



Living alongside a volcano in Baliau, Papua New Guinea

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Abstract

Purpose – The paper aims to further understand the contribution of indigenous knowledge to disaster risk reduction through reviewing the experiences of Baliau village situated on Manam Island in Madang Province, Papua New Guinea.

Design/methodology/approach – Indigenous strategies for disaster risk reduction were identified through participatory group discussions with community members, including a strengths-weaknesses-opportunities-threats analysis.

Findings – The paper outlines how indigenous knowledge was used for disaster risk reduction and to cope with enforced evacuation. It demonstrates the need for community consultation alongside the benefits of applying the sustainable livelihoods approach to better understand volcano-related opportunities, rather than just focusing on the volcano's threats.

Practical implications – Indigenous knowledge has both relevance and applicability when applied to disaster risk reduction. Communities should be consulted at all stages of disaster risk reduction and disaster response in order to ensure the relevance and applicability of any strategy.

Originality/value – Through a new case study, this paper explores the contributions of indigenous knowledge to disaster risk reduction and outlines the disruption of evacuation upon indigenous communities. Lessons learnt for future evacuation and rehabilitation scenarios are outlined through application of the sustainable livelihoods approach.

Keywords Volcanoes, Papua New Guinea, Risk Management, Communities

Paper type Case study

Introduction

The following observations emerge from a research project in Papua New Guinea (PNG) which identified how indigenous and scientific knowledge bases may be integrated to reduce vulnerability to environmental hazards (Mercer *et al.*, 2007, 2009). PNG is a very hazardous country impacted upon by floods, earthquakes, tsunamis, frost, drought and cyclones amongst others (United Nations International Strategy for Disaster Reduction (UNISDR), 2007). It follows that disaster risk reduction including the incorporation of indigenous knowledge should be high upon the agenda (UNISDR, 2005). However, many communities at risk live in isolated, hard to access settlements resulting in limited research and interaction with appropriate stakeholders. In addition, PNG is a developing country limited by resources and hindered by a population divided up into different ethnic groups where over 800 indigenous languages are spoken (Brouwer *et al.*, 1998).

Disaster risk reduction in PNG is centrally managed by the National Disaster Centre (NDC) based in Port Moresby. The NDC is supported in its activities by 18 Provincial Disaster Centres (PDCs) based in each province. PDCs are supported by Provincial



Government Funds but can if needed apply to the NDC for additional funds in the event of an emergency. Funding for disaster risk reduction is scarce in PNG and it depends upon the Provincial Government as to how much funding is allocated to the PDC. Many PDCs lack basic office necessities and do not have vehicles that would enable them to visit and assess communities impacted upon by environmental hazards. Despite being a hazard prone country PNGs National Disaster Management Plan has not been updated since 1987 when it was first developed (NDC, 2008). It was reviewed in 1999, but changes were not implemented (NDC, 2008). However, the NDC provides guidelines for communities in dealing with various hazards and has developed a framework for action 2005-2015 in which the importance and potential benefits of drawing upon indigenous knowledge for disaster risk reduction have been recognised (NDC, 2005).

This paper discusses the community of Baliiau located on the North Western Shore of Manam Island, approximately 16 kilometers off the coast of Bogia District of Madang Province and affected by the nearby Manam volcano (Figure 1). Manam Island has a population of approximately 10,000, is circular and 10 kilometers in diameter (Plate 1). As a result of a large volcanic eruption in 2004 and a subsequent evacuation Baliiau community are divided up between the island and one of four established care centres on the mainland, named Asuaramba Care Centre (it takes approximately two hours by motor boat to reach the island depending on weather conditions). The island is still declared a disaster zone by PNG's Government and so returning is at the community's own risk, with no government assistance forthcoming in the event of a further emergency. Hence, to date 297 villagers from Baliiau have returned to the island permanently with approximately a further 100 villagers living in Asuaramba Care Centre on the mainland. On the island, Baliiau community is situated in a linear pattern above the shore line, surviving through gardening and cash cropping (copra).

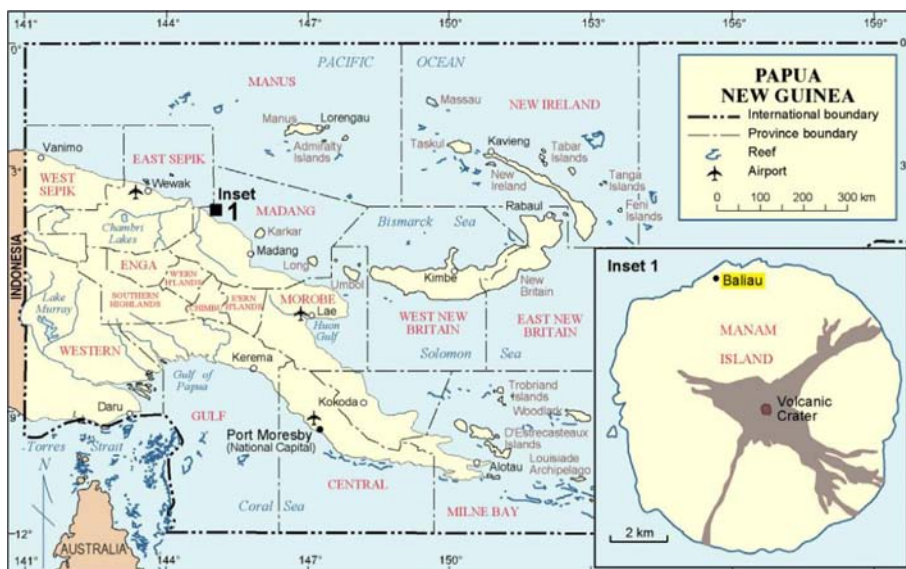


Figure 1.
Map showing the location
of Baliiau village and
Manam Island in PNG

Note: Based on UN Map No. 4104



Plate 1.
Manam Island as seen
from a neighbouring
island

Source: Photo taken by author

As a result of the 2004 eruption all amenities on the island are now closed. There were previously a number of pre-schools, primary school, church, convent, aid post and ambulance. This paper will analyse in more detail the indigenous knowledge utilised by Baliau community to cope with living alongside a volcano and the impact of an enforced evacuation upon Baliau from a community perspective.

Baliau community under threat

Manam Island volcano has a long history of eruptive behaviour, resulting in the surrounding villages being constantly under threat from eruption. Baliau community is however, situated on the safest side of the island away from direct lava flow. Major eruptions recalled by the villagers include 1937, 1957 (in which the Australian administration evacuated everyone to the mainland for an extended period of time), 1992, 1996 (when five villages on the opposite side of the island from Baliau were evacuated), 2004 (enforced evacuation of the whole island by the government to the mainland where many islanders still remain), 2005 and 2006. It was during these years that their use of indigenous knowledge for disaster risk reduction was especially important in reducing the risk to themselves and their livelihoods. However, the ability of Baliau to live alongside the volcano and utilise their indigenous knowledge was threatened by the evacuation in 2004. Baliau community alongside other communities on the island were thrust into a foreign environment on the mainland without adequate planning or forethought. The community recalled the evacuation as a forceful, uncommunicative

process, which in their minds continues today as authorities, without any community consultation maintain their refusal to allow the islanders to return to the island.

A first visit to Baliau community occurred in December 2006 which was followed up by a three week stay both on the island and within Asuaramba Care Centre in January-February 2007. During this time, indigenous strategies for disaster risk reduction were identified through participatory group discussions with community members. The community both on the island and in Asuaramba Care Centre were highly aware of their situation, with those remaining on the island pro-active in utilising their indigenous knowledge to ensure their continued survival living alongside the volcano. The main indigenous strategies used to cope with the volcano are outlined below.

Use of indigenous knowledge

The main disaster risk reduction strategies utilised by Baliau community in living alongside an active volcano include building methods, social linkages, land use planning, food strategies and environmental strategies. In many cases, these strategies are embedded within community culture and daily life, unidentifiable by the community as specific strategies for disaster risk reduction, yet nonetheless assisting in living with the volcano and the potential for a volcanic eruption. The indigenous knowledge outlined below was identified through community consultation both on the island and within Asuaramba Care Centre (Mercer *et al.*, 2008).

Building methods

On the island, villagers in Baliau use traditional bush materials to build their houses. Materials are easily accessible, easily replaceable and simple to erect and dismantle. The houses have traditional long sloping roofs in order to eliminate the potential for collapse under the heavy weight of volcanic ash in case of an eruption. There is the potential for fire but the roofs are designed so that volcanic ash slips from the roofs to the ground, away from house walls, thereby significantly reducing the fire risk. In the event of fire, houses are spaced far enough apart to ensure fire breaks between them so if a roof catches fire, the fire is less likely to jump to a nearby dwelling because embers have farther to travel. The roofs are also stiffened utilising local materials to:

- minimise the potential for them to be blown away; and
- ensure volcanic ash slips from the roof surface rather than potentially getting caught and settling upon the roof.

The houses are built on stilts as ground-based dwellings are considered more vulnerable to fire. The stilts serve the additional purpose of keeping animals and pests out of dwellings. Each dwelling is also surrounded by drainage channels to ensure adequate drainage in the event of heavy rain or flooding. Outside influences are affecting the use of traditional building methods and materials as villagers see modern materials, such as iron roofing, as a status symbol or sign of wealth. However, villagers regard the traditional methods of construction as far superior to more modern, scientific methods when coping with the volcano.

Social linkages

In the past, Baliau villagers have adequately prepared for and utilised social linkages in living alongside the volcano. Baliau village is led by a chieftaincy system in which

the village chief leads the villagers and controls all activities. A Garamut (traditional drum) is used to announce warnings, gatherings or meetings. A different beat is used to identify the type of announcement. Villagers are all well aware of the meaning of the different beats as the sound resonates throughout the village and the island. In addition, the wantok (friend) system of exchange ensures friends and family both within Baliau village, the island itself and outside are available to call upon in times of need. This occurred more frequently in the past than today as the community is divided due to the impact of the 2004 evacuation.

However, Baliau community all assist and help each other where required, whether in preparing gardens, making food utensils or fishing. If a warning message needed to be spread to other island villages, a system exists whereby the Garamut message is passed from one village to the next. The sound is able to be picked up by the nearest village who then passes it on to the next village and so forth. Alternatively, if the message was of more importance and needed to be received quickly a messenger was sent from one community to the next. This person had special status and was protected amongst all the communities in case of fighting between villages. Information is carefully considered and discussed with the chief and a team of advisors or community elders before decisions are made and passed down to the community. All community members are aware of this hierarchy system, which ensures a high level of organisation in the event of an emergency.

Land use planning

Locations of villages and housing in PNG were often influenced by hazard vulnerability and Baliau community is no exception. Baliau is located on the safest side of the island away from the most likely lava flow routes. Aware of their land limitations, the land is used wisely to ensure the continued fertility of the soil. Shifting cultivation is practised with land in the mountains used for cultivation, whilst flatter land close to the sea and water sources is used for construction. A drainage network exists across the community and the community have established safe areas where the whole village is able to gather in relative safety in the event of an emergency to establish an appropriate plan.

The community are very adaptable and knowledgeable about their immediate environment, having the local knowledge necessary to survive. For example, in times of drought or water scarcity the community know to limit their usage and where to dig to access more water. Soil fertility is high as a result of volcanic ash fall and this is used to the community's advantage both for subsistence agriculture and cash cropping.

Food strategies

The community all work together to ensure adequate food supplies for the whole village, both sharing resources and experiences. Bananas and coconuts are considered disaster crops as they are able to survive or recover quickly from heavy falls of volcanic material, whereas other crops may be ruined. Food such as fish is often preserved through smoking, whilst other foods, such as breadfruits are buried to preserve them for a later date. Previously, rainwater was collected and stored in bamboo, although today the community have large water tanks, supplied by World Vision as part of a community disaster preparedness programme. According to the community this occurred in 2002.

The community have proven their flexibility and use of indigenous knowledge both in relation to their volcanic environment and in terms of their new circumstances post

evacuation in 2004. Where possible (and affordable for a select few with access to transportation) villagers are attempting to alternate their lives between the island where fertility levels are much higher and the care centres on the mainland where fertility levels are low but they are supplied with food rations from non-governmental organisations (NGOs) and the government. In addition, crops are rapidly harvested and stored if a significant volcanic event is forecast.

Environmental strategies

Baliau community is dependent upon their environment for their livelihood and have developed an in-depth knowledge enabling them to identify signs of impending volcanic activity. For example, the villagers have identified that the presence of a blue smoke ring around the volcano in approximately April time means that a volcanic eruption around July is likely. If the eruption does not take place by the end of July then the community can rest easy as things have returned to normal within the volcano. Additionally, if a prolonged low tide takes place or if the dry season is extended, then the volcano is likely to be active. Other signs include earthquakes, singing from a certain indigenous bird, extended silence (no noise from wildlife or domestic animals), very hot sun, sudden hot air, restless babies, roosters crowing at unusual hours, grass dying around the top of the volcano, birds flying away and fig tree leaves falling. The accuracy of these signs has not been confirmed although the villagers claim that warning signs have been witnessed (see below).

Baliau community having lived alongside the volcano all their lives feel extremely capable at recognising warning signs of impending volcanic activity. A careful eye is kept on the volcano at all times to ensure that the community are aware of any strange activity and can give adequate warning to others of the potential for a volcanic event. Within PNG, oral traditions passed down through generations in the form of legends, visions and stories are plentiful (Blong, 1982) and reliance is often placed upon these for guidance as to what to do when disaster strikes. Prior to the eruption of 2004 for example, the villagers claimed they witnessed warning signs including blue smoke rings, grass dying around the top of the volcano, a continuous low tide and a very hot dry season. People were therefore preparing for an eruption and were expecting it before the warning was given by the Volcano Observatory Centre using scientific technology.

Utilising indigenous knowledge and the effect of the 2004 evacuation

The indigenous knowledge used by Baliau for disaster risk reduction is currently contained solely within the community both on the island and in the care centre and has been utilised for generations to enable them to live alongside the volcano. Baliau community feel the risks of living alongside an active volcano are worth taking considering the prosperity they have experienced as a result. Manam Island as a whole has traditionally been prosperous, initially in the subsistence farming years and latterly in its production of copra as a result of volcanic soil fertility. The presence of a Catholic Mission on the island further developed amenities, with the addition of a number of pre-schools and primary school. This ensured that Manam Islanders were some of the most highly educated within Madang Province. However, their links to the mainland were few and far between. No disaster risk reduction plans or evacuation plans were set up or discussed with the villagers by authorities. Rather, as identified above, the communities utilised their own warning methodology, having previously

successfully coped with volcanic eruptions. They were therefore unprepared for the impact of an enforced and unplanned evacuation, as occurred in 2004.

The evacuation of 2004 was implemented in direct response to a large volcanic eruption. According to community members there was no discussion of the potential need for an evacuation scenario despite previous eruptions. As a result, whilst the process of moving people from the island to the mainland via boats went smoothly, the process of setting up care centres and finding homes for islanders, unused to mainland customs, was exceedingly difficult.

Care centres were set up by NGOs on land rented from mainlanders by the Provincial Government. Islanders were left to clear the land themselves and were segregated from the mainland community, reducing their morale and leaving a feeling of worthlessness amongst the islanders. Islanders were not assisted in a smooth transition from their previous homes to the mainland, nor were they kept up to date with developments, except to be told that under no circumstances would the government provide any protection for those who returned to the island. This scared many into not returning. However, the chief of Baliau returned to the island and his home within a couple of months of the evacuation.

The island was seen as more prosperous because islanders were able to grow crops and continue the farming of copra, which were restricted and difficult on the mainland. Land on the island is fertile volcanic soil, whereas the land loaned to them on the mainland was of minimal quality and required extensive preparation prior to cultivation. Crime levels increased and education levels decreased as Baliau community members struggled to adapt on the mainland. As a result and despite the island still declared a disaster zone, many villagers from Baliau and elsewhere on the island followed their chief and moved back to their former homes on the island. They argued that they were far more able to cope with the impact of volcanic activity than the effects of starvation experienced in the care centres as a result of infertile land, different crops and cultivation techniques used on the mainland.

For example, the types of breadfruit on the island lasted many months when buried, whereas those on the mainland were not suitable for prolonged storage underground. Table I outlines the strengths-weaknesses-opportunities-threats (SWOT) analysis completed by residents of Asuaramba Care Centre (including Baliau villagers). However, whilst there were clearly many problems which arose as a result of the evacuation, many islanders worked to mitigate this by alternating their lifestyles between the care centres on the mainland and their island homes. For example, their dwellings on the mainland were built from materials brought from Manam Island due to a lack of materials on the mainland. Islanders continued to farm and harvest copra and vegetables on the island where the land was more fertile whilst also making use of limited supplementary food supplies provided by NGOs and the government.

Clearly disruption to their traditional lifestyles and use of indigenous knowledge has been severe with considerable unrest and debilitating circumstances arising as a result. One serious error of judgement included the placement of warring villages in the same care centres on the mainland (whereas on the island they would have been some distance apart), thereby contributing to increased tensions and fighting. This could have easily been mitigated against if the communities had been consulted. Government bodies and NGOs involved in the evacuation should have consulted community

Strengths	Weaknesses	Opportunities	Threats
Strong leaders Community cooperation – good planning and setting up of community groups – care centre development committee, agricultural groups, water supply groups, etc. Obedient and respectful citizens World Vision support – food (finished now) and livelihood project Well-organised groups Good sporting facilities	Changing situation Increased crime and trouble with youths Land insufficient for gardening Revenue ending – no cash crops Lack of governmental support Transport costs (sending kids to school) Poor housing – no access to materials No lamps because of lack of money for kerosene Not enough medicine for clinic No gravity fed water supply/money for pump repairs Weak relationship with land owners Indigenous knowledge not relevant to mainland situation	Permanent resettlement area Semi-permanent housing (no access to bush materials) Income generating projects – chickens Gravity fed water supply Cash cropping – started peanuts Medicine Adult literacy classes in pidgin Training – proposal writing and business planning	Unstable situation – no feedback or information provided, i.e. do not know whether it is long or short term Food shortage Water supply (too many using few pumps) Land owners – planning a fight to claim more land as have given up on the government Population ever increasing Loss of indigenous knowledge

Note: Consisting of villagers from Baliau, Dangale, Kolang and Kuluguma

Table I.
SWOT analysis
completed by Asuaramba
Care Centre community
members

members in order to set up a culturally sensitive evacuation and rehabilitation process which considered community needs and utilised indigenous knowledge.

Indigenous populations have adjusted their livelihood strategies to adapt to gradual change for centuries (Mercer *et al.*, 2007). Yet even though research and development organisations have acknowledged the existence and importance of indigenous knowledge and strategies related to disaster risk reduction, in practice little documentation of its application through official channels exists (Dekens, 2007). PNG, in developing a national disaster risk reduction and disaster management framework for action 2005-2015, identified the need to “integrate traditional knowledge into disaster management systems” but not how this may be achieved (NDC, 2005). It is essential that indigenous knowledge is drawn upon in addressing the accelerated pace of change today, its impacts upon environmental hazards and the consequences for indigenous communities situated within hazard prone areas (Mercer *et al.*, 2007). Kelman and Mather (2008) suggest the application of the sustainable livelihoods approach to volcano-related opportunities. If applied to Baliau community and Manam Island in 2004 such an approach would have enabled the positive and negative effects of Manam volcano to be identified, potentially allowing for a clearer and more considered approach to the evacuation. The following section reviews the potential for Kelman and Mather’s (2008) sustainable livelihoods approach for volcano-related opportunities.

The potential for the sustainable livelihoods approach

The severest impact of the volcanic eruption in 2004 was on the opposite side of the island from Baliau village, who whilst affected had the potential to rapidly recover, rebuild and regrow their livelihood. However, such a scenario was not considered during the enforced evacuation of the island in 2004. The volcano has since erupted in 2005 and 2006, with the villagers who unofficially returned to the island utilising indigenous knowledge to cope with the impact. Baliau community members on the mainland are currently in a state of flux, not officially allowed to return to the island and not informed of current developments or whether they will be allowed, if ever, to officially return in the future. This has resulted in Baliau villagers taking action and returning to the island despite the closure of all island amenities and unavailability of assistance. This in turn has contributed to a dramatic fall in the economic prosperity of Baliau villagers and Manam Island as a whole.

Whilst the negative impacts of the volcano were considered by authorities in organising the evacuation and preventing the return of villagers to the island, the positive benefits of living alongside a volcano were not taken into consideration. Kelman and Mather (2008) suggest applying the sustainable livelihoods approach to volcanic scenarios in four ways:

- (1) understanding, communicating, managing vulnerability and risk, and local perceptions of vulnerability and risk beyond immediate threats to life;
- (2) maximising the benefits to communities of their volcanic environment, especially during quiescent periods, without increasing vulnerability;
- (3) managing crises; and
- (4) managing reconstruction and resettlement after a crisis.

The application of these to Baliau community and Manam Island would have enabled the development of a much clearer and more appropriate scenario as opposed to the enforced evacuation with no consultation which occurred in 2004.

The field work showed that Baliau community have the indigenous knowledge available to be able to understand, communicate and manage the vulnerability and risk. This however, could be further enhanced through integration with relevant and applicable scientific knowledge and support from appropriate stakeholders (Mercer *et al.*, 2009). The community themselves have maximised the benefits of their fertile volcanic environment, adapting where necessary to their environmental limitations and hazard potential through the indigenous strategies listed above. The enforced evacuation in 2004 resulted in the immediate loss of their livelihoods. There was no specific plan in place either on the part of authorities or the community to manage the reconstruction and resettlement after a potentially large volcanic eruption.

If applied to Baliau community the sustainable livelihoods approach, whilst not a panacea, could have enabled both the positive and negative benefits of the volcano to be considered, rather than solely the negative impacts. This would have enabled a more informed management of the crisis and subsequent reconstruction and resettlement during the evacuation phase (Kelman and Mather, 2008). There needs to be a planned and coordinated approach to evacuation in order to ensure sustainable livelihoods for affected communities. A more careful and thought out evacuation plan utilising

the sustainable livelihoods approach and developed in consultation with Baliau would have reduced the issues outlined in the SWOT analysis.

Conclusions

The indigenous practices described above and used by Baliau community for volcanic risk reduction have been shown and supported as a good way to minimise the risks of living alongside a volcano. However, an enforced evacuation without community consultation has resulted in a loss of indigenous knowledge and difficulty in adapting to new circumstances. It should be the communities directly affected by environmental hazards, deciding and developing policies to deal with them (Wisner *et al.*, 2004). In doing so, communities should be supported by relevant and applicable stakeholders (Cronin *et al.*, 2004; Mitchell, 2006) utilising a participatory approach and building upon community knowledge (Kumar, 2002). Consultation and communication are essential for the implementation of effective and applicable disaster risk reduction and preparedness strategies (Mitchell, 2006; Haynes *et al.*, 2008a, b; Paton *et al.*, 2008).

All too frequently a paternalistic viewpoint is taken, ignoring the voices of those directly affected. As this example shows, indigenous knowledge has both relevance and applicability, and communities themselves should be involved in decision making as those who often know their situation best. Whilst indigenous communities are able to adapt it is essential their indigenous knowledge is utilised in the process. However, the integration of indigenous knowledge with scientific knowledge can only serve to increase the capacity of indigenous communities such as Baliau to cope. In addition, the application of the sustainable livelihoods approach enables the analysis of both the positive and negative impacts of living alongside a volcano, thereby ensuring a more informed approach. Consultation within and between communities, and relevant authorities would ensure the establishment of a culturally sensitive and viable evacuation and rehabilitation process considering wider social, political and environmental processes.

References

- Blong, R.J. (1982), *The Time of Darkness: Local Legends and Volcanic Reality in Papua New Guinea*, University of Washington Press, Seattle, WA.
- Brouwer, E.C., Harris, B.M. and Tanaka, S. (Eds) (1998), *Gender Analysis in Papua New Guinea*, World Bank, Washington, DC.
- Cronin, S.J., Petterson, M.J., Taylor, M.W. and Biliki, R. (2004), "Maximising multi-stakeholder participation in government and community volcanic hazard management programs; a case study from Savo, Solomon Islands", *Natural Hazards*, Vol. 33, pp. 105-36.
- Dekens, J. (2007), *Local Knowledge for Disaster Preparedness: A Literature Review*, International Centre for Integrated Mountain Development (ICIMOD), Kathmandu.
- Haynes, K., Barclay, J. and Pidgeon, N. (2008a), "The issue of trust and its influence on risk communication during a volcanic crisis", *Bulletin of Volcanology*, Vol. 70 No. 5, pp. 605-21.
- Haynes, K., Barclay, J. and Pidgeon, N. (2008b), "Whose reality counts? Factors affecting the perception of volcanic risk", *Journal of Volcanology and Geothermal Research*, Vol. 172 Nos 3/4, pp. 259-72.
- Kelman, I. and Mather, T.A. (2008), "Living with volcanoes: the sustainable livelihoods approach for volcano-related opportunities", *Journal of Volcanology and Geothermal Research*, Vol. 172 Nos 3/4, pp. 189-98.

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- Kumar, S. (2002), *Methods for Community Participation: A Complete Guide for Practitioners*, ITDG, Rugby.
- Mercer, J., Dominey-Howes, D., Kelman, I. and Lloyd, K. (2007), "The potential for combining indigenous and Western knowledge in reducing vulnerability to environmental hazards in small island developing states", *Environmental Hazards*, Vol. 7 No. 4, pp. 245-56.
- Mercer, J., Kelman, I., Lloyd, K. and Suchet-Pearson, S. (2008), "Reflection on use of participatory research for disaster risk reduction", *Area*, Vol. 40 No. 2, pp. 172-83.
- Mercer, J., Kelman, I., Taranis, L. and Suchet-Pearson, S. (2009), "Framework for integrating indigenous and scientific knowledge for disaster risk reduction", *Disasters*, Vol. 34 No. 1, pp. 214-39.
- Mitchell, T. (2006), "Building a disaster resilient future: lessons from participatory research on St Kitts and Montserrat", PhD thesis, Department of Geography, University College, London.
- NDC (2005), *Papua New Guinea National Disaster Risk Reduction and Disaster Management Framework for Action 2005-2015*, National Disaster Centre, Port Moresby.
- NDC (2008), "Disaster management laws and policies", available at: www.pngndc.gov.pg/Disaster%20Mgmt%20Laws/Disaster%20Laws.htm (accessed 28 May 2008).
- Paton, D., Smith, L., Daly, M. and Johnston, D. (2008), "Risk perception and volcanic hazard mitigation: individual and social perspectives", *Journal of Volcanology and Geothermal Research*, Vol. 172 Nos 3-4, pp. 179-88.
- UNISDR (2005), *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters*, United Nations International Strategy for Disaster Reduction, Geneva, available at: www.unisdr.org/eng/hfa/docs/Hyogo-framework-for-action-english.pdf (accessed 8 December 2007).
- UNISDR (2007), *Papua New Guinea: Disaster Profile*, United Nations International Strategy for Disaster Reduction, Geneva, available at: www.unisdr.org/eng/country-inform/papua-new-guinea-disaster.htm (accessed 8 December 2007).
- Wisner, B., Blaikie, P., Cannon, T. and Davis, I. (2004), *At Risk: Natural Hazards, People's Vulnerability and Disasters*, 2nd ed., Routledge, London.

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