

Research paper

## Alternative paradigms of volcanic risk perception: The case of Mt. Pinatubo in the Philippines

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### Abstract

The literature on people's response to volcanic hazards tends to be split between two paradigms. The first argues that the choice of adjustment depends on how people perceive rare and extreme volcanic phenomena and the associated risk. The second considers that people's behavior in the face of natural hazards is constrained by social, economic and political forces beyond their control. The present paper addresses both paradigms and demonstrates that, in order to understand people's behavior in the face of volcanic threats, volcanic risk perception has to be balanced with non-hazard related factors and structural constraints. These conclusions are based on a case study of Mt. Pinatubo and the lingering threat of lahars from the 1991 eruption. Drawing on the results of a questionnaire-based survey and additional interviews with key informants, it is shown that a high perception of risk does not stop people from choosing to forms of living that put them at high threat from lahars. Furthermore, the paper argues that insufficient opportunity for making a livelihood in resettlement centers and strong attachment to native villages push people back to the banks of lahar channels. Everyday hazards of poverty and the threat to cultural heritage weighed heavier than this seasonal natural hazard. In other words, in a context of economic and social hardship, risk perception of volcanic hazards is necessarily balanced with other risk perceptions. This study does not argue that risk perception is unimportant for understanding people's adjustment to volcanic environments but rather stresses the need for placing it in its larger and daily contexts which are independent of volcanic hazards.

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### 1. Risk perception, people's vulnerability and scientific paradigms in the face of volcanic hazards

Since G.F. White's (1945) pioneering work, risk perception has been the central focus for many social scientists interested in natural hazard and disaster studies. It has been very common to argue that individuals choose to adjust or not to the threat of natural phenomena, or hazards, such as volcanic eruptions, which are rare, in time, and extreme, in magnitude (Table 1). The choice of adjustment basically depends on how people perceive rare and extreme threats and the associated risks for themselves. An individual or a society with a low perception of risk, it is argued, is likely to adjust poorly to the threat. On the other hand, people with a high risk perception are likely to behave in a positive way in the

face of natural threats. Risk perception is different from the simple knowledge that a hazard exists in the environment and instead refers to the possibility people give that a hazard will affect them (e.g. Kates, 1971). In a landmark book entitled "The environment as hazard", Burton et al. (1978) propose a society-based classification of adaptations and adjustments to natural hazards depending on people's perception of Nature's threat. This classification distinguishes unconscious biological and cultural adaptations from incidental or purposeful adjustments. It contrasts traditional societies, with an alleged poor capability of facing natural hazards, with industrial Western societies whose adjustment is more effective albeit still not perfect. Table 1 shows several studies focused on risk perception and people's adjustment in volcanic setting, mostly in the Western world. The perception-adjustment paradigm also spread to the institutions (e.g. national governments, international organizations, consultant agencies) in charge of managing volcanic hazards and disasters. In the face of volcanic threats and inadequate behavioral

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Table 1  
Main characteristics of the two opposing paradigms on people's perception and adjustment to volcanic hazards

Scientific paradigm	Focus	Implications	Determining factors	Remedial measures	Conceptual references	Volcanic references
Perception-adjustment	People's perception of risk linked to rare and extreme volcanic hazards	In the face of volcanic hazards, people have a range of choice of adjustment depending on risk perception	Hazard-related: magnitude, recurrence, experience, information	Structural and technical: sabo dams and dikes to control lahars, electronic devices to closely monitor the activity of the volcano, hazard mapping, evacuation plans and information campaign	White (1945), Burton et al. (1978), Kates (1971)	Murton and Shimabukuro (1974), Johnston et al. (1999), Paton et al. (2001), Becker et al. (2001), Johnston and Houghton (1995), Gregg et al. (2004a,b), D'Ercole and Rañon (1994, 1999), Leone and Lesales (2004, 2005), Hodge et al. (1979), Green et al. (1981), Perry (1990), Perry et al. (1982), Perry and Lindell (1990a,b), Lindell and Perry (1993), Dominey-Howes and Minos-Minopoulos (2004), Yoshii (1992), Davis and Ricci (2004), Davis et al. (2005), Finnis et al. (2004), López-Vázquez et al. (2006), Nomura et al. (2004).
Vulnerability	People's propensity to suffer from damage in the event of volcanic eruptions. Rooted in daily life	In the face of volcanic hazards, people's behavior is constrained by social, cultural, economic and political forces	Independent from hazard: access to resources, historical and cultural heritages, political-economy system	Non-structural: poverty reduction, fair access to land and resources, better societal protection through government investments in social services	Wisner et al. (2004), Hewitt (1983), Cannon (1994), Wisner (1993)	Dibben (1999), Dibben and Chester (1999, 2002), Laksono (1988), Wisner et al. (2004), D'Ercole (1991, 1994, 1996), D'Ercole and Peltre (1992)

response, structural and technical solutions (e.g. sabo dams and dikes to control lahars, electronic devices to closely monitor the activity of the volcano, hazard mapping) are preferred along with evacuation plans and information campaigns to raise people's perception of hazardous phenomena. The influence and recommendations emanating from the perception-adjustment paradigm were evident at the advent of the 1990s International Decade for Natural Disaster Reduction (IDNDR). The United Nations at this time pushed for an increased financial, technological and experience transfer from industrialized countries, where it was argued volcanic eruptions do not cause much damage, to developing states, where volcanoes wreak havoc (Benblidia, 1990; Lechat, 1990).

This dominant perception-adjustment paradigm was first challenged in the late 1970s with several strong critiques of White's ideas (Waddell, 1977; Torry, 1979). Most of the critiques challenge the argument that people have a range of choices to adjust to the threat of a natural hazard. Drawing on cases from the economically developing world, scholars such as O'Keefe et al. (1976), Hewitt (1983), Wisner et al. (2004) argue that people's behavior in the face of natural hazards is constrained by social,

economic and political forces beyond their control (Table 1). Political neglect, social marginalization and difficulty in accessing resources compel powerless individuals to live in hazard-prone areas without appropriate physical and social protection. This perspective emphasizes people's vulnerability or their susceptibility to suffer from damage should natural hazards occur. A set of indicators reflect the vulnerability of disaster victims (Cannon, 1994). Victims of natural hazards are frequently disproportionately drawn from marginal social groups such as women, children, elderly and the disabled. Vulnerable people are also those with limited or precarious incomes (low wages, informal jobs, lack of savings) that reduce their ability to protect themselves in the face of natural hazards (location of home, type of housing, knowledge of protection measures). Vulnerability also results from inadequate social protection (health insurance, health services, construction rules, prevention measures, etc.) and limited social capital (solidarity networks). It is thus crucial to consider both people's vulnerability and its root causes which lie in their daily and unique local contexts (Chester, 1993; Wisner, 1993). Natural hazards are then viewed as a highlighter or amplifier of daily hardship and everyday emergencies rather than

as an extreme and rare phenomena (Hewitt, 1983; Maskrey, 1989). Table 1 shows that there is only a handful of studies of vulnerability in volcanic context. Recommendations on how to mitigate people's vulnerability in the face of natural hazards are fundamentally social, political and economic in nature, e.g. poverty reduction, fair access to land and resources, better societal protection through government investments in social services. Specific risk management measures are viewed through community-based disaster risk management which underlines people's participation in hazard, vulnerability and risk assessment (e.g. Anderson and Woodrow, 1989; Bankoff et al., 2004). Such activities have been championed during the 1994 International Conference on Disaster Reduction held in Yokohama, Japan, by the United Nations which marked a change in international disaster management policies (Nations Unies, 1995).

In the following sections, it will be argued that risk perception has to be balanced with non-hazard related factors and structural constraints in order to understand people's behavior in the face of volcanic threats. This will be based on a case study of the Mt. Pinatubo, in the Philippines, and the lingering threat, since the 1991 eruption, from lahars. The first section will cover the context and events that occurred since the Mt. Pinatubo eruption. The second section will outline the methodology used to assess volcanic risk perception and the weight of daily constraints around Mt. Pinatubo. In the third and fourth sections, people's perception and adjustment to the threat of lahars and the weight of daily constraints will be analysed. The final section will discuss volcanic risk perception and daily constraints in the larger Philippine context.

## 2. Focus on the 1991 Mt. Pinatubo eruption

Mount Pinatubo is a strato-volcano located on the main island of Luzon in the Philippines, at the meeting point of the provinces of Pampanga, Tarlac and Zambales (Fig. 1). In 1991, it violently awoke after five centuries of quiescence in what is considered to be the second most powerful volcanic eruption of the 20th century (Volcanic Explosivity Index=6). The first signs of the volcano's restlessness were detected in early April and eventually intensified until June 1991. The main eruptions occurred on June 12 and June 15. On these particular dates, the volcano spewed some 5 to 7 km<sup>3</sup> of pyroclastic materials (Pinatubo Volcano Observatory, 1991; Wolfe 1992). Since the 15 June 1991, destructive lahars (volcanic debris flows), triggered by typhoon-associated downpours, tropical monsoon rains and lake break outs, have flowed down the flanks and foothills of the volcano (Umbal, 1997). The eruption and subsequent lahars have been described in extensive detail in Newhall and Punongbayan (1996).

Official figures show that 320 people were directly killed by the eruption in 1991. 353 people, especially Aeta indigenous people, eventually died of epidemics inside evacuation centers. 261 people were also killed during lahar episodes in 1991 and 23 others remained missing (Department of Social Welfare and Development Region III; Banzon-Bautista, 1996). Between 1992 and 1998, 245 more individuals died in lahars with a

further 63 missing. Noteworthy is the unknown number of Aetas who refused to leave their home and perished during the eruption, buried by pyroclastic flows in cave shelters (Shimizu, 2001). Overall, about two million people were affected by the Mt. Pinatubo eruption and lahars that followed. The economic losses probably reached more than one billion US dollars with more than 140,000 houses were totally or partially destroyed, thousands of public infrastructures were affected and tens of thousands hectares of farmland were buried under deep pyroclastic and lahar materials (Table 2 and Leone and Gaillard, 1999).

The relatively low death toll, given the magnitude of the eruption, is testimony to the widely acknowledged success of the eruption crisis management. Early forecasting, an intense information campaign and effective monitoring by the Philippine–American scientific team led to a timely warning and evacuations which greatly limited the number of victims (Punongbayan et al., 1996; Tayag et al., 1996). Lahar management turned out to be much more challenging for scientists and authorities who struggled to cope with recurrent events and to define the spatial extent of the phenomena (Rodolfo, 1995; Leone and Gaillard, 1999). The main difficulty was allowing the affected area to be rehabilitated while preventing further loss of life in lahars. Two conflicting strategies were offered to the authorities: 1/ to relocate all the threatened populations or 2/ to undertake structural measures to protect the villages exposed to lahars. Torn between the two theories, the government in Manila opted for a compromise solution. The victims of the eruption and of the first lahars were transferred to huge resettlement centers built in safe areas, while most of the lahar paths were channeled with dikes. An intergovernmental structure, the *Task Force Mount Pinatubo*, which became, in 1992, the *Mount Pinatubo Commission* (MPC), was created to develop and implement the government policy of resettlement and oversee other rehabilitation works. Eruption and lahar victims were relocated in huge and uniform resettlement centers, organized around a central plaza housing the main public buildings (police stations, health center, playgrounds...). Each family received a piece of land of 94-m<sup>2</sup> and a 27-m<sup>2</sup> concrete house equipped with sanitary facilities. Kilometers of roads and an electric network as well as scores of school buildings were built to meet the needs of the victims. A number of projects, especially the creation of 'productivity centers,' were designed to provide the victims with new jobs near the biggest resettlement areas (Tariman, 1999). In addition to the relocation of the populations already affected, the Philippine government undertook some big and costly works to prevent lahars from reaching inhabited areas. Encouraged by foreign experts, kilometers of dikes and other structural equipment (barriers, dams, dikes, drainage gutters, sand pockets, spillways) were built to limit and control the flow of sediments from their source to the sea along the main active lahar channels (Mount Pinatubo Commission, 1994; Tayag and Punongbayan, 1994).

The following particularly focuses on the municipality of Bacolor located in the province of Pampanga, on the southeast side of Mt. Pinatubo, along the Pasig–Potrero river (Fig. 2). Between 1991 and 1997, the town was progressively buried

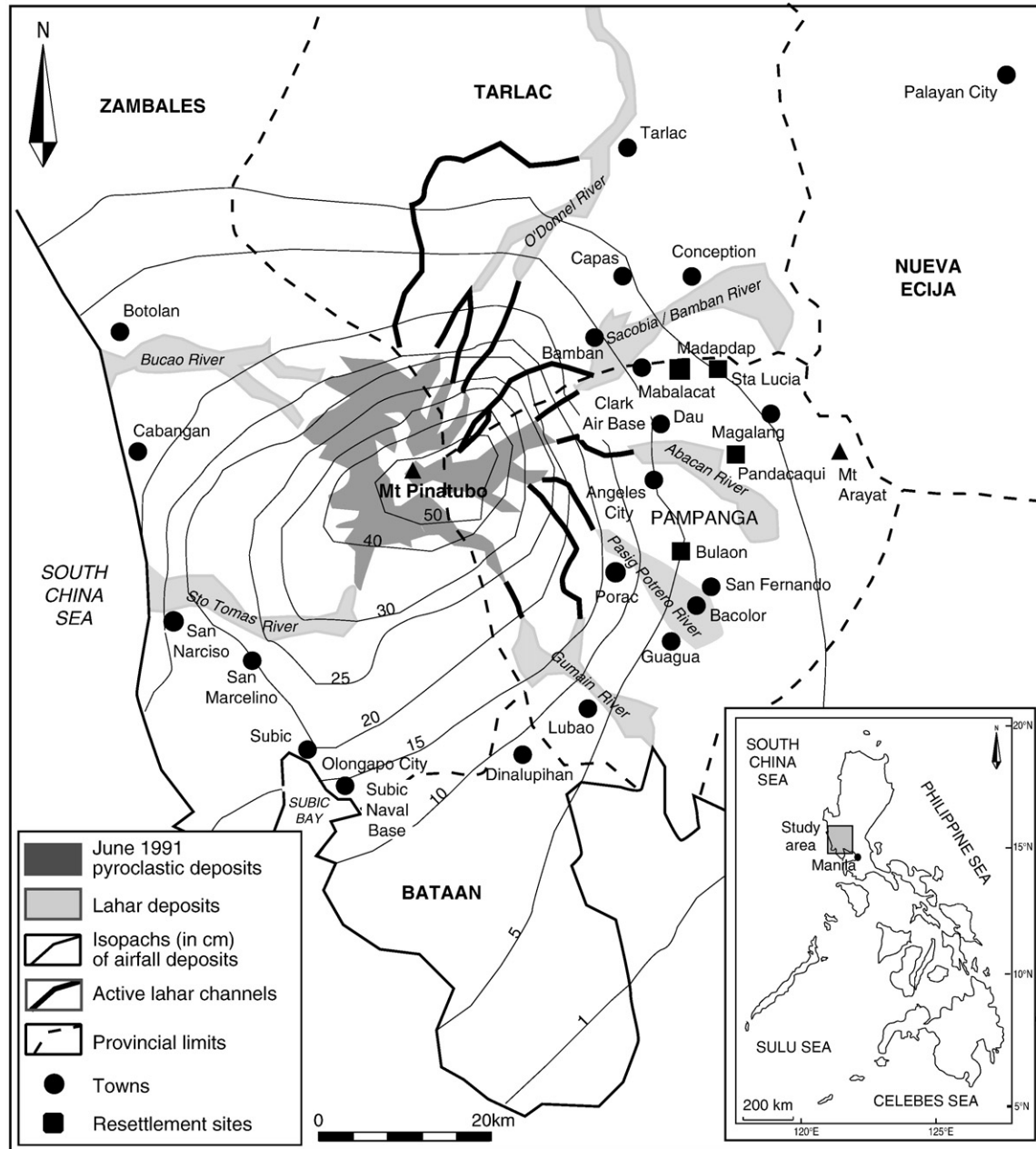


Fig. 1. Location of the study area and main active lahar channels and other destructive phenomena linked to the 1991 Mt. Pinatubo eruption, Philippines (adapted from Pinatubo Volcano Observatory Team, 1991).

under almost ten meters of lahar deposits (e.g. Arboleda, 1997). Crittenden (2001) noted that 353 houses were covered by an average of 2 m of mud in 1991, 1 m in 1994, and another 3.5 m in 1995. In October 1995, a single event killed more than 100 people in the village of Cabalantian in what remained the worst Mt. Pinatubo lahar tragedy (Crittenden and Rodolfo, 2002). The Cabalantian tragedy reflects the failure of the initial diking program set up to control Pasig–Potrero lahars. Yet, it did not discourage the authorities from engaging, in 1996, in a massive and controversial 50-million US dollar project called *Megadike* (Agapay et al., 1997; Department of Public Works and Highways-Mount Pinatubo Rehabilitation/Project Management Office, 1995; Philippine Institute of Volcanology and Seismology, 1996). The construction of the *Megadike* led to the

transformation of the town of Bacolor into a catch basin for the Pasig–Potrero lahars to protect the provincial and regional capital, San Fernando, and another town of almost 100,000 inhabitants, Guagua. The current diking system closely follows the contours of the municipal boundaries (Fig. 2). In parallel, most of the victims from Bacolor were relocated in four resettlement centers, Bulaon, Madapdap, Pandacaqui and Santa Lucia, respectively located in the neighboring municipalities of San Fernando, Mabalacat, Mexico and Magalang (Fig. 1). The almost yearly recurrence of events, the scope of physical and human toll and the controversial diking system put Bacolor at the forefront of media and scientific attention during more than a decade. Bacolor became a powerful symbol of the struggle against the Mt. Pinatubo lahars.

Table 2  
 Damages and casualties of the 1991 eruption and subsequent lahars of Mt. Pinatubo, Philippines, as of 1999 (data from Department of Social Welfare and Development Region III, 1999)

	Dead and missing	Number of affected families	Number of damaged houses
1991	957	249,371	112,236
1992	19	164,400	6,212
1993	43	353,658	6,474
1994	61	169,295	3,415
1995	97	123,792	14,490
1996	6	44,597	46
1997	26	224,610	285

The following sections explore people’s perception of volcanic risk in Bacolor and the weight of daily cultural, social and economic constraints in their behavior in the face of the threats from Mt. Pinatubo.

### 3. Methodology

The following analysis relies first on a questionnaire-based survey carried out in the basin of the Pasig–Potrero river between January and March 1998. This survey was intended to

determine the perception of risk within the population living in the Pasig–Potrero basin, and to assess their behavior in response to the threat of lahars (Gaillard et al., 2001). The following analysis will be limited to data from Bacolor town proper, which was one of the initial six different study sectors in the municipalities of Porac, San Fernando, Bacolor, Guagua, Santo Tomas and Minalin. These sectors were selected depending on the distribution of the diking system and to be socio-economically similar. As part of the larger survey, 220 interviews, proportionally distributed between each sector, were conducted. 32 people were interviewed in the Bacolor town proper. Voting registers, collected for the presidential elections of May 1998, were used as a sampling frame, and because it is legal requirement for all those over 18 to vote this was expected to be a highly representative of the population as a whole. One person was sampled for every 300 registered voters. This source of information was used because it represented the most recent data available, even though its reliability at times may be questionable. The selection of interviewees reflected the actual distribution of the population in terms of age and sex distribution. Extracting part of that data from the original survey meant that the sample was reduced and the statistical power of inferential tests and other forms of modelling were reduced. We, therefore, rely exclusively on descriptive statistics.

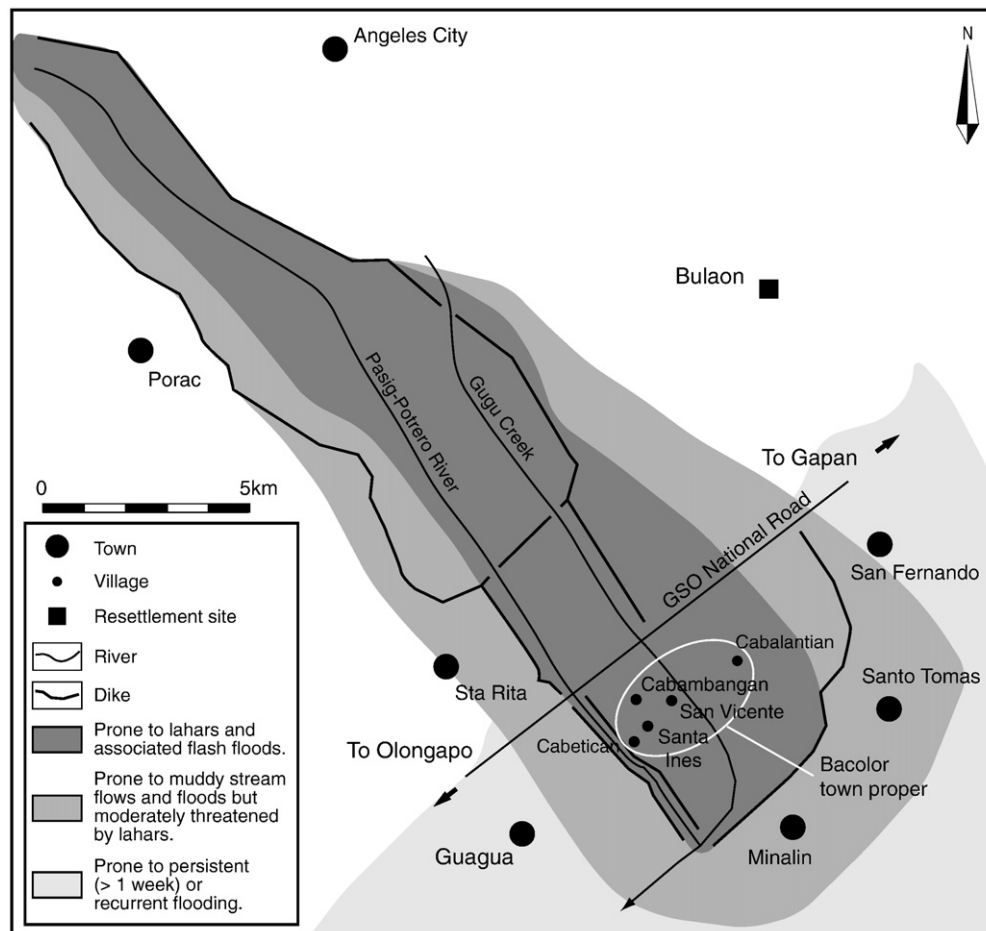


Fig. 2. Hazard map of the Pasig–Potrero hazard map, location of Bacolor, Pampanga, and alignment of the diking system as of 1998 (data from Philippine Institute of Volcanology and Seismology, 1998).

Table 3  
Perception of risk associated with volcanic hazards among people of Bacolor, Pampanga, in early 1998 (n = 32)

Questions	Answers		
	Yes	No	Does not know
Do you think that Mt. Pinatubo could erupt again?	41%	47%	12%
In case of eruption, do you think your house could be affected?	81%	0%	19%
Do you think that lahars could occur again?	91%	6%	3%
In case of lahars, do you think your house could be affected?	85%	9%	6%

The 40-question questionnaire was designed with three main objectives in mind. First, it aimed at assessing the personal risk perception of the inhabitants. Second, it sought to evaluate the effectiveness of the behaviors adopted in the face of the lahar threat. The third aim was to assess the extent to which economic, social and cultural factors were either restrictive or favorable for crisis preparation and management. Thus, the questionnaire included an initial series of questions concerning personal experience of volcanic hazards. In a second series of questions accompanied by a mental map, personal risk perception was addressed, followed by an analysis of behavior

when dealing with lahars, knowledge of means of protection and confidence felt. A third section on general demographics concluded the questionnaire. Interviews were conducted in Tagalog.

In addition to this survey, conducted in the Pasig–Potrero river basin — notably in the Bacolor town, 30 more interviews were conducted in the Madapdap resettlement sites (Mabalacat, Pampanga), and a further 30 at the Bulaon resettlement center (San Fernando, Pampanga). The interviews were proportionally distributed depending on the number of inhabitants from each of the original communities. These two resettlement sites are among those that accommodated victims of the Pasig–Potrero lahars, in particular those from Bacolor. A similar questionnaire to that described above was used, except that it included a series of questions about conditions inside the resettlement sites. These questions replaced the section concerning crisis preparation and management.

The questionnaire-based surveys were complemented by a series of interviews with people from the civil society and disaster management sectors. These included the Mt. Pinatubo Commission (MPC), other government agencies (Department of Social Welfare and Development, Department of Environment and Natural Resources, Department of Public Works and Highways, Department of Health, Department of Agriculture,

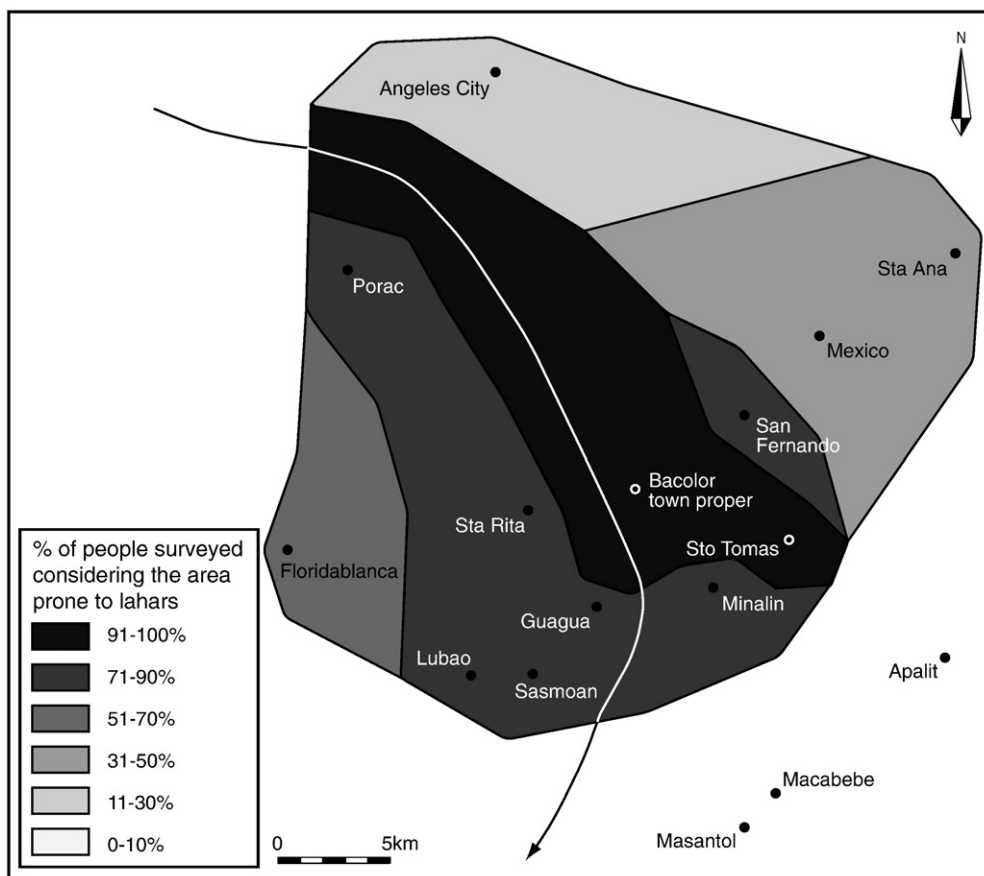


Fig. 3. Mental representation of the people of Bacolor the places threatened in case of lahars, as of early 1998 (It should be noted, that in order to assess the mental representation of the places threatened, interviewees had to delimit, the zones which they thought could be affected. Results are expressed as a percentage of persons surveyed).

Table 4  
Main adjustment measures adopted in early 1998 by the people of Bacolor, Pampanga, in the face of volcanic hazards ( $n=32$ )

Preventive measures	% of people surveyed who adopted these measures
House raised onto posts	53%
Seasonal relocation	31%
Sandbags	25%
Others	12%
None	34.4%

Department of Education), local government units (LGUs) and non-government organizations (NGOs). These interviews were aimed at assessing the role of the authorities in the shaping of the observations made in the field. A large amount of useful primary written documents was also collected during visits to these institutions.

Field work was completed with the collection of secondary written documents such as journal publications, conference proceedings, and relevant press clippings from regional and national newspapers.

#### 4. Risk perception and people's adjustment in the face of volcanic threats

The perception of personal risk was higher in Bacolor town, than in the rest of the study area. 84% of those surveyed in Bacolor had a high to very high perception of the risks from lahars and a possible eruption of Mt. Pinatubo. These interviewees felt that their homes could be affected by further events (eruption and lahars) or at least lahars (Table 3). Their mental representation of the area that could be affected by further lahars, occurring along the Pasig–Potrero river, was very similar to that of the Philippine Institute of Volcanology and Seismology hazard map (Fig. 3). Furthermore, more than 90% of the surveyed population predicted that the lahars would return in the following rainy season. This prediction was even

higher in the resettlement centers visited where 96% of the inhabitants of Bacolor considered that lahars would return in the next rainy season. Risk perception correlated highly with previous experiences of lahars since all interviewees had been affected at least once by this phenomenon and one third of the respondents had been hit seven times or more. However, risk perception did not increase with the number of times someone had experienced a lahar. 92% of those affected one to three times had a high to very high risk perception versus 89% for those affected seven times or more. Beyond the first experience, the recurrence of lahars does not seem to significantly influence risk perception.

Despite the high level of threat they face, their realistic perception of this and their belief that lahars would return during the next rainy seasons, the people of Bacolor chose to remain in their village and face the lahar threat. Others chose, on mass, to come back from relocation centers despite the fact that they felt the lingering lahar threat as well. In 1990, the population of the Bacolor town proper reached 16,143 people. In 1997, an informal census conducted by American sociologist K. Crittenden counted 1755 people (Lacsamana and Crittenden, 1997). Eventually, the 2000 census of the Philippines recorded 3817 people in the same area. In facing the threat of lahars, the people of Bacolor displayed a wide range of adjustments of a technical and non technical nature (see also Crittenden, 2001; Gaillard, 2002). Table 4 shows that the most frequent technical adjustment (53% of those surveyed) was to raise houses onto concrete posts (Fig. 4). Such precautions had already withstood several rainy seasons and appear to be a safe form of protection from lahars in contrast to sandbags, widely used in some areas. Indeed, while sandbags can be effective in combating floods, Rodolfo (1995) challenges their effectiveness against lahars, arguing that they might actually increase the destructive power of the lahars. 31% of the population of Bacolor also regularly relocated at the eve of the rainy season. Seasonal relocation would usually be to a relative's home outside of the lahar-prone



Fig. 4. Houses raised on concrete posts in Cabambangan, Bacolor, in December 1997 (photograph by J.-C. Gaillard).

area (38% of those surveyed), in resettlement sites (28%), or in rented houses (11%). Interestingly, the primary reason (31% of answers) quoted by those who did not take any preventive measure was financial.

Of greater concern was that, in the event of a lahar warning, only 65% of people interviewed in Bacolor would have evacuated their home or their village (Table 5). Moreover, some of them would evacuate to areas that could be affected by lahars or floods. In addition to the evacuation areas, which often corresponded to evacuation centers already visited during previous evacuations, the environs of these destinations and the zones that would have to be crossed to reach them could also be dangerous. This point has already been highlighted by a Philippine Institute of Volcanology and Seismology study that took place following the lahars in 1993 (Tayag et al., 1994). It determined that 101 of the 206 evacuation centers in operation in the Pampanga province at that time were in fact not safe.

As with risk perception, behavior in the face of the threat of lahars tended to be defined to a large extent by an individual's previous experiences. The percentage of the population displaying effective behavior, when confronting the threat of lahars (seasonal relocation, safe place of evacuation, efficient protection measures), increased with the number of evacuations already experienced. Many individuals indicated that the evacuation center where they have previously been evacuated to as their intended destination should they be required to evacuate again. The experience of such crises – which also enhances risk perception – could under such circumstances increase the interest that populations take in ensuring the physical protection of their homes. These persons would thus work out effective measures to allay such concerns (raised houses, creation of a second floor to be used as a shelter in times of crisis).

To explore the findings of previous studies (Blong, 1984; Johnston and Houghton, 1995; Greene et al., 1981; Perry et al., 1982; Perry and Lindell, 1990a,b), the survey also investigated the sources of information, on volcanic threat, used by the people of Bacolor (Table 6). It seemed that the most widespread source of information was the television and radio which were used by respectively 69% and 75% of those surveyed. 38% of the people of Bacolor, in contrast, relied on local authorities for this information while 22% used newspapers. It is important to note that most of the “serious” national newspapers reporting on lahars was written in English, and thus, was much less accessible than the tabloids published in Tagalog. Finally, it seems that word of mouth was a widespread means of

Table 6

Source of information on volcanic hazards of the people of Bacolor in early 1998 ( $n=32$ )

Source of information	% of people surveyed who rely on this source of information
Radio	75%
TV	69%
Local authorities	38%
Newspaper	22%
Word of mouth	19%
Others	13%
School and children	9%
Police	0%
Church	0%

communication of lahar information (19% of the population). Other sources of information were more marginal.

While not directly asked about in the survey, religious and cultural beliefs cannot be avoided in a search for the factors shaping risk perception and people's behavior in the face of volcanic threats (e.g. Chester, 2005a). Bankoff (2004a) provides a detailed and pathbreaking analysis of this in the Philippine setting. He notes that the successive onslaughts of lahars in Pampanga led political leaders, religious representatives and disaster victims to join in a common claim that God was punishing them. Bankoff further argues that in the face of those ‘uncontrollable’ forces of Nature, Filipinos resort to a wide array of coping mechanisms rooted in cultural beliefs such as their traditional “active calculation of the odds”, sense of ‘communalness’ and burden-bearing mechanisms. Other authors (e.g. Galang, 1995) noticed an intensification of religious practices among people of Bacolor following the burial of their town probably in order to both mentally and socially cope with the tragedy and to ward off further events by appeasing deities.

## 5. Risk perception in its context

The dichotomy between a high level of risk perception among the inhabitants of Bacolor and their determination to remain in or return to lahar-prone areas is startling. What pushed people to stay on the banks of the Pasig–Potrero river despite evident seasonal danger and compelled them to develop unique strategies to protect themselves from the threat of lahar, is clear when one studies the struggle for access to resources, poverty, political strategies and cultural heritage inherent in the daily routines of life.

Before the 1991 Mt. Pinatubo eruption, Bacolor was a small provincial town whose economy was based around administrative functions, commercial activities and agriculture (Pampanga Provincial Planning and Development Office, 1989). Almost none of these survived the successive lahar onslaughts, so that in 1998, economic conditions were harsh in Bacolor. Most of the agricultural fields were temporarily rendered infertile by lahar deposits and the tiger grass that spread all over the town. Only small-scale or informal businesses (canteens, photocopy shops, school furniture outlets, etc.) catered to the students of the Don Honorio Ventura College of Arts and Trades, the oldest vocational school in the Far East, which managed to

Table 5

Evacuation destination planned in early 1998 by the people of Bacolor, Pampanga, in the event of lahar flows ( $n=32$ )

Evacuation destination	% of people surveyed who would have gone there
Rooftop	22%
Surrounding houses	13%
Resettlement sites	34%
Neighboring municipalities	16%
Evacuation centers	6%
Do not know	9%



keep going despite its partial burial. Table 7 shows that 25% of those surveyed in Bacolor in early 1998 had no permanent job while 31% were engaged in low-skill formal or informal work (public transportation driving, contractual construction works, small-scale craft workshops, etc.). Another 15% were housewives and 9% made a living from subsistence fishing and farming. Only 3% of those living in Bacolor in 1998 were professionals. However, living conditions were even more difficult in the resettlement centers set up by the government in the neighboring municipalities. In 1998, a survey conducted by the Mount Pinatubo Commission matched the results of our interviews and evaluated the unemployment rate at 26% in the resettlement centers or 15 percentage points higher than the regional average. At the same time, 64% of the population of the resettlement sites were living below the poverty line set by the Philippine government or less than 200 dollars per year per capita (Mount Pinatubo Commission, 1999; Sampang, 1999). Another study by Nelson (1997) estimated the unemployment rate at 33% and showed that 61% of the victims living in the resettlement centers complained about insufficient incomes. One of the major issues was the lack of farm land which may have enabled former Bacolor farmers to re-establish their pre-eruption livelihoods. Initially, the Mount Pinatubo Commission had dedicated large tracts of lands for agricultural. However, the annual increase in the number of victims, with the recurrence of lahar flows, compelled the commission to progressively convert these farm lands into housing lots (Mount Pinatubo Commission, 1995; Martinez, 1996). In the resettlement centers, the survey showed that a majority of Bacolor former farmers turned to contractual or informal jobs (especially construction works, driving motorized or non-motorized tricycles, street vending, small retailing shops) to make a living. Still, 90% of the displaced families complained about the difficulty of accessing job opportunities and 57% about lingering food insecurity. The standard of the houses, public amenities and the location of the site were also an object of concern for those relocated. The harsh economic environment compelled many of the poorest people of Bacolor to choose to risk seasonal lahar threat rather than daily economic pressure. 60% of those interviewed in 1998, in the Bacolor town proper, actually spent a few months or years in resettlement centers before coming back to their native town.

Difficulties in accessing resources in the resettlement centers were intensified by the political policies of the local and national governments. The Mt. Pinatubo resettlement program was top-down in nature and few decisions trickled down to the

victims (Anderson, 1993). The lack of involvement of the victims at the different stages of the resettlement process meant that they had a limited control over livelihood opportunities, especially the poorest who had no access to capital. The Philippine government focused primarily on infrastructure development to accompany its resettlement plan. Livelihoods and social services were only second priority. Despite the lack of livelihoods available, displaced victims had to pay the government back, over a period of 25 years, for the house they got in the resettlement centers. They were also charged for water and other services like garbage collection, whereas in their native village in Bacolor, they were not. During the 1990s, the successive mayors of Bacolor took advantage of this situation by encouraging their citizens to keep strong links with their native town by continuing to register in their former voting precincts. This aspect was very obvious immediately before the election periods since the registrations on the electoral list determines the amount of Internal Revenue Allotment (IRA), which constitutes a significant part of the town budget. The difficulty of accessing resources in the resettlement centers and the political strategies of the local and national government acted as ‘push factors’, explaining why the people of Bacolor choose to face lahar hazards rather than live a safe life in the relocation sites. These push factors were accentuated by historical and cultural factors that also pulled people back to Bacolor.

The people of Bacolor had a very strong cultural attachment to their native town (Crittenden, 1997; Lamug et al., 1999; Gaillard, 2002). They associated the town of Bacolor with a rich history and cultural heritage. From 1706 to 1904, Bacolor was the provincial capital of Pampanga under the Spanish government. It had even been elevated to the rank of national capital of the Spanish government during the 2 years of British occupation of Manila from 1762 to 1764 (Henson, 1963; Larkin, 1993). The inhabitants of Bacolor took pride in their famous ancestors who were involved, at the end of the 19th century, in the emergence of a very influential local culture. Attachment to place was apparent in the banners displayed in 1994 by some of the people who never evacuated. A couple of these banners for example mentioned that “we are dead and drowned but we will never leave Bacolor” and “because it is my birth place and because I love it, I will never abandon Bacolor” (Fig. 5). The presence of many statues in the memory of the local artists helped define the cultural identity of Bacolor, symbolically called the “Athens of Pampanga”. These monuments and the parish church evoke the history or the myth of a community. With the eruption of Mt. Pinatubo and the progressive burial of the town, the church and the statuary became the tangible signs of the link between the community and place, in contrast to public buildings, whose architecture was similar to that of the whole country. The church and the statues thus became essential territorial markers with symbolic value. The parish church is particularly interesting. Given its history and remarkable architecture, the church was, until the awakening of Mount Pinatubo, more a symbol representing Bacolor to the inhabitants of the neighboring municipalities. With the crisis and the ceremonial practices that took place in at that time, it acquired a stronger meaning beyond its architectural and religious value. A

Table 7  
Main occupation of people residing in Bacolor, Pampanga, in early 1998 ( $n=32$ )

Occupation	% of interviewees
Low-skill work (construction worker, driver, etc.)	31%
High-skill work (teacher, learned professions)	3%
Housewife	16%
Farmer/Fisherman	10%
Student	6%
Shopkeeper/Peddler	3%
Jobless	25%

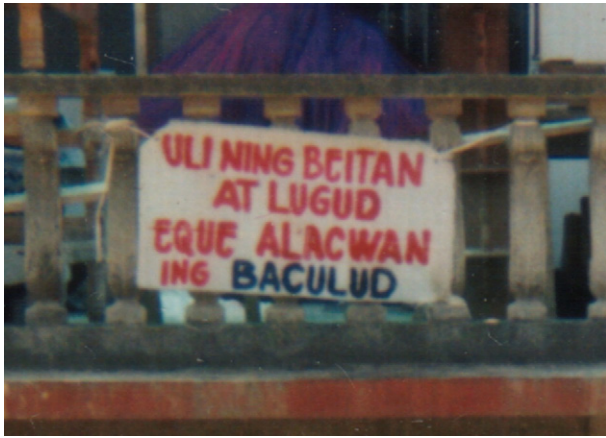


Fig. 5. Streamer displayed in Bacolor town proper at the end of 1995. “Uli ning beitan at lugud, eque alacwan ing Baculud” means “because it is my birth place and because I love it, I will never abandon Bacolor” in the local Kapampangan language (photograph by Rodrigo M. Sicat).

female interviewee reflected this in the following quote: “I do not believe in God and I never went to Church before Mt. Pinatubo erupted but now I regularly attend the Sunday mass just to meet my former village mates”. The church had become the symbol of the resistance of the inhabitants to the damages brought by the lahars. The church and the statues were probably the last visible signs of the past of Bacolor, whose remembrance is being maintained through their exhumation (Fig. 6). These symbols thus represent a symbolic anchoring point for people within their historical lands. The church allows the people of Bacolor, scattered in many resettlement places, to meet once a week and maintain a collective existence.

## 6. Volcanic risk perception versus daily constraints

The previous sections illustrate how risk perception associated with extreme and rare volcanic hazards and daily constraints

conflict. In 1998, the perception of risk in Bacolor was high but nevertheless people chose to face the threat of lahar. Daily livelihoods in resettlement centers were not enough to secure their family needs and pay for their house and other amenities. These ‘push’ factors were accentuated by the cultural attachment to Bacolor which pulled people back to their native town. In this case, the threat to an individual’s identity through a loss of cultural heritage combined with everyday poverty weighed heavier than the seasonal volcanic hazard. Perception of risk related to poverty and the loss of cultural heritage was actually higher than perception of risk linked to volcanic hazards. In other words, risk perception of returning despite lahar threat was lower than the risk perception of not returning because of menace to livelihoods and cultural heritage. Interestingly, risk perception associated with other recurrent natural hazards such as floods and tropical cyclones stood lower than volcanic risk perception in the mind of the people of Bacolor (respectively 72% and 78% of those surveyed thought that these hazards may affect their life). In a context of economic and social hardship, risk perception of volcanic hazards is necessarily being balanced with other risk perceptions (livelihoods, quality of life, community and place attachment, etc.). In the case of Bacolor, what turned out to be the most critical factor behind people’s choice to face the lahars was overall risk perception, not just lahar risk perception but also the perceived threat to cultural heritage or to livelihoods.

This observation is valid for other Philippine volcanoes and other communities living around Mt. Pinatubo. Indeed, the Mt. Pinatubo Aetas, who have been living on the slopes of the volcano for centuries, have flocked back to their native village because of the cultural value of the mountain and harsh economic situation in resettlement centers (Seitz, 1998; Gaillard and Leone, 2000; Seitz, 2004; Gaillard, 2006). Lowland landless farmers of the Albay province are increasingly migrating to the flanks of Mt. Mayon to escape servile relationships under powerful landlords to whom they have to give up 50 or 75% of their harvest (Heijmans, 2004; Tayag, 1985). These farmers prefer to squat on government-owned land and risk an occasional eruption to a daily life



Fig. 6. Statue of J.C. Soto, a local hero of Bacolor, exhumed in front of the Bacolor public market in November 1999 (photograph by L. Desbiez).

characterized by food insecurity. Similarly, the Taal volcano island is settled by more than 5000 people despite its official declaration as a permanent danger zone by the government (Oppenheimer, 1991; Blaikie et al., 1994; Termelo, 1997). The income potential offered by tourism activities, vacant agricultural lands and small-scale scoria quarry easily overcomes the threat of a volcanic eruption in the minds of Taal people.

Volcanic risk perception cannot be fully understood and addressed if taken out of this wider context of economic constraints and cultural milieu. Firstly, as shown in the case of Bacolor, history and culture are of importance to understanding the present situation and the relationships people nurture with their land (e.g. Larkin, 2001; García-Acosta, 2002; Bankoff, 2004b). The larger political-economic framework is also of critical importance. As underlined by Sen (1981a,b) and Watts and Bohle (1993), people's access to livelihoods goes beyond the specific availability or unavailability of those livelihoods but encompasses the capability or entitlement to use available resources. It reflects class relationships and the larger distribution of economic wealth, social opportunities and political power within the society (Wisner, 1993). In the case of Bacolor, Crittenden et al. (2003) show that the ability to recover livelihoods and avoid falling into poverty varied by social class and was greatly helped by higher education. The present study further shows that the lack of available economic resources was the major constraint on the adoption of preventive measures.

A full understanding of the weight and impact of those structural constraints is critical to effective volcanic risk management. Overlooking them may lead people to distrust official risk reduction policies as evident in the partial disdain for the resettlement program felt by the people of Bacolor. Scores of other studies reported evacuees going to their native villages to secure their daily needs in the Philippines (Seitz, 1998; Gaillard and Leone, 2000; Seitz, 2004), Montserrat (Lesales, 1997, 1999; Pattullo, 2000; Loughlin et al., 2002), Ecuador (Tobin and Whiteford, 2002; Lane, 2003; Lane et al., 2003), Indonesia (Laksono, 1988), and Tonga (Lewis, 1981, 1999). To avoid such misunderstanding between decision makers and people living on volcanoes, Kelman and Matter (2008-this issue) suggest a sustainable livelihoods approach for volcanic disaster risk reduction. The Bacolor case study illustrates that living in volcanic hazard-prone areas is possible as long as adequate preventive measures are considered by the community. However, for those measures to be culturally and economically acceptable, Kelman and Matter (2008-this issue) further underline the crucial importance of community involvement. They emphasize that “the most successful outcomes are seen with broad support and action from local residents, rather than relying only on external specialists, professionals, or interventions”. Nevertheless, external guidance often provides helpful resources as in the case of Bacolor, where people benefited from technical assistance to raise their houses on concrete posts (Crittenden, 2001). Community-based volcanic disaster risk management has been successfully implemented around Mt. Mayon volcano (Anderson and Woodrow, 1989), in Vanuatu and the Solomon Islands (Cronin et al., 2004a,b), near Nevado del Ruiz volcano (Anderson and Woodrow, 1989) and in St. Kitts and Montserrat (Mitchell, 2006).

## 7. Closing remarks

The initial review of literature shows that volcanic risk perception may be a significant factor contributing to people's behavior in the face of volcanic hazards. However, as underlined by Blong (1984), most of the existing studies deal with volcanoes located in industrialized countries. In economically developing countries, the present research matches most of the other available case studies in Ecuador (D'Ercole, 1991; Tobin and Whiteford, 2002; Lane, 2003; Lane et al., 2003), Indonesia (Laksono, 1988; Schlehe, 1996; Lavigne and Gunnell, 2006; Dove, 2007a,b; Dove and Hudayana, 2007), Colombia (Anderson and Woodrow, 1989), Tonga (Lewis, 1981, 1999) and Montserrat (Mitchell, 2006). It confirms that structural constraints rooted in difficulty in accessing resources, historical and cultural heritage and political-economy are of much greater importance and may largely overcome high risk perception in shaping people's behavior in the face of volcanic hazards.

This is not to underestimate the importance of risk perception associated with rare and extreme volcanic hazards in people's adjustment to a volcanic environment. It is rather to emphasize the importance of understanding it within its larger and daily contexts, a context that is frequently largely independent of volcanic hazards itself. Clearly, the choice of the people of Bacolor to remain in their native town despite lingering and well perceived threats has little to do with lahars. Volcanic risk perception should be seen as one among many aspects of people's vulnerability in the face of natural hazards. It is one form of risk perception that is balanced, by individuals with other forms of perception including risks to livelihood and cultural heritage. As Chester (2005b, pp. 425–426) summarized: “developing vulnerability analysis for volcanic regions involves conflating conventional hazard analysis with the study of those aspects of the wider physical environment, culture, and society, which either exacerbate or diminish its susceptibility to losses and potential for recovery. Volcanic activity may interact with the physical environment (...), but the key to understanding vulnerability is to recognize that there are aspects of risk which are independent of a region being volcanic and relate to dynamic changes in population, history, culture, and politics. An eruption may be the trigger, but it is often not the underlying cause of disaster.”

Despite encouraging progress during the 1990s (e.g. Chester, 2005b), the current discourse on volcanic risk management still often focuses solely on hazard prevention and mitigation and ignores risk emerging out of the fabric of society. This leads to volcanic risk being dislocated from daily life and thus to underlying structural constraints such as the difficulty of accessing resources, historical and cultural heritage and political economy being ignored. The dominant discourse on volcanic risk management usually limits its focus to treating the symptoms, which are definitely important, but often disregards the root sources of harm. There is however enough evidence to suggest that efficient volcanic risk mitigation goes far beyond the sole, still essential, prevention of “rare” and “extreme” hazards and requires poverty alleviation, fair access to resources and adapted social and societal protection. Those are part of the larger

development policies and do not refer to disaster management programs disconnected from their social and politico-economic context.

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