Royal Geographical Society with IBG
Advancing geography and geographical learning
AREA
Area (2010) 42.1, 117–126 doi: 10.1111/j.1475-4762.2009.00899.x

Doing social volcanology: exploring volcanic culture in Indonesia

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Revised manuscript received 14 March 2009

Social volcanology refers to the integration of social science research methods into the traditionally physical domain of volcanology. This emerging multi-methodological research area draws from many disciplines in order to examine hazard-mitigation strategies that are community focused. A key facet of social volcanology is the role of culture and this paper explores the influence of traditional cultural values in relation to the 2006 volcanic crisis at Mt Merapi (Java). This paper describes the complex amalgam of cultural and socio-economic factors that influence community reactions to volcanic hazards and demonstrates the need for interdisciplinary hazard research.

Key words: *volcanology, culture, Merapi, social, interdisciplinary, participatory*

Introduction

In 1983, when discussing the incomplete nature of disaster studies, the geographer Kenneth Hewitt suggested that physical hazard research had stagnated, arguing that by only focusing on 'information that centres the problem upon natural extremes and damaging events, they easily miss the main sources of social influence over hazards' (Hewitt 1983, 7). His remarks came during a period in the 1970s and 1980s when quantitative physical hazard and disaster research was shifting to incorporate social factors (e.g. Burton *et al.* 1978; Alexander 1993; Merriman and Browitt 1993; Bell 1999; Smith 2001; Wisner *et al.* 2004). That shift gained some momentum when the United Nations designated an International Decade for Natural Disaster Reduction (1990–2000) and called for dialogue between scientists, social scientists and the at-risk community. Then in 2005, the United Nations International Strategy for Disaster Risk Reduction implemented the Hyogo Framework for Action (HFA). Its goal is by 2015 to holistically build resilience to and reduce loss from disasters. As a consequence of all these initiatives, volcanologists have begun to undertake and publish work incorporating social science theories and methodologies (e.g. Cashman and Cronin 2008; Chester *et al.* 2008; Dove 2008; Haynes *et al.* 2008; Lavigne *et al.* 2008; Paton *et al.* 2008). This creative discipline focuses on reducing volcanic risk by examining the local societies and in this paper will be referred to as *social volcanology*.

This paper provides an insight into the importance of social volcanology through a current interdisciplinary research project examining cultural reactions to volcanic hazards. Local traditions and belief systems can be extremely influential in volcanic regions, motivating local reactions during and prior to a crisis (Cashman and Cronin 2008; Swanson 2008). Various fatal volcanic events over the last decade have demonstrated the need to improve the long-term understanding of those communities at risk. These events also emphasise the need for volcanologists to initiate and join interdisciplinary projects that combine the physical and social sciences to produce holistic risk reduction strategies.

Examining both risk and culture brings together many research strands, in particular vulnerability and geomythology. Vulnerability studies encourage a sustainable livelihoods approach that attempts to develop more resilient communities by tackling their basic socio-economic issues (Dibben and Chester 1999;

Paton and Johnston 2001; Kelman and Mather 2008; Mercer *et al.* 2008). Geomythology explores local knowledge to aid the compilation of volcanic eruptive histories, focusing on oral histories and traditional beliefs that retain information about hazard events that may not be obvious in the geological record (Piccardi *et al.* 2008; Vitaliano 2007; Chester 2005; Chester *et al.* 2008; Swanson 2008). These previously discrete research strands overlap within volcanic cultural studies. For example, indigenous oral histories can be used to reconstruct past eruptions, but can also provide culturally acceptable and effective mitigation techniques (Cronin *et al.* 2004a 2004b; Cashman and Cronin 2008). This was demonstrated by the self-evacuation of 78 000 residents of Simeulue Island (150 km off the west coast of Sumatra, Indonesia) during the 2004 Indian Ocean tsunami. Remarkably, less than 1 per cent of the population died during the crisis. The community were motivated to evacuate to higher ground based on an oral history that had been influenced by a previous tsunami (impacting over a century ago) that had killed 70 per cent of the population (Gaillard *et al.* 2008; McAdoo *et al.* 2006). In this way, traditional cultures can actually reduce vulnerability by strengthening their resilience. Despite this, volcanologists and disaster managers have often disregarded cultural adaptations when designing and implementing risk reduction strategies. In doing so, any 'well-intentioned' actions could erode traditional hazard knowledge and in fact reduce community resilience (Oliver-Smith 1996).

Culture is shaped by poverty, politics and the environment, but elements of culture such as theodistic coping strategies often occur regardless of socio-economic boundaries. In other words, cultural vulnerability is a global indicator of risk that can produce unpredictable reactions beyond scientific logic, even in countries that consider themselves highly developed, scientific and modern. For example, Chester *et al.* (2008, 221) describe the religious reactions to eruptions in Italy, detailing how at Mt Etna in 1971 and on Mt Vesuvius in 1944, those who were threatened by lava flows 'paraded images and bones of local saints' in order to halt the advance of lava flows. Recently, in 2001, the Archbishop of Catania, Sicily, held mass in order to prevent Mt Etna's advancing lava destroying the city (Chester 2005). These reactions seem unpredictable and uncontrollable, causing additional complications for emergency managers.

Indonesia is a nation that has an intense cultural relationship with volcanoes and hazards. Indonesians have a diverse, complex and deeply devout connection with the environment and as a consequence often rely on their traditional, animistic beliefs during a crisis (Lavigne *et al.* 2008). An example of this occurred in 1963 when over 2100 people were killed during an eruption of Mt Agung in Bali (Zen and Hadikusumo 1964). Mt Agung is the most sacred volcano in Bali and believed to be the dwelling place of both holy and evil deities. Hundreds died whilst processing towards the lava flows, believing that these hazards represented their gods descending from the summit.

The examples from Indonesia (Simeulue Island and Mt Agung) suggest two counter perspectives concerning cultural responses to geological hazards. One argues that having built on past experience communities have developed effective mitigation techniques. The other suggests that traditional beliefs have the potential to increase a population's vulnerability by encouraging a refusal to accept official warnings. The remainder of this paper will explore both of these perspectives through a case study of the 2006 eruption of Mt Merapi. The reaction to this eruption in Central Java is intriguing because the findings correspond to both perspectives of culture. In early 2006 local residents refused to evacuate because they reportedly trusted their traditional belief systems more than official warnings (BBC 2006; Alfano 2006). The residents relied on their knowledge of traditional precursors, and although this placed them in extreme danger they survived. In order to understand the events in 2006, this case study is divided into three parts. The first part introduces Mt Merapi and its extensive eruptive history. The second part considers the main field sites and the qualitative methodology. The final section presents and discusses residents' hazard perception and cultural reactions.

Case study: Mt Merapi, Central Java

The fire mountain

Indonesia is one of the most volcanically active countries in the world, with over 130 active volcanoes claiming over 130 000 casualties since 1800 (Thouret *et al.* 2000; Voight *et al.* 2000a). However, 60 per cent of its population live around just 16 active volcanoes, and of these Mt Merapi in Central Java is the most active, with over 23 eruptive episodes in the last 100 years (Voight *et al.* 2000b). Approximately 1.1 million people live on the flanks of this volcano, which erupts effusively (non-explosive) almost continuously, explosively every 8–15 years, and violently every 26–54 years (Thouret *et al.* 2000). The conical stratovolcano looms over the 400 000 residents of Yogyakarta city,

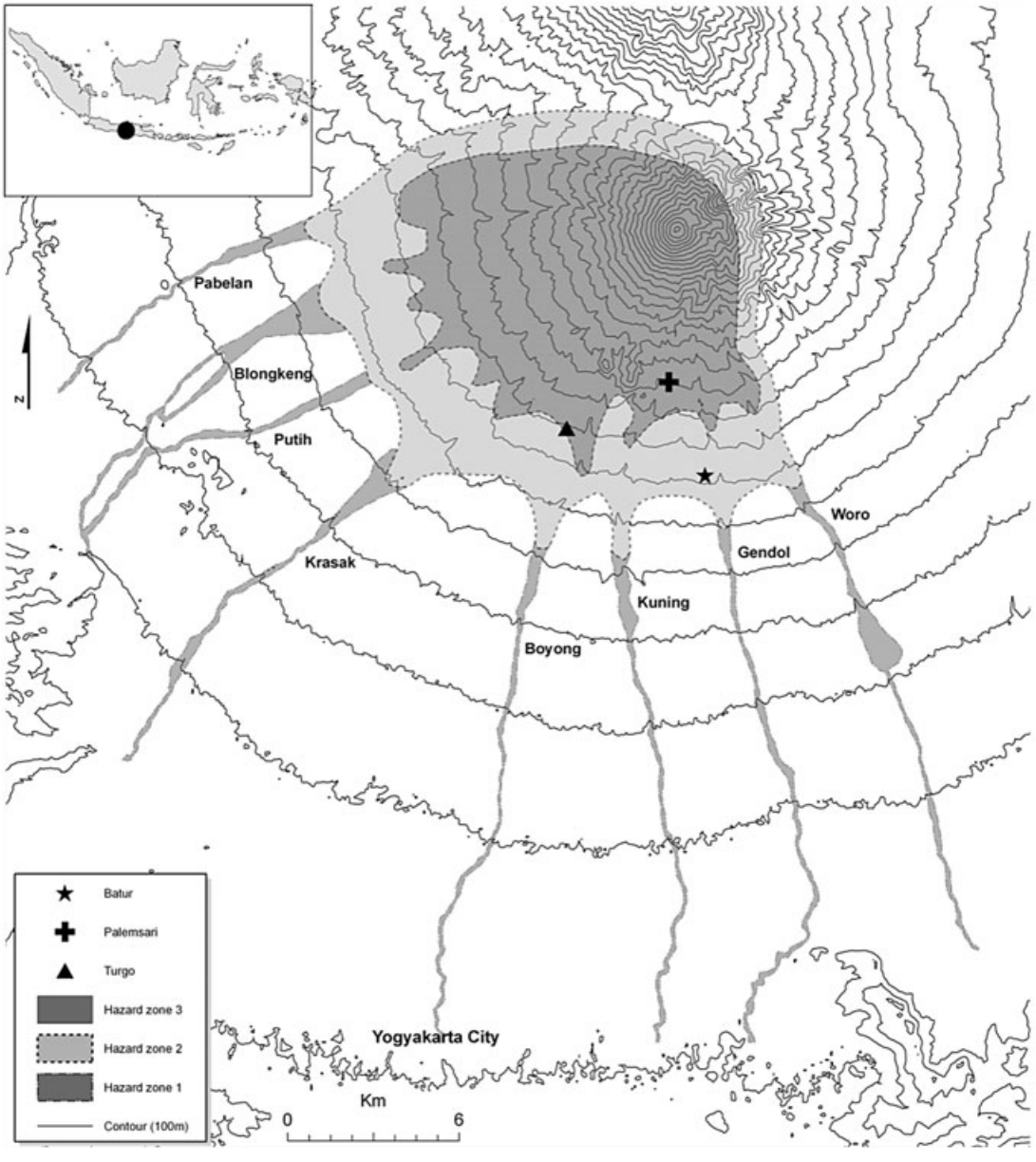

Figure 1 Mt Merapi, key field sites, settlements and official hazard zones
Source: Derived from Hadisantono *et al.* 2002 and courtesy of BAKOSURTANAL the National Agency for Survey and Mapping (Indonesia)

situated less than 25 km to the south of the summit dome (Figure 1). Geological evidence, noted by Thouret *et al.* (2000), confirms that pyroclastic flows (burning clouds of ash) have travelled over 20 km from the vent and structures in the vicinity of the city have been buried by metres of volcanic material. Even relatively small eruptions in 1872 and 1930/31 killed 200 and 1300 people respectively, whilst in 1994, 64 people were killed and over 2000 were made homeless (Thouret *et al.* 2000; Schlehe 1996).

Area Vol. 42 No. 1, pp. 117–126, 2010
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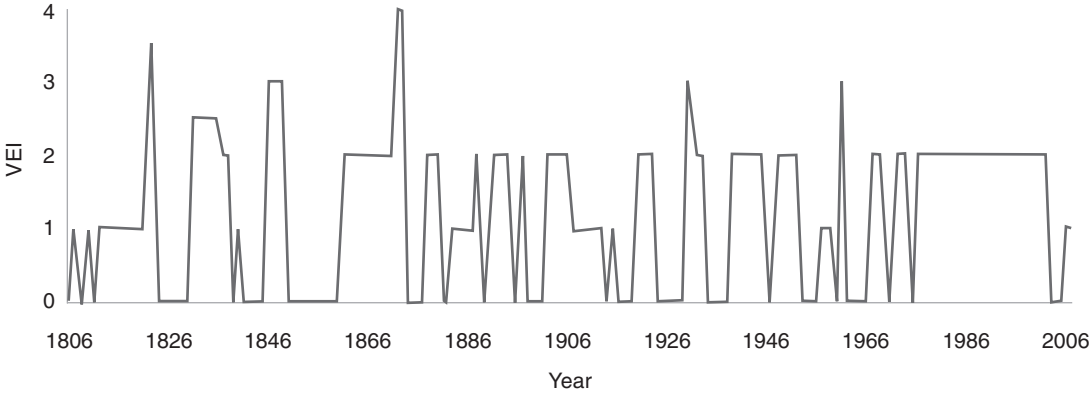

Figure 2 The eruptive history of Mt Merapi (VEI/Year)
Source: Derived from Voight *et al.* (2000b) and the Global Volcanism Program

During the past 200 years, Mt Merapi has experienced two styles of eruption. In the 1800s Mt Merapi produced relatively large explosive eruptions, whereas in the twentieth century the volcano's activity has consisted of viscous lava dome growth and collapse, producing pyroclastic flows directed mainly towards the west (Voight *et al.* 2000b). Figure 2 provides a segment of Mt Merapi's extensive explosive eruptive history using Newhall and Self's (1982) Volcanic Explosivity Index (VEI). Periods marked as VEI 0 should be considered with caution, as even during these reportedly quieter periods Voight *et al.* explain that the volcano could have been experiencing 'low-rate dome growth' (2000b, 76). A concise description of Mt Merapi's long eruptive history is recorded within the Merapi Edition Special Issue of the *Journal of Volcanology and Geothermal Research* (2000, volume 100).

Figure 1 shows the existing hazard zones for Mt Merapi. These are apparently based on the last 100 years of eruptive history and therefore only take into account relatively small lava dome collapse eruptions (Hadisantono *et al.* 2002). These hazard zones underestimate the potential eruptive power and hazard impact around the volcano (Thouret and Lavigne 2005). Therefore, although Voight *et al.* (2000a) notes that Mt Merapi is a 'well-used *natural* laboratory', effective risk reduction measures seem to be limited, as the hazard map is inadequate during moderate to large eruptions and no official risk map exists for the volcano.

The hazard map is currently used by officials in order to identify safe areas during a crisis so that residents of the higher regions can be evacuated efficiently. Emergency evacuations were thoroughly tested in 2006 when the volcano entered its latest volcanic episode. Starting in March, the lava dome grew at an extraordinary rate and subsequently collapsed, creating a large scar running from the summit to the lower flanks (Plate 1). Unusually, lethal pyroclastic flows travelled south, entering the Krasak, Boyong and predominantly the Gendol river systems. The 'burning clouds' devastated an area less than 300 metres from inhabited settlements and the resultant material was then re-mobilised as multiple mudflows (lahars) that filled the steep-sided Gendol river. Even as they were exposed to these dangers, the residents living along the Gendol river reportedly refused to evacuate, choosing instead to trust their traditional knowledge (BBC 2006). This traditional knowledge is guided by Javanese culture that attributes a sacred status to mountains: Mt Merapi is believed to be home to a powerful spirit kingdom (Schlehe 1996; Zeilinga de Boer and Sanders 2002). This connection to the volcano is expressed through myths, legends and ceremonies that reinforce an attachment to their villages and a reluctance to move (Lavigne *et al.* 2008).

So despite the extensive monitoring systems and associated emergency plans at Mt Merapi, the local residents paid little attention to the official warnings, and refused to come down the volcano. These actions made any volcanologists' monitoring role redundant, as it seemed no matter how bad the situation became, local people were not prepared to respond to scientific-based warnings and evacuate. This case study demonstrates the necessity to understand the cultural and social dynamics of the at-risk community.

Plate 1 The scar on Mt Merapi
Note: A view of Mt Merapi showing the large southern scar created during the 2006 eruption and local residents living and working in hazard zone 3 (Photograph by author, August 2007)

Methods and field sites

McNeil and Chapman (2005) suggest that in order to really understand a community, the researcher must do more than simply survey a region; they must immerse themselves into that community and analyse the individuals through conversation, interview, workshops, focus groups and other methodological strategies. Qualitative data collection methods can be used in 'order to explicate the ways people in particular settings come to understand, account for, take action and otherwise manage their day-to-day situations' (Miles and Huberman 1994, 7) and are therefore ideal for this research.

Inspired by the work of volcanologists Cronin *et al.* (2004a 2004b) and Chambers, originally a social scientist (1983 1994), field methods consisted of semi-structured interviews and observational micro-ethnographic techniques (described by Bryman 2004), complemented by two participatory-based workshops carried out in each settlement. Participatory Rural Appraisal (PRA)-based activities (facilitated by a Javanese research assistant and translator) included daily and seasonal timelines, community hazard mapping, listing and ranking exercises, village emergency plans, storytelling, community timelines, and the session would often conclude with a general discussion. Despite criticisms of PRA exercises by van Aalst *et al.* (2008), Kapoor (2002) and Mosse (2001), the activities adapted from the PRA philosophy do create a dialogue between the researcher and the community, enabling a deeper understanding of local knowledge for the researcher whilst giving the community an opportunity to discuss and find solutions to the problems they face.

Whilst carrying out everyday village activities and living with host families, over 80 semi-structured interviews were conducted. These semi-structured interviews or *conversations with purpose* became the main source of information and provided valuable insights into the events of, and personal reactions to, the last eruption.

This data collection took place from June to October 2007 and was concentrated in two villages on the southern side of the volcano that had been directly impacted by the last eruption, Pelem Sari and Batur. Pelem Sari is a small settlement of 245 residents and is just 2 kilometres south of the summit and within the highest hazard zone 3. Pelem Sari is part of the larger Umbul Harjo region and was chosen because it incorporates Kinorejo, the home of Mbah Marijan, the *Juru Kunci* (one who guards a sacred place) of Mt Merapi. The settlement is therefore regarded as being a spiritual centre and hosts many important ceremonies. The villagers' primary income derives from dairy farming, with each household owning at least two head of cattle. The cattle are stall-fed grass collected by hand from the fertile government-owned forests just north of the village. This is a common means of income for most of the higher settlements on the volcano (Dove 2007 2008). The second village is Batur, located 5 kilometres from the summit along the western banks of the Gendol river, and is home to 435 people, and unlike Pelem Sari, the residents have taken advantage of the frequent volcanic activity. The villagers collect and sell the lahar deposits as building materials, in addition to being employed to construct new sabo dams downstream of the village. Batur was chosen in contrast to Pelem Sari, as the residents are not renowned for their spiritual beliefs; in this respect Batur could be regarded as a *normal* Javanese settlement. Despite apparently differing levels of traditional beliefs, residents from both regions refused to evacuate, making these settlements ideal field sites.

ISSN 0004-0894

The *makhluk alus* of Mt Merapi

A number of key recurring themes emerged from the field data. These themes relate to broad concepts of hazard perception, traditional beliefs and socio-economic issues. In this section four themes will be addressed: volcanic mythology, oral histories, geography of hazard perception and livelihood.

Volcanic mythology

The villagers from both settlements believe that Mt Merapi is not just a volcano but also a home to many spiritual creatures, referred to as *makhluk alus*, or unseen creatures. According to Javanese mysticism there are two types of *makhluk alus*, ones that are born as creatures and ones that were originally human (Sangga Sarana Persada 1999). Those dominant at Mt Merapi have a human origin attributed to residents that have disappeared mysteriously on the volcano. As one villager, Yadi, explains below, creatures can take people as a punishment.

> The people who died last year were wrong to be in the bunker because they knew it was dangerous. The supernatural creature wanted them. (Yadi, male, 40, resident of Batur, interviewed 20 July 2007)

The creatures can also control eruptions and therefore many people living high on the volcano attempt to placate the creatures by offering food, clothes and money during various ceremonies. In Pelem Sari, the annual Labuhan ceremony organised by the Kraton of Yogyakarta (the Sultan's palace) provides the creatures with clothing and food, while Mbah Marijan chants their individual names. This and other similar ceremonies are to ensure protection from the hazards.

These supernatural creatures exist in a parallel dimension that can interact with reality. They can bridge dimensions, not being visible in our dimension, but able to take the form of a human to pass on information and warnings to especially *sensitive* individuals in the villages. The warnings are called *wisik* and are essentially premonitions through dreams.

> The dreams come from Merapi's supernatural creature not from god. (Samijo, male, 33, resident of Pelem Sari, interviewed 9 August 2007)

The supernatural creatures are feared and respected to such an extent that some residents would not even talk about them for fear of causing another eruption. The influence of these stories is strong enough to stop a community evacuating, and instead prepare offerings or wait for a *wisik*.

Oral histories as traditional warnings

There are many stories relating to the volcano and its hazards that have a cautionary or even moral subtext. Some of these seem to have originated from actual events, and then been interpreted by the villagers using their own cultural beliefs. For example, during the 1994 eruption, the village of Turgo to the west of Pelem Sari was devastated by pyroclastic flows and unfortunately the majority of those killed were attending a wedding ceremony.

> In 1994 the farmers in the village of Turgo were given permission to live in Turgo by the creature, with one request: If you plan a ceremony or wedding party do not use the days: Jumat Gliwon and Selasa Gilwon. The victims of the 1994 eruption were attending a wedding on Selasa Gliwon. (Karyo, male, 90, resident of Pelem Sari, interviewed 28 July 2007)

In the quote above, Karyo implies that the residents of Turgo had disobeyed the rules of the local *makhluk alus* and had therefore suffered the consequences. Other stories include taboos for those wishing to climb the volcano or ways in which it is possible to cross lahars. These oral histories may be based on real events, but they cannot be used to provide a reliable warning.

Traditional precursors, such as unusual animal movements, intense lightning storms or *wisik*, have a strong influence, particularly in Pelem Sari with over 40 per cent of interviewees relying on these indicators. In the workshop sessions, both communities illustrated, through their own emergency plan, that they would not take action unless they had received both a traditional and official warning (Figure 3). Additionally, the majority of interviewees who discussed traditional signs did not feel that they had seen any evidence of a traditional precursor in 2006 and therefore felt that the government reaction was unnecessary. Interestingly in Pelem Sari three of the youngest workshop participants (20–25 years old) had received official hazard training and became frustrated during the workshops when discussions, led by the elders, focused on traditional warnings. The young men's influence will increase through time, but at present the opinions and actions of the older generations still influence both communities.

The perception of hazard spaces

The geographical dispersal of hazard threats around the volcano shape the development of oral traditions and myths, and offers clues into the ways indigenous populations react to different hazards (Cashman and

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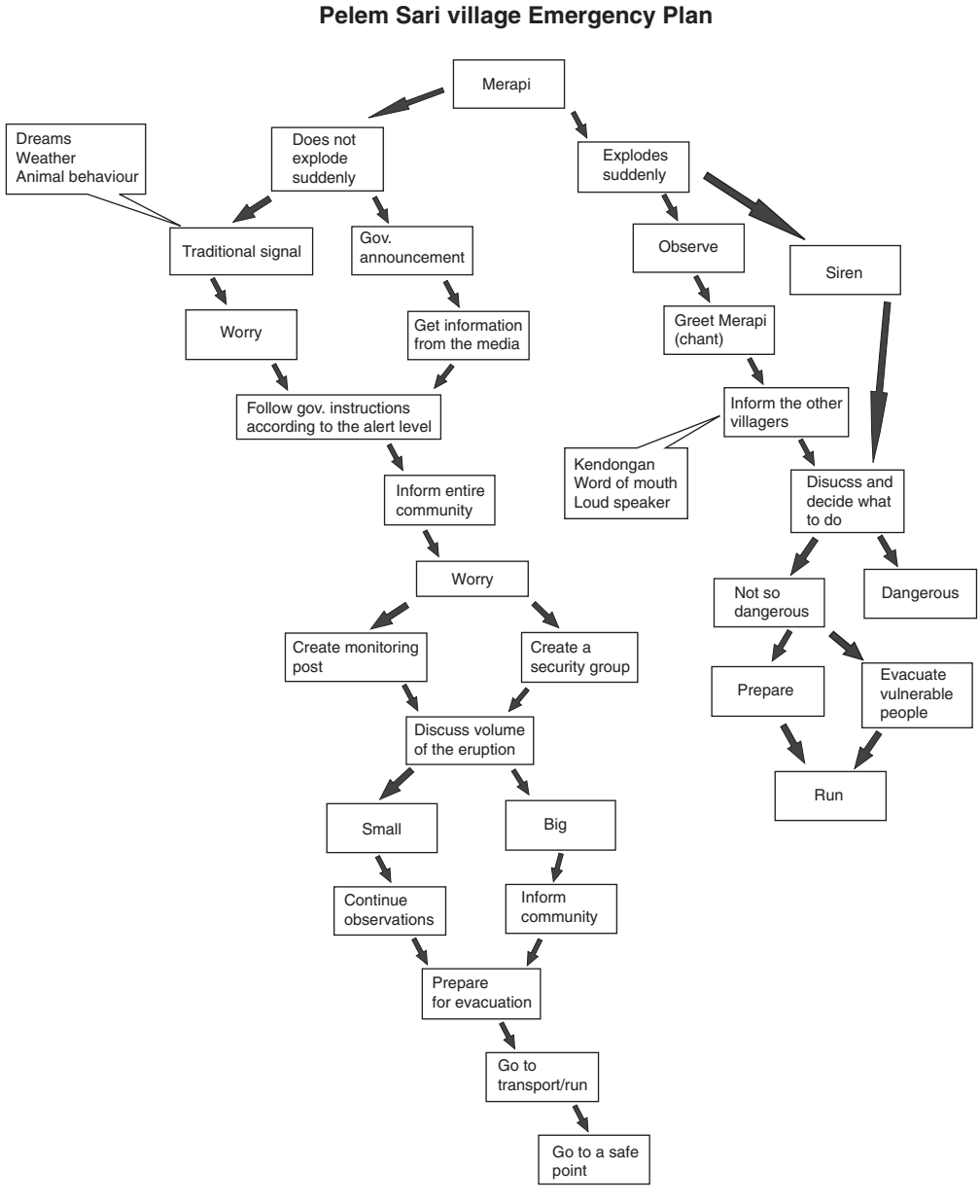

Figure 3 An emergency plan designed and drawn by the participants of the Pelem Sari workshop
Note: This diagram was originally drawn on paper using Javanese terms and has subsequently been translated into English and re-drawn using CoralDraw X3. As far as possible the design of the plan has not been changed

Cronin 2008). At Mt Merapi, the villagers' perception of hazards and consequently their reaction to an eruption is greatly influenced by their previous experience, which is directly related to geographical location. An example of this occurs in Batur, where most interviewees were convinced that Mt Merapi had only erupted three times in 2006, 1994 and 1961, despite the fact that Mt Merapi has erupted over nine times in the last 50 years (Global Volcanism Program 2009). Their hazard experience and isolation has created an

ISSN 0004-0894

inaccurate localised template for future eruptions, giving them a false sense of safety. This perspective is described by Douglas as an 'unjustified sense of subjective immunity' (1985, 29), as all of the interviewees from both regions believe their villages to be entirely safe, despite actual events proving otherwise.

Livelihoods

A key motivating force for the villagers of Pelem Sari and Batur is their reliance on livestock. Livestock represent the villagers' sole investment, and when the need to protect it combines with the overwhelming beliefs that their homes are safe, the villagers see no reason to evacuate. As suggested by Narti, below, if they evacuated, their abandoned cattle would die of starvation.

> If I stayed in the evacuation place I get food, but my cow does not. (Narti, 50, female, resident of Pelem Sari, interviewed 6 July 2007)

Instead they rely on the *makhluk alus* to protect their livelihoods that are so intimately linked to the volcano.

Despite efforts from non-government organisations such as Pro-Fauna International, cattle were not evacuated during the last eruption (D Wright, ProFauna International UK representative, personal communication 16 July 2008). Therefore the government transported the villagers back home during the day in order to collect grass and take care of their livestock, returning them to their evacuation sites at night. This 'part-time' evacuation meant that, although the villagers were more cooperative, over 80 per cent of interviewees were at home during the largest of the pyroclastic flow events that killed two local people.

Conclusion

Initially it was assumed by the media that the people of Mt Merapi refused to evacuate because of their cultural beliefs alone. This study has shown that although the residents have a strong cultural connection to the volcano, this was not the only influence. The motivation not to evacuate was based equally on their reluctance to abandon livestock and in the belief that their villages were safe, either through the protection of supernatural creatures or knowledge gained during past experiences. Past experiences manipulate their traditional belief system and this is dependent on the spatial dispersion of the hazard. Therefore their cultural beliefs and socio-economic needs are interdependent. Additionally, the higher settlement of Pelem Sari has a different hazard perception and consequent will to evacuate than Batur. This is not influenced by Mbah Marijan but by their proximity to the summit.

Although the villages in the south were spared in 2006, the next large eruption will most likely devastate this region (Thouret and Lavigne 2005). It is therefore vital to identify areas of cultural vulnerability, and communities who may refuse to evacuate in the future. Examining and designating just the hazard impact and variability is not enough in culturally and socially sensitive regions and producing just a quantitative vulnerability assessment does not detail the desires and beliefs of communities. It is therefore necessary to work with communities to develop strategies that they will accept and comply with. This can be done partly through participatory methods that give the community a voice and immerse the researcher within their cultural environment. Overall, it is a community-based multi-modal methodology combined with physical hazard studies that will produce holistic and effective emergency procedures.

Acknowledgements

This project is funded by a joint ESRC/NERC studentship. My thanks go to Iain Stewart, James Sidaway and Mark Cleary. *Terima kasih* Aris Suharyanto, and the Inter-Cultural Institute, Yogyakarta. Thanks also go to the three anonymous reviewers for their insightful comments and to the editors for their support.

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