by Balinese Hindus. Besides the temple being the religious centre and being used for worship, the location facing toward the Mt. Agung causes this temple is also used for conducting rituals or traditions that are related to the mountain.

Stern (2007) writes about disaster from multiple perspectives, including Hinduism. In general, Hindu people's interpretation of God is different from Abrahamic religions (Christianity, Judaism, and Islam) that see God as a universal God, instead of God being present in all things. For Balinese Hindu, the manifestation of God can be found in both mountains and the ocean. Mt. Agung is such a manifestation of God and is called *Guru Toh Langkir*. Although God exists in Hinduism, moral judgment is placed within the doctrine of *karma*; a universal causal system that continuously harmonises nature (the environment) with people's way of living.

Balinese Hindus belief systems are created by and in turn create indigenous knowledges such as folklore, myths, and notes in temples or ancient leaves, and include teachings about how the face natural phenomena. Indigenous knowledge is the relationship between people and their environment over a period of time, and the characteristics of this knowledge are dynamic, depending on the physical, political, economic, and social situation (Dekens, 2007; Mercer et al., 2009). Indigenous knowledge has benefits and drawbacks for the community depending on how the knowledge is used. For example, in the past, Balinese people identified signs of eruption and shared this knowledge with the following generations via myths and ancient notes. This helped people to understand when the possible danger of eruption became real, however, when people only take this particular knowledge into account and ignore (the benefits) of technological development, the knowledge can be misleading. In the case of the 2017 eruption, people were informed about the volcano's activity by CVGHM (Indonesian name: PVMBG) and leaders took action to evacuate based on their recommendation, but remembering the prior eruption in 1963 some people performed *Ekadasa Rudra*, a ritual in the crater, believing that even an eruption could not cause the ritual to be skipped.

Dekens (2007) build a framework to help identify the linkage between- and possible outcomes from the relation between local knowledge (including indigenous knowledge) and disaster management. As determined by UNESCO, local and indigenous knowledge refers to the understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings.

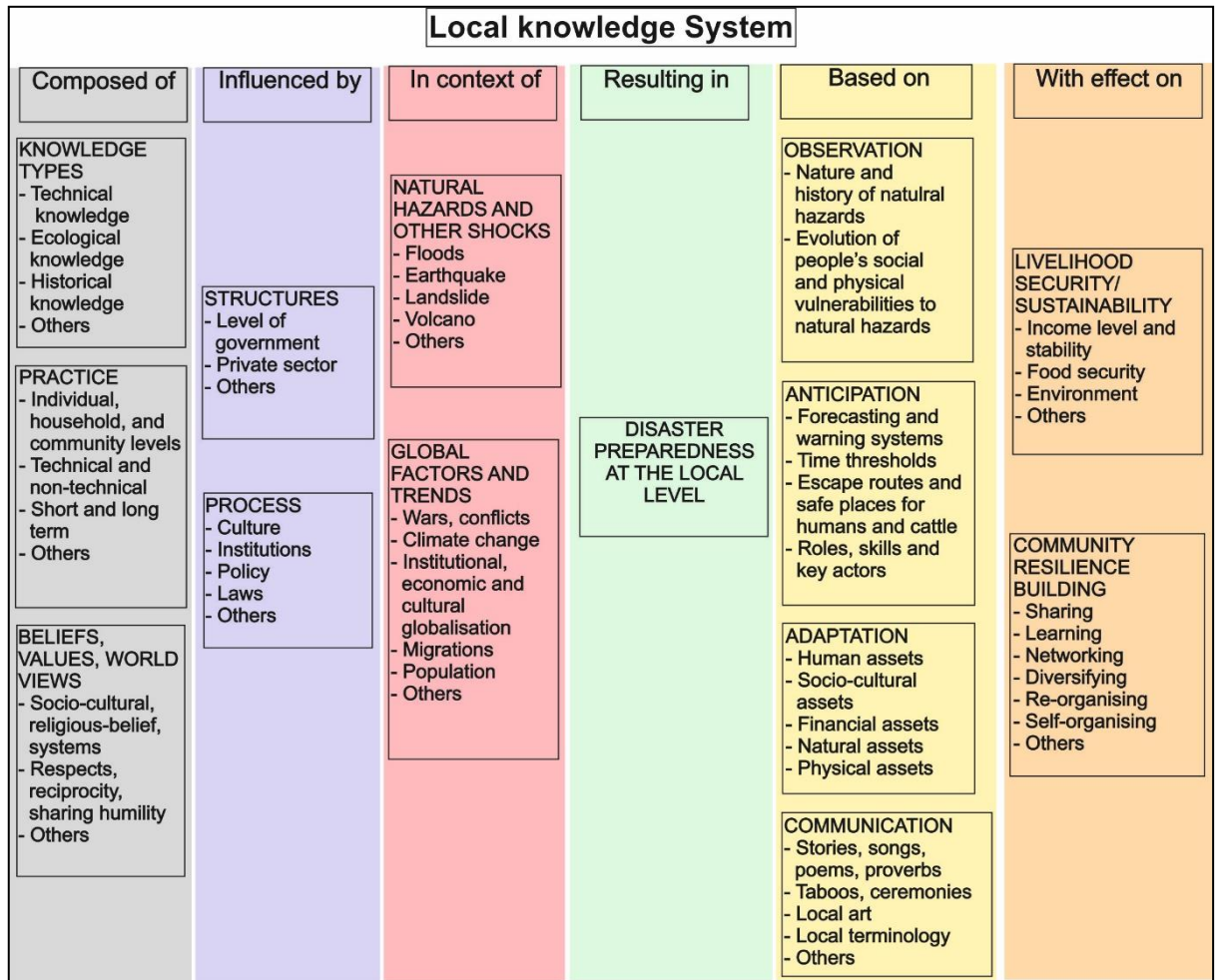


Figure 4. Local Knowledge System by Dekens (2007)

Mercer et al. (2009) argue for integrating indigenous and scientific knowledge to give factual and reliable information supporting communities' disaster risk reduction strategy. The growing body of literature about the importance of integrating indigenous and scientific knowledge shows that it is becoming more and more popular (Mercer et al., 2009). The relation between cultural heritage and communities' vulnerability that is expected to be found in this research will support this integration.

II.1.5. Governance

The term "governance" is mostly used in political science emphasising the presence of multiple actors and processes to steer a group of people to act in a certain way (Lange, Driessen, Sauer, Bornemann, & Burger, 2013a; Van Asselt & Renn, 2011), for example reduce the risk of disaster by the communities. Governance applies to several issues such as environmental problems, disaster problems, poverty problems, etc. It is introduced since this research will later discuss about governance in disaster risk reduction.

Governance is important in disaster risk reduction because the problem of disaster is complex, uncertain, and ambiguous (Tierney, 2012; Van Asselt & Renn, 2011). To support governance in disaster management, formal institutions and regimes and informal actors are involved (Van Asselt & Renn, 2011). UNDRR mentions that risk can potentially destroy physical, social, economic, environmental, cultural, or institutional aspects over a certain time. In solving disaster risk in particular, there should be a shift in governance from government-led to multi-dimensional (Lange, Driessen, Sauer, Bornemann, & Burger, 2013b) by multi-agents (Tierney, 2012), where every agent can contribute to reach a communal goal. Risk governance is then about decisions and actions in pre-, during, and post-disaster phases, including multiple actors such as the government, business sectors, or civil societies (Birkmann et al., 2013). As mandated by SFDRR in the four priorities of actions, risk governance is seen as an important attribute to manage disaster risk. Pre-event actions, such as reducing vulnerability and understanding the risk, are part of the governance activities (Hilhorst, 2013; Tierney, 2012).

Damaged infrastructure, poverty increases, and economic losses caused by disaster events prove that disaster risk reduction and sustainable development are interlinked (Uitto & Shaw, 2016). Development may be set back for years by a disaster event, and haphazard development focusing on only profit will exacerbate disaster risk and impact (Uitto & Shaw, 2016). For example, the over-exploitation of the sand that has purpose to normalise³ the river in the area of Mt. Merapi changes the landscape pattern, potentially bringing about ecosystem change.

Therefore, disaster risk governance should be aligned with the transformation toward sustainable development by considering its complexity and involvement of many actors. In the area where the potential damages might occur, “business as usual” governance may not protect the development process. Protecting the continuity of development from a disaster event can be done by preparing communities (subjects) to be ready for the uncertainty of the disaster (SQc).

Lange et al. (2013a) conceptualised modes of governance to face the complexity of the problem taking into account the political process (politics), institutional structure (polity), and policy content (policy). Ideal-typical governance modes are formulated which are: centralised governance, decentralised governance, public-private governance, interactive governance, and self-governance.

The emergence of governance in disaster risk reduction was highly discussed amongst scholars (Van Asselt & Renn, 2011). It has resulted in the concepts of multi-level governance (sometimes also referred to as vertical governance) for disaster risk reduction which covers local, municipal, provincial, and national level authorities and horizontal governance where a certain geographical area is governed by several actors (Benz & Eberlein, 1999; Van Asselt & Renn, 2011).

The increasing trend in disaster events can be seen as a governance issue (Twigg, 2011, p.073) comprising values, policy, institutions, and mechanisms for implementation by many different actors such as the state, civil society, and private sector. Meanwhile, when it comes to disaster risk reduction state governments have the task and authority to protect their citizens from the impact of disaster using their resources, large-scale multi-disciplinary initiatives, and directive mandate (Twigg, 2011, p.075).

³ Volcanic eruption brings volcanic materials from inside the Earth to flow through the river. Volcanic material (magma) is liquid so it flows following the topographic shape of the Earth. It has very high temperature but slowly it will be cold. When it flows through the river, the river will be full of sand. The sand should be taken away to make the river normal again (normalise).

Natural disasters, including volcanic eruptions, are caused by a natural phenomenon (biophysical) that disturbs society (social) (Grattan, 2006; Weichselgartner, 2001). The natural phenomenon and society living within the hazard zone are part of the earth system. Governing society to be able to face upcoming disaster (i.e. to build resilience) is part of earth system governance (Biermann et al., 2010; Tierney, 2012). Moreover, focussing on Mt. Agung, this research involves people's cultural background and local knowledge in using natural resources wisely for current and future generations considering the presence of the hazard.

II.2. Conceptual Operationalisation

It was mentioned earlier that risk is a function of hazard, vulnerability, and capacity. This research defines each component in the figure 2. Regardless the different types of hazards, this research focuses only to Mt. Agung eruption. The dynamic of eruption is ignored because this research is more focusing on the vulnerability and the capacity.

In this research, capacity is represented by the presence of current government initiative (Destana). Government initiative has a long period, so the capacity is assumed to be stable. Meanwhile, the vulnerability component is the only component can be measured, this research assesses the vulnerability through an assessment tool. The assessment tool is developed based on the existing literatures.

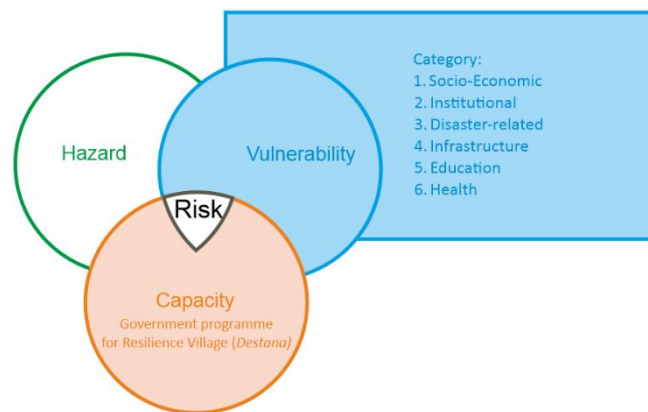


Figure 5. Conceptual framework (Source: author's own)

Six categories (variables) have been formulated to assess communities' vulnerability to the hazard. These categories are *socio-economic*, *institutional*, *disaster-related issue*, *infrastructure*, *education*, and *health*. As widely researched, the socio-economic parameter addresses the material possession of the community (e.g. income and assets). The institutional parameter is chosen because of the high relation between governance and the government (Andreastuti et al., 2018; Hizbaron & Maarif, n.d.; Maarif et al., 2013), and this category will mainly discuss the role of the disaster management authority (BNPB/BPBD) and how communities perceive that board (e.g. activities done by the board with the community). Following the Institutional category, the disaster-related issue category identifies communities' perspectives about the disaster (e.g. evacuation).

Although some studies take the variables of education and health to be a part of the socio-economic situation of communities, this research deliberately regards them as separate categories. Education and health are mostly analysed in terms of accessibility (e.g. distance). Infrastructure represents the communities' basic physical and organisational structures and facilities, such as their housing and energy, electricity, and water resources. These categories tend to be in danger when a disaster occurs (Weichselgartner, 2001).

Table 1. The categorization of the vulnerability assessment framework

Categories	Explanation	Source
Socio-economic	Socio-economic is used in most of the vulnerability toward hazard studies.	Birkmann et al. (2013); Birkmann (2007); Cox & Hamlen (2015); Cutter et al., (2008, 2003); Tambo & Wünscher (2017); Twigg (2007, 2015)
Institutional	This category targets how perceive the presence of the government and if and how the disaster management board plays a role within the community.	Andreastuti et al. (2018); Arya Maulana Wijaya et al. (2019); Cox & Hamlen (2015); Maarif et al. (2013); Twigg (2011)
Disaster-related issue	The disaster category assesses the communities' preparedness for the upcoming disaster.	BNPB (2012); Cox & Hamlen (2015), Perka Destana (2012) and Permensos (2011), Paton & Johnston (2001); Surjan, Kudo, & Uitto (2016)
Infrastructure	The infrastructure category shows factors related to shelters.	Cox & Hamlen (2015); Weichselgartner (2001)
Education	The education category sheds light on educational levels of the communities.	Cutter et al. (2012); Tambo & Wünscher (2017)
Health	This category gives information about communities' health levels and access to health.	Hahn et al. (2009)

To operationalise the framework, literature from (Birkmann et al., 2013; BSN, 2017; Cox & Hamlen, 2015; Cutter et al., 2008, 2003; Hahn et al., 2009; Kurniawan, Ascholani, Irawan, Nurdin, & Wermasubun, 2012; Tambo & Wünscher, 2017; Twigg, 2011; Webb, 2018; Weichselgartner, 2001) has been synthesised, translating both vulnerability and resilience aspects into twenty-nine variables. Based on these variables, the questions for assessing vulnerability have been given to the communities through structured interviews, as shown in [Appendix 1](#).

III. Chapter 3 (Methodology)

III.1. Demarcations

As with any research, choices have been made with regards to scope and focus of research. To prevent the scope of this research becoming too broad, demarcations have been made based on administrative and geographic location, hazard type, government initiative and scientific perspective.

First, administrative and geographic demarcation determines the location of the research. The village is chosen as the unit of analysis, based on Bali's administrative infrastructure. The four villages that have been selected are within a single regency to make coordination easier, especially coordination related to technical permits and administrative procedures. The geographic demarcation indicates that the villages are based on the proximity to the volcano and the cultural heritage. The villages are Besakih (the closest to Mt. Agung and cultural heritage), Sebudi (relatively close to Mt. Agung and cultural heritage), Tulamben (the farthest from Mt. Agung), and Ulakan (relatively far from Mt. Agung). Besakih and Ulakan have implemented the resilience village regulation (Destana), whereas Sebudi and Tulamben have not.

Secondly, although there are various types of hazards in Bali, this research will only focus on volcanic eruption from Mt. Agung as a hazard. As the highest mountain in Bali, Mt. Agung is acknowledged as a God by Balinese people. Its activity can be hazardous to the communities and their assets. By seeing volcanic eruption as a hazard, the researcher can find the relation to the belief system of Balinese Hindu that is manifested into tangible and intangible heritage. The phenomenon of volcanic eruption facilitates in capturing both cultural heritage and disaster-related discussion.

Governments, NGOs, and business sectors have established the concept of community resilience. This research will focus on government initiative in building community resilience as a formal and public document. Thus, the third demarcation of this research is the type of resilience strategies that are regulated by governmental initiative namely Perka 1/2012 about Destana.

Fourth, although vulnerability studies have been approached through various disciplines, this research will only focus on the perspective of hazard and disaster risk reduction (or management). This is because the government initiative for resilience in Indonesia (Perka 1/2012 about Destana) mainly addresses the disaster-related issues. However, works of literature on vulnerability that are applied in other perspectives are also involved as long as they are still relevant to hazard and disaster risk reduction.

III.2. Research Strategy

The umbrella concept used in this research is vulnerability within disaster management. The research strategy used is Comparative Case Study, with some interviews to gather the primary data. Comparative Case Study means that this research goes deeper into the research locations (Besakih, Sebudi, Tulamben, and Ulakan) and gathers detailed data through the communities within the villages. Then the four different villages will be juxtaposed and compared to one another to support in answering the research questions. Secondary data from reports, literature, and government documents complement the primary data in comparing the villages.

In total the research took nine months (45 ECTS) including desk research, research design, site visit, fieldwork, analysis, and reporting. The fieldwork lasted 1.5 months (January – February 2020).

The following sub-sections will describe in detail the strategy and methods used for this research.

III.2.1. Comparative Case Study

Verschuren & Doorewaard (2010) define that case study is a research strategy to go deeper into and get a more holistic insight of one or several objects or processes, involve a relatively small number of research units, take a strategic sample to be surveyed, and it is done through *on-site* research. The specific type of case study in this research is *the comparative case study* where several communities within a single research unit will be researched independently in series and are compared based on its result (ibid). In this research, the research object are communities in Besakih, Sebudi, Tulamben and Ulakan and the research unit is Karangasem Regency, Bali Province. This research aims to shed light on the relationship between vulnerability and the communities' cultural heritage and government intervention on communities, by using a case study in four different villages. The vulnerability assessment result of each village supported with in-depth interviews will help to answer the research sub-questions.

Site Visit is included as part of the process in this research. Site Visit means a certain stage for the researcher to get a general overview of the locations. In additional support to the Comparative Case Study strategy, several practical methods are used: Desk Research, Interviews, and Quantitative Analysis.

In this research vulnerability is the dependent variable. There are six categories as the independent variable that influence vulnerability. Two more independent variables, namely cultural heritage, and government initiative are excluded from the indexing vulnerability, instead they are used in the analysis to support in answering the research questions. It is also expected that confounding variables might occur (see section [IV.2.2](#)).

III.2.2. Site Visit

Before the idea for this research had come about and a research design had been made, I had the opportunity to stay in the area during the disaster in 2017 since I worked for Disaster Management Authority of Indonesia (phase 1 site visit). Impressions about Mt. Agung and Bali drove the design of the research which emphasises the presence of cultural heritage. In the evacuation shelters, people still conducted religious rituals that are supposed to be done in Besakih Temple. Religious actors asked permission to represent the people in delivering offerings to Mt. Agung so its activity would not cause a lot of calamities. I could see that cultural heritage can support local and national disaster management.

In 2019 I was finally able to follow up on what I had seen and experienced in 2017 via the means of this thesis. Shortly before the actual interviews were done, familiarisation of the area was done (phase 2 site visit). It was planned to gain an understanding of the social structure, general characteristics of the society, the contour of the topography, the local actors, and communication with the society. It was found that generally, hierarchy is important for Balinese people. It was clear that, to engage the local actors who have strong power within the communities and communities themselves, the head of the village should be approached.

Bali is a patriarchal society, where men are considered 'higher' than women and hold primary power. It also means that on average men have more opportunity to obtain a higher education and have access to all kinds of information. However, in practice it turned out that it was easier (for me) to approach women than it was approaching men, because some of them stay at home during daytime. The fact that I am a woman myself could have possibly also played a role in this.

During the 2nd phase site visit (January 2020), the questionnaire was piloted. Rewording and revising the questions were done to adjust to the actual condition of society. Especially for scientific terms such as *hazard* or *drills*, simple words and explanations were given to make understandable to the communities, especially for them who have limited information or knowledge.

III.2.3. Desk Research

Desk research intends to review relevant literature that can be used to support this research. Literature includes scientific journals, governmental reports, legal documents, and guidelines. Literature is used for several purposes. First, at the beginning of the research the underlying problem and knowledge gaps are identified through a literature review. Following the problem definition, literature helps to frame the research within a specific context and scope. Secondly, related to the vulnerability assessment, a literature review is done to create the assessment tool, including defining the methods for calculating the result. Lastly, reviewing the literature helps the analysis process.

III.2.4. Interviews

Two types of interviews have been used in this research. The first one is called a structured interview. This type of interview is a survey with closed-ended questionnaires. To be able to engage respondents with various educational backgrounds, the close-ended questionnaires was filled through interview (lasting approximately 10-20 minutes) and it was guided by the researcher. The assessment tool provided in [Appendix 1](#) is used to gather data on communities' vulnerability. Delivering the questions through interviews open the possibility of the respondents to answer in various ways of answer. Variation of answers by the respondents is coded (following the structured questionnaire).

The second type of interviews used in this research is in-depth interviews. These in-depth interviews have only been conducted with a limited number of respondents, namely those who were identified as 'key actors'. The key actors are the people who have specific knowledge about the villages, the culture, the mountain or the villagers. An example of such a key actor are village-heads. Village heads, having the power and the duty to lead the village and provide services for the villagers, they have to have an understanding of life in the village. The focus of the in-depth interviews lies on cultural heritage and government regulation implemented in the villages. The outline of the qualitative interviews can be found in [Appendix 2](#) and detailed information of the interviews done with eleven key actors can be found in [Appendix 3](#). The key actors that have been interviewed are:

1. The founder of Bali Cultural Heritage Conservation
2. The head of Besakih Village represented by the Secretary
3. The head of Sebudi Village
4. The head of Ulakan Village represented by the Secretary
5. The head of Tulamben Village
6. The head of Farmer Association
7. The head of Pasebaya
8. *Bendesa* (religious head) Adat
9. The head of Planning Division of Ulakan Village
10. The head of Disaster Management Authority of Karangasem Regency (BPBD)
11. Resilience Village facilitator

The structured interviews have been held with a total of 114 respondents of which 65 are male and 49 are female. 42 people are farmers, 30 people work in the business sector or as a seller,

and the rest have various occupations, such as teacher, labourer, fisherman, climbers, and officers. One limitation with regards to the 'type' of respondents, is that it has been difficult to access people who work in the formal sector because during the day they are usually at the office. Meanwhile, interviews have also not been conducted during the evening out of respect to the communities' customs.

It was not possible to use a framework from the literature without modifying it. Existing frameworks as found in the literature mostly use secondary data (Cutter et al., 2003; Siagian, Purhadi, Suhartono, & Ritonga, 2014). Meanwhile, this research combines secondary data (comparative case study section) with fieldwork data (vulnerability assessment). The open-ended questionnaires were piloted in the early stages of the fieldwork (site visit stage). During the pilot, some questions were updated considering the context 'on the ground'. The target of the interviews are communities in general. The result of this type of interview is a set of quantitative data, showing the vulnerability index of each village.

III.2.5. Quantitative Analysis

Quantitative Analysis intends to calculate the answer of structured interviews into numbers. Coding process is done initially to transform the actual answer into structured answer (see [Appendix 4](#) for the Coding). The calculation refers to Hahn et al. (2009) with some modifications.

The initial value for each category is different from one to another. Hahn et al. (2009) uses simple calculation method which all categories are made into same values. To transform all the categories into same values, Hahn et al. (2009) follows the method in Human Development Index (HDI), but this research modifies that method. Instead of using HDI, this research uses multiplier to standardise the valued. After each variable has the same values as the others, average calculation is used.

There are several steps to reach the result as below:

Step 1

Based on the interview, each variable is coded, following the table *Codes for the survey* in [Appendix 4](#). All the variables will be made into uniform value by standardization. Standardization is done by calculating each variable code with the multiplier. The multiplier is generated by:

$$Multiplier = \frac{1}{highest\ score\ of\ the\ category\ (i)}$$

Step 2

After the standardization of all the variables, calculate the Average of all the variables in each village.

$$Variable\ (i) = \frac{sum\ all\ the\ standardised\ variable\ (i)}{number\ of\ interviewees\ in\ each\ village}$$

Step 3

Each category has several variables. The next step is calculating the average of the variable within each category for each village.

Table 2. Number of variables in each Indice

Category	Number of variables
Socio-economic	8
Institutional	3
Disaster	3
Infrastructure	7
Education	4
Health	4

$$Category (i) = \frac{\text{sum all the average variable (i)}}{\text{number of variable within category}}$$

Scenarios

It is common that in the interview, some respondents refuse to answer some questions. This unavoidable situation causes the result that contains some missing data. In statistic calculation, missing data usually is problematic so statistical approaches should be employed to fix this problem. In this research, before the decision of using a certain approach to solve the missing data problem, some scenarios in the calculation process were made. The scenarios are used to make a decision in avoiding the problem of missing data. Those are:

1. The missing data (N/A) is filled with 0.
2. The missing data (N/A) is filled with the lowest number for each variable.
3. The missing data (N/A) is filled with the null (no value or blank) for each variable.
4. The missing data (N/A) is filled with an average of each village.
5. The missing data (N/A) is filled with the highest number.

The area is divided into three areas: Zone I (least hazardous), Zone II (moderate), and Zone III (most dangerous). To map a hazard zone, two types of danger are taken into account: the potential of the lava flow and the potential of the exposure by the hot volcanic ash. Zone III has a high potential for the hot volcanic ash, lava flow, and poisonous gas. Due to the potential for stone spewing and heavy volcanic ash within a 5 km radius of the crater, this area is also included in Zone III. Risk maps highlight the importance and complementary functions of communication, background hazard, crisis hazard, and ashfall prediction maps (Andreastuti et al., 2019). Based on this map and the activities of the volcano, CVGHM releases the warning.

Mt. Agung has erupted in 1808, 1821, 1843, 1963, and the latest in 2017 (ESDM, 2014; Gertisser et al., 2018). Mt. Agung is one of the volcanoes in Indonesia with a limited monitoring record (Zen & Hadikusumo, 1964). The uncomplete of the records was caused by the long period of dormant and at that moment, Indonesia had less developed technology. While record in 1963, Zen & Hadikusumo (1964) and Self & Rampino (2012) wrote a report about the eruption. It was known that after almost 120 years of dormancy, the eruption in 1963 was quite big and caused many calamities. For more detailed notes, see [Appendix 5](#).

Table 3. Notes of Mt. Agung eruption

Year	Notes
1808	Volcanic ashes and pumice were blown from the crater.
1821	There was a normal activity. There was no annotation for this eruption.
1843	Earthquakes were recorded in the beginning of the eruption. Materials blown from the crater were ash, sand, and pumice. In 1908, 1915, and 1917 several craters with fumarole were found.
1963	The eruption started on 18 February 1963 and ended on 27 January 1964. It was a magmatic eruption. 1.148 people died and 296 were injured.

Source: ESDM, 2014

In 1963, the first cycle of activity killed about 1700 people in total of which 1500 died caused by *nuees ardentes*⁴. The first eruption was recorded on 18 February that year. Cold lahars after the eruption killed another 200 people and devastated villages and construction on the southern slope (Sebudi area). Another *nuee ardente* from the second cycle killed 200 more people.

59.99% (50.810,49 Ha) of Karangasem Regency is a high-risk area (BNPB, 2015). 243.599 people live within the hazard area of which 46.704 are considered vulnerable. The potential economic loss by an eruption is Rp 300,85 million. Potential environmental loss by an eruption is 6.726,51 Ha (BNPB, 2015).

The table 4 shows the timeline and the alert of the eruption.

⁴ A *nuée ardente* is a turbulent, fast moving cloud of hot gas and ash erupted from a volcano. In Javanese language, it is called "Wedus gembel" (wedus means goat, gembel means curly). This name was used since the *nuee ardente* looks like curly goats from distance.

Table 4. Alert of volcanic eruption

Level of volcanic activity	Indication	Community response	Date
Normal level	Indication Visual observations and instrumental records show normal fluctuations and no change of activity. Hazards in the form of poisonous gas may be present near vents, depending on the volcano's characteristic activity.	Communities in Hazard Zones (HZs) I and II may carry out daily activities. Communities in HZ III may carry out daily activities if they are in compliance with regulatory requirements from local government according to the technical recommendation of the Geological Agency, Ministry of Energy and Mineral Resources.	1964
Waspada level (advisory)	According to visual observations and instrumental records, there are indications of increasing volcanic activity.	Communities in HZ I and II may carry out their normal activities but must keep alert. For communities in HZ III it is recommended that they do not carry out daily activities in areas near summit craters or other vents.	Mid 2017
Siaga level (watch)	According to visual observations and instrumental records, there are prominent indications of increasing volcanic activity. Eruptions may take place, but do not threaten settlements and/or activities of communities near the volcano.	Communities in HZ I should improve their awareness and must not carry out activities along river valleys that originate at or are near the volcano's summit. Communities in HZ II should prepare for evacuation and await an evacuation order from the local government according to the technical recommendation of the Geological Agency, Ministry of Energy and Mineral Resources. Communities in HZ III are not permitted to carry out daily activities and should prepare to evacuate.	22 September 2017
Awas level (warning)	According to visual observations and instrumental records, there are significant indications of ongoing volcanic activity, with eruptions that potentially threaten settlements and or communities around the volcano.	Communities in HZ I, II, and III are to immediately to evacuate by the order of local government, according to technical recommendation from Geological Agency, Ministry of Energy and Mineral Resources.	22 September 2017

Source: Andreastuti et al., (2019) and Irawan⁵ (2017)

IV.3. Locations

In general, Bali consists of several social groups which has an important role within the society. Those are Desa Dinas, Banjar Dinas (Dusun Dinas), Pakraman Adat (Desa Adat), Banjar Pakraman, and Subak. Explanation about these social groups and each function is important to prevent confusion in further explanation followed by the research locations overview.

First, Desa Dinas which means village. This term is only used in Bali. Village is the smallest official administrative unit Indonesia. Under Desa Dinas, there is sub-village which is called Banjar Dinas in Bali. However, Banjar Dinas is not an official administrative unit, instead of more tribal structure which is used to help Banjar Dinas in doing official duties.

Head of Desa Dinas is called Perbekel. Head of Banjar is called Keliyan Banjar Dinas. Keliyan Banjar Dinas is the person responsible directly to society. All information from Keliyan Banjar

⁵ Irawan, A.S (26/11/2017) retrieved from: <https://jatim.tribunnews.com/2017/11/27/mengenal-tingkatan-status-gunung-agung-bali-dari-level-normal-hingga-awas-begini-ciri-cirinya> (15 /5/2020). The information is about the date.

Dinas is delivered to Perbekel and information from Perbekel is shared with the people through Keliyan Banjar Dinas.

Besides official administrative structure, Bali also admits tribal structure. Tribal village in Bali called Pakraman Adat. It consists of two or more Desa Dinas but under the same tribal community boundary. The head of Pakraman Adat is called Bendesa. Under Pakraman Adat, there are several Banjar Pakraman. Pakraman Adat and Banjar Pakraman have the role of guiding people in practicing Hindu-related activities (*upakara-upakara*) (Vipriyanti, 2008). The head of Banjar Pakraman is called Keliyan Adat.

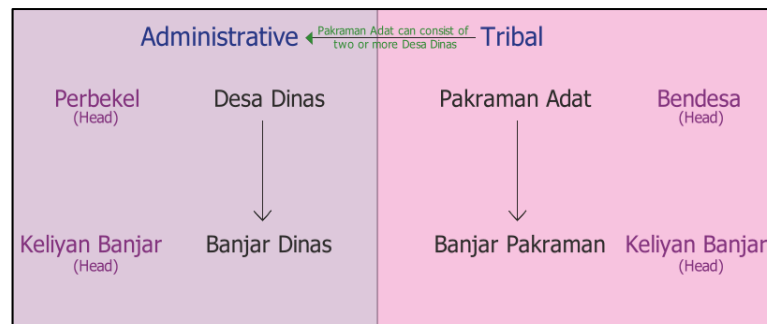


Figure 7. Administrative and Tribal Village in Bali (Source: author's own)

Another type of group that is important to understand is *Subak*. Initially, *Subak* was a water irrigation system that was used to water the rice field in Bali but during agricultural development, *Subak* turned into a social group. It consists of water irrigation, water setting, paddy cultivation, and rice terrace mechanisms to distribute the water amongst rice fields. Geertz (1980) said that *Subak* includes farming plans, regulation, cooperation, and aspects of belief.

Bali has two different type of agricultures, wet-type agriculture (e.g. paddy field) and dry-type of agriculture (e.g. corn, cassava, etc). There are two types of *Subak* that are dedicated to two types of agriculture: *Subak sawah* and *Subak abian*. *Subak sawah* are organizational structures found in rice field areas where water is required to plant the paddy. Attached to *subak sawah*, there is "*Pura air*"; the temple of the water where Balinese Hindu perform rituals related to agriculture. The second type of *Subak* called *Subak abian* which means an organisational structure to manage dry type of farmland, such as coconut, coffee, and another type of plantations. *Subak abian* is also completed with a temple. The temple is also called *Subak abian* and has the same function as *Pura air*. Both in rice fields and dry farm fields, the farmers are grouped to cooperate to run the *Subak* system.

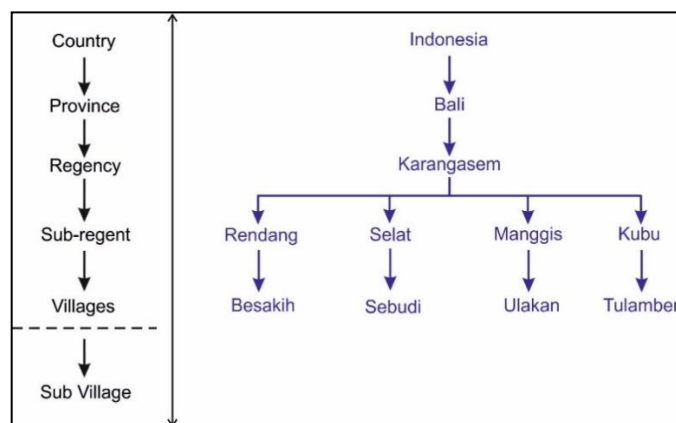


Figure 8. Administrative Structure in Indonesia and The Researched Locations (Source: author's own)

Refer to figure 8, Indonesia has 34 provinces. Bali is a province in Indonesia. The next level is regency (municipality) which in this research is Karangasem Regency. Under regency, there are sub-regencies and under sub-regencies there are villages.

This research is done in four different locations: Besakih Village, Sebudi Village, Tulamben Village, and Ulakan Village. Besakih and Sebudi are in the north-west part of Karangasem Regency, close to the volcano, and belong to Rendang and Selat sub-regency respectively. While Tulamben in Kubu sub-regency and Ulakan Village in Manggis sub-regency are still within Karangasem Regency but are adjacent to the coast. Farmers in Besakih, Sebudi, and Tulamben follow *Subak abian* to manage their agriculture. While in Ulakan there are both *Subak Sawah* and *Subak Abian* because this area has both rice fields and dry-agriculture fields. Figure 9 shows the four locations in Karangasem Regency, Bali Province.

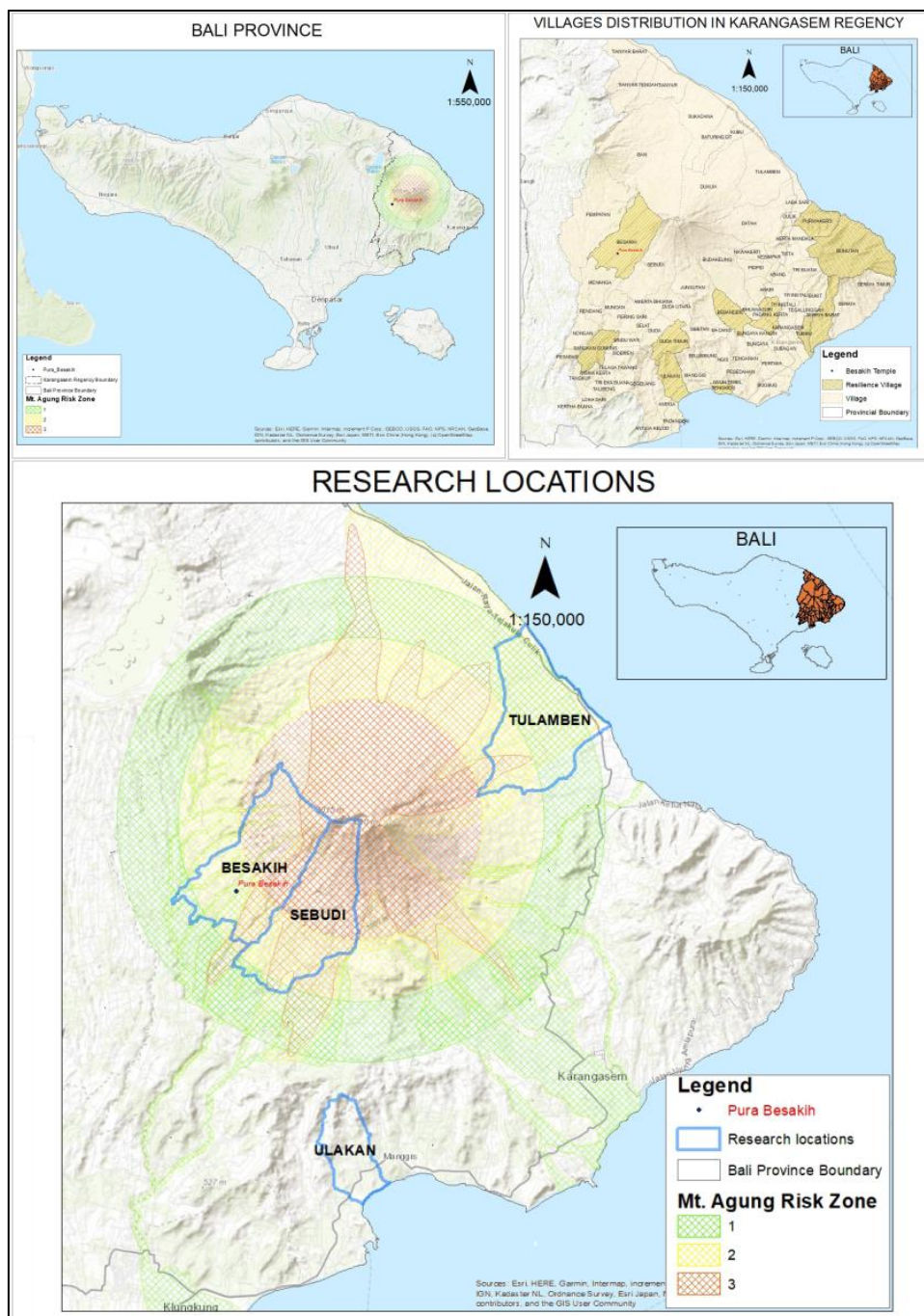


Figure 9. Maps of the Bali Province, Village in Karangasem Regency, and Research Locations inside the risk zone

Some information about the villages is provided in the table below.

Table 5. Overview of the Locations

Village	Sub-regency	Area (hectare)	Population
Besakih	Rendang	3073.48	7682
Sebudi	Manggis	2735.06	6059
Ulakan	Selat	1044.93	6488
Tulamben	Kubu	2881.17	12067

Source: BPS, 2015

Tri Hita Karana and Cosmic orientation

Tri Hita Karana is one of the life philosophies of Balinese Hindu. The literal translation of Tri Hita Karana is the Three Sources of Happiness. The concept originates from Hindu teachings, which are encrypted in ancient documentation and written in Sanskrit language (classic Indian language which was used to spread Hinduism, Buddhism, and Jainism). It states that in life, there should be an equilibrium between men and nature, men and men, and men and their God (Pitana, 2010). It consists of three teachings called *parahyangan*, *pawongan*, and *palemahan*. Parahyangan means people's life on earth to reach peace and prosperity. This becomes the basis in creating tolerance amongst people with various religions, ethnicity, and languages. It emphasises harmonious living between humans and God (Parahyangan), between groups of people (Pawongan), and between humans and the environment (Palemahan).

This philosophy is used in every custom in Bali. In practice, the implementation of Palemahan can be seen from farmers who always strive to keep the balance of the environment. Rituals are offered by farmers to ensure that their plantations stay healthy and free from danger, and that nature will give an optimal harvest.

Subak is another example of the implementation of Tri Hita Karana. As explained in the previous paragraph; *subak* is an irrigation system in Balinese rice fields and using the *subak* will distribute the water equally and follow the order fairly (the field in the highest position will get the water first, followed by the lower position. This order is made to make sure that the paddy is planted continuously to prevent rice scarcity).

Balinese people put nature as the cosmic (center) that should be kept its balance. There are many rituals geared to maintaining a balanced cosmos⁶. These rituals are the religious expression in purpose to keep the equilibrium and glorify the nature and all components on it (*sarwa prani*). Rituals that are done in the mountain, ocean, rivers, lake, and forest are the manifestation of the people's awareness of the cosmic. Cosmic orientation shapes the Balinese belief and culture which results in Tri Hita Karana.

IV.4. Disaster Governance in Indonesia

Governance structures in Indonesia are mainly vertical and this is reflected in disaster management related issues. Authority in national level for disaster management is given to an agency called Disaster Management Authority of Indonesia (BNPB). BNPB runs disaster management based on Law 24/2007 about Disaster Management. Since Indonesia implement regional autonomy system where lower-level government (provincial and municipality) can conduct their management, in disaster management, BNPB authorise lower-level governments (province or municipality) to establish an authority for disaster namely Badan Penanggulangan

⁶ Those rituals are *tumpek bubuh*, *tumpek wariga*, *tumpek landep*, *candi narmada*, *bhumi suda*, *mapekelem*, *melabuh gentuh*, *ngerebeg*, and *nangluk merana*.

Bencana Daerah (BPBD) – BPBD Province and BPBD City/Regency. The tasks of national, provincial, and municipal governments are the same, especially during a crisis. Currently, all 34 provinces in Indonesia have established BPBDs and 514 BPBDs are at the level of municipality. To showcase the hierarchy in disaster response, as an illustration, if any disaster—such as a volcanic eruption—occurs, the first authoritative responder is the municipal government (BPBD Kota/Kabupaten). Only when the disaster is beyond the municipality’s capacity, the provincial level (BPBD Provinsi) will take over. Meanwhile, BNPB focuses on policymaking for all disaster phases (pre-, during-, and post-disaster). BNPB will take over responsibility of provincial or municipal government units during a crisis if the scale is beyond their capacity. In practice, the work of municipality-level government is supported by lower-level administrative units at regency and village level and includes capacity building or mobilising communities during the crisis.

Disaster issues have become one of the main priorities for the development of Indonesia. The government, through the BNPB, attempts to improve disaster management by policymaking, creating awareness, and expanding the management from solely ‘responding’ during the crisis to include rehabilitation and reconstruction. The underlying reason to integrate disaster management and development, is that the increasing trend in disaster events hampers development aspects, for example because it cuts into the financial budget for poverty eradication (BNPB, 2012; Twigg, 2011; Uitto & Shaw, 2016).

Even though the willingness of the government to manage disaster effectively is high, disaster always affects society first and therefore requires community strategies to face upcoming crisis. Strengthening communities’ capacity is relevant and should be encouraged through community-based disaster risk management (CBDRM). Although CBDRM usually means community-driven governance (Kurniawan et al., 2012; Shaw, 2014b; Twigg, 2011), Indonesia’s government has initiated a top-down approach to increase communities’ capacity through Disaster Village Resilience Programme or as it is referred to most of the times: Destana. The programme is implemented under the regulation of Head of BNPB Number 1/2012 (Perka Destana) by involving the local-level government (from province to village government).

Nevertheless, the impact of disaster can affect to everybody and this relevance allows all people to respond and pay attention. Another agency that is relevant in Indonesia’s efforts to disaster risk reduction is initiated by the Ministry of Social Service under the regulation Number 128/2011 and is called: Prepared Village (translated from *Kampung Siaga Bencana*, i.e. KSB). KSB has similar programmes as Destana but operates in different areas. Their efforts are on community-based disaster risk reduction that has the main goal to protect society from the direct effect of the disaster event. It aims to prepare society for future disaster events.

During the period of this research it was found that two villages had already implemented Destana, namely Besakih and Ulakan, and that Sebudi had implemented KSB to support disaster risk reduction activity in the village. The abstraction of those policies can be seen in [Appendix 8](#).

The village, as the smallest legal administrative and political unit in Indonesia, build a development plan based on the vision and mission of the head of the village as well as be aligned to the regional development plan. To support the development plan at the village level, under The Government Legal Number 6/2014 Village and Government Regulation Number 66/2014 about Village Monetary, each village is given a certain amount of development budget from the national development budget. The fund can be used for several activities, including disaster risk reduction and environmental protection at the village level. It is permitted to access this fund to finance the implementation of community-based disaster risk management. Furthermore, the

government of Karangasem Regency has regularly communicated the use of village funds for many aspects of development, including disaster risk reduction (Interviewee number 9, personal communication, 15 January 2020).

V. Chapter 5 (Result and Discussion)

V.1. Result

This section presents the fieldwork data and provides both quantitative and qualitative analysis of these results. The quantitative approach is used to analyse the vulnerability assessment which is done in four different locations (Besakih, Sebudi, Ulakan, and Tulamben). These locations were chosen based on the proximity of the village to Mt. Agung, the cultural heritage and the implementation of the government initiative. The framework to assess these villages is explained in section II.2 and how to calculate the score is explained in section III.2.5. Vulnerability Assessment result (sub-section V.1.1) will support the following Comparative Case Study section (sub-section V.1.2) which uses a qualitative approach.

Comparative Case Study (Sub section V.1.2) presents observational data of each village obtained during the fieldwork, supported by secondary data from government documents such as the Statistical Report and Village Report (BPS, 2018). Since the locations have different proximity of cultural heritage and government initiative implementation, a Comparative Case Study sheds light on differences and similarities between the locations.

Following those two prior sub-sections, sub-section V.1.3. answers the first Sub Research Question “Does the presence of cultural heritage reduce communities’ vulnerability? (SQa)”. Sub-section V.1.4 answers the second Sub Research Question “Which aspects of vulnerability are influenced by cultural heritage? (SQb)”. Sub-section V.1.5 answers the third Sub Research Question “Does the presence of cultural heritage reduce vulnerability in different ways than the current government initiative? (SQc)” and sub-section V.1.6 answers the fourth Sub Research Question “Does the analysis provide insights into how cultural heritage aspects might be used to better design resilience strategies? (SQd)”.

V.1.1. Vulnerability Assessment

This sub-section will address the result of the Vulnerability Assessment that was done in Besakih, Sebudi, Tulamben, and Ulakan Village in January and February 2020. Proximity to heritage and implementation of government initiatives were used to determine the research locations (see Figure 9). The Vulnerability Assessment has resulted in numerical data that represent the vulnerability of every village. The numbers are calculated from the average of the categories (see sub-section [III.2.5 for the Quantitative Analysis](#)). The categories are: Social-Economic (SE), Institutional (Ins), Disaster-related (D), Infrastructure (Inf), Education (E), and Health (H).

Part of the data obtained for this research was done through questionnaires. The questionnaires obtained 29 questions that were given through interviews, yet there were interviewees who did not answer all of those. If half or more of the questionnaire was not filled in, the data has not been included in the analysis. This process is part of data sorting to take out the “bad” data. This method is commonly used to prevent random mistakes (Saunders et al., 2006).

After the deletion process, the rest of the data comes from interviewees who answered the questions although some of them did not answer completely. The questions which are not answered (blank) are filled by the average number of the filled answer. For example, in the question “*How much money do you spend on electricity in a month?*”, 6 out of 27 did not answer the question. These 6 data are blank. Thus, the average score of 21 people is used to fill the blank answer. Filling blank data by a certain number is called interpolation. In this case, the interpolation uses “average” ([see Appendix 6](#)).

This interpolation is justifiable in statistical analysis and considered the easiest (Saunders et al., 2006). Although this method is the easiest and the fastest method to recover cases, according to

Saunders et al. (2006) this phenomenon rarely happens. He explains that this type of missing data is called *missing completely at random*, which means that there is no relation between the data “missingness” and the study variables. Put simply: the data are missing due to an unrelated event. It will eventually result in a potential bias if the missing data are in a large number (Saunders et al., 2006). Therefore, the previous process (deletion) is done, to reduce the missing numbers in the data. This research follows the practicality of using averages to fill the missing data by assuming that people who did not answer the question tend to answer what the average respondents would answer.

By employing the assessment framework from section II.2 and using the methodology from section III.2.5, the result of the Vulnerability Assessment is as follows:

Table 6. Vulnerability assessment result

Village	SE	Ins	D	Inf	E	H	average all	Rank	Label
BESAKIH	0.690249	0.580505	0.687757	0.659227	0.612346	0.589028	0.636519	4	Least vulnerable
SEBUDI	0.705789	0.594383	0.652405	0.624692	0.659054	0.615051	0.641896	3	Less vulnerable
TULAMBEN	0.724491	0.663492	0.675854	0.628685	0.65839	0.631228	0.66369	1	Most vulnerable
ULAKAN	0.709801	0.703432	0.713675	0.569597	0.59544	0.57654	0.644748	2	Vulnerable

Note: colours are used to help in visualising the results. The range from green to red represents the lowest score (least vulnerable) to the highest score (most vulnerable) of variable (indicator) per village.

The statistical analysis shows us that there are variations in the four villages’ vulnerability. Based on the average of all in each village; the highest overall vulnerability is found in Tulamben village (0.66369), followed by Ulakan village (0.644748), and then Sebudi (0.641896). The least vulnerable village is Besakih (0.636519).

From the perspective of each category, Social-Economy (SE) has a high score in the vulnerability index for all villages (within the range of 0.690249 to 0.709801), followed by Disaster-related (D) (from 0.652405 to 0.713675). This means that each village struggles in SE and D aspects. Besakih has the most vulnerable Infrastructure (I) amongst other villages, which is indicated by the lowest score for that categories. Meanwhile, Besakih has the lowest score for Social-Economic (SE) and Institutional (Ins) amongst the villages. This means that Besakih is the least vulnerable in terms of SE and Ins.

Sebudi has the highest score amongst all villages in Education (E). This means that in terms of Education, Sebudi is the most vulnerable. While in terms of the Disaster (D) category, Sebudi has the lowest score, meaning that the Disaster aspect in Sebudi is quite good in terms of quality.

Tulamben is the most vulnerable village according to the vulnerability assessment. The scores for Social-Economy (SE) and Health (H) are the highest amongst other villages which indicates that these aspects are very vulnerable. Institutional (I), Infrastructure (Inf), and Education (E) have the second position amongst all villages. This means that the quality of these categories is bad.

Ulakan has the highest score for Social-Economic (SE), Institutional (Ins), and Disaster-related (D) which means that those categories are the most vulnerable aspect in Ulakan and also amongst all other villages. However, for the Infrastructure (Inf), Education (E), and Health (H) criterium, Ulakan has the lowest score which means those aspects are least vulnerable in Ulakan and amongst all other villages.

This vulnerability assessment result adds information for the discussion of the following paragraph, Comparative Case Study. To bridge the discussion, it is introduced the aspect of cultural heritage and risk zone overview of the locations. Regarding cultural heritage, Besakih village is the location of Besakih Temple. In other words, Besakih village is the centre of cultural heritage (0 km). As the neighbouring village of Besakih, Sebudi is around 5.3 km away from the centre. Ulakan and Tulamban are respectively 15.1 and 19 km outside of the cultural heritage centre. Section V.1.3 discusses whether proximity to Besakih Temple is a factor in the cultural heritage-specific assessment.

Within risk zone II (medium) and III (low), Tulamben is at risk. While Besakih and Sebudi are within risk zone I (high), II (medium), and III (low). These two villages are the closest to the Mt. Agung crater so when the volcano erupts, these areas are most likely to be directly affected. While Ulakan is the only village outside the risk zone. This information can be seen in figure 10.

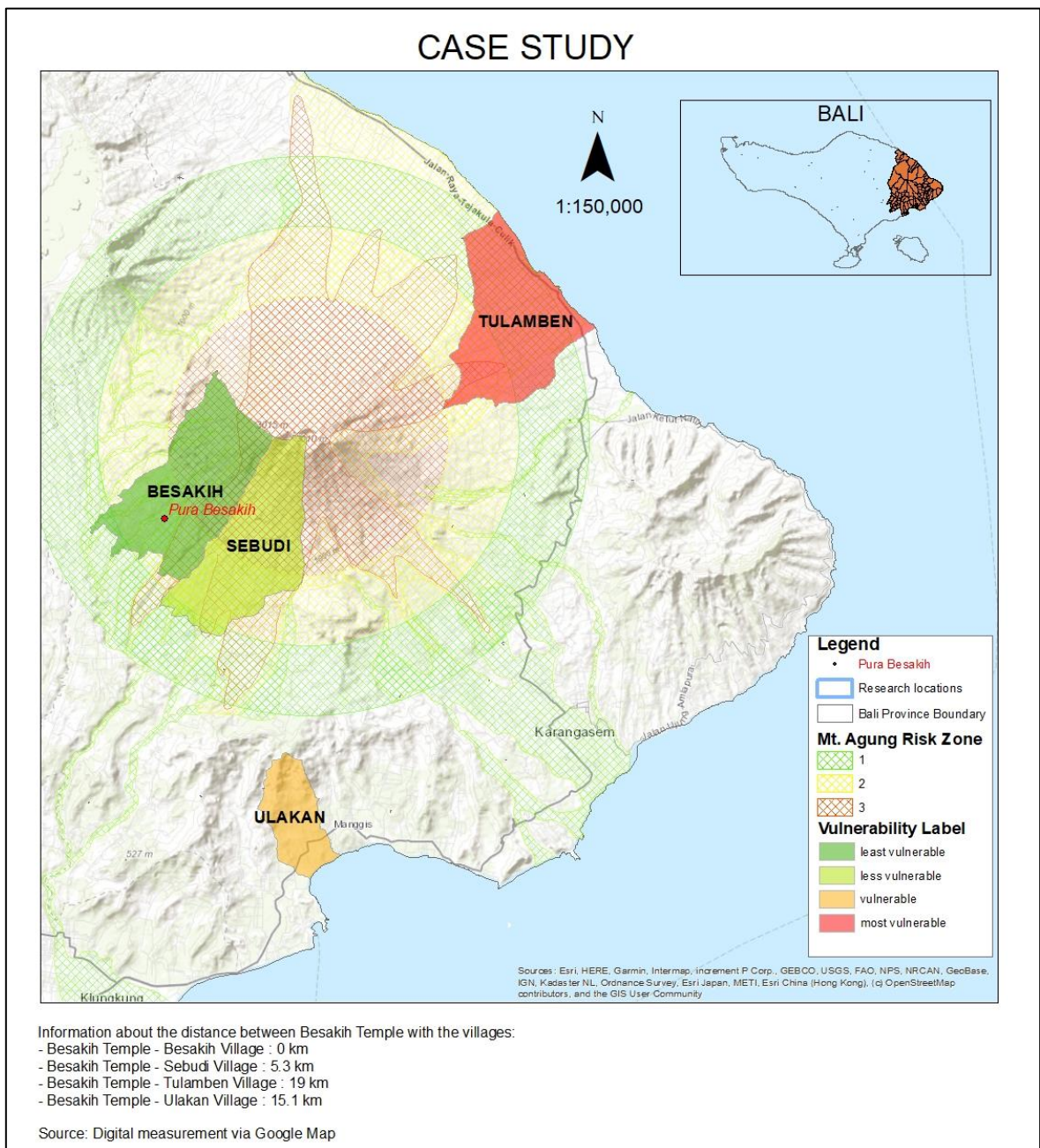


Figure 10. Villages, Besakih Temple (center of cultural heritage), distance the village to the Besakih Temple (authors' own)

V.1.2. Comparative Case Study

This section will address each researched village. The data is gathered from fieldwork observations, through in-depth interviews and secondary data from government reports, journals, and online information. This sub-section is presented to give information of the locations which support in explaining the vulnerability assessment in the previous sub-section.

The locations were chosen based on the proximity to Besakih Temple as a form of cultural heritage and government initiative implementation. The assumption is that the areas close to tangible cultural heritage have stronger intangible cultural heritage, and that areas that are further away from tangible cultural heritage (the cultural heritage site) have a weaker intangible cultural heritage. Information shown in Comparative Case Study clarifies this assumption and gives strong arguments (evidence) why in the vulnerability assessment there are some aspects with a low score and high score. This sub-section is highly related to the vulnerability assessment because the score resulted from the assessment is related to the existing condition of the locations which cannot be included in the assessment. Besides that, this overview bridges the next discussion in addressing all research sub-questions. Table 7 shows the criteria of classification used in the Comparative Case Study.

Table 7. Comparative Case Study criteria and the connection with the Vulnerability Assessment

Criteria of classification	Type of answer	Connection with the Vulnerability Assessment (VA)
Location and topographic overview	- Mountainous or Coastal area - The altitude of each village	Supports the Infrastructure aspect in VA
Water availability	Rain harvesting Buy from other places Natural resource (well or springs)	
Place within the risk zone map	1, 2 or 3	Supports the Institutional and/or Disaster-related aspect in VA
General insight on the relation with cultural heritage	Religion and religious practices Perspectives on Besakih Temple	Supports choosing the locations
Type of village (urban or rural)	Urban or rural area	Supports the Social-Economic, Institutional, Infrastructure, Education, and Health aspect in VA. Typically, urban areas have more development than rural areas.
Type of livelihoods for the villagers	- Farmers - Fishermen - Office-based workers - Traders - Small-to-high business owners - Labourers	
<i>Subak</i> that is available in the location	<i>Subak abean</i> <i>Subak sawah</i>	Supports the Socio-Economic and Infrastructure aspect in VA. This information also relates to cultural heritage.
A general overview of the village government and village structure (number of <i>banjar</i> ⁷)	- Number of <i>banjar</i> - Period of working of the village head	Supports the Institutional aspect in VA
Disaster management efforts, including government initiative that is available	- Volunteers - Budget allocation for disaster management - Implementation of resilience village regulation (Destana and KSB) - Information about the disaster in 1963 and 2017	Supports the Institutional and Disaster-related aspect in VA
The score of the vulnerability index	Number of VA	

⁷ Village structures (Desa Dinas, Banjar Dinas, Pakraman Adat, Banjar Adat,) are explained in Chapter 4, section [IV.2.](#)

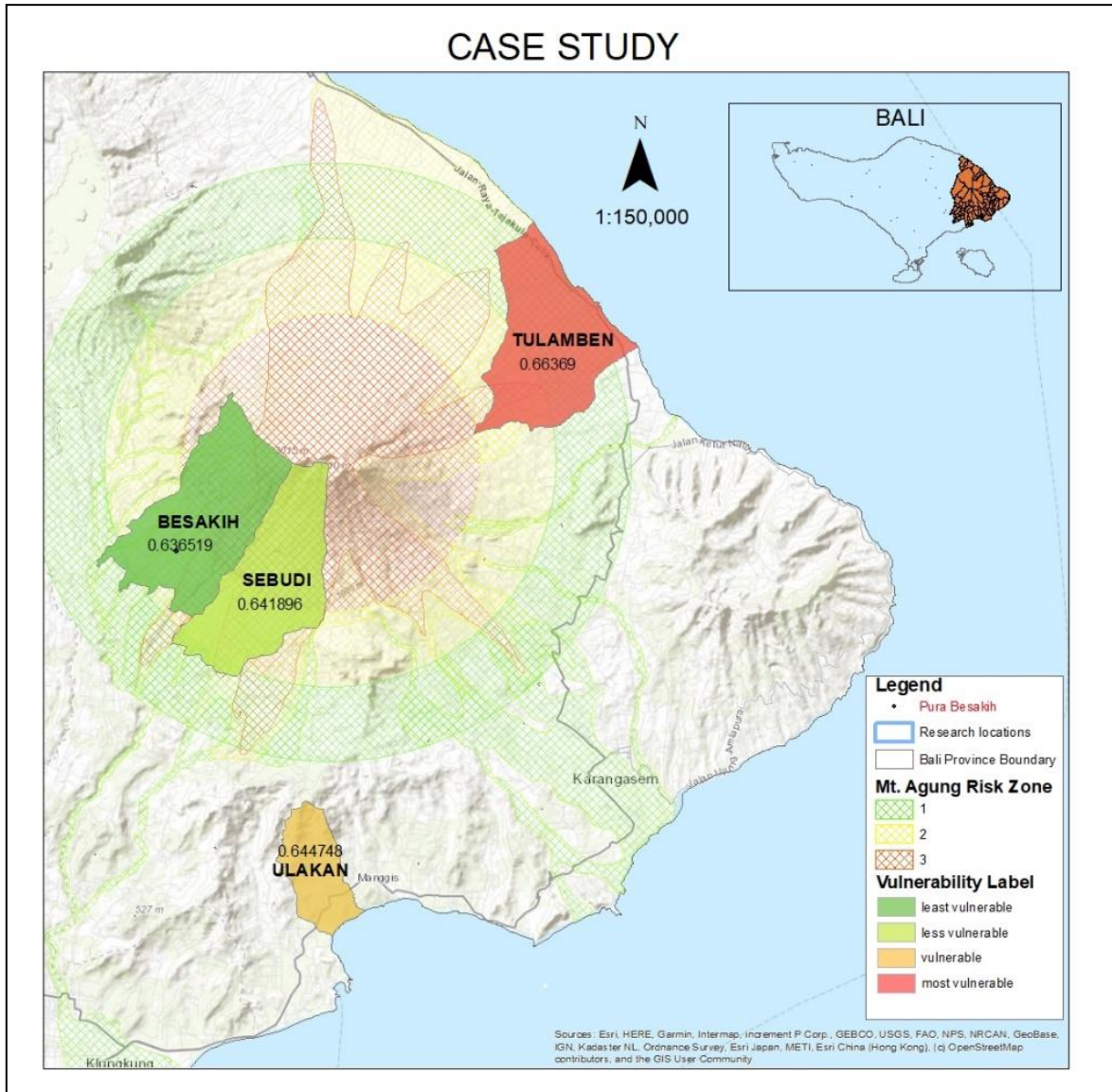


Figure 11. Map of the Locations and Vulnerability Index

Figure 10 shows the locations of the case study, Besakih Temple, and the vulnerability score in each village. In the legend, the level of a vulnerability is shown in colours that also indicates the colour of the village. Complementing the vulnerability assessment and this map, here is the detailed information for each village.

Besakih Village

Besakih is in the north-west of Karangasem Regency, under Rendang sub-regency. The landscape is mountainous or hilly, with a distance of 0-8 km to the Mt. Agung crater. The altitude is above 700 m above mean sea level and due to this altitude there are no water springs in the area, causing people to collect water from the rain or buy water from a water service provider. This village is within the area of risk zone I to III (KRB I to III).

Besakih Temple is the epicentre of religious activity. Because of this, this is one of the most frequently visited temples in Bali, not only for religious reasons by Hindus but also by tourists. It is located in Besakih Village. The maintenance of this temple is done by the collaboration of national government and a third party through the Management and Operation of Besakih Temple.

Besakih village lies in a rural area where agriculture dominates the livelihood of the communities, although some businessmen own hotels or villas to support Besakih Temple as a tourist destination. *Subak Abeyan* governs the agricultural community to align farming activities with their belief system. Besides that, *Subak Abeyan* which consists of a temple, a committee for agriculture, and activities related to farming, is also used as a medium for farmers to exchange information in their village. In Besakih, *Subak Abeyan* is also used to update information related to Mt. Agung.

There are eleven sub-village (*Banjar Dinas*) in this area, where Banjar Kedungdung is chosen as the meeting point for evacuation if the volcano erupts. The head of the village (*Perbekel*) was chosen recently in 2019, but his secretary has been working in the village since early 2017. The secretary also actively worked on the implementation of the Disaster Resilience Village regulation (Destana).

There are 30 trained disaster volunteers in the area under the coordination of the *Perbekel*. However, in 2019, budget allocation for disaster management was zero. In the 1963 eruption, intensive and strong earthquakes were felt by the communities, but at that time in this village there were no calamities. This eruption drove some people to migrate to other places within or outside Bali. The latest eruption was in 2017. Some witnesses of the eruption in 1963 are still alive and they experienced the same situation again in 2017. Based on the interview, some people compared the authority's responses to the 1963 and 2017 eruption. From the villagers' stories, it is known that in 2017 the government of Indonesia was proactive to reduce the risk and asked all people within the KRB to evacuate.

This village is one of the villages driven by the national and regency government to implement Disaster Resilience Village regulation (Perka 1 Tahun 2012) in 2017, shortly before the eruption. The regulation has worked as a stimulus for the village to enhance disaster management activity in reducing upcoming risk. Because of it, some activities such as drillings, providing documents for pre-disaster (e.g. risk assessment, contingency plan, and operational plan), and budget allocation for disaster management have been done. According to the local facilitator who assists the implementation process, Besakih gained the most advanced achievement in running and sustaining the regulation. To fund the disaster risk reduction activities, Besakih incorporates third parties such as *Dana Desa* (special budget for village) and business sectors.

Sebudi Village

Sebudi Village is close to Besakih Village and lies on the east-side of Selat sub-regency. Similar to Besakih, the distance from the Mt. Agung crater lies between 0-8 km. This village is within KRB I and III. The condition of the village is also quite like Besakih village with a mountainous/hilly and rural landscape, and most people depending on agriculture and sand mining. Having a dry-type plantation, there is no water irrigation system for farming (*Subak Sawah*), instead there is *Subak Abean*. Water is obtained through rainwater harvesting and several *Banjar* in the lower altitude can enjoy natural spring water. Nevertheless, a big river (*tukad*) passes through Sebudi that brings along volcanic materials, allowing people to work in the sand mining sector. According to the village-head, a significant amount of income for Sebudi Village comes from the that sand mining sector.

Sand mining in Sebudi has both benefits and drawbacks. Similar situation of sand mining that bring benefits and drawbacks is seen in Mt. Merapi, Yogyakarta, Java as well. It is proven to be problematic and poses dilemmas in both Sleman, Yogyakarta (Mt. Merapi) and Karangasem Regency (Mt. Agung). On one hand, it is an important source of income for the Sleman and Karangasem government and many people living in the surroundings, especially when it is proven that the volcanic materials have the best quality for building infrastructures. Sand mining plays an important role in reducing sand-deposits after an eruption released lahars. As a livelihood, they usually build temporary shelters in the mining area and equip motor/vehicle to mine the sand.

Some informal stores that produce profits for some people are built in the surroundings to provide the miners' drinks and foods nearby where the workers can rest and have a meal. However, on the other hand, environmental damage might occurred due to sand over-exploitation and worsens the risks for upcoming disasters (Laksono, Hendratno, & Triyono, 2008; Sutrisno, 2016; Uitto & Shaw, 2016) which can be the next eruption of landslides. The people working in the sand mining area are also susceptible by the eruption if the lahars come very fast and expose them(Laksono et al., 2008).

Related to government, there are ten *Banjar Dinas* in Sebudi. The *Perbekel* has been leading the village since 2017 and has focussed more on issues of water scarcity than disaster-related issues, essentially prioritising the former over the latter. In 2019, the village allocated Rp 4.421.500,- for pre-disaster activities.

There are sixty trained and registered volunteers in Sebudi and the surrounding area, ready to help the community when the volcano erupts. This village is not part of any/the programme of the BNPB, Destana (Disaster Resilience Programme) but it does adhere to a regulation from the Ministry of Social Service, called Permensos Number 28. This regulation helps the local government build disaster management strategies within pre-disaster events, by for example executing drills and coordinating the communities and volunteers. This programme is completely participative which means that it is the village who has to seek out and implement the programme in their own village.

During the 1963 eruption it was the area around Sebudi that was the worst affected. This had to do with the character of Mt. Agung's explosion and the topographic situation surrounding the mountain. Moreover, at the time of the eruption, a ritual called *Ekadasa Rudra* was taking place in the village (Zen & Hadikusumo, 1964). The ritual should have been done in Besakih Temple (in Besakih Village), but people conducted that in Pasar Agung Temple in Sebudi because Besakih Temple was closed due to some destruction in the temple after the strong earthquake. Since Pasar Agung Temple (a certain temple dedicated to Mt. Agung from the east side, still part of Besakih Temple) is located in Sebudi Village, many people joined the ritual to welcome the volcanic activity, besides they were excited to *Ekadasa Rudra* celebration. It was precisely during this ritual that pyroclastic materials washed away the life and property in Sebudi. This event has deeply affected people and the communities surroundings and significantly altered the communities' hazard perspective. During the 2017 eruption people were instructed to evacuate the majority of people followed this instruction, referring to the disastrous event that had taken place in 1963 as a 'lesson-learned'.

In 2017, coordination about the danger status of the volcanic activity and possible evacuation strategies took place between the village and the authorities (Karangasem Regency government, BNPB, Basarnas). The presence of the sand mining sector also means the presence of trucks, and therefore truck owners⁸ were coordinated to evacuate villagers at noon on 22 September 2017. However, the initial plan, the government will inform the status increase on 22 September 2017 at 6 pm so they have plenty time to prepare the resource. However, information about the status was leaked earlier than that and the earthquake became stronger and more intense, so just a day before the danger status was increased, truck owners evacuated themselves, their family members and their belongings to safer places. In the end, some people evacuate themselves with their own vehicles, and people who did not have vehicles were mobilised by the government and volunteers using rescuer's trucks and cars.

Tulamben Village

⁸ Usually the more well-off people.

Tulamben Village is in the north-east of Karangasem Regency, within Kubu sub-regency. This village is bordered by two big rivers that bring volcanic materials. The area is coastal-rural and the western area is hilly. Most people living in the hilly area rely on agriculture and people living close to the coast rely on fishing for their livelihood. Others work in the tourist sector or as labourers. The area is very popular for diving and obtaining diving certification—both for leisure and professionals. This village is located around 5-12 km outside the crater.

Since the village is in the coastal area, some Hindu rituals are done on the beach although some specific rituals have to be done in the mother temple, namely Besakih Temple. Besakih Temple is around 19 km from Tulamben. On special occasions people will travel to Besakih Temple, usually by car, shared by one big family.

Tulamben has six *Banjar Dinas* and at the time of this research in early 2020 the village-head had only just been selected. According to the village-head, this village appreciates the presence of tourist activities. Contribution to village income is provided by the tourism sector in this area.

Since it's a coastal area, in terms of disaster risk governance the priority lies with tsunami hazards. Since it's a coastal area, Tulamben has six *Balawista* (coast guard) who have been trained in survival and disaster response. *Balawista* work under the coordination of the Local Disaster Management Authority (BPBD Karangasem). Under the coordination of Balawista, some tsunami response drills have been done in Tulamben, engaging the communities living in the coastal area.

However, the 1963 Mt. Agung eruption swept the entire Kubu sub-regency (including Tulamben). The current risk zone has been made considering the eruption in 1963, which has resulted in almost complete inclusion of the coastal north-east Karangasem Regency in KRB II. Some witnesses are still alive and said that in 1963 you could see the smoke coming out from the crater and feel the earthquake clearly. Some of those people were reluctant to be evacuated in the 2017 eruption because according to them, the signs of the eruption in 2017 were less convincing than in 1963. They felt safer in 2017 than in 1963.

In Tulamben, there is no government intervention yet regarding disaster management. Based on the interview with the village-head, disaster management capacity needs to be improved for the community. The local government expects that both national and regional level governments will provide a stimulus or support to implement Destana in Tulamben. Mainstreaming disaster risk reduction is highly needed in Tulamben, especially for the village government.

Ulakan Village

Ulakan Village is the only urban area in this research. It is located to the south-east from Mt. Agung, directly bordered by the sea. This area is mostly coastal, but hills can be found in the north-western part. There is a wider variety of livelihood activities compared to the other villages, although most of the people in the north-west rely on agriculture and most of the coastal area communities rely on fishing as a source of income. Local business in this area is significant because of its location and because of the presence of a national oil refinery. Water is not an issue for people in Ulakan Village. Ulakan is the only research site that has a rice field which is also reflected in the *Subak Sawah* system in water management.

Ulakan consists of six *Banjar Dinas* and Ulakan's village-head was elected in early 2020. The secretary was still the same secretary as during the previous term and this secretary has proven competent in disaster management. He is also the key person understanding the implementation of the Disaster Resilience Village Regulation.

Ulakan first implemented the Disaster Resilience Village regulation in 2017. Considering its coastal location and the fact that Ulakan lies outside of the Mt. Agung risk zone, tsunami hazards have been given priority for the implementation of this regulation. Some evacuation drills/simulations have been done in the area, engaging the biggest oil company in its area, Pertamina.

In 1963, Ulakan Village was temporarily used as the capital of Karangasem Regency since Karangasem City had to evacuate its governmental activities and offices for around a year due to the eruption. In 2017, the national command post and logistics supply were also placed in Ulakan, in the half-built port in Banjar Tanah Ampo. Ulakan residents were not evacuated during the eruption in 2017, instead they helped people who have had to evacuate their hometowns.

Although Mt. Agung eruption is not a hazard priority in management, Ulakan does prepare for the eruption, especially in its function as a buffer area. Being a buffer area means that Ulakan will temporarily take in any displaced people due to disaster. The large public area should be provided in Ulakan, as well as budget to support the disaster response if people from the surrounding of Mt. Agung are mobilised there. In 2017, various shelters have been built—the biggest one being in the village square. Two village government officials were deployed to assist the survivors, especially in administrative-related issues and aid management. According to the chief of the Planning Division, the village government has requested the national government for administrative and financial support to build a large auditorium that in time of need could provide evacuation centres (Interviewee number 4, personal communication, 29 January 2020). The proposal suggests a dual function for the auditorium, for example as a sports arena in ‘normal’ times, and for evacuation centres if the disaster occurs.

V.1.3. The presence of cultural heritage within communities’ vulnerability

Donovan et al. (2012) state that culture is a highly influential element of vulnerability to natural hazards (such as volcanic eruptions). However, due to its difficulty to identify and map, the element of culture is not integrated into common risk assessments. Poverty, politics, and the environment are all elements shaping culture, but elements of culture such as coping strategies for disaster based on their belief are presented regardless of the economic situation (Donovan, 2010). Culture determines the social character of how a community faces the crisis caused by a natural hazard. Donovan et al., (2012) introduce the term “sub-culture” to name specific cultural emergences of a community by the influence of disaster events. Disaster events in this context are caused by the physical condition of the surroundings. This physical environment and the ways of dealing with its hazards can, over time, be embedded into local culture. For example, residents in a volcanic area may give mythological value to the volcano and pass these values on from generation to generation in the form of stories (Chester & Duncan, 2007; Donovan et al., 2012).

Disaster risk reduction scholars commonly determine vulnerability from its relationship with socioeconomics, but vulnerability also consists of intangible elements that are cultural such as psychological response to the disaster, attachment to the physical condition of the place, and perspectives on the risk based on ancestral beliefs. Based on the observation, it is known that people in the surroundings of Mt. Agung relatively easily accepted the 2017 disaster because of their belief. People also recovered from the disaster soon after the government pronounced their area as safe. After what happened in 2017, the government encourage the people to be more prepared if the volcano erupts again (current status⁹ of the volcano is level 3 – *Siaga Level*).

Donovan (2010) claims that the presence of cultures can be the communities’ resilience. Table 8 demonstrates cases of traditional culture as the source of communities’ resilience.

⁹ Last checked: 26 June 2020 via <https://magma.vsi.esdm.go.id/>

Table 8. The use of traditional knowledge in disaster studies

Event	Local knowledge (myth)	Reference
Indian Ocean Tsunami 2004	<i>Smong</i>	Suciani et al. (2018)
Merapi Volcano in Indonesia	<i>Labuhan Merapi</i>	Lelono (2015); Rahman, Nurhasanah, & Nugroho (2016)
Ruapehu Volcano in New Zealand	<i>Ngati Rangi</i>	Gabrielsen et al. (2018)
Hawaii, the United States of Amerika	<i>Pele</i> in Kīlauea	Swanson (2008)

Along with the vulnerability survey, some questions related to cultural heritage—especially intangible—were given to the respondents. The questions involved topics such as rituals for Mt. Agung (“Do you have a certain ritual for Mt. Agung that is held every year, every 100 years, or so on?”); hazard type, i.e.: the considered danger during the ritual (“What type of danger that people do the ritual?”); temple preservation (“Who preserves the temple when a disaster destroys the temple?”); and monetary expenses to support the ritual or religious activity (“How much money do you spend for the daily ritual?”).

These criteria are developed to measure the magnitude of cultural heritage in the villages and consequently measure if villages located close to the centre of tangible heritage have stronger intangible heritage and vice versa. (See Figure 10 for the research locations and the centre of tangible cultural heritage, i.e.: Besakih Temple).

The questionnaires paid special attention to ritual activities. For example, there are many rituals such as *mapekelem*, *nangluk merana*, *tumpek bubuh*, etc, in Bali that is intended to protect society from dangers in general but also rituals that deify Mt. Agung. Thus, answers to questions about whether society has rituals for Mt. Agung will give an overview of the magnitude of intangible cultural heritage from people living in the village close to the Mt. Agung and people living in the coastal area.

The second question in this section is related to hazard type. Since Bali has many rituals to protect society from danger, the type of hazards (danger) that people focus on are varied. As Mt. Agung is chosen to be the main hazard and intangible heritage is attached to the mountain, question “What type of danger that people do the ritual?” is intended to confirm that Mt. Agung has a big role within society. In fact, 63 people answer that Mt. Agung is the main hazard, and 51 people answer that the danger they face is all types of hazards (not explicitly mention that Mt. Agung is the only hazard they face), i.e. Mt. Agung eruption, drought, floods, etc.

Temple preservation-related questions are given to see how society engages in preserving their temples. Every village in Bali has many temples such as Pura Pusek (village temple), Pura Subak (temple to deliver agriculture- or water-related rituals), and Pura Dalem (family temple). Usually, the surrounding communities take care of the temple by assigning special personnel or by having a schedule for every head (usually male) of the household to take on that task. Thus, people who answer that the temple is preserved by the communities and the assigned people will be given a high score. For example, if the temple is preserved by assigned people, the score is 1; if the temple is preserved by the society, the score is 2, and if the temple is preserved by both assigned people and the society, the score is 3.

Daily ritual-related questions will give information about the amount of money spent on daily rituals. Every family in Bali spends a certain amount to support their daily ritual. Since these criteria can be monetised, this means that this criterion is highly related to the economy.

Before the calculation, the answers are coded. The highest value is given to the highest score (see Appendix 4 for the Coding), unlike the calculation in the Vulnerability Assessment where the least value is given to the highest score. Take the following question: “Do you have a certain ritual for Mt. Agung that is held every year, every 100 years, or so on?”. If this question is answered with “yes”, this answer will be coded as 2 and if the answer is “no”, the code is 1. After the coding, all criteria will be calculated on their average (following the calculation steps in sub-section III.2.5). The result of the calculation is below:

Table 9. Cultural Heritage (CH) Measurement Score

Village	Ritual	Hazard type	Temple preservation	Daily ritual	Average	Rank for the level of CH	Label for CH measurement
BESAKIH	0.966735	0.774348	0.469479	0.664952	0.718879	1	Has strongest CH
SEBUDI	0.934842	0.84225	0.463306	0.560528	0.700231	2	Has a strong Ch
TULAMBEN	0.822016	0.709559	0.457973	0.530133	0.62992	4	Has the weakest CH
ULAKAN	0.808555	0.789694	0.559788	0.609591	0.691907	3	Has a weak CH

Note: The colours help in visualising the result. The range from green to red represents the lowest score (weakest CH) to the highest score (strongest CH).

The calculation results in a score for each village. The score determines the proximity of the village to the cultural heritage (i.e.: Besakih Temple). The score for Besakih is 0.718879, followed by Sebudi with 0.700231 and Ulakan with 0.691907. Meanwhile, Tulamben has the lowest score of 0.62992. Given the physical distance between the village and the tangible cultural heritage spot (Besakih Temple), Besakih village has the lowest distance (very close – 0 km), followed by Sebudi (close – 5.5 km). Tulamben and Ulakan are located the furthest away from Besakih Temple (19 km and 15 km).

Cultural heritage magnitude is defined by ritual, danger type and money spent on the ritual. Based on this definition it is found that Besakih and Sebudi have a higher cultural heritage magnitude than Ulakan and Tulamben. This coincides with Besakih and Sebudi being relatively closer to the cultural heritage site, and Ulakan and Tulamben being further away. This finding supports prior research by (Donovan et al., 2012) that states that the magnitude of cultural heritage depends on the spatial condition.

Based on the literature, data, and in-depth interview, cultural heritage has an influential relation with vulnerability. Both positive and negative influences can be found in the relation. How people respond to disaster and how they recover psychologically are positively influence vulnerability. Meanwhile, money spent for tradition might negatively influence vulnerability.

The rituals that require a specific budget are an additional burden for the communities’ economic situation. Yet, based on in-depth interviews, some informants claim that rituals are investments for a better living. This finding is supported by statements made by interviewee number 1, 2, 4, 6, 7, and 8).

“The Balinese Hindu believe that by giving some offerings through their rituals will be paid back by good karma. We feel relieved if we are already done the rituals, although conducting rituals require specific things for rituals, and sometimes, we have to spend some money. Practicing the belief system is also part of our good deeds.”

“There is a theory about Natural Balance that we believe. The underlying philosophy of Balinese beliefs is how people look after the Buana Agung (nature) and Buana Alit (place to live). In that

theory, we believe that nature has its right to live and humans give offerings to support the life of nature.”

It is also confirmed by the interviewee number 6 (Interviewee number 6, personal communication, 14 January 2020). As an agriculture practitioner, he notices that the demand and price of Gunitir flowers are stable. The price is Rp 30.000,- per kg (equal to 2 euro). Gunitir flower is an orange flower used in Balinese Hindu daily and special worship offerings. Despite disaster or economic issues, this type of flower is always wanted.

Table 10 shows the vulnerability assessment scores and cultural heritage measurement. It can be seen when the vulnerability is low, the cultural heritage score is high and vice versa.

Table 10. Vulnerability and Cultural Heritage Measurement Score

Village	Vulnerability Assessment Score	Rank	Label for Vulnerability	Cultural Heritage Score	Rank for the level of cultural heritage	Label for CH measurement
BESAKIH	0.636519	4	Least vulnerable	0.718879	1	Has strongest CH
SEBUDI	0.641896	3	Less vulnerable	0.700231	2	Has a strong Ch
TULAMBEN	0.66369	1	Most vulnerable	0.62992	4	Has the weakest CH
ULAKAN	0.644748	2	Vulnerable	0.691907	3	Has a weak CH

Tulamben has the highest vulnerability and the magnitude of cultural heritage is the lowest. Sebudi has the third position of vulnerability and the second position of cultural heritage score. Ulakan has the second position of vulnerability and has the third position in cultural heritage score. Meanwhile, Besakih has the lowest vulnerability and the strongest magnitude cultural heritage. This result shows that villages having a low vulnerability also have a strong cultural heritage. This result supports the first hypothesis: “Cultural heritage reduces the communities’ vulnerability” and answers the first sub-question (SQa).

Figure 11 visualises the four villages based on their vulnerability assessment and cultural heritage measurement. It shows that cultural heritage is not only seen from the score but also the spatial location. Besakih and Sebudi have a high score in cultural heritage and are the closest village to Besakih Temple and Mt. Agung.

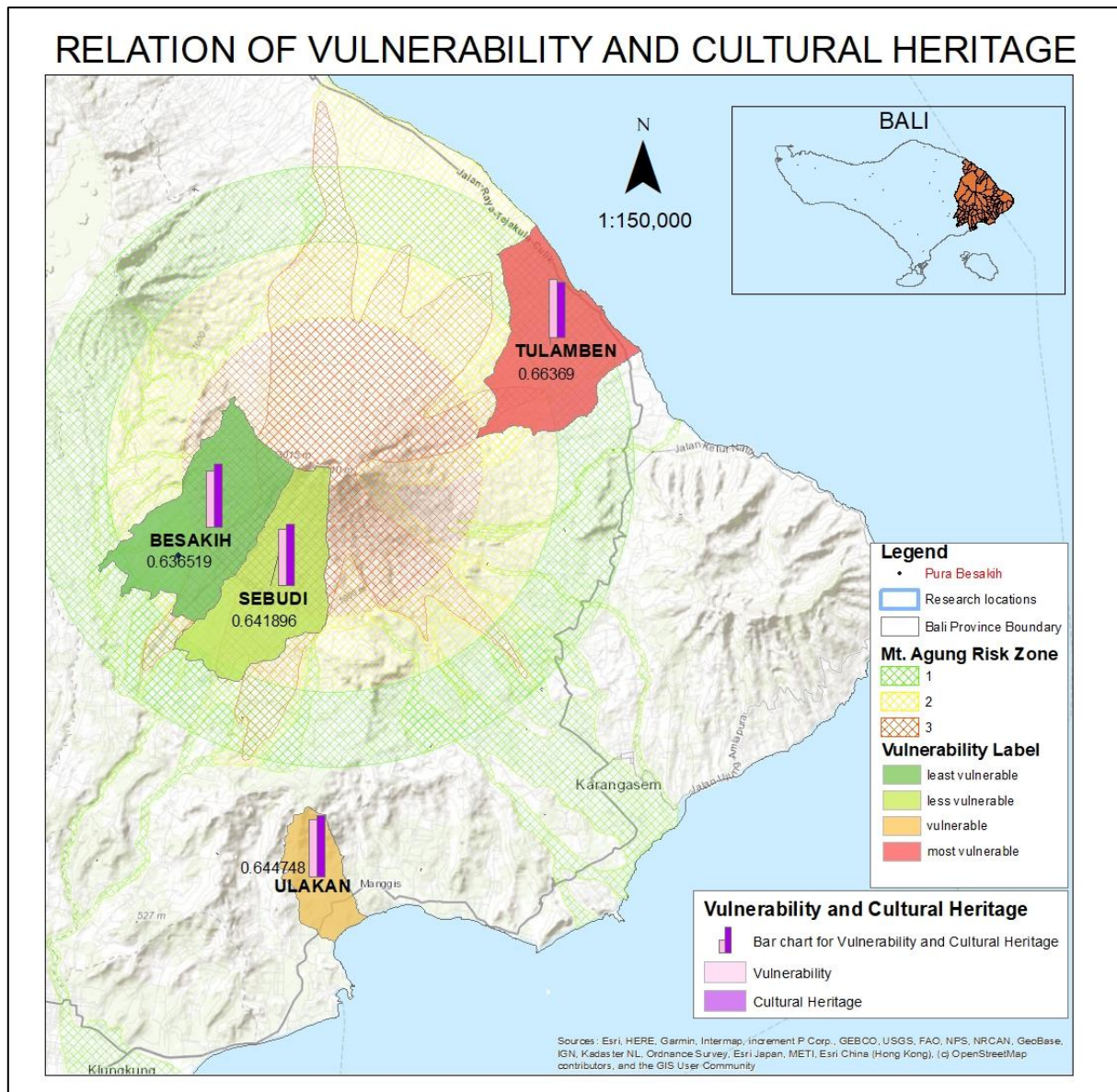


Figure 12. Map of Vulnerability and cultural heritage chart

V.1.4. Aspects of vulnerability influenced by cultural heritage

This section will address the second sub-research question of “Which aspects of vulnerability are influenced by cultural heritage? (SQb)”. It is identified that there are three aspects of vulnerability influenced by cultural heritage. Those aspects are: Economic, Disaster information, and Disaster Psychological recovery.

Economic

The economy is one of the aspects wherein vulnerability can be monetised. There are eight socio-economic variables: members of a family, food provision, income, money savings, asset ownership, food source, financial emergency need, and insurance. Monetised variables used in this research are income and saving money. Members of a family cannot be monetised, but the argument is that the more people there are in the household, the more resources (foods, water, space etc) are needed. Food provision concerns people’s access to food, keeping in mind that the scarcer the food is, the higher the price is likely to be. Asset ownership and insurance indicate their ability to survive

economically if the main income is not available anymore. Meanwhile, in the cultural heritage measurement, there is one related variable that can be monetised, namely: money spent on daily ritual(s).

As offerings can be monetised, money to be spend on the rituals (offerings) is provided in every Balinese Hindu's budget. The range of the money spent on daily ritual is from Rp 10.000,- to Rp 20.000,-. For special occasion rituals such as *Kuningan*, *Galungan*, or *Rayinan* the money spent is much higher (for middle-income households approximately Rp 6.000.000,- per household). Sometimes savings are tapped into to fund the special rituals. Special occasion rituals are also budgeted by the village and provincial governments within the development plan.

If the money needed for a day is Rp 10.000,- on average, each household needs Rp 300.000,- for daily rituals. Meanwhile, an income survey within this research shows that many people in those villages get Rp 1.500.000,-. Thus, rituals reduce the monetary availability for other needs. However, communities believe that daily rituals are a religious mandate and are an investment to prevent danger. The emphasis lies on getting more income—or at the very least not losing their livelihood—by performing the rituals. They refuse to admit that rituals bother their economy.

Moreover, for special rituals such as *Kuningan* and *Galungan*, the funds needed are nearly Rp 6.000.000,- per household for middle-income communities—and can be more for richer communities. Some communities put some money aside on a monthly basis, to save especially for this ritual although they do not have savings for emergencies. Again, this shows that communities' beliefs can be more important than the economy.

Special rituals such as *Kuningan* and *Galungan* are also conducted by communities (besides *Kuningan* and *Galungan* rituals are done by every household, a celebration by village is also done - not on a household-level). Having Besakih Temple in their location, the community of Besakih will provide offerings and host the rituals. In this case, the government of Bali or Karangasem Regency will support in organising the rituals. *"The money to conduct special rituals are provided by the government."* Interviewee number 2, 5, and 10 explain that for special occasions, aid is given to some villages by the government. The money comes from a Special Budget Allocation (DAK) from the Bali Province of Karangasem Regency.

"Especially for Besakih Village, we also have Besakih Temple here. Many big rituals are conducted in Besakih Temple where usually some important people such as the Governor, the Regent, or even national actors attend. Thus, the government provides some budget to support those special rituals in Besakih Temple through Besakih village government" This quote was given by the Interviewee number 2 that shows how important the rituals and the financial support.

Although for communal rituals there is funding from the government, daily rituals done within the home need to be funded with the household income. Eventually, the household budget for rituals will influence the economic situation of the household.

"How much money people should spend to conduct the rituals depends on the economic situation of the people. So, it is quite flexible depends on the economic ability of each person". This sentiment was mentioned several times during the interviews with the villagers and it was confirmed by the in-depth interview with Interviewee numbers 2 and 7.

Disaster information

The second aspect of vulnerability that relates to cultural heritage is Disaster Information. In the past, people gained and created an understanding of their surrounding's risk via folklore and ancestors' stories. Their ancestors created the stories from the natural signs that were sensible.

This information is told from time to time. Especially in the case of Mt. Agung, old people taught the following generation about the power of Mt. Agung and said that when it is angry, there will be a strong earthquake and voices coming from the volcano. Thus, when these signs occur, it is believed that certain rituals or spiritual activities need to be performed, asking God not to cause calamities or to accept that this *karma* (the disaster) deserves to happen to them.

For as far as it has been recorded, Mt. Agung has erupted in 1808, 1928, 1943, 1963, and 2017. The eruption in 1963 has been documented by scientists and the government, including information about how people responded to the disaster. There was gap information from 1943 and 1963 because it took place in two different generations. In 1963, people did not have access to the scientific information, and they relied on religious key actors and their belief. The big ceremony, *Ekadasa Rudra*, which is done every 100 years had its schedule in the year of 1963. People continued the ceremony despite the mountain's activity.

The perception of hazard changed after the experience in 1963, when a lot of people passed away because of the misunderstanding of the disaster. People no longer believed the stories as they were told but also considered the scientific-based public information. Strong earthquakes and voices from the volcano are still in people's minds, but instead of interpreting them as an instruction to perform a ritual in the volcano, they prepare to evacuate. The rituals are still done, but they are done in the evacuation centre. Some respondents state that in the 2017 eruption people were panicking due to natural signs that are similar to their ancestors' story yet agreeing that technological development has led to more accurate information. This statement is supported by Lavigne et al. (2018).

"We rely on government data and information to decide the response." This sentiment was generally mentioned by all the village government officials and volunteers (Interviewee number 2, 3, 4, 5, personal communication).

"In the past, the religious leader said that the activities of Mt. Agung are a blessing. Last time I heard from old people, though, many people died in 1963 because they kept conducting the rituals. In 2017, we did not want to speculate, when the Keliyan or Perbekel said we have to evacuate, we follow the instruction. The sign of danger is also announced through Kentongan by Pecalang¹⁰." Some statements by the villagers.

"We avoid of what happened in 1963 that the villagers did not want to evacuate because the religious leaders asked them to stay and continue the rituals (Ekadasa Rudra). It was also happened in Mt. Merapi with the presence of Mbah Maridjan who said that he was assigned to be the keeper of Mt. Merapi and when it erupted in 2010, he refused to evacuate. Both experiences brought people to died due to the eruptions." (Interviewee number 2, 7 and 8)

"We follow what the government instruction. If we need to evacuate, we follow although my parents and/or my old neighbours refused to evacuate." A view mentioned by several villagers.

Communities follow the update of Mt. Agung's activity from the government's news delivered through tv, website, and social media. Community gatherings such as religious rituals, *subak* meetings, and *sangkepan* (weekly tribal discussion) were used by the authorities to share the accurate information.

¹⁰ Kentongan is the traditional bamboo tool. It makes a loud sound when the big bamboo is beaten by the small bamboo. Communities agree if the Kentongan is beaten very fast and non-stop means that a dangerous situation happens related to Mt. Agung.

Pecalang is the assigned person (tribal) who has the duty to guard the tribe (village).

The change in delivering disaster information from traditional to scientific is triggered by technological development. However, for some people, delivering scientific information through traditional ways are more effective. This is why the emergence of *Pasebaya*, a local radio communication channel to share information about Mt. Agung, instructions to respond to the activity of Mt. Agung, and education about the activities of Mt. Agung—will be discussed in depth in V.2. Discussion.

Psychological Recovery

Disasters cause both physical and psychological damage to the community. Yet, disaster managers pay more attention to physical damage (Cashman & Cronin, 2008). For example, a strong earthquake might damage houses and water pipes and the government often has funds in place to recover that, but psychological-related damage due to disaster has fewer funds allocated.

However, communities' psychological situation during the disaster, and the ways in which they face crises, plays a role in their ability to adapt to the new (disaster) situation and their recovery. Societies that have a strong belief system usually have oral stories, myths, or traditions that are attached to the surrounding biophysical condition (Cashman & Cronin, 2008; Donovan, 2010). Some religions also have specific doctrines related to disaster that can influence people's attitudes (Gaillard & Texier, 2010b; Lavigne et al., 2008). For example, Balinese people, who are mostly Hindu, believe that God, nature, and people (*Tri Hita Karana*) are connected. In practice, when nature shows signs of uncommon activity, people believe that God is sending them a reminder and that people should reflect upon themselves (Martha et al., 2018).

According to Besakih villagers, despite the calamity and economic damage in 2017, some people have relatively easy accepted the disaster. By accepting the disaster, they did not get stuck in a situation where they could not do anything except for being pessimistic. Soon after the government allowed them to go back to their houses, they started to repair the damage. Some cows were sold at a cheap price, some died, and some others were stolen during the disaster, but the owners tried to continue their life. External aid for rehabilitation and recovery were given and managed effectively by the communities.

Cultural heritage that is shaped by the presence of oral stories, myths, and traditions is present in the way Balinese people accept disaster, especially because of the theodicies value in the mountain. This finding is strongly supported by the writing of (Chester & Duncan, 2007) about geom mythology which emphasises that reactions vary between societies who live in a volcanic area, but eruption with no religious element in human response was relatively few recorded.

During the vulnerability assessment, there was a question asking how people feel in the current situation (normal). 101 out of 114 people answered that they are not afraid of Mt. Agung eruption because they do not see any signs of activity. Some of them claim that after 2017, they have become more aware and prepared for a potential eruption in the future. This phenomenon also occurs in the people who live in Dieng and Merapi volcanos (Java island) who have the least fear of eruption because they relate beliefs with biophysical phenomenon (Lavigne et al., 2008).

V.1.5. Role of government initiative in communities' vulnerability

Three out of four research villages have implemented two different government initiatives (see [Appendix 8](#) for the details). Besakih and Ulakan have implemented the Disaster Village Resilience Programme (Destana) which is mainly supported by BNPB, while Sebudi has implemented Prepared Village (KSB) that is led by the Ministry of Social Service. These programmes are implemented through policies; Perka 1/2012 for Destana and Permensos 28/2011 for KSB respectively. Both regulations focus on the efforts in disaster management within the community (village level) to

prepare resources in facing upcoming disasters, to respond to disaster events, and to conduct rehabilitation and recovery. However, the main activities are done in the pre-disaster phase, examples being awareness campaigns, trainings, emergency drills, and building groups of volunteers.

Interviews with stakeholders in Besakih and Ulakan Village have given insights on how the Destana worked in their village (Interviewees number 2, 4, personal communication, 14 January 2020, 29 January 2020). Some positive takeaways given by the interviewees are:

- The activities help the local actors to understand disaster management and how to engage the communities in the evacuation phase.
- The activities give insights to the planner to make disaster management budgeting and programmes and integrate the programmes in the development plan.
- The activities have made local actors aware of the importance of giving reliable information service to the communities and to build volunteer groups.

However, some points of critique were also given on Perka 1/2012 (Destana), regarding its budget sustainability, monitoring process, and evaluation. The village government has an annual income from their village and higher-level government but the allocation for disaster management is limited. Changing community leaders often causes challenges for the continuation of Destana as a new person has to familiarise him/herself with the workings of Destana and the ways in which local governments can manage disaster risk. Monitoring and evaluation with the guidance of a regency-level government or national-level government are expected to be done, especially to refresh the existing activities.

The head of Sebudi Village did not give a detailed explanation about KSB during the interview. According to him, the policy was implemented in 2019 and directly steered by the Minister of Social Service. The activities contained training for the volunteers, drills, and assets assessment. At the end of 2019, the Ministry of Social Service monitored the village on the KSB implementation, especially checking the assets. The community was engaged by giving them a week of training about disaster emergency response. KSB helped the village to build a disaster volunteer group. However, how the community and the national government communicate is not known. The head of Sebudi Village did not express any point of critique regarding the KSB.

Meanwhile, the head of Tulamben is motivated to build resilience village in Tulamben, especially if the strategies are supported by BNPB (Perka 1/2012) (interviewees number 5). The main reason that Tulamben does not have any disaster management strategies at the moment is due to financial limitations but also because the area is (regarded as) reasonably safe from Mt. Agung eruption. He referred to the eruption in 2017 stating that Tulamben was not affected by volcanic ash or pyroclastic materials.

Although initially these government initiatives were imagined as community-based disaster risk management which entails a more bottom-up approach, the regulation documents clearly show that they use a top-down approach (from the national level to the community level). National government decides which village is eligible for the programme, and on top of that Perka 1/2012 gives a set guidance on how villages must implement it. Permensos 28/2011 explicitly mentions that villages can request implementation of KSB in their village through regency level government. In practice, for both government initiatives, provincial and municipality governments are involved in bridging the communication and technical aspects. Thus, instead of applying CBDRM and being bottom-up, in practice the government's involvement is more directive than coordinative.

Together with the vulnerability assessment, some questions related to the government initiatives were given to the respondents. This numerical finding gives insight into how far the government initiative influences the communities' vulnerability. The questions are about Drills/Simulations, Familiarisation of the volunteers, and Instruction to evacuate during the crisis.

The Drills/Simulation criterium is given to find out how the government conducts this activity and how far the communities are involved. In government initiatives, both Destana and KSB put Drills/Simulation as the main activity. It is also emphasised in the CBRDM concept. Regardless it is the government proposing a drill or the community; communities' participation is required.

Related to Drill/Simulation, the groups of volunteers are important in the areas that have a high disaster risk. Thus, the Familiarisation of the volunteers' criterium is given to find out to what extent communities are aware of their presence. Volunteers are also considered as a human resource in disaster management concepts whose capacity should be improved through the village-, or higher-level government. As a result, volunteers are expected to build communities' awareness and help the communities in disaster response.

In disaster management, especially during the response phase, the instruction should be systemised. For example, when a tsunami occurs, people must evacuate to higher places via a predetermined and fixed route. The instruction to evacuate via the evacuation route must be announced by the authority to avoid chaotic response due to limited resources (transportation, space of the evacuation route, personnel, et cetera). The Instruction to evacuate in a crisis criterium aims to show which actor that communities follow most. For disaster managers, it is particularly important to evaluate the work during the disaster.

The calculation for this measurement is the same as the calculation in Cultural Heritage measurement where the higher score stands for the highest value. The answer is coded by using the Coding in [Appendix 7](#). For example, if the questions "Have you ever heard about disaster simulation? If yes, how was the simulation done in your village?" are answered with "I don't know", then this answer will be coded with score "1". If it is answered with "I know about that. But I don't join. I only heard from my husband" this will be coded with score "2". If it is answered with "I have experienced to join the drills with my neighbours..." this is coded with the score "3". After the answers are coded, the calculation follow steps in [sub-section III.2.5](#). Thus, the measurement for government initiatives implementation results in the numbers below:

Table 11. Table of Government Initiative (GI) Measurement

Village	Drills/ Simulations	Familiarisation of the volunteers	Instruction to evacuate in a crisis	Average	Rank for GI measurement	Label
BESAKIH	0.518519	0.641975	0.958467	0.70632	1	Has strongest influence of GI
SEBUDI	0.504572	0.601738	0.902606	0.669639	2	Has strong influence of GI
TULAMBEN	0.421569	0.441176	0.90494	0.589229	3	Has the weakest influence of GI
ULAKAN	0.525641	0.576923	0.666502	0.589689	4	Has the weak influence of GI

Note: The colours help in visualising the result. The range from green to red represents the lowest score (a weak influence of GI) to the highest score (strongest influence of GI).

On average Besakih has the highest score, followed by Sebudi, Ulakan, and Tulamben respectively. Ulakan and Tulamben have nearly the same score for the average. When looked upon in detail, Besakih has the highest score in Familiarisation of the volunteers and Instruction to evacuate in a crisis. Ulakan has the highest score in Drills/Simulations followed by Besakih, Sebudi, and Tulamben

respectively. Especially for the criteria of Instruction to evacuate in a crisis, Besakih, Sebudi, and Tulamben have a very high score (almost 1), whereas Ulakan only reaches 0.666502. This gap will be addressed in the discussion section.

According to the local facilitator¹¹, the success of government initiative implementation depends on the village government's capacity, willingness to apply disaster management strategies, and engagement with the communities. Besakih Village is such a case of successful implementation of Destana because of the village government's willingness to plan DRR programmes and to fund them using Dana Desa (a special budget for village development). Consultations with the facilitator in sustaining Destana-related programmes are frequently done by Besakih Village government (Interviewee number 10, personal communication, 15 January 2020).

As part of the Destana implementation, the village should create a disaster risk reduction (DRR) forum. DRR forum is a platform where disaster decision makers and practitioners (activists) can discuss the management in pre-, during-, and post-disaster. DRR forum is expected to share the knowledge of DRR and to get people's involvement. It should employ authoritative personnel as the chair to prevent the possibility of contrasting arguments between the village government and the communities. Authoritative personnel mean a person who has the power to communicate with the village government but also can lead the village community. This person is not necessarily the village head but could for example be a village government officer who leads the voluntary group. Ulakan has been facing challenges to incorporate the community into the Destana programme, since the DRR Forum chief (elected by the community) did not have the same understanding (vision) on disaster management as the village government.

Table 12. The score for Government Initiative and Cultural Heritage Measurement

Village	Government initiative measurement score	Rank for GI	Label for GI measurement	Type of government initiative	Cultural Heritage measurement Score	Rank for the level of cultural heritage	Label for CH measurement
BESAKIH	0.70632	1	Has the strongest influence of GI	Destana	0.718879	1	Has the strongest CH
SEBUDI	0.669639	2	Has a strong influence of GI	KSB	0.700231	2	Has a strong Ch
TULAMBEN	0.589229	4	Has the weakest influence of GI	None	0.62992	4	Has the weakest CH
ULAKAN	0.589689	3	Has a weak influence of GI	Destana	0.691907	3	Has a weak CH

Note: The colours help in visualising the result. The range from green to red represents the lowest score (a weak GI influence and weakest CH) to the highest score (strongest GI influence and strongest CH).

Besakih has the highest score both for government initiative and cultural heritage, followed by Sebudi in the second position. The pattern remains the same for Ulakan which is in the third position and Tulamben in the fourth position although the difference between Tulamben and Ulakan is very little.

Despite the fact that the results show that government initiatives and cultural heritage can go hand in hand, the current government initiatives of Destana and KSB do not include cultural heritage as

¹¹ To implement the Destana Policy (Perka 1/2012), the national government involve the provincial and municipality government to choose a facilitator. The facilitator assists the village government to build disaster resilience village.

an addition to support village governments in engaging the communities. However, most activities done in the name of the government disaster management initiatives (such as workshops, drills/simulations, and training), were done during already existing sociocultural gatherings. For example, the weekly meeting to discuss sociocultural or religious-related issues, called *Sangkepan*, was used as a medium to inform the community about new programmes in disaster management and steps to undertake to face future disaster (Interviewee number 10, personal communication, 15 January 2020). This shows the potential to include cultural heritage aspects in future government initiatives.

Subak is another alternative to educate communities about disaster risk reduction. In 2017, most farmers were economically affected by the disaster, especially when their crops had dried up, and they had to sell cattle at a cheap price. *Subak* meetings can be a medium to build consensus on how to prepare for- and protect agriculture and cattle when the volcano erupts. Interviewee number 6 also explained that *subak* can be the medium for coordination before the disaster occurs or even in the disaster event.

Another aspect where the importance of including cultural heritage in disaster management comes up is in governance; Balinese communities know two types of governance: formal and tribal (called *Awig-awig*). These two types of governance each have their own laws as well. Violating the formal law (governmental law) will bring the people to the punishment. While tribal law assesses the violation and punishes the people with social norms. For example, based on the *Tri Hita Karana* teaching, Balinese people are not allowed to cut trees in high-altitude forests unless the trees block the road. People who violate *Awig-awig* will be socially abandoned until he/she and his/her village conduct a ritual (Interviewee number 8, personal communication, 18 January 2020). The ritual must clean their village from a negative spirit that might be brought by the violating person and to pay back for the distraction caused by that person. In practice, people are more afraid to violate this law because the punishment affects not only him/her, but the entire village.

Disaster events shape communities' adaptation culture (Linkov et al., 2013; Wardekker et al., 2020). Documenting adaptation processes and learning from them could benefit disaster risk management. Take Sebudi Village for example: in the 2017 Mt. Agung eruption, all people from Sebudi evacuated to safer places. When the situation had become safe enough, communities were allowed to return to their village (although the alert status is still *Waspada*-advisory) and focus on recovery (economic, physical, infrastructural). Some farmers bought seeds and cattle. However, most households bought a vehicle (motorbike/car/truck) to anticipate future evacuation. People who bought a truck could make some money out of renting the truck to the sand mining sector.

Whether the government initiative reduces vulnerability in the same way on how cultural heritage reduce vulnerability is shown in the following paragraph (SQc).

Table 13. Vulnerability, Government Initiative, and Cultural Heritage Measurement Score

Village	Vulnerability Assessment (VA) Score	Rank of VA	Label for VA	Government initiative measurement score	Rank for GI	Type of government initiative	Cultural Heritage measurement Score	Rank for the level of cultural heritage
BESAKIH	0.636519	4	Least vulnerable	0.70632	1	Destana	0.718879	1
SEBUDI	0.641896	3	Less vulnerable	0.669639	2	KSB	0.700231	2
TULAMBEN	0.66369	1	Most vulnerable	0.589229	4	None	0.62992	4
ULAKAN	0.644748	2	Vulnerable	0.589689	3	Destana	0.691907	3

Table 13 shows that vulnerability is inversely proportional to government intervention and cultural heritage. It indicates that a village that has a high score in the level of cultural heritage and implements government initiative has a low vulnerability. On the contrary, a village that has a low score in the level of cultural heritage and does not implement government initiative is the village with high vulnerability.

It is proven that villages that implement government initiatives manage disaster risks better. Based on the survey, cultural heritage and government initiatives do not contradict each other in terms of reducing vulnerability. On the contrary: cultural heritage and government initiatives go hand in hand when it comes to a village's disaster management. Employing both formal and informal law supports the government initiative implementation. Especially on the grassroots level cultural heritage will accommodate in bringing the government's message across. Thus, including cultural heritage in disaster risk management might help bridge the divide between the government's top-down approach and bottom-up community disaster preparedness. For example, the necessity to evacuate if the alert status is increased into *Waspada* (advisory) should be part of *Awig-awig* rules to empower communities in terms of awareness, preparedness and management (Interviewee number 9, personal communication, 15 January 2020).

V.1.6. Designing resilience strategies

Perka 1/2012 (Destana) and Permensos 28/2011 (KSB) were created to build community capacity in facing the disaster. The focus lies on *community* capacity since the first affected and the first to respond to disaster are communities themselves. In Perka Destana 1/2012, it is specifically mentioned that all activities to build communities' capacity are included in resilience strategies that are aligned to the village government development plan.

Understanding Balinese communities' characteristics and belief systems, cultural heritage should be used in the development of resilience strategies. This idea is supported by Appler & Rumbach (2016); Chester & Duncan (2007); and Pica (2018). Current resilience strategies have not included the local character of areas. Customising regulation to local culture is the key to effectiveness in approaching and including the community in designing resilience strategies (Shaw, 2014b). It is easier for communities to relate if their knowledge and cultural heritage are presented in the disaster resilience strategies.

“What already exists in the communities (culture) should be used to build resilience strategies. By using their local genius (knowledge), they will appreciate more the document, they will learn and have a sense of belonging.” (Interviewee number 2, personal communication, 15 January 2020 and Interviewee number 7, personal communication, 15 January 2020)

A success story in integrating cultural aspects within public policy is Ngati Rangi in New Zealand (Gabrielsen et al., 2018). Ngati Rangi is an indigenous tribe of Aotearoa New Zealand. They live on the southern slope of their ancestral mountain, Ruapehu. Besides giving specific values and beliefs to the mountain, Ngati Rangi have constructed a mechanism for monitoring the volcano, collecting information, and a system of communication to produce an effective early warning system with their capability. These efforts were brought to the national decision-making process and have been integrated in the governmental policy. As a result, Ngati Rangi are more acknowledged and their achievement can inspire another indigenous to show their local knowledge.

Chester & Duncan (2007) prove that the presence of intangible cultural heritage caused by biophysical activities in people's living environment is relevant in past and present-day society. Based on this idea they have developed the concept *Geomythology*, which can be the starting point in designing a resilience strategy. Engagement with local communities and acknowledging their

locality (beliefs, myth, way of living, and more) can support an effective response to volcanic hazards to mitigate risk (Chester & Duncan, 2007).

The government of Indonesia engages faith-based organisations to educate people about disasters and disaster risk reduction. Moreover, because religion is admitted by the government as part of citizen rights, it is effective to share information through religion teachings especially in low-educated areas (rural areas). Previous disaster events have shown that faith-based organisations are willing to support disaster response and education. Although there are six recognised religions in Indonesia with different interpretations and perspectives, people have a strong bonding with religion. Thus, religion can be an alternative way to incorporate disaster resilience strategies into society.

Similar to the development of religions, cultural heritage as a form of ancient belief is the fruit of a cultural journey from the past to the present. Especially in Bali cultural heritage cannot be put aside from Hindu religion. Hinduism is strongly influenced by ancestral beliefs. Hence, using cultural heritage as an aspect to be considered in designing resilience strategies is an innovative development.

Adding cultural heritage as an aspect of resilience could be seen as an innovation. It embraces and up-scales bottom-up products into top-down policy. It is also a conservation in terms of the culture itself, because acknowledging culture in designing resilience strategies will broaden people's horizon on the cultural diversity within society. This in turn could result in societal awareness when it comes to protecting cultural heritage.

In sum, the analysis provides insights on how to incorporate cultural heritage for better resilience strategies.

V.2. Discussion

IV.2.1. Testing the Hypotheses (Answering the main RQ)

Cultural heritage indeed reduces communities' vulnerability (SQa). The economic situation, availability and access to disaster information, and (cultural) ways of psychological recovery from disaster are aspects of vulnerability that are influenced by cultural heritage (SQb). The answer for SQa is in line with first hypothesis "*Cultural heritage reduces the communities' vulnerability*". Regarding SQb there is a particular interesting finding in the economic aspect that is discussed in section [IV.2.2.](#)

On the one hand, rituals done by communities to support their cultural heritage require money for the offerings and ceremonies. In this case, rituals can be an additional burden for communities' economies. Logically, the increasing burden can negatively influence vulnerability. According to interviewee number 1, there was prior research from the National Statistical Bureau about this which found that reducing rituals can decrease communities' economic burden. However, this finding was not accepted by the communities and cultural heritage activists since their perspective on rituals is not only economical but includes other factors, such as belief, custom, social bond, and more. The benefit cannot be monetised, unlike the offerings and ceremonies needs.

On the other hand, people claim that rituals are part of their belief system which cannot be skipped. Most rituals are also adjusted to the communities' economic situation, so most people agree that rituals are not a burden. They believe that rituals can be sources of strength in facing difficulty during disaster. Besides that, Balinese people believe that giving in advance (rituals for wealth) is a spiritual investment to receiving more (for example more harvest, better weather, or fertile soils).

Although the result confirms the first hypothesis, a similar study in other places or with different assessment tools can produce results differently. There will be uncertainties in further research, but what would be found in the future research will enlarge the knowledge development in vulnerability and cultural heritage scope of study. Besides that, there is a contrasting argument that will be interesting for further research. The study from the perspective of the economy can see rituals as an economic burden, but the study from a psychological perspective can see rituals as a source of resilience.

Referring to the general concept of disaster risk, where risk is the function of hazard, vulnerability and capacity ([sub-section II.1.1](#)), reducing vulnerability, will reduce the risk. The potential of cultural heritage in reducing vulnerability supports the disaster risk reduction concept which is used by the government as one of main goals in disaster management.

When it comes to the role of government initiatives (SQc), Balinese communities have both a formal and informal governmental architecture. The formal architecture refers to the national government architecture. Informal architecture emphasises the presence of tribal and communal functions within the communities. Informal architecture is considered the product of intangible heritage.

Following this architecture, formal and tribal law are present in Bali. In some cases, tribal law is more socially coercive than formal law. This opportunity is used by the village government to align the formal and informal law altogether.

“To support reducing communities’ vulnerability, cultural heritage can be added into current disaster governance initiative” (Interviewees number 7 and 10, personal communication).

To effectively govern the disaster risk, a place that has a strong belief system or cultural heritage should be facilitated by government initiatives that work with informal forms of governance. In Bali, existing informal governance (Awig-awig) to implement a certain government initiative will be easy to run by the village government rather than the village government should engage the communities to take actions themselves. Thus, embedding cultural heritage into policy is an innovative approach to disaster risk governance.

There are some benefits from the government initiatives in which local actors are directly affected by those benefits. When the local actors achieve those benefits and know how to implement them, the communities will also indirectly be benefited, especially during the disaster event. Communities’ vulnerability can be reduced by several relations:

- During the evacuation, communities will be given basic needs such as food and shelter. Capable in disaster management local actors will prepare these needs. In 2017 the basic needs were provided by the national government under the coordination of local actors.
- The local actors will update and share information related to the danger and provide evacuation routes. Communities can prepare a private evacuation plan for the crisis. The disaster in 2017 was a trial for the implementation of Destana for Besakih, especially. The government’s decision on evacuation was conveyed to the community in advance through local radio communication and social media (Whatsapp). The evacuation process was smooth: people who had a private car helped their neighbours who did not have a car or transportation and the village government took care of those who did not want to evacuate. Ulakan Village communities were ready to provide their public facilities for the displaced people due to evacuation.
- Understanding Destana helps the village government to encourage the community to have livelihood planning after a disaster. By having plans to continue the economic stability in times

of disaster, communities' vulnerability will be reduced. In 2017 livelihood was critical, especially for people who own farmland and cattle.

The question of how to better design a resilience strategy (SQd) should reflect on the result found in this research. Within the vulnerability there are six categories measured: Social-Economic (SE), Institutional (Ins), Disaster-related issues (D), Infrastructure (Inf), Economic (E), and Health (H). Some categories have high scores, and others have low scores. A high number indicates that aspects related to the categories should be improved. Improving those aspects helps in designing better resilience strategies.

In general, the Social-Economy (SE) category has a high number for all villages (average 0.707583), followed by Disaster-related (D) category (average 0.682423). This means that vulnerability specifically from the perspective of SE- and D-side are high in all villages. Governmental programmes should prioritise reducing this score. Poverty eradication and family planning should be done to decrease economic vulnerability. To reduce the score for the disaster-related factor, more activities should be conducted by BPBD to familiarise communities with government bodies that handle disaster management.

It is interesting to see how the vulnerability assessment results are varied. Besakih obtains the lowest score in the Socio-Economic (SE) and Institutional (Ins) categories (see sub-section V.1.1). This means that for these categories, Besakih has the least vulnerability. While Ulakan reaches the lowest score in Infrastructure (Inf), Education (E), and Health (H) indicating these categories are the least vulnerable. Other factors which are not included in the assessment might influence these results. The fact that in Besakih, SE has the least vulnerability might be because the area is a rural area, where people who depend on agriculture have their own farmland and often have cattle. They tend to have a stable economy. Related to Institutional category in Besakih, Besakih also has a high score that is influenced by the experiment in 2017 Mt. Agung eruption when the BPBD/BNPB cooperated with the village government. . However, since Ulakan did not experience any disaster event, the Institutional factor (Ins) is the most vulnerable. Meanwhile, Ulakan is the only urban area and urban areas tend to have better development than rural areas. Thus, it is obvious that Infrastructure (Inf), Education (E), and Health (H) are better developed than other places.

Another factor might be the presence of urbanisation. Migration of young people from rural areas to urban areas is rising everywhere, including in Bali. Although Ulakan is the only urban area amongst the four villages, it is less urban than Denpasar City (the capital of Bali). Many young people go to Denpasar City or Badung Regency hoping to get better jobs or pursuing higher educations. People who succeed in getting a better job and higher income send the money home to build a better house for themselves and/or their family. This is one explanation as to why the Infrastructure (Inf) aspect is good in Ulakan. Although many young people from Besakih migrate to the city as well, due to their lower education they fail to obtain the same jobs as young people from Ulakan manage to get. As a result of that their income is often lower.

Related to the Disaster category, Sebudi has the lowest score (least vulnerable). This might be because Sebudi experienced disaster in 1963 and 2017. Out of the four villages, it was Sebudi that had the most calamities in the 1963 disaster. It has led the society to strengthen their preparedness. Ulakan has the highest score (most vulnerable) which might be because Ulakan is outside the risk zone and never experienced being exposed by the disaster.

Despite the evidence that supports the hypotheses, the methods chosen in this research have some weaknesses too. First, the quantitative method that is used to assess the vulnerability only gives a general overview on the vulnerability of the communities. Part of this method have been interviews with closed-ended questions. One of the drawbacks of closed-ended questions is that the

researcher steers the direction of the interview and with that the information obtained. Although qualitative, in-depth, open-ended interviews have been used to support the quantitative data, these interviews have only been done with local actors—and not communities. Thus, future research could benefit from additional, rich and detailed information obtained through qualitative interviews with the communities.

This study proves Webb’s (2018) statement that there must be relation between culture heritage and disasters. However, this research has been mostly explorative in understanding cultural heritage—only scratching the surface of what it is and could mean in the context of disaster risk management. More in-depth research is needed and collaborative research between managers, sociologists, anthropologist, and geologist would be beneficial.

IV.2.2. Unexpected Findings

Confounding Variables

During the data analysis, some independent variables were found in the secondary data and the researcher’s observations. These new independent variables are called confounding variables or variables that might simultaneously have a negative and positive influence on the dependent variable. A positive influence means that the presence of these confounding variables can increase the vulnerability and a negative influence means it can decrease the vulnerability. In this research, the dependent variable is the vulnerability that was initially assessed and addressed in the result section (IV.1.1).

Table 14. Confounding Variables in Vulnerability Assessment

Category	Variable	Type	Potential influence
Vulnerability	Vulnerability	Dependent	
Biophysical factor	Distance to the crater	Independent	Positive
	Water source	Confounding	Positive
	Hazard zone (KRB)	Independent	Positive
Cultural Heritage	Distance to the CH (Pura Besakih)	Independent	Negative
	CH measurement	Independent	Negative (due to result)
Institutional	Measurement	Independent	Negative (due to result)
	Govt. intervention	Independent	Negative
	The capacity of local govt (based on the head of the village)	Confounding	Negative
	Risk (toward Mt. Agung eruption)	Independent	Positive
	Rural/urban	Confounding	Positive
Socio-economic related	Distance from the village to the capital of the subdistrict	Confounding	Positive
	Education service	Independent	Positive
	Health service	Independent	Positive
	Subak system	Confounding	Negative
	Tourist-related	Confounding	Negative
	Number of members within a household	Independent	Positive
	Area	Confounding	Positive
	Population density	Confounding	Positive
	Population growth	Confounding	Positive
	Number of populations	Confounding	Positive
Type of landscape	Confounding	Positive	

Perception of hazard

Perceptions of hazard (by the communities) have changed over time (due to the 1963 and 2017 experiences) and differ between the different villages. In other words: perceptions of hazards are

time- and context-bound. In Besakih and Sebudi, the communities see Mt. Agung eruption as the main threat in their area. Initially, the power of Mt. Agung was experienced as a blessing (1963). This belief changed due to technological development and improved information dissemination causing people to shift to an interpretation of volcanic activity as a normal volcanic process that is a hazard and might damage their living environment (2017). Thus, social construction (which includes culture and religion) of hazards should be considered by allowing disaster managers (including volcanologists and hazard planners) and communities to discuss together (Chester & Duncan, 2007).

Villages' communities that directly experience disaster events tend to have a better perception about hazards than the people who never had the experiences. This finding is supported by the vulnerability assessment on the Institutional (Ins) category (sub-section V.1.1) and the way government initiatives are implemented (sub-section V.1.5). Further research is needed to prove this finding.

Meanwhile, despite the history of volcanic activity and prior disasters, Ulakan and Tulamben prioritise tsunami hazards over volcanic ones. In their local disaster management, the village government conducted not volcano but tsunami simulations and evacuation drills. Hazard perception of the communities are focused more on tsunamis than a Mt. Agung eruption in these areas.

Pasebaya (Community-based radio communication group)

Communities around Mt. Agung created a local radio communication system called *Pasebaya*. This radio communication system is run by the community and volunteers. A conflict between the community and the regional government in 2017 triggered its emergence. During the 2017 crisis, there was a communication problem between the communities and the regional government that caused a distrust in the government. The national government then advocated for the development of a local radio communication system and recommended to follow the mechanism done by the existing community-based radio communication. Community-based radio communication was firstly initiated by Mt. Merapi communities called *Jalin Merapi* and it delivers information about the status of the mountain and what communities should do real time through *Jalin Merapi* (Andreastuti et al., 2018).

Pasebaya is funded by the community, although the head of Pasebaya continuously strives to get third party funds from the business sector. Since Bali is a tourist destination, a lot of tourist businessmen financially support this communication model. All information related to Mt. Agung's activity and what actions should be taken is shared through Handie Talkie (HT). People who have this device can set it to the frequency of Pasebaya. The Karangasem Regency support local actors with HT to receive and exchange information with the head of Pasebaya. All four village-heads confirmed that Pasebaya is a valid information source.

This platform was also used to educate people during the crisis and to disseminate instructions. The 2017 disaster involved several eruptions. The first eruption was in September 2017 and at that time all residents in the surrounding of Mt. Agung had to evacuate. Shortly after communities went back home from the evacuation shelters where they had stayed temporarily Mt. Agung erupted again. This time the government used Pasebaya to instruct people to evacuate. Not everyone fully understood the eruption. Some people thought that the eruption was not that dangerous and therefore refused to stay in the evacuation shelters. Some others were afraid and did not trust the news that was presented on the shelter's television. Because Pasebaya shared the necessary information using the communities' approach, the (truthfulness of the) information was accepted way more easily.

Interviews showed that there was a difference in willingness to evacuate between the generation who had witnessed the 1963 eruption and the generation that had not. In 2017, the government obliged people to follow CVGHM's recommendation to evacuate. Pasebaya, taking on the role to enforce this recommendation, entered the villages to pick up people who did not want to evacuate. A paper had to be signed by those who did not want to be evacuated, stating that if something bad were to happen (calamity) it would be at their own risk and not the government's responsibility.

Pasebaya has a role in communicating the risk, similar to what *Jalin Merapi* does (Andreastuti et al., 2018) which is changing the perspective about disaster within the communities. During the interview, the head of Pasebaya shared a quote: "Science without belief is death and belief without science is death". This quote was also mentioned by Interviewees number 2, 7, 8, 9, and some people during the fieldwork. This quote implicitly stated that it is becoming more and more relevant that the integration of local beliefs and scientific knowledge are integrated and accepted by society. This is important so that misunderstandings about volcanic eruptions in communities can be corrected. Education about the disaster is also delivered by appreciating the existing culture (how communities see Mt. Agung through folklore, oral stories, etc) but also acknowledging the presence of technological development that can produce more precise information.

Pasebaya strengthens the idea of integrating indigenous belief (local knowledge) and science. The argument that science and indigenous knowledge should be integrated has been increasingly found in research on disaster management. (Andreastuti et al., 2018; Mercer et al., 2009; Raymond et al., 2010). Although Raymond et al. (2010) argue that there is no optimal approach to intertwine scientific and local knowledge, findings from this research will strengthen the background in integrating both types of knowledge. Donovan (2010) has found that both science and belief are used by communities to interpret disaster and shape the response to it, especially when cultural belief helps in accepting the disruptive event, and science will support sensible early warning.

Dana Desa (Village Fund)

Translating Dana Desa to English it means Village Fund. Dana Desa is a government initiative under The Government Legal Number 6/2014 about Village and Government Regulation Number 66/2014 about Village Monetary. It is a fund given to every village in Indonesia to support village development and other related issues. As disaster management is part of Dana Desa's priority, mainstreaming the DRR programme with the use of Dana Desa is highly recommended.

The government of Karangasem (through Bappeda and BPBD) has been actively campaigning Dana Desa for disaster management. The head of BPBD states it is important to encourage each village to use Dana Desa to implement Disaster Resilience Village. The regional government gives guidance in the technical process from the plan, execution, and evaluation of the programme. This means that Dana Desa can be the solution to one of the biggest problems in implementing Disaster Resilience Village: a lack of funds.

What complicates Dana Desa is that not every village (government) sees disaster as a major problem. Instead, the focus lies on poverty, infrastructure, and water resources. Whereas Dana Desa can only be used if the disaster is prioritised as a development issue. Thus, village governments should plan so that all issues can be accommodated within Dana Desa. By using this budget, villages can do more in governing disaster risks in their area, without disregarding other problems.

According to the interviews, there are pros and cons to Dana Desa:

- (+) helps the village fund activities with quite a lot of money
- (+) is easy to access as long as the village has consensus on their activities

- (-) needs more assistance to be more transparent and accountable
- (-) depends (too much) on the workings of the village government in question (a village government who has the willingness and capacity will use this fund optimally).

Urbanization

There is a trend of young people born in rural areas moving to the city (urbanisation). Currently half of the world population lives in cities and the trend is increasing. Bali is no different. The motives for young people to move to the city are varied but job opportunity is at the top of the list. Job opportunities are more in the cities than in the village, especially in the service sector. Young people from Besakih, Sebudi, Tulamben, and Ulakan move to the city too, namely Denpasar City (the capital of Bali Province). However, their moving out of the village to the city does not change the demographical administration. Although in reality people no longer live in the village, on paper they still do. When a disaster strikes, “rapid assessments” need to be done by disaster managers to get the actual data of who lives in the area. Rapid assessment maps people, their locations, their needs, and the victims during a disaster as separate from existing demographic data. The actual data support the accountability of the disaster managers in providing aid, shelters, and resources. The accountability here means that the amount of the aids should be same as the amount of the actual disaster survivors.

IV.2.3. Challenges

This research has interesting findings that should be further addressed. However, it is an individual master thesis that requires a compact study. Adding all information would have made it too much for an individual project. A similar study with complete findings and deep analyses requires a collaborative study that can capture the perspective from different disciplines.

Religion and culture are related to each other. Sometimes, religion shapes culture, and sometimes culture defines religion. It is something that is referred to as ‘co-constructing’. However, for anthropologists, these two entities can be studied separately. This research does not segregate religion and culture since the focus lies on disaster risk reduction with cultural heritage as an addition in the management. Cooperation with researchers from anthropology and sociology in future studies will enrich the analyses of the culture of society.

In general, Balinese Hindu worship in the same way. To understand culture in all its richness and variety is very difficult. It requires long term field research whereby the researcher, ideally, lives among and with the people he or she is studying. However, for this study the researcher did not stay in all four villages. While gathering data on Ulakan Village, the researcher stayed in a neighbouring sub-district due to limited availability of accommodation in Ulakan. As a result of this the data-generation in Ulakan has been less rich than the other village.

As Bali has a hierarchical socio-cultural structure, it would be easy for the researcher to gather data in the field and get to know important actors as long as the researcher succeeds to establish rapport with the focal point (the highest in the hierarchy). However, the hierarchy can be challenging, especially in finding people who are willing to share their ideas and answer the researcher’s questions without feeling oppressed. Focal points tend to direct the researcher to actors with whom he/she has a personal connection. This challenge can be reduced by verifying the answer of the actors with the actual situation on the ground. For example, one local actor said that disaster drills involve all villagers. However, when asking people living in the village about disaster drills, some of them knew nothing about it. During the analysis, these different answers should be considered.

VI. Chapter 6 (Conclusion)

Generally, cultural heritage in Bali can be seen as both a source of- and burden to resilience. On one hand, Balinese people are devoted to their cultural heritage through the practice of Hindu teachings and rituals to deify Mt. Agung. Mt. Agung is the biggest volcano in Bali and its activity can be dangerous for the communities living in the surroundings (hazard). Both people and their possessions (vulnerability) may be endangered by the volcano. The belief system that is attached to Mt. Agung drives the communities to live in harmony with the disaster risk or see the traditions related to Mt. Agung as a source of resilience. Regardless of the presence of cultural heritage, the national government has a policy for resilience strategies to encourage the communities in using their resources to face the risk of disasters.

The assumption is that the activities are done by Balinese people in relation to Mt. Agung can be a burden to- or a source of resilience. Thus, two hypotheses underline this research, namely: "Cultural heritage reduces the communities' vulnerability" and "To reduce communities' vulnerability, cultural heritage should be added to current disaster governance initiatives". Meanwhile, aiming to study (1) the role of cultural heritage within communities' vulnerability facing possible eruption of Mt. Agung and (2) which aspects of cultural heritage can be included in the development of government initiatives supporting communities' resilience, this research focuses on cultural heritage as a source of resilience. To test the hypotheses, a comparative case study is conducted in four different areas within Karangasem Regency, Bali Province. These areas are: Besakih, Sebudi, Tulamben, and Ulakan village.

Employing comparative case study in those villages, supported with desk research, and structured- and in depth-interviews, this research proves that there is a relation between cultural heritage and communities' vulnerability. Although the vulnerability assessment shows the variety of vulnerability between villages, the in-depth interviews help the analysis of what aspects relate to cultural heritage. It has been identified that cultural heritage plays an important role in communities' economic situation, how they perceive disaster information, how they recover psychologically from the disaster. Besides that, the presence of cultural heritage and government initiative gives a positive influence on the communities in a similar way, meaning they both reduce vulnerability.

Given the main research question which is: "How do cultural heritage and government initiative relate to the community vulnerability and resilience toward volcanic disaster?" with the sub research questions: "Does the presence of cultural heritage reduce communities' vulnerability? (SQa)"; "Which aspects of vulnerability are influenced by cultural heritage? (SQb)"; "Does the presence of cultural heritage reduce the vulnerability in different ways than the current government initiative? (SQc)"; and "Does the analysis provide insights into how cultural heritage aspects might be used to better design resilience strategies? (SQd)", this research concludes that there is a relation between cultural heritage and government initiative to communities' vulnerability. First of all, the general conclusion is that a place which is within the hazard zone, close to the centre of cultural heritage and implements disaster resilience strategies tends to have less resilience compared to a place which is outside the risk zone, further away from the centre of cultural heritage and does not implement any disaster resilience strategy. There is thus a gradation in the magnitude of cultural heritage and a spatial pattern in the communities' vulnerability. Second, the vulnerability that has been assessed by a vulnerability assessment (categories: social-economic, institutional, disaster-related, infrastructure, education, and health) varies from one village to the other. Third, some additional information about the villages being in place giving an overview on how the communities see disaster, including the change of hazard perception, and cultural heritage in their area bridges from the fact of vulnerability conditions of the villages to the finding that cultural heritage has relation to vulnerability. Fourth, cultural heritage positively influences the community's vulnerability, meaning

that cultural heritage can reduce vulnerability. Fifth, aspects that should be considered to reduce vulnerability are: communities' economic conditions, disaster information dissemination, and strategies for psychological recovery from disaster. Sixth, the presence of disaster resilience strategies within the communities help them in using their resources (resilience) facing disaster. Also, these strategies work in the same way as cultural heritage. Seventh, interventions for some of the categories within communities' vulnerability should be given to improve the community's resilience. Lastly, a cultural heritage can be a new parameter in vulnerability assessment.

Having found some confounding variables (that relate to vulnerability) with this study has led to some additional reflections. Namely: although some confounding variables that relate to vulnerability have been found, it is not yet known *how* they relate. In other words: it is not yet known whether it is a positive or negative relation. To analyse these confounding variables in the future, it should be taken into account that communities themselves have a changing perception of hazard—which can be seen in particular in pre- and post-2017 perceptions. The change of hazard perspective might be related to the emergence of radio communication in 2017 that allows the communities to use both traditional and scientific knowledge to prepare themselves for facing disasters. Meanwhile, to sustain the resilience strategies, financial intervention from third parties and actual data of the vulnerability during the disaster are important.

Considering the knowledge that this study has generated and the new reflections it has brought about, there are opportunities for further research. Firstly, further and more in-depth research on the relationship between cultural heritage and volcanic eruption *and* on improving disaster resilience strategies should be conducted in collaboration with disaster managers, anthropologists, sociologists, and geologists. Secondly, research that uses different tools for vulnerability assessment and different methods in researching the relation between cultural heritage and vulnerability and resilience can provide us with different insights. Third, especially in economic aspect that relates to the cultural heritage, a specific research should be done to analyse whether the economy is burdened by the cultural heritage or the other way around. Lastly, a new assumption concerning communities who experience disaster have more understanding about the disaster and are more open to the improvement of resilience strategies shows that research on them and *with them* should be further developed.

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Appendix 1 (Questionnaire)

Categories		Variable	Question	Literature	Justification
Social-Economic	SE1	Member of family	How many people live in your house?	Cox & Hamlen (2015; Cutter, Burton, & Emrich (2010)	Disaster will directly impact to the residents within the hazard zone.
	SE2	Food provision	Have you ever experienced food scarcity?	Tambo & Wünscher (2017)	People who do not have any problem with food provision tend to be ready to face the disaster.
	SE3	Income	How much do you earn each month?	Cox & Hamlen (2015; Cutter et al. (2010; Tambo & Wünscher (2017)	Income indicates the ability of people to provide basic needs. As a society are the front-liners facing the disaster, poor people are more vulnerable. In this research, low income is used to see the vulnerability.
	SE4	Savings money	Do you have saving money for emergency needs?	Hahn et al. (2009; Tambo & Wünscher (2017)	Saving money can be used in a crisis. Taken as it is from Tambo & Wünscher (2017), this variable is used also for this research.
	SE5	Assets ownership	Do you have land beside your house? Do you have cattle?	Cutter et al. (2010; Tambo & Wünscher (2017)	Assets ownership is highly related to the socio-economic situation of the household.
	SE6	Food source	Do you buy or get from your yard (or field) to provide food in your family?	Hahn et al. (2009; Tambo & Wünscher (2017)	Modified from Hahn et al. (2009); Tambo & Wünscher (2017), food provision variable targets
	SE7	Financial emergency need	If there is an emergency for money, how do you attain that need?	Hahn et al. (2009)	This variable is modified from Hahn et al. (2009). Communities who borrow money from banks tend to be more vulnerable because of their interest.
	SE8	Insurance	Do you have another insurance beside BPJS?	Cutter et al. (2010; Tambo & Wünscher (2017)	Insurance outside BPJS (mandatory health insurance from the government) can help the community during the crisis.
Institutional	Ins1	Familiarisation of Disaster Management Agency - local and national level	Question 1: Do you know about BPBD or BNPB? Have you ever heard about it? Question 2: Do you know its function?	modified from Perka Destana (2012) and Permensos (2011) for Disaster Resilience Village; Cox & Hamlen, 2015; Twigg (2011)	BNPB or BPBD has responsibility for disaster management within the community. It is assumed that the board is well-known by the community, the task is also known by the community.
	Ins2	Disaster information	From whom you get information about disaster?	Cox & Hamlen (2015; Hahn et al. (2009)	The communities should get actual information. However, there is a potential for miss-leading information Webb (2018). In this regard, it is needed to identify where the communities get the information from.
	Ins3	Basic needs aids	Questions: How were the disaster aids (logistics, shelters) being provided for the disaster survivors in the 2017/2018 eruption?	modified from Perka Destana (2012) and Permensos (2011) for Disaster Resilience Village.	The responsibility of BNPB and BPBD is to provide basic needs during the crisis for the evacuees. The perception of these aids from the communities is important to evaluate the work of BPBD and BNPB.

Categories	Variable	Question	Literature	Justification	
Disaster	D1	Disaster preparedness	Do you know what to do if Mt. Agung erupts again? Where is the meeting point before evacuate? Where is the evacuation center?	modified from Perka Destana (2012) and Permensos (2011) for Disaster Resilience Village; Cox & Hamlen (2006)	As the communities have a variety of education or capacity in disaster management, information on the understanding in responding to the disaster by the community is important to be known.
	D2	Psychological condition	How do you feel about the Mt. Agung eruption? Based on your experience and understanding, are you afraid or feel safe?	Paton & Johnston (2001; Surjan, Kudo, & Uitto (2016)	A psychological state never causes any hazard, however, psychological factors influence indirectly how the society perceive the hazard and in some case determine how to react facing a certain hazard.
	D3	Vehicle ownership	Do you have a vehicle for your family? What are they?	Cox & Hamlen (2015)	The ownership of the vehicle is the easiest way to measure the ability of the community to evacuate during the crisis.
Infrastructure	Inf1	House construction	Is your house permanent (made from brick) or semi-permanent (made from bamboo)?	Cutter, Mitchel, & Scott (2000); Cox & Hemlen (2006)	Cox & Hamlen (2015); Cutter et al. (2012) mentioned that infrastructure is part of the vulnerability. In this research, the infrastructure category focus on household infrastructure. One of them is housing.
	Inf2	House for business	Besides living, do you use your house for any business?	Cutter et al. (2012); Tierney (2007) Cox & Hamlen (2015); Cutter et al. (2010); Tierney (2007)	In Indonesia, some people earn money by opening an informal business in their house. This information is related to the economy and infrastructure itself. When a disaster came and destroy the house, they will have double burdens (economic and infrastructure burden)
	Inf3	Electricity need	How much money do you spend on electricity in a month?	Cutter et al. (2010); Tambo & Wünschler (2017)	Cox & Hamlen (2015); Cutter et al. (2012) mentioned that infrastructure is part of the vulnerability. In this research, the infrastructure category focus on household infrastructure. One of them is the house's electricity.
	Inf4	Energy for cooking	What type of energy do you use for cooking?	Cox & Hamlen (2015); Cutter et al. (2010)	Cox & Hamlen (2015); Cutter et al. (2012) mentioned that infrastructure is part of the vulnerability. In this research, the infrastructure category focus on household infrastructure. One of them is energy for cooking.
	Inf5	Water source	How do you get water?	Cox & Hamlen (2015); Cutter et al. (2010)	Cox & Hamlen (2015); Cutter et al. (2012) mentioned that infrastructure is part of the vulnerability. In this research, the infrastructure category focus on household infrastructure. One of them is a water-related matter.
	Inf6	Extended water need	Besides basic living, do you use water for any other activities?	Cox & Hamlen (2015); Cutter et al. (2010)	Cox & Hamlen (2015); Cutter et al. (2012) mentioned that infrastructure is part of the vulnerability. In this research, the infrastructure category focus on household infrastructure. One of them is water-related matter
	Inf7	Water need	How much money do you spend to get water for your family?	Cox & Hamlen (2015); Cutter et al. (2010)	Cox & Hamlen (2015); Cutter et al. (2012) mentioned that infrastructure is part of the vulnerability. In this research, the infrastructure category focus on household infrastructure. One of them is water-related matter
Education	E1	Literacy and numeracy	Can you read and write?	modification from Cutter et al. (2012) & Kementerian Pendidikan (12 years of formal education)	Indonesian government gives the right to education to everybody (12 years school). Within the vulnerability study, education is also very important. Literacy and numeracy are a common indication of education exposure.

Categories		Variable	Question	Literature	Justification
	E2	Latest education	What is your latest education?	modification from Cutter et al. (2012) & Kementerian Pendidikan (12 years of formal education)	Following the literacy and numeracy, the latest formal education attained gives information about the communities' education level.
	E3	Extension education	Do you have any other education (training or course) outside formal education?	modification from Cutter et al. (2012)	People who have extended education tend to have finished formal education.
	E4	Closest education center	How far is your house to the closest education center (SD)?	modification from Cutter, Mitchel, & Scott (2000); Tambo & Wunscher, (2015); Kementerian Pendidikan (12 years of formal education)	Taken from Tambo & Wunscher (2017), the accessibility to the closest education.
Health	H1	Health center accessibility	How far is your house to the health facility you usually go to?	modification from Hahn et al. (2009); Tambo & Wunscher (2017)	This variable indicates the health system within the communities and how do the communities can access the health facility.
	H2	The intensity of going to the health center	How often do you go to the health center?	modification from Hahn et al. (2009)	This variable shows the health of the community from how frequent they go to the health center.
	H3	Disability-related information	Do you have a relative who has a disability?	modification from Cutter et al. (2010); Hahn et al. (2009)	Disability is a matter of inclusion in disaster management (Twigg, 2011). This variable is modified from (Cutter et al., 2012; Hahn et al., 2009)
	H4	Health problem	Do you go to the doctor (health center) in the past two weeks?	Hahn et al. (2009)	Taken from Hahn et al. (2009), this variable indicates the health situation of the communities.

Appendix 2 (Qualitative Depth Interview)

Questions for Depth Interviews

General

1. Does your community have a special representative for disaster issues?
2. Does your community experience water conflicts? How often that happens?

Cultural Heritage

3. How far do the people in your community practicing tradition or rituals related to the disaster (Mt. Agung)?
4. How does the tradition/ritual be held?
5. Do you think the rituals done by the community improve their awareness of disaster? Or people tend to be more afraid of disaster?
6. Do the beliefs of the community put more stress on the community?

Policy Initiative for Resilience Village

7. How does the resilience village programme affect the community's understanding of Mt. Agung hazard?
8. Do the community know what to do to prevent the calamity if Mt. Agung erupts?
9. What are the actual implementations that become the community's routine agenda following this programme (i.e. drill/simulation)?

Appendix 3 (Interviewees)

List Interviewees

Interviewee affiliation	Name	Date of Interview
The founder of Bali Cultural Heritage Conservation	Dalem	13 January 2020
The head of Besakih Village, represented by the Secretary and the head of Banjar Besakih Kangin	I Nyoman Artana Doni	14 January 2020 and 20 January 2020
The head of Sebudi	I Mangku Tinggal	17 January 2020
The head of Ulakan Village, represented by the Secretary and head of Planning Division	I Nengah Sujawan and Kadek Sukertina	29 January 2020
The head of Tulamben	I Nyoman Pica	21 January 2020
The head of Farmer Association in Sebudi	I Gusti Ngurah Alit	14 January 2020
The head of Pasebaya	I Gede Pawana	15 January 2020
The religious focal point (Bendesa Adat)	I Mangku Widiarta	18 January
The head of BPBD Karangasem Regency	Ida Ketut Arimbawa	15 January 2020
Resilience village facilitator	Kadek Suyasa	15 January 2020

Appendix 4 (Coding)

Table 15. Codes for the survey

No	Category	Variables	Question	Answer and Code	Multiplier	
1	Social-Economic	SE1	Member of family	How many people live in your house?	8++ = 3 5- 8 = 2 1 - 4 = 1	0.333333333
2		SE2	Food provision	Have you ever experienced food scarcity?	yes = 2 no = 1	0.5
3		SE3	Income	How much do you earn each month?	N/A = 0 0 - Rp 50.000,-/day = 4 Rp 50.000,- - Rp 100.000,-/day = 3 Rp 100.000,- - Rp 200.000,-/day = 2 Rp 200.000,- - Rp 500.000,-/day = 1	0.25
4		SE4	Savings money	Do you have saving money for emergency needs?	no = 2 yes = 1	0.5
5		SE5	Assets ownership	Do you have land beside your house? Do you have cattle?	N/A = 0 nothing = 4 cattle or poultry = 3 farmland = 2 cattle and farmland = 1	0.25
6		SE6	Food source	Do you buy or get from your yard (or field) to provide food in your family?	buy = 2 harvest = 2 buy and harvest = 1	0.5
7		SE7	Financial emergency need	If there is an emergency for money, how do you attain that need?	n/a = 0 bank and relative = 4 bank = 3 relative (s) family(s) = 2 never = 1	0.25
8		SE8	Insurance	Do you have another insurance beside BPJS?	no = 2 yes = 1	0.5
9	Institutional	Ins1	Familiarisation of DM board	Question 1: Do you know about BPBD or BNPB? Have you ever heard about it? Question 2: Do you know its function?	never heard = 3 moderate = 2 good = 1	0.333333333
10		Ins3	Disaster information	From whom you get information about disaster?	Direct observation = 4 HP = 3 HT = 3 TV = 3 HP+HT = 2 HP+TV = 2 HP+HT+TV = 1	0.25
11		Ins4	Basic needs aids	Questions: How were the disaster aids (logistics, shelters) being provided for the disaster survivors in the 2017/2018 eruption?	-N/A = 0 did not evacuate = 4 -bad = 3 -moderate = 2 -good = 1	0.25
12	Disaster-related stuff	D2	Disaster preparedness	Do you know what to do if Mt. Agung erupts again? Where is the meeting point before evacuating? Where is the evacuation center?	less ready = 2 ready = 1	0.5
13		D3	Psychological condition	How do you feel about the Mt. Agung eruption? Based on your experience and understanding, are you afraid or feel safe?	N/A= 0 afraid = 3 feel safe = 2 feel safe and more prepared = 1	0.333333333
14		D4	Vehicle ownership	Do you have a vehicle for your family? What are they?	no = 3 yes = 2 yes (motorbike and car) = 1	0.333333333
15	Infrastructure	Inf1	House construction	Is your house permanent (made from brick) or semi-permanent (made from bamboo)?	semi-permanent = 2 permanent = 1	0.5
16		Inf2	House for business	Besides living, do you use your house for any business?	yes = 2 no = 1	0.5
17		Inf3	Electricity need	How much money do you spend on electricity in a month?	N/A= 0 Rp 200.000,- ++ = 4 Rp 100.000,- - Rp 200.000,- = 3 Rp 50.000,- - Rp 100.000,- = 2 Rp 0 - 50.000,- = 1	0.25
18		Inf4	Energy for cooking	What type of energy do you use for cooking?	wood = 2 fossil fuel = 2 gas = 2 wood and gas = 1	0.5
19		Inf5	Water source	How do you get water?	PAM and rain harvest = 3 rain harvest = 2 PAM/water spring = 2 Private well = 1	0.333333333
20		Inf6	Extended water need	Besides basic living, do you use water for any other activities?	yes = 2 no = 1	0.5
21		Inf7	Water need	How much money do you spend to get water for your family?	N/A = 0 Rp 250.000,-++ = 4	0.25

No	Category	Variables	Question	Answer and Code	Multiplier	
				Rp 150 - Rp 250.000,- = 3 Rp 50.000,- - Rp 150.000,- = 2 0 - Rp 50.000,- = 1		
22	Education	E1	Literacy and numeracy	Can you read and write?	not able = 2 able = 1	0.5
23		E2	Latest education	What is your latest education?	N/A = 0 did not go to school = 5 SD (elementary school) = 4 SMP (junior high school) = 3 SMA (senior high school) = 2 University = 1	0.2
24		E3	Extension education	Do you have any other education (training or course) outside formal education?	no = 2 yes = 1	0.5
25		E4	Closest education center	How far is your house to the closest education center (SD)?	N/A = 0 4 - 8 km = 3 2 - 4 km = 2 0 - 2 km = 1	0.33333333
26		Health	H1	Health center accessibility	How far is your house to the health facility you usually visit?	N/A = 0 8 ++ = 4 4 - 8 km = 3 2 - 4 km = 2 0 - 2 km = 1
27	H2		The intensity of going to the health center	How often do you go to the health center?	Often = 1 (more than 6x a year) = 2 rarely = 2 (0 - 6 x a year) = 1	0.5
28	H3		Disability-related information	Do you have a relative who has a disability?	N/A = 0 yes = 2 no = 1	0.5
29	H4		Health problem	Do you go to the doctor (health center) in the past two weeks?	yes = 2 no = 1	0.5

Appendix 5 (Notes of Mt. Agung Eruption)

Eruption in 1963

Zen & Hadikusumo (1964) started their note about Mt. Agung from the fact that there were no volcanological observations on the island of Bali. This caused the limitation of instrumental records, instead of the experiences and observation of the villagers who lived close to the volcano.

According to them, the first indication activation of the volcano was frequent and recurrent feelable earthquake tremors and shocks. People live in Jehkori, a village on the southern slope of Mt. Agung (at the elevation of 928 m, 6 km from the crater). It was around 18th February 1963.

People who lived in Tianyar, the north coast, were alarmed by the tremors as well in the 18 February. At 3 am on 19th February, they stayed awake and put attention to the light and smoke coming from the top of the volcano. According to them, at 5 am, the first explosions were heard and at the same time pyroclastics were spread into the air. From the first explosion, the activities became more and more frequent.

Lava started to flow soon after the explosion. In March 1963, the length of the lava reached 7 km from the summit. The end of the flow was recorded on 3rd April with a width of 1 km and a thickness of 75 m. The temperature of the lava was 280 C.

Nuees ardentes déxplosion flowed down to the southern and southeastern slope continuously and devastated many villages and temples in the Selat sub-district. There was a death toll in this area, around 1200 people died. In this are *nuees ardentes* reached the distance of 14 km from the top and washed away everything on their way. Generally, *nuees ardentes* follow the river flow.

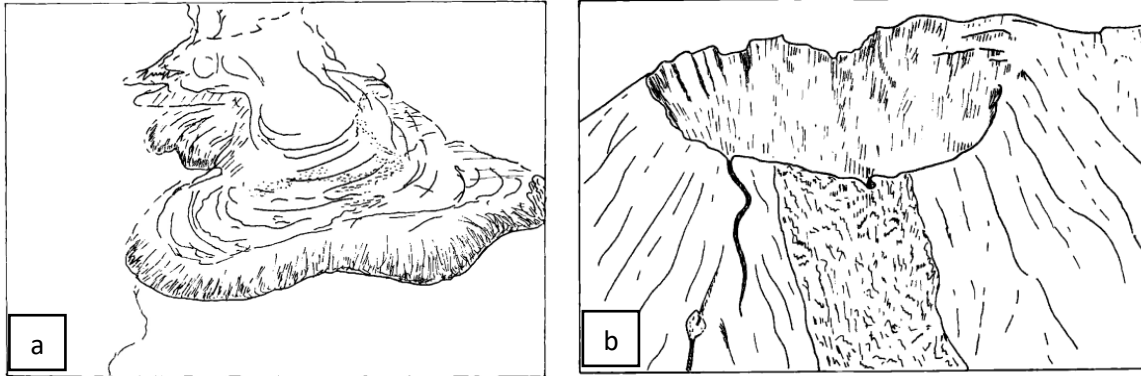
The eruption continued until May 1963. There was another big eruption (second proximal eruption) on 16th May and the aerial survey was taken on the 18th of May. The flow of *nuee ardente* went to the south, southeastern, northern, and western sector of the volcano. The northern sectors were covered completely by ash, sand, and lapilli. In the main road of Kubu, it was observed that there were *nuee ardente* deposits along the rivers and valleys. Many houses in Kubu collapsed under the lapilli load.

Bombs, lapilli, sand, and ash even fell to a distance of 17 km in Karangasem (the capital). Boms caused a fire in the place (forest and villages) they arrived. Death casualties caused by these were reported.

On May 18, strong earthquakes were felt by people in Rendang sub-district. Some cracks on the wall occurred although they were not strong enough to destroy the houses. Some landslides happened along steep slopes. In the complex of Besakih, the shocks destroyed most of the temples, also most houses in Kubu and Tjulik.

In tropical countries, lahars are a typical phenomenon, especially in Indonesia. "A lahar is a mudflow, containing debris of angular blocks of chiefly volcanic origin which sometimes attain thicknesses of dozens of meters. In Indonesia, two types of lahars are known, normal or cold lahars which might originate from heavy rain-fall on slopes covered with loose material, and the hot lahars. Ash, sand and *nuee ardentes* materials freshly deposited on the volcanic slope might still form lahar flows with a high temperature and these lahars are sometimes designated as cold lahars, no matter that the temperature is above room temperature. Some volcanologists call this hot lahar." (Zen & Hadikusumo, 1964).

Lahars formed a new topographic feature in the surrounding of Mt. Agung. Deposits in the river or lahar flow were huge because of this eruption. The current risk map of Mt. Agung was modified after the eruption in 1963.



- a. Sketch of the lava flow (20 April 1963). Source: (Zen & Hadikusumo, 1964)
- b. Aerial view of the crater of Mt. Agung from the North (6 May 1963). Source: (Zen & Hadikusumo, 1964)

The official number of death casualties in the eruption in 1963 were 1700 people. 1200 of the victims lived within 10 km in the south slope of Mt. Agung. Only 154 people were recorded to be wounded during the first cycle of activity and suffered burns caused by *nuees ardentes*. 772 cows and pigs were hit by the *nuees ardentes* as well and died. Approximately 53.670 arable lands would be a non-producing area for years. Besides, 19.395 forest areas were destroyed.

The high number of calamities were caused by the reluctancy of the people to move or evacuate during the crisis. Lack of governmental enforcement to evacuate made even worse although the Volcanological Survey of Indonesia has submitted its first report about Mt. Agung on 13th March and demanded immediate evacuation.

The eruption lasted in 1964.

The last eruption before 1963 was 120 years before. The rapture stories and witnesses decreased the awareness of Balinese people. No one remembered the prior eruption in detail and people who lived on the coast did not realize that the deposit can hit their area.

Some residents moved to other places, even other islands in Indonesia. Some of them were trickling back after months or years of evacuation. Some others move for good in a safer area.

Cultural Perspective of the eruption in 1963

Around March 17, Balinese people would have religious ceremonies in Besakih, called Ekadasa Rudra. Normally, thousands of Balinese people will come to Besakih to conduct the rituals. In March 1963, the area of Besakih was closed, but some minor temples in Selat sub-district continued the rituals. This was also the reason why people were reluctant to move.

According to Balinese people, Ekadasa Rudra, the biggest Balinese ritual that held every 100 years, and the eruption in 1963 were not a coincidence. People think that the eruption was the anger of God for something that people might have done wrongfully. Rituals to purify the sins should be conducted regardless of the eruption. Thus, in 1963, although Besakih village was closed, people kept conducting

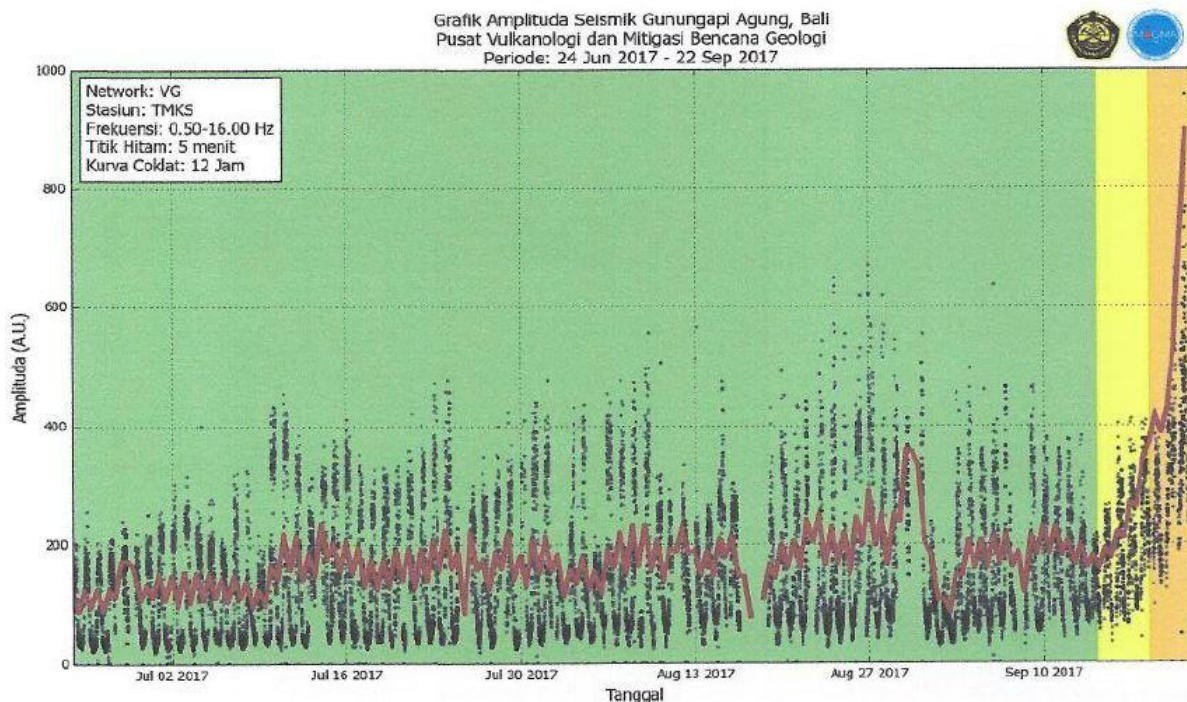
the ritual in Pura Pasar Agung (Sebudi village) which its location is even closer to the crater. Some local actors (priest and high-level religious actors) went to the crater to give the offerings (animal, foods, etc) and delivered the religious worship, including playing traditional music as part of the prayer.

Eruption in 2017

Mt. Agung erupted again in 2017, September 21. This eruption lasted on 13 June 2019. The danger came from volcanic materials such as pyroclastic flow, lava, ashes, and lahars, similar to the eruption in 1963. However, the situation was different from the previous eruption (in 1963).

The eruption in 2017, the government had been having more advanced knowledge about Mt. Agung and disaster governance. The eruption started in mid-August 2017 and since then the volcanological agency kept monitoring the activities. The reports were regularly sent to the local and national governments as the consideration in decision making, especially for the local government. Thus, when there was a signal for an eruption, the government reacted as soon as possible to demand people for evacuation.

The increase of volcanic earthquakes demands the CVGHM to raise the Alert Level to 2 in August 2017. In September 2017, both deep and shallow seismic tremors that were caused by the signal from the magma from inside the volcano increased, and the level of alert was increased into the 3rd level. After the frequent in seismicity and the increased probability of an eruption, on 22nd September 2017, the alert was suddenly increased to 4th level and people who live within a 12 km radius were asked to move. Throughout October, the earthquakes reached 1000 earthquakes per day.



In 2017, the disaster management board for the regency- and provincial-level of Bali had been established. This board had been trained and prepared to be aware of each disaster risk in their area and to be ready to do the response for the crisis.

In September 2017, the earthquakes continued to happen. Some people who witnessed in 1963 were afraid and asked people to move, but some others remained calm because what happened in 2017 was not as big as what they experienced in 1963. However, to be more preventive in saving people, the

government instructed all the residents in the surrounding of Mt. Agung (10 km radius) to evacuate. The survivors were around 150.000 evacuated to the buffer areas in Bali.

The volcanic ash in the first eruption in 2017 was reached 4000 meters above. This caused an aviation emergency and force closure of the airport (Ngurah Rai International).

From the perspective of volcanologists, the volcanic crisis in 2017 provides important lessons. Within six-week-long seismic activities from September to October 2017 show the magma activities inside the volcano. Such a process can be a signal for an eruption, but after the initial increased activities of Mt. Agung, the mountain calmed down again.

Cultural Perspective of the eruption in 2017

The belief related to the eruption of Mt. Agung remained the same which according to them the eruption is a sign of God's anger. However, the interpretation of this belief is not yet as blind as what happened in 1963 due to technological development. In 2017, the government shared information about the activities of Mt. Agung massively through TV, social media, website, and many other news canals. The local governments also communicated more frequently to convince people not to only listen to religious actors. Religious actors were also involved by the government in decision making.

Some old people refused to evacuate. Besides, because they witnessed the eruption in 1963, they also thought that eruption can be calmed down by conducting collective rituals.

Technological development can change people's perspectives about the Mt. Agung eruption. Although the belief remains the same, the people are more aware of its danger because of the real-time monitoring from the CVGHM that is placed in the slope. People own phones and HT to update the information so delivering early warnings was easier.

From the perspective of volcanologists, Mt. Agung had signed the eruption but remained calmed again in the end. The hypothesis was that the energy was not strong enough to trigger an eruption. However, from the perspective of Balinese religious leaders, when God is angry and the people read that sign then do repentance (by conducting collective rituals), the disaster can be avoided. This does not mean that the eruption can be controlled, but the calamities can be reduced by the prayers. What happened in 2017, the mountain did not erupt as strong as in 1963, the people had been evacuated, and the result, no calamities in 2017 due to eruption.

The eruption hampered economic activities. The airport was closed, the tourists were not allowed to climb to the mountain and the tourist's destination within a 12 km radius was closed, and some countries publish emergency alerts for Bali. Until now, the status of alert is still in the 3rd level which means that climbing activities are still not allowed.

Appendix 6 (Sensitivity Analysis)

It was mentioned in chapter 5 that some interviewees in the quantitative interviews did not answer the questions. In result, some blank answers occur that should be considered in the calculation. Sensitivity analysis then is done by applying several scenarios (Chapter 3). Here are the calculations with each scenario:

- 1st scenario = the missing data (N/A) is filled with 0.

	SE	Ins	D	Inf	E	H	average all	rank
BESAKIH	0.685185	0.574074	0.685185	0.653439	0.609259	0.54321	0.625059	4
SEBUDI	0.701389	0.576132	0.641975	0.623016	0.657099	0.601852	0.633577	3
TULAMBEN	0.719669	0.652778	0.671569	0.6257	0.651961	0.612745	0.655737	1
ULAKAN	0.706731	0.689103	0.713675	0.569597	0.591346	0.561699	0.638692	2

- 2nd scenario = the missing data (N/A) is filled with the lowest number for each variable.

	SE	Ins	D	Inf	E	H	average all	rank
BESAKIH	0.693287	0.584362	0.6893	0.662698	0.614198	0.616512	0.643393	4
SEBUDI	0.708333	0.604938	0.658436	0.625661	0.660185	0.622685	0.646707	3
TULAMBEN	0.727022	0.669118	0.678105	0.630252	0.661765	0.640931	0.667865	1
ULAKAN	0.711538	0.711538	0.713675	0.572344	0.597756	0.584936	0.648631	2

- 3rd scenario = the missing data (N/A) is filled with the blank (no data) for each variable.

	SE	Ins	D	Inf	E	H	average all	rank
BESAKIH	0.707988	0.59496	0.693257	0.671485	0.61916	0.750842	0.672949	3
SEBUDI	0.72309	0.637511	0.67275	0.628256	0.661966	0.726326	0.674983	2
TULAMBEN	0.736821	0.692157	0.684046	0.63506	0.665359	0.70131	0.685792	1
ULAKAN	0.71738	0.750557	0.713675	0.572344	0.599359	0.650081	0.667233	4

- 4th scenario = the missing data (N/A) is filled with an average of each village.

	SE	Ins	D	Inf	E	H	average all	rank
BESAKIH	0.690249	0.580505	0.687757	0.659227	0.612346	0.589028	0.636519	4
SEBUDI	0.705789	0.594383	0.652405	0.624692	0.659054	0.615051	0.641896	3
TULAMBEN	0.724491	0.663492	0.675854	0.628685	0.65839	0.631228	0.66369	1
ULAKAN	0.709801	0.703432	0.713675	0.569597	0.59544	0.57654	0.644748	2

- 5th scenario = the missing data (N/A) is filled with the highest score for each variable.

	SE	Ins	D	Inf	E	H	average all	rank
BESAKIH	0.717593	0.615226	0.701646	0.690476	0.627778	0.700617	0.675556	3
SEBUDI	0.729167	0.687243	0.707819	0.633598	0.666358	0.675926	0.683352	2
TULAMBEN	0.745404	0.718137	0.697712	0.643908	0.681373	0.693627	0.696694	1
ULAKAN	0.721154	0.778846	0.713675	0.580586	0.610577	0.638622	0.67391	4

Appendix 7 (Coding CH and GI)

A. Coding for Cultural Heritage (CH)

Questions	Answer and Code	Multiplier
Do you have a special ritual related to Mt. Agung?	n/a = 0 no = 1 yes = 2	0.5
What kind of danger that the ritual is offered?	n/a = 0 all hazard = 1 Mt. Agung eruption = 2	0.5
How do the temples being preserved?	n/a = 0 assigned people = 1 society = 2 both = 3	0.3333
How much money do you spend every day to provide daily ritual?	n/a = 0 Rp 0 - Rp 10.000 = 1 Rp 10.000,- - Rp 20.000,0 = 2 Rp Rp 20.000,- - Rp 40.000,- = 3	0.3333

B. Coding for Government Initiative (GI)

Questions	Answer and Code	Multiplier
Question 1: Have you ever heard about disaster simulation? Question 2: How did the simulation do in your village?	n/a = 0 do not know = 1 know = 2 know and join the simulation = 3	0.3333333
Question 1: Do you know that this village has volunteer(s) or a group of volunteers to help in disaster response? Question 2: How do they work in an emergency? Question 3: Have you experienced to work together with them or being rescued by them?	N/A = 0 -do not know = 1 -moderate = 2 -good = 3	0.3333333
Who to follow the instruction to evacuate if the mountain erupts again	N/A = 0 self-information = 1 government = 2	0.5

Appendix 8 (Govt. Initiative)

Extraction of the Government Initiative Policy

A. Peraturan Kepala Badan Nasional Penanggulangan Bencana tentang Desa Tangguh Bencana Nomor 1 Tahun 2011

Issued in 2012 by the Disaster Management Authority of Republic Indonesia (BNPB).

The emergence of this policy was underlined by the fact that people living under poverty are the front-liner when a disaster struck. Community-based disaster risk management becomes important to facilitate grassroots in understanding the risk, doing the response in a crisis, and building back better the livelihood and living environment after the disaster.

This policy is the derivative of the higher policy, Disaster Management Policy (Undang-Undang Nomor 24 Tahun 2007). The focus of the higher policy which is then detailed in Perka Destana is the necessity of the government has to protect the community, including from disaster/crisis.

Resilience village is a village that can independently adapt and face disaster risk (hazard) as well as build back immediately after the shock (disaster). In a resilience village, the society/community is actively assessing, analyze, responding, monitor, evaluate, and reduce disaster risk in their area, especially to maximize the local resource to ensure sustainability.

To implement this policy, at least it should be created Head of Village Regulation.

The objective of this policy:

1. Protect the community, especially who are vulnerable from disaster impact,
2. Improve the community's role in managing resource to reduce disaster risk,
3. Strengthen the community's institution in managing resource and maintaining the local wisdom for disaster risk reduction,
4. Strengthening government's capacity in supporting resource and technical aspect in disaster risk reduction,
5. Strengthen the cooperation between stakeholders, local government, business sector, academia, NGO, and other organizations.

Generally, Resilience Village has some components:

1. Legal
2. Village Disaster Management Plan
3. Institution
4. Budget Allocation
5. Capacity Building
6. Disaster Management Programmes Implementation

In the implementation phase, there is three-level of Resilience Villages:

1. Desa/Kelurahan Tangguh Bencana Utama
2. Desa/Kelurahan Tangguh Bencana Madya
3. Desa/Kelurahan Tangguh Bencana Pratam

Activities in implementing the policy are:

1. Risk Assessment (assess the hazard, assess the vulnerability, assess the capacity, and assess the risk)
2. Disaster Management and Contingency Planning
3. Creating a Disaster Risk Reduction Forum
4. Improving the Capacity for Community and Village Government and Actors
5. Integrating DRR into Development Plan
6. Executing DRR Programme
7. Evaluating and Monitoring as well as Reporting the progress

B. Peraturan Menteri Sosial Nomor 128 Tahun 2011 tentang Kampung Siaga Bencana

Issued in 2011 by Ministry of Social Service Republic Indonesia

Kampung Siaga Bencana (Disaster Preparedness Village) is a medium for community-based disaster management which is used as a place for disaster management programmes.

KSB is created to give protection to the community from hazard and disaster risk by organizing some disaster prevention and management activities through the use of the local natural and human resources.

Objectives of the KSB:

1. Give understanding and awareness to the community about the hazard and disaster risk.
2. Create community-based preparedness network and strengthen the social network
3. Organize the trained community
4. Ensure sustainable community-based disaster preparedness
5. Optimize the potential and resources for disaster management.

Mechanism of implementation: Regent/Mayor determines KSB. The community can purpose to create KSB in their places.

Pasal 10 continues this statement:

1. Community discussion to elect KSB team.
2. KSB team proposes the establishment of KSB through the social agency, completed by the head of the village recommendation letter.
3. Regent/Mayor establishes the name, location, and KSB team.

Qualification of KSB:

1. It has a specific hazard within the community's place of living.
2. Has the readiness and active participation of the community within the risk zone to create KSB.

Team of KSB:

1. Leader/chief
2. Secretary
3. Treasurer
4. Evacuation division
5. Public kitchen division
6. Logistic division

7. Temporary settlements division.

Tasks of the team:

1. Plan and create a work plan
2. Evaluate the programme implementation
3. Report the result to the social agency or social ministry
4. Coordinate with stakeholders in disaster management

Activities are done by the KSB team. Activities mentioned are:

1. Socialization, Counselling, and Awareness Building about disaster
2. Prepare local early warning system
3. Map local hazard zone and evacuation route
4. Inventory the local resource
5. Build disaster “lumbung” (a place where people can gather to talk about disaster)
6. Perform capacity building
7. Perform drills (adjusted to the hazard type)
8. Build a network with stakeholders
9. Perform preparedness briefing in special time
10. Create a database for disaster victims/survivors when disaster strikes
11. Implement the effort of disaster risk reduction to face upcoming disaster
12. Support all agencies in social recovery

Comparison of those policies

Differences	Perka BNPB	Permensos
Team	Established during the implementation Village government take the lead	Can be proposed by the village The team can be anyone as long as the consensus between community accepts
Legal aspect	Legalised by the village head regulation	Legalised by Regent/Mayor regulation
Product	Documents (DM plan, Contingency plan, report for implementation)	A secretariat (place) – called lumbung Documents (report for the activity)
Approach	Top-down	Bottom-up
Issues addressed	All the phase of the disaster management, strengthening in the pre-disaster	All the phase of the disaster management, but the goal is to run drills
Continuity	Dependent on the national/regency government for the first three stages (Utama, Madya, Pratama), then the continuity depends on the community.	Dependent on the community