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SOFT MITIGATION IN AREAS OF REOCCURING NATURAL DISASTERS: FLOODS IN QUEENSLAND, AUSTRALIA AND THE VOLCANIC ERUPTIONS OF MT. MERAPI IN YOGYAKARTA, INDONESIA

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ABSTRACT

The random nature of natural disasters makes it difficult to study the effectiveness of government policies to prepare for natural disasters and reduce their detrimental impacts. Natural disaster preparation is often reactionary to prior events, yet the effectiveness of disaster preparation and mitigation are not easily measured due to the unpredictability of future events. The 2011 and 2013 floods of Queensland, Australia and 2006 and 2010 volcanic eruptions of Mt. Merapi in the Yogyakarta Special Region, Indonesia provide unique opportunities to study the effectiveness of government and community actions taken between the first and second disasters. This work synthesizes academic research, government reports, and agency findings from Australia and Indonesia to draw conclusions about the disaster management preparation, mitigation, response, and recovery in Australia and Indonesia. This work focuses on soft mitigation measures including governance's role in the disaster management, the cooperation of national and regional emergency management agencies, and measures of engagement with the local communities.

Keywords: Disaster mitigation; Disaster management; Emergency preparedness; Resilience

1. INTRODUCTION

Australia and Indonesia are regularly exposed to natural disasters and both governments are consistently searching for ways to mitigate the risks and effects. A Productivity Commission (2014) report identified Australian natural disaster funding as "not efficient, equitable or sustainable." This lack of financial efficiency stems partly from governments over investing in post-disaster reconstruction while simultaneously underinvesting in disaster mitigation.

Disaster mitigation can be divided into hard and soft measures (Lichterman, 2000), both are vital to disaster preparedness and response. Hard mitigation refers to the investment in physical infrastructure, such as the construction of seawalls and dykes to mitigate against tsunamis and floods (Aldrich & Sawada, 2015). Soft mitigation reduces the effects of natural disasters that hard mitigation cannot protect against. Soft mitigation measures include investments into insurances, improved land use planning and building regulations, and community preparedness (Aldrich, 2015).

The return on the investments of hard and soft mitigation measures are often difficult to assess due to the randomness of natural disasters (Productivity Commission, 2014). For example, a homeowner may never have to file a claim on a flood insurance policy if no flooding occurs. This randomness makes it difficult for the governments and households to clearly understand the benefits of disaster mitigation investments (Kunreuther, 2006).

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This lack of understanding is a challenge in building government policies which encourage and enable disaster risk management at community, household, and individual levels.

This paper compares the effectiveness of soft disaster mitigation measures in Queensland, Australia and Yogyakarta Special Region, Indonesia, with a focus on the economic and social preparedness. The reoccurrence of disasters in Queensland and Yogyakarta may provide some insight into the effectiveness of the implemented mitigation measures between the prior and latter disasters. The economic and demographic divergence between Australia and Indonesia provide uniquely different cases to study disaster management governance and soft mitigation measures. In conducting this analysis, the paper strives to identify best practices for economic and social mitigation measures and provide policy recommendations for more strategic disaster preparation.

Section 2 overviews the background behind the Queensland floods, Mt. Merapi eruptions, as well as recent disaster research about soft mitigation measures. Section 3 describes the methodology and information sources used to determine the soft mitigation measures. Section 4 analyzes the governance and soft mitigation measures found in the case studies. Section 5 concludes with the takeaway messages and policy recommendations from this paper.

2. BACKGROUND

2.1. Queensland floods in 2011 and 2013

From December 2010 to February 2011, Queensland experienced floods that affected 210 towns and suburbs and caused damages in excess of $6.8 billion AUD (Queensland Reconstruction Authority, 2011). The 2011 floods affected 78% of Queensland (an area larger than Germany and France combined), affected 29,000 homes and businesses as well as 2.5 million people, and resulted in 33 deaths (Queensland Floods Commission of Inquiry, 2012). In 2013, Tropical Cyclone Oswald passed over parts of Queensland resulting 6,500 properties across 90 towns being damaged or uninhabitable at a cost of $2.4 billion AUD (Meteorology, 2013). Such devastation is not unique. Australia recorded 83 floods from 1965 to 2010, with 14 considered as major flooding events (Queensland Reconstruction Authority, 2011). The widespread devastation and economic impact of floods has prompted the implementation of a Strategic Policy Framework for Disaster Management by the Queensland Government (2010).

The 2014 Australian Government Productivity Commission (2014) report highlights the disaster insurance as an important risk management option. The disaster insurance as a measure of economic preparedness and mitigation is viable option in an industrialized and sparsely populated nation such as Australia. However, a more heavily populated and less wealthy nation such as Indonesia may not have the financial resources to invest as heavily in economic mitigation measures like disaster insurance. A country lacking financial resources can still employ measures of social preparedness as a soft mitigation technique.

2.2. Mt. Merapi eruptions in 2006 and 2010

Mt. Merapi sits 2,980 meters above sea level and spans the provinces of Yogyakarta Special Region and Central Java. The 26 October 2010 eruption of Mt. Merapi was the largest of the previous five eruptions from 1994 to 2006, with a total value of loss assessed at US$36.2 billion (World Bank GFDRR, 2014). The 2010 eruption claimed a

total of 386 lives (277 in Yogyakarta and 109 in Central Java) and heavily damaged 2,856 houses in addition to disrupting roads, bridges, and educational, health, and other public facilities. Over 350,000 people were evacuated from the affected areas, and while many people were able to return to their homes over 150,000 people were displaced (Pearson, 2013).

From April to July 2006, Mt. Merapi experienced a series of seismic activities and eruptions that were smaller in scale than the 2010 eruption, yet still required a large scale evacuation. By 19 May 2010, the Red Cross estimated that over 20,000 persons were housed in the emergency shelters (Wilson, Kaye, Stewart, & Cole, 2007). The most devastating impact of the activity was caused by a M 5.9 earthquake on 27 May that strucked 30km south-southwest of Mt. Merapi. The earthquake killed over 5,800 people, injured over 20,000, and destroyed over 150,000 homes in the region (Wilson et al., 2007). Although such seismic and volcanic activity cannot be prevented, the Indonesian government has taken initiative to reduce their impacts.

The community based disaster mitigation programs are an important element of disaster governance, as recognized by the former Indonesian President H.E. Dr. Susilo Bambang Yudhoyono's 2012 address to the United Nations Office of Disaster Risk Reduction (UNISDR, 2012). One example of community based disaster mitigation in Indonesia is the founding of Jalin Merapi, a community based radio station that attempts to spread quick and accurate information to residents during a disaster. The formation of Jalin Merapi was a response to a perceived lack of government ability to handle emergencies (Djalante, 2013) and an example of the downward trickle of disaster management to the community level. Even at the highest level of government, President Yudhoyono recognizes that a strategic and effective financing is needed to achieve local capacity for disaster risk mitigation (UNISDR, 2012).

2.3. Disaster mitigation as a local responsibility

The Australian and Indonesian governments are attempting to devolve the responsibilities of disaster mitigation from the government to the community, household, and individual levels. Yet, there are poorly understood elements of this process.

First, the government strategies to encourage disaster mitigation at local levels are not clearly outlined. Many government reports and academic papers describe the importance of community engagement, but there is less information on the concrete strategies to engage the community. One example is the Queensland's AUD $24 million per annum Natural Disaster Resilience Program, where no public information exists on how the program funds are being spent.

Second, the efficacy of disaster mitigation at local levels is not clearly understood. It remains uncertain how disaster mitigation policies, such as investing in insurance or creating community information databases, may benefit a community, household, or individual.

Finally, there has been no effort in Queensland and Yogyakarta region to measure the social impacts of such policy. A recent wave of research suggested that measuring a community's level of social capital – the number of networks and ties that bind people together – has predictive ability about a community's resilience and ability to recover from a disaster (Aldrich, 2012; Aldrich, Oum, & Sawada, 2014). It remains unclear in Queensland and Yogyakarta whether any of the initiatives to increase local disaster mitigation responsibility has had any measurable effect in the communities.

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3. METHODOLOGY

The first goal of this research is to identify Australian and Indonesian government strategies to move disaster mitigation to local levels. Second, the research searches for the documented impacts on disaster mitigation and the community as a whole following these policies. Third, suggestions for both countries to improve their community local mitigation strategies are given.

Local level disaster mitigation information was collected from a range of government reports, academic papers, and news sources. General information on the Queensland floods was obtained from the federal Australian Government and the state Queensland Government. General information on the Mt. Merapi eruptions were obtained from the National Disaster Management Authority (BNPB), World Bank Global Facility for Disaster Reduction and Recovery (GFDRR), and other related agencies.

4. ANALYSIS

4.1. Queensland floods disaster governance

In 2010, a Disaster Management Strategic Policy Framework was issued by the Queensland Government (2010) to outline disaster management arrangements. This Policy Framework describes the importance of "[working] with communities to focus on mitigation strategies as part of a long term recovery." Researchers also support a model of shared responsibility among the central government, local government, and community as central to effective disaster mitigation (McGowan, 2012). The success of future disaster mitigation is believed to be contingent upon effective community engagement (Howes et al., 2015). Some of the Queensland Government's actions of community disaster mitigation are undertaken through the Natural Disaster Resilience Program (NDRP) (Queensland Reconstruction Authority, 2011).

The NDRP operates at an annual cost of AUD $24 million to support the delivery of natural disaster resilience projects to local communities (Queensland Government, 2014). Previous projects funded by the NDRP include disaster management training programs for schools, businesses, community groups, and volunteers for the Cassowary Coast Regional Council; improving disaster support for those with disabilities throughout Queensland; and youth education programs regarding disaster resilience. Programs like NDRP support the idea of transferring both disaster governance and mitigation functions (Melo Zurita, Cook, Harms, & March, 2015) and funds (de Souza, Kinoshita, & Dollery, 2015) from the central government to the regional and local levels, but the outcomes are uncertain. Yet, opaque accounting and lack of public information makes the outcomes of the NDRP program unknown and immeasurable by the greater public.

The effectiveness of the NDRP in Queensland is difficult to judge partially due to a lack of public accounting of the types and locations of programs, as well as their levels of funding. This lack of public information for a soft mitigation program such as NDRP is in stark contrast to hard mitigation investments. Queensland's Community Resilience Fund operates at an annual cost of AUD $40 million and clearly outlines the types of hard mitigation and infrastructure projects supported by the funding scheme (Queensland Government, 2016a). The Queensland Government emphasizes having adequate insurance, knowing your neighbors, and being aware of communication networks as disaster mitigation techniques. Yet, programs to promote and adapt such measures and subsequent obstacles in their implementation are not clearly outlined.

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4.2. Queensland floods soft mitigation measures

4.2.1. Financial mitigation measures

Even when disaster mitigation programs reach the broader community, believing disaster mitigation is a personal responsibility does not necessarily translate into measurable action (Keogh, Apan, Mushtaq, King, & Thomas, 2011). A survey of Queensland residents and business owners in the flood prone community of Charleville reported a strong sense of personal responsibility to prepare and mitigate for disasters. Despite this belief, less than a third of surveyed residents and less than half of businesses had insurance to cover a disaster. Difficulty in obtaining flood insurance for households and businesses located in the flood plain was cited as a reason for low levels of insurance coverage.

The anecdote of Charleville brings up an important obstacle in promoting soft mitigation through insurance: government policy may clash with the financial interests of insurance companies. If the government wants residents and businesses to invest in disaster insurance, additional government regulations, mandates, or subsidies may be required to ensure the affordable levels of coverage. For example, subsidizing insurance for households and businesses located in the flood plains may lead to lower long term disaster expenditures from the government. Yet, to the author's knowledge, no such cost-benefit study currently exists in the Queensland context. It is also uncertain whether any additional government regulations promoting disaster insurance has been implemented since the Charleville study or whether flood events prompted investments into flood insurance.

4.2.2. Social mitigation measures

Other Queensland communities, such as the town of Mackay, have deemed disaster mitigation and management as government responsibilities (Apan et al., 2010). However, the rising omnipresence of smartphones and social media may be viable platforms to shift disaster mitigation and management to local levels. During the 2011 Queensland floods, information from emails, text messages, and Twitter were used by the Australian Broadcasting Channel to create real-time flood maps and reports accessible to anyone with an internet connection (McDougall, 2012). In the early days of the flood, the maps reported flooded areas, road closures, and the location of evacuation centers. Later on, the information progressed to include water supplies, garbage bin locations, and lost and found pets. Twitter allowed people to post about the flood in real time. Facebook allowed government groups like the Queensland Police Service to provide flood information to users.

Cell phones and other personal electronic devices are tools for soft mitigation during a disaster by increasing a person's social capital. Having access to platforms such as Twitter and Facebook allows users to have direct contact to others undergoing the same experience. For example, multiple users can connect to find the best route to evacuate from the same town. People from different walks of life that would otherwise not have anything in common may share their knowledge to achieve a common goal of safely navigating a disaster via social media platforms. Such action is a form of "bridging" social capital, which builds connections between different heterogeneous groups and is generally considered more difficult to create.

The first shortcoming of using cell phones and personal electronic devices as a disaster management measure is the reliance on a functioning network infrastructure. Cell towers and internet access need to be available for people share on social media platforms. This may not be realistic depending on the natural disaster's catastrophe

level. A secondary system, such as Jalin Merapi's radio news reports, may be a valuable failsafe when more technologically advance networks fail.

The second shortcoming of personal electronic devices as a disaster mitigation tool is that they are often turned to once a disaster is already imminent. Although many people are turning to their cell phones as a resource in times of a disaster, there may be those that are not as technologically savvy and uncertain of how their phones can be used in an emergency. In Queensland, the attempts to increase disaster mitigation via electronic devices during peaceful times are unclear. Testing disaster warning systems, such as through trial SMSs, may lead individuals to associate disaster mitigation with their personal electronic devices. Using disaster simulations to train vulnerable populations and the greater public on using their phones to navigate a disaster during peaceful times may contribute to the improvement of disaster mitigation.

4.3. Mt. Merapi disaster governance

Disasters in Indonesia are managed at the federal level by the National Agency for Disaster Management (BNPB) and at the regional level by the Regional Agency for Disaster Management (BPBD). Since the inception of the BNPB in 2008, the role of the organization has been to develop the capacity and regulations for disaster recovery (United Nations Development Program, 2014) through cooperation with other agencies. For example, the National Army and National Police are engaged for rescue efforts. The Ministry of Social Affairs is involved in the management of displaced persons. The Ministry of Energy is involved in the development of warning systems, and the Ministry of National Education is involved in the disaster risk reduction.

The coordination of BNPB with other institutions is largely focused on recovery and relief (Bakkour et al., 2015). Yet, recent efforts push for disaster mitigation at all institutional and societal levels (Intarti, Fitrinitia, Widyanto, & Simarmata, 2013) through direct community engagement for preparation, trust building, education and training, self-organization and attempts at faster dissemination of disaster data.

4.4. Mt. Merapi soft mitigation measures

4.4.1. Social mitigation measures

Direct community engagement to build capacity against and mitigate disasters have occurred through 'sister village' and 'desa tangguh bencana' (disaster resilient village) strategies. The 'sister village' strategy partners a village in a disaster prone area with a safer village (United Nations Development Program, 2014). Residents in the safer villages have agreed to provide shelter, food, and other daily essentials when disasters strike. As a result, thousands of people from 32 sister villages have evacuation plans for future disasters (Ramsay, 2013). The disaster resilient village program engaged five from 156 government targeted villages (Rahadi, 2013) to exchange knowledge with higher levels of disaster management (Maarif, Damayanti, Suryanti, & Wicaksono, 2012), but several obstacles were recognized in this disaster mitigation attempt.

First, the local community participated in formulating the disaster resilient village strategy, but engagement with business owners, SMEs, and stakeholders from the private sector have been limited (Rahadi, 2013). The Yogyakarta Disaster Risk Reduction (DRR) forum is another initiative to bring together CSOs, NGOs, businesses, and government agencies to implement disaster management and mitigation at local levels (Shaw & Izumi, 2014). Yet, no representatives from SMEs were at the forum due to coordinators believing they did not have enough capacity for impact (Pearson, 2013).

Coordinating local disaster resilient village strategies with disaster agencies at the Yogyakarta DRR forum may be essential to distribute disaster mitigation to many stakeholders. A way to engage the community and organizational levels is to include SMEs in the Yogyakarta DRR forum. SMEs already have a stake and valuable insights into the local communities, and their participation in the Yogyakarta DRR forum could serve as a first judgment over the viability of new disaster management policies.

Additionally, the participation of SMEs in the Yogyakarta DRR forum may increase trust during times of disaster. During the 2010 eruption, many local business owners refused to evacuate until the military agreed to protect their assets from looters (Pearson, 2013). Using the Yogyakarta DRR forum to establish agreements and clarify stakeholder roles may expedite the evacuation process and mitigate disaster risks.

A second obstacle recognized while creating disaster resilient villages was a perceived lack of information dissemination from agencies to the local communities and uneven levels of disaster mitigation awareness (Rahadi, 2013).The perceived lack of information from the Indonesian government and agencies has led to self-organized information distribution at the community level, such as the Jalin Merapi (Merapi information network) and Padang community radio stations (Djalante, Thomalla, Sinapoy, & Carnegie, 2012). The perceived lack of information from the government to the community has inadvertently raised some communication barriers between government agencies and community organizations. For example, Jalin Merapi incorporated NGOs and community based organizations in their radio network (Djalante, Holley, Thomalla, & Carnegie, 2013), but was reluctant to further expand their collaboration due to the fear of losing efficiency and timeliness in their ability to disseminate information (Pearson, 2013).

The reluctance of Jalin Merapi to build additional collaboration reflects a greater need from governing agencies to clarify stakeholder roles during non-disaster times. Beyond Jalin Merapi's radio network, reports from the field through social media platforms like Twitter, Facebook, and SMS may be critical in distributing the extent of damages, evacuation processes, and onsite community conditions (Djalante et al., 2013). Integrating several levels of direct disaster communication can be essential to mitigation, but sufficient planning and funding are required for recipients to trust in the information.

Education in the Yogyakarta Special Region has integrated disaster risk reduction into formal school education, university level training, and training for journalist and media (Rahadi, 2013). The utilization of different communication platforms needs to be incorporated into community education. For example, websites and social media hash tags for the community to retrieve and share information should be well established prior to a disaster. Disaster simulations can allow residents to practice the distribution of information and highlight any difficulties in the process. Information can also be coordinated with Jalin Merapi so areas without internet access can still listen to the vital information. As technology continually changes, education programs needs to be aware of current trends while providing a database and reliable source of information.

This brings up a third obstacle in creating disaster resilient villages, that public information and access to disaster databases are limited (Djalante et al., 2013). Creating a database of disaster information that engages local residents can be a cost effective manner to spread information and mitigate disasters. For example, Queensland has created a website with a series of interactive maps to pinpoint locations that are particularly vulnerable to floods (Queensland Government, 2016b). The level of public

engagement with the website is unclear, but ongoing community education in disaster awareness can inform a wider public of available information.

4.4.2. Financial mitigation measures

Finally, there is an ongoing difficulty in getting community members and disaster agencies to buy insurance to mitigate disasters (Djalante et al., 2013). At the community level, individuals often perceive the risk caused by disasters to be so low that they cannot justify buying insurance (Kunreuther, 2006). At the government level, few parties are interested in providing disaster insurance for vulnerable families (Rahadi, 2013). Even when funds are allocated to provide financial services, the distribution of support is often non-systematic (Nurdin, 2015). The return on investment of disaster insurance is unclear. Countries like Indonesia, which is more limited financially than Australia, are left to make tough decisions about the expenditure of disaster funds. The next section aims to guide future disaster mitigation spending.

5. CONCLUSION

A skewed perception of disaster risks is a barrier in getting both Australians and Indonesians to financially mitigate disasters through purchasing insurance. Additionally, there is a lack of government mandates for insuring at-risk communities. The combination of factors results in communities that are financially exposed to future natural disasters. Mandating disaster insurance may be a quick fix for governments to unload the financial burden of disasters, but may result in backlash from businesses and communities due to the increased costs and less capital to be spent in other areas of the economy. Alternatively, the governments can improve understanding and awareness of disaster insurance benefits. For example, providing a web based calculator of the potential long term savings with disaster insurance may contribute to a better understanding of the financial risks associated with natural disasters.

Australia and Indonesia both have agencies that raise awareness and preparedness for disasters, but seem to lack a sense of disaster mitigation that is ingrained into the culture. Japan, a leader in disaster preparation (Rauhala, 2011), has several levels of soft mitigation techniques to increase disaster awareness. Handouts on disaster procedure and evacuation maps of the local area are given to new renters and property owners. Flood and tsunami prone areas are marked on public streets. The Tokyo Fire Department puts on an annual New Year's performance that is promoted as a cultural event, but also acts as platform to educate the public in disaster safety. Even September 1st is Disaster Prevention Day to commemorate the 1923 Great Kanto earthquake. In the long term, continued community engagement may change community perceptions and increase disaster mitigation.

There was only sparse information of the community impacts of disaster mitigation programs. Additionally, it was unclear which measures from prior disasters helped the community during subsequent disasters. In order to determine the effectiveness of government programs and expenditures, future work should set quantitative measures of participation and effectiveness. In Australia, insurance coverage data can be applied to determine whether disaster awareness programs or disaster exposure affects insurance purchasing behavior. In Indonesia, user traffic on disaster management websites and social media can be used to gauge levels of community engagement.

Australia and Indonesia both recognize the emergence and importance of community organized information networks like Jalin Merapi or social media platforms. Clear planning of how to process the different levels of information and high quantities of

data can improve disaster coordination and mitigate risks. Additionally, training schemes for the greater public and vulnerable populations (seniors, people with disabilities) can help insure that more people are able to attain and use vital information through community organizations and government databases.

Finally, more transparent accounting for funded disaster mitigation programs can allow other communities to learn from the initiatives in Queensland and Yogyakarta Special Region. Greater details of disaster mitigation programs can add both scrutiny and recommendations for improvement from disaster management agencies, researchers, the general public, and others with a stake in disaster mitigation.

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