Disasters, Deaths and the Sendai Framework's Target One: A Case of Systems Failure in Hiroshima Landslide 2014, Japan

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Introduction

From the 19th to 21st of August 2014, the city of Hiroshima in Japan experienced a torrential rainfall triggering 166 landslides, which led to 107 debris flows and 59 shallow slides (Wang et al., 2015). These landslides were compounded by flash flooding (Wang et al., 2015). The consequence of the landslides and flooding led to 74 deaths in the two wards[1] of Asa-Kita and Asa-Minami, which are in the northern parts of Hiroshima (Fukuoka et al., 2015). The reasons for these deaths have been captured by experts and researchers through the lens of risk and vulnerability perspectives, as described below. This paper engages with a 'complex perspective' (Ray-Bennett, 2017a, 2017b) to explain why these deaths occurred and how these deaths could have been avoided in Hiroshima.

Avoiding or reducing disaster deaths is an emerging scientific field (Ray-Bennett, 2017a, 2017b). In 2015, the UN's Sendai Framework for Disaster Risk Reduction 2015-2030 (successor to the Hyogo Framework for Action 2005-2015) identified seven Global Targets, of which the first Target is to "Substantially reduce global disaster mortality by 2030" (UN, 2015: 12). This is welcoming news as it is envisaged to lead to new actions, strategies, funding and research to reduce disaster deaths. It is envisaged also to lead to the systematic collection of mortality data at local, national and international levels, which is currently lacking (Ray-Bennett, 2017a, 2017b). This research contributes to the progressively emerging domain of knowledge by bringing the case of Hiroshima to the forefront.

Deaths and Disasters Perspectives

This section engages with one of the pertinent concerns: why deaths occur in disasters (Ray-Bennett, 2017a, 2017b). Although research that scrutinizes the causes for men's and women's deaths in disasters is rather limited, it usually relies on one of two perspectives: traditional (or risk-based) and/or vulnerability (Kapur, 2010; Ray-Bennett, 2017a, 2017b). These perspectives are analytically different but in practice they are related. Most recently, Ray-Bennett (2017a, 2017b) proposed a 'complex perspective' to explain why deaths continue to occur. This perspective is built from the tenets of risk, organizational and soft-systems theories. This perspective adds new layers of understanding to risk and vulnerability perspectives to understand the reasons for deaths, as well as identifies measures to reduce them (Ray-Bennett, 2017a, 2017b).

Traditional Perspective

The traditional perspective is the most dominant and mainstream perspective. According to the traditional perspective, natural hazards originate from natural systems and they can cause harm and loss. One way of mitigating the effect of nature is through technology or a 'technical fix' (Ariyabandu and Wickramasinghe, 2003; Wisner et al., 2004; Bryant, 2005; Ray-Bennett, 2017a, 2017b). This line of thinking was dominant in the UN's General Assembly Resolution 44/236, adopted on 22 December 1989. Four out of five of the UN's General Assembly's goals underlined the importance of the dissemination of technical information and the transfer of scientific and engineering knowledge for the mitigation of disasters in developing countries (Bankoff, 2001; de Senarclens, 1997; Ray-Bennett, 2017a, 2017b). As a result, structural mitigation measures, such as building concrete houses, flood levies, ocean wave barriers, cyclone shelters, embankments and dams attained primary importance over non-structural mitigation measures, such as policies, laws, training, raising public awareness and aid – amongst many (Davis and Gupta, 1991; Haque and Zaman, 1994; Thomson and Penning-Rowsell, 1994; Zaman, 1999; Kaiser et al., 2003; Ray-Bennett, 2010, 2017a, 2017b). This traditional perspective evolved subsequent to the mid-term evaluation of the International Decade for Natural Disaster Reduction (IDNDR) (1990-2000) in 1994 (known as the Yokohama Strategy), followed by the Hyogo Framework for Action (2005-2015), and most recently the Sendai Framework for Disaster Risk Reduction (2015-2030) (UN, 2015). Now there is widespread acknowledgement that hazards can include “latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological and biological) or induced by human processes (environmental degradation and technological hazards)” (UNISDR, 2015a: 3/25).

Despite these changes, governmental organizations often use natural causes or the geophysics of a hazard to explain deaths in disasters. This was noted by Kapur (2010) whilst reviewing the effects of 16 natural hazards on human deaths from 1977 to 2002 in India. Geophysics of a hazard can be understood in three ways: first, the higher the intensity of a hazard, the more likely it is to kill people. Second, hazards are seasonal and so are human deaths (Kapur, 2010; Ray-Bennett, 2017a, 2017b). In Japan, the months of August and September are typhoon-prone, while tornados are more likely in September. In July and August more lightning is recorded, and the months of January and February are prone to extreme low temperatures. It was noted that 83 per cent of typhoons made landfall from July to September. In 2017, circa 60 per cent of all deaths due to disasters (84 out of 134) occurred in these three months. The most severe rainfall disaster in the Heisei era (the Japanese era, which started in 1989 and ends in 2019) occurred in July 2018 and has led to more than 200 casualties to date. Third, the effect of a hazard is spatially determined and likewise, the deaths due to disasters are spatially varied (Kapur, 2010; Ray-Bennett, 2017a, 2017b). Japan’s diverse and different regions are exposed to different types of hazards; for instance, in the south-west of the country, Kyushu Island and Chugoku- Shikoku region are exposed to strong typhoons, whereas the north-east of the country is exposed to heavy snow. Three-fourths of all casualties due to snow occurred in the north-east’s five prefectures (Hokkaido, Aomori, Akita, Yamagata and Niigata), which is out of the 47 prefectures in the country (Kamimura, et al., 2015).

The traditional perspective provides an important insight into the dynamics of geohazards and their effect on humans. As a result, national and international organizations are investing heavily to build the capacity of the experts and practitioners by embracing state-of-the-art technologies, such as space technology and multi-hazard early warning systems in order to promote effective disaster management systems to reduce deaths (UNISDR, 2015b; Ray-Bennett, 2017a, 2017b; WMO, 2017). Nonetheless, this perspective does not explain why some groups of people are more vulnerable to disaster deaths.

Vulnerability Perspective

The vulnerability perspective, on the other hand, aims to explain why some people are more vulnerable to disasters than others. According to this perspective, the impacts of natural disasters are not entirely 'natural', rather they are determined by people's unequal exposure to risks, which are a consequence of their socio-economic system (Cannon, 1994; Neumayer and Plümper, 2007; Ray-Bennett, 2017a, 2017b). The significance of natural hazards as trigger-events is not denied by this perspective, but emphasis is placed on the various ways in which social and economic systems can render people more vulnerable to disasters (Cannon, 1994; Varley, 1994; Winchester, 2000; Wisner et al., 2004; IPCC, 2012; Ray-Bennett, 2017a, 2017b).

According to this perspective, differences in mortality to disasters are explained due to biological vulnerability, social and cultural vulnerabilities (caste, race, gender, and age), economic vulnerability (class) and physical vulnerability (housing structures). These vulnerabilities are not distinct; they often are conjoined and reinforce each other during the times of disaster (Ray-Bennett, 2017a, 2017b). This is evident in the discussion below.

Biological and physiological differences between men and women put women at higher risk during disasters (Neumayer and Plümper, 2007). Men in general are physically stronger than women and, therefore, they are likely to withstand the impact of a disaster better than women. For instance, a physically robust man has a better chance to swim or climb up a tree in order to survive against an emerging storm surge. However, biological and physiological differences may also be socially determined.

Social and cultural norms related to role behavior put women, more than men, at a greater risk when it comes to rescue efforts (Neumayer and Plümper, 2007). Dress codes such as *saree* or *burqa* were found inhibiting women's mobility during the 1991 cyclone in

Bangladesh. Learning to climb a tree or to swim are socially not permissible in some societies. In Sri Lanka, a study conducted by Centre on the Epidemiology of Disaster (CRED) noted that only 12 to 20 per cent of women were able to swim compared to 75 to 85 per cent of men (Eklund and Tellier, 2012).

Social stratification based on class and race can be highly detrimental in putting some lives at risk during disasters (Barnshaw and Trainor, 2007; Ray-Bennett, 2010). An individual's class and race often determine the choice one can make and the social capitals they can acquire in their everyday lives. Social choices and capitals are critical assets to build an individual's agency and social networks. Vulnerable groups often lack agency and networks due to structured inequalities and lack of social resources that exist in their everyday lives. In this vein, communities that are better placed within their social networks during their everyday lives will be in a better position to evacuate and even survive a disaster. On the contrary, communities that are not, will bear the brunt of the disaster. Unsurprisingly, poor African Americans were the predominant victims in Hurricane Katrina, compared to their white middle class counterparts, because they lacked social capital in their everyday lives (Barnshaw and Trainor, 2007).

In addition to the social and cultural vulnerabilities, physical vulnerabilities can also lead to gender differences in mortality (Ray-Bennett, 2017a, 2017b). Kapur (2010) argued that a greater number of women's deaths occurred in the 1993 Latur Earthquake in India due to the nature of house structures. Higher numbers of deaths were recorded in stone and mud houses (86.32 per cent) compared to shacks (0.40 per cent) and brick and mortar (1.15 per cent) (Kapur, 2010).

The vulnerability perspective played a crucial role in changing theory and practice related to disaster risk reduction (DRR) (Enarson, 1998; UN, 2005; Ray-Bennett, 2017a, 2017b). However, a limitation of this perspective in the context of this research is its over-emphasis on the vulnerabilities of communities 'living with' or 'at risk', rather than the organizations and professionals who are involved in the day-to-day business (Schön, 1983) of averting disaster risks (Ray-Bennett et al., 2015; Ray-Bennett, 2017b). As a result, understanding organizational vulnerabilities that can manifest through inaction (UNISDR, 2006; Chatterjee et al., 2010; The National DIET of Japan, 2012; Aalst et al., 2013), human errors (Reason, 1990; Perrow, 1999), mismanagement (Toft and Reynolds, 2005), lack of coordination, communication (Weick, 1990; Prizza, 2007; Srivastava, 2009; Chatterjee et al., 2010), hierarchy and other features (Weir, 1996) in national and local authorities, non-governmental organizations and environmental agencies have received far less attention by the DRR community (DFID, 2006, 2012; Masys et al., 2014; Ray-Bennett et al., 2015; Ray-Bennett, 2017a, 2017b). As such, human deaths can also occur due to vulnerabilities that exist in human-built organizations[2] (Perrow, 1999; Weick, 1990), such as a disaster management system. This is explained through the lens of a 'complex perspective' below.

Complex Perspective

According to the complex perspective, a disaster management system is a conglomeration of different professional groupings and actors designed for specific tasks and goals (Ray-Bennett, 2017a, 2017b). This will be evident later in the description of the disaster management system in Japan. Actors and organizations involved in disaster management belong to linear systems which are spatially segregated (Perrow, 1999; Ray-Bennett, 2017b). For instance, disaster management involves multiple agencies across the public, private and voluntary sectors at local, regional, national and global levels. These organizations are diverse, hierarchical and interdependent (Ray-Bennett, 2017b). A typology of these organizations is provided in **Table 1**.

<<Table 1 inserted here>>

Each organization has dedicated connections and an extensive understanding of the nature of risk (such as landslides/flooding) (Perrow, 1999; Ray-Bennett, 2017b). These organizations are also highly complex in their structures and processes of work. At the outset, they may look like separate entities but in reality, they are highly inter-dependent (Weick, 1990; Ray-Bennett, 2017b). In this context, deaths from disasters are a complex problem, because the decision to save lives during disasters sits across many governmental departments and institutions (Rittel and Webber, 1973; Grint, 2008; Ray-Bennett, 2017a, 2017b). Unfortunately, these complexities have remained unexplored by risk and vulnerability perspectives. Vulnerabilities of actors and organizations that exist at the seams of the disaster management system are explained further through the analytical tools of complex perspective, which are *coordination failure*, *communication failure* and *subjective worldviews* (Ray-Bennett, 2017a, 2017b). The advantages of these analytical tools are understood in the light of '*core information*', which is early warning information that serves as near-real-time information about the impact of an event (Comfort et al., 2004; Ray-Bennett, 2017b).

Coordination Failure

Disaster management organizations, such as primary, secondary and tertiary, undertake a myriad of activities; it is not possible to track them all (Ray-Bennett, 2017b). For the purpose of this research, the focus is on coordination problems in a disaster climate. A disaster climate offers a 'window of opportunity' to identify uncoordinated activities and greater opportunities to learn lessons. Coordination studies have focused on coordinating human personnel, the division of labor by function (Prizza, 2007) and stakeholder partnerships (Chatterjee et al., 2010). This research focusses on the coordination of a flow of 'core information' in order to save lives during disasters (Ray-Bennett, 2017b).

Early warning ('core') information is largely generated by meteorologists and meteorology offices using early warning systems. The interpretation of this core information involves a complex interaction of humans and technology (Alexander, 1993). Problems of coordination can occur when there is a lack of core information. For example, prior to the Indian Ocean Tsunami in 2004, there was no early warning system in place to monitor the Indian Ocean's water surface (UNISDR, 2009). As such, there was no core information for the

Category 1 and 2 responders to rely on. The consequence of this was a death toll of more than 225,000 people (Romo-Murphy et al., 2011; Channel 4, 2015). The lack of core information can blind a response system and has the potential to hamper efforts to save lives (Comfort et al., 2004).

The problem of coordination is also closely connected to decision making. Decision making is both a social and cognitive process at the interface of technology in a disaster climate (Ray-Bennett, 2017b). First, it is a social process because the knowledge of core information can be a political tool for some interest groups. As such, powerful groups may deliberately avoid coordinating core information (Alberts and Hayes, 2003; Herrmann, 2009). The decision to coordinate core information can also be hindered by a culture of complacency (Acton and Hibbs, 2012), poor administrative structures (Chatterjee et al., 2010; UNISDR, 2006) and a lack of adaptive leadership amidst the convoluted roles and many actors present in a DRR climate (multi-stakeholder and multi-sectoral approach) (Prizza, 2007; Lalonde, 2011; Aalst et al., 2013; Ray-Bennett, 2017b; Global Emergency Group, 2012). Second, looking at decision making from a cognitive perspective, coordination problems can arise under conditions of 'uncertainty' (Kolen and Hesloot, 2012). Uncertainties and ambiguities are inevitable when dealing with complex problems (Grint, 2008). For example, although early warning systems have greatly advanced, it is still not possible to provide exact forecasts of the landfall of a tropical cyclone or exact predictions of flooding or flash flooding (Herrmann, 2009; Ray-Bennett, 2017b). In uncertainties, decision makers and practitioners could be left without "a reliable warning of a potential threat with enough lead-time to take appropriate evasive action" (Herrmann, 2009: 14). In such a dynamic situation, decision makers (Category 1 and 2) have to cope and react with limited information and uncertainties about potentially fatal conditions (such was the case in Hiroshima, which is discussed later) (Ray-Bennett, 2017b).

Communication Failure

It is also argued that systems can fail due to deficient communication (Ray-Bennett, 2017b). According to Anderson and Goolishian (1988), human systems are communicative systems. They are “language-generating, meaning-generating systems engaged in an activity” (Anderson and Goolishian, 1988: 188). One can view the early warning systems as language-generating and meaning-generating systems, whose objectives include “detection and warning, communication and response” (Kalsi, 2003: 68). The relevant actors in a socio-technical disaster management system generate core information at the interface with technology. This technical information is then interpreted in order to communicate across actors and organizations with the aim of supporting a response system. The relevant actors are then generating, as well as communicating, core information between and across actors in order to minimize deaths in the at-risk communities. Through this process, the first responders make sense of this core information and develop an appropriate disaster response (Arnoldi, 2001). As such, core information and the disaster response are tightly coupled. Loose coupling (either due to the non-availability or miss-interpretation of the core information) will lead to an ineffective response (Hanai, 2014; Ray-Bennett, 2017b).

Communication is then *everything* in a disaster management system (Luhmann, 1993, 1999; Ray-Bennett, 2017b). Without communication between the relevant actors, actors to technology and likewise, the function of this sub-system to reduce societal loss and damage from disasters will collapse. This is explained once again through the flow of the ‘core information’ generated by the early warning systems. The flow of core information can fail for a number of reasons. The most relevant in the context of this research are physical disruption in the early warning systems, the communicating devices and hierarchy – amongst others (Ray-Bennett, 2017b).

Physical Disruption: In the information age, disaster management organizations, including the meteorological offices, use a number of information and communication tools or devices and social media to communicate, exchange and share core information amongst themselves and with the at-risk population (Alberts and Hayes, 2003; Srivastava, 2009; Moore and Verity, 2014; Ray-Bennett, 2017b). Some of these include: telephone, e-mail, satellite phone, mobile, TV, radio, newspaper, paging devices, twitter and the Internet. These communication devices are central to improving the capacity of the first level responders (Comfort et al., 2004), as well as that of the at-risk population (Harun-Al-Rashid, 1997; UNISDR, 2006; GIZ, 2012; Moore and Verity, 2014; Ray-Bennett, 2017b). However, a random failure of the communications networks or of power supply caused by a disaster could significantly damage the flow of information between organizations and with the people at-risk (Srivastava, 2009; Ray-Bennett, 2017b).

Hierarchical barrier: Communication can fail in a disaster climate due to rigid hierarchical systems. “In rigidly hierarchical systems, there are overt barriers to the free flow of information, even when that information is of a kind that is crucial for effective managerial decision-making” (Weir, 1996: 119). These overt barriers can manifest due to a system's reliance on the traditional chain of command structures where decision making is centralized. Such a system creates a ‘mind-set’ which disables imagination, dynamism and foresight (Masys et al., 2014; Ray-Bennett et al., 2015; Weick, 1990). Rigid hierarchical systems also enable the possibility of core information either evaporating or getting delayed in the structures of human-built organizations.

World Views

The disaster management system can also fail due to conflicting world views (Ray-Bennett, 2017b). Under the aegis of the UN’s DRR framework, disaster management systems involve a combination of: early warning practitioners, Category 1 and 2 responders, gender and DRR specialists at international, national and local levels – to mention a few. These actors have their own world views or *Weltanschauung* on how to best avert disaster risks. Some of the world views of the DRR, vulnerability and gender studies were discussed earlier in order to explain why deaths occur. Strategies and targets emanate from the world views that these actors adopt. As such, examining the world views of actors is salient to this research (Ray-Bennett, 2017b).

A world view is a “complex set of perceptions, attitudes, values and motivations that characterize an individual or group” (Waring, 1989: 12). It also involves a kind of perceptual ‘window’ or ‘tinted spectacles’ through which each of us interprets the world (Checkland, 1981; Waring, 1989). It encapsulates the “notion that our experiences of the world are mediated or interpreted in terms of our purposes, knowledge, values, and expectations etc., which have developed in particular ways through our previous experiences” (Mingers, 1980: 6). Past experiences and world views shape mental models (Mingers, 1980), which could either be detrimental or an enabler for an organization to learn (Senge, 1990; Ray-Bennett, 2017b).

It is argued here that the problems of coordination and communication are tightly coupled with the conflicting world views of the different actors and organizations of the disaster management system (Ray-Bennett, 2017b). One of the consequences of these subjective world views is a lack of an ‘overall objective’ or a ‘goal’ (Jenkins, 1969) to avoid deaths. In the context of this research, lack of an objective is synonymous to a lack of input into the system to reduce ‘deaths’, and this is demonstrated below (Ray-Bennett, 2017b).

Category 1, 2 and Early Warning Practitioners: Currently the generation and dissemination of core information by meteorologists is done in a gender-neutral way. They do not target the ‘at-risk’ community as their primary end user. Instead their target group includes: decision makers (Category 1 and 2); media; businesses, such as insurance companies; the aviation sector; and grain producers – to mention a few (Glantz, 2009; Ray-Bennett, 2017b). The purpose is to communicate effective warnings for current and future threats. However, some discretion is left with the Category 1 and 2 responders to decide who they want to warn and how.

DRR Advocates: Much like its predecessor (the Hyogo Framework for Action), the Sendai Framework emphasizes the importance of early warning approaches ‘that are people centered’ (UN, 2005: 4-5, iid.9; UN, 2015; UNISDR, 2006). People centered approaches are highly useful but at the same time the concept of 'people' raised by the UN requires further examination (Ray-Bennett, 2017b). Emphasis on people or humans has the potential to assume gender-neutrality, which can "often be an expression of the masculine in which the gender dimension can be overlooked, hence providing only a partial understanding of issues", according to Hudson (2005: 157).

People centered approaches may also be dubbed as the 'whole community approach' or 'risk reduction approach', and they can often overlook the needs of vulnerable groups, including women, men, [the physically and mentally challenged] and children during disasters (Ikeda, 2009; Ray-Bennett 2016a; Ray-Bennett, 2017b). In this light, this can be considered as an *omission* in the DRR framework. Omissions are the by-product of latent errors of human actors (Reason, 1990). They are "the simple failure to carry out some of the actions necessary to achieve a desired goal" (Rasmussen, 1985, quoted in Reason, 1990: 184).

Having presented the framework for a complex perspective, the next sections present the case study. In doing so, the analytical advantages of a complex perspective are presented in the Discussion section to add an additional layer to understand why 74 people died in Hiroshima in 2014.

Methodology

To develop the case study for Hiroshima, a desk-based literature review, a field site visit and, five key informant interviews were conducted by the authors in 2016. For the desk-based literature review English newspapers such as Kyodo News and the Japan Times were selected. Our initial analysis, based on newspaper reports indicated a failure in the early warning system, evacuation and severity of the hazard. Based on this, the wider literature on traditional perspectives on risk, vulnerability and complexity were mined (currently section 'Deaths and Disasters Perspective' above) to understand and theorize the failure in Hiroshima. In order to develop the case study further, the second author reviewed the grey literature due to limited literature in English. This included both English and Japanese reports, census data and website material from the City of Hiroshima, the Hiroshima Prefectural Government, The Headquarters for Earthquake Research Promotion, The Cabinet Office, Japan Meteorology

Agency, IFRC, and the City of Hirakata. These sources are open to the public and added information on demographics, history of the place, and disaggregated deaths data by age and gender.

In the month of July 2016 the authors spent two-week in Hiroshima interviewing five key informants. This included: two representatives from the Asaminami Social Welfare Council; two representatives from Chugoku Regional Development Bureau, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT); and a representative from Hiroshima Local Meteorological Office, the Japan Meteorological Agency (JMA). The authors contacted staff of the Directorate General for Disaster Management twice, but they were unavailable for interviews.

The key informants were purposively selected because these organizations are part of the disaster management system in Hiroshima. Asaminami Social Welfare Council, a local branch of the National Council of Social Welfare, is a private organization that was formed by the government during WWII to improve regional welfare in Japan. This organization generally coordinates voluntary activities that are required after a disaster. Strictly speaking, it is a private organization, but it is based on a public-private partnership. It is mostly government funded and is required to follow the government's Act of Social Welfare. The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is one of the Ministries in Japan, which was founded in 2001 due to restructuring of the central government (MLIT, 2008). The new Ministry combined the following four previous government departments and organizations: Ministry of Transport, Ministry of Construction, Hokkaido Development Agency and National Land Agency. The main roles of this Ministry involve: land development, improving meteorological service – amongst other activities. DRR is one of the main roles of the Ministry and the Japan Meteorological Agency (JMA) is one of the sub-organizations of this Ministry. The JMA generates weather forecasts and early warnings for Hiroshima (JMA, 2016a) (more details below).

The semi-structured interviews were conducted in Japanese. While the second author is native Japanese, the first author is not, but she can speak functional Japanese. As such, a translator was hired to translate the interviews conducted by the authors. Although interview questions were partially informed by the components of systems failure (such as coordination, communication, and goals), the protocol for the interviews were largely open-ended and context-specific (See Appendix 1). Interview protocols were shared a week in advance to all the five key informants upon their request. Since the sample size was small, a traditional method of data analysis was used. This included listening to and reading and re-reading of the selective transcripts during data analysis. During the interviews, the participants traversed between traditional disaster risk reduction, vulnerability studies, as well systems failure in order to make sense of the Hiroshima landslide. As such, the section on 'Disaster and Deaths Perspectives' engaged with a wide range of literature to theorize the context. World views on *hito-goto* (literal translation: 'their story and not ours') and *jibun-no-koto (*literal translation: 'their story to our story') emerged in discussion with the representatives of the Asaminami Social Welfare Council. These informants spent an hour to explain this concept. A field diary was also maintained by the first author to maintain observations, translated notes and informal statements from the informants. The data presented below are the triangulation of recorded data, field diary and secondary literature. Regarding the issue of validity, the question to answer is whether or not the research can stand a test of replication. Exact replication would be hard to achieve due to the uniqueness of this research and also the subjective nature of social life. However, similar methods can be tested elsewhere in documenting the impact of disasters on people's lives and the reasons why deaths occur in disasters.

Findings

Hiroshima: The Land of Multiple Disasters

Strictly speaking, there are two Hiroshimas in Japan. Hiroshima Prefecture and the city of Hiroshima. While the city is included as a part of the Prefecture, Hiroshima city has also been designated by the Cabinet of Japan as a 'major city' in Japan[6] (Ohsugi, 2011). This means that most of the local authority owned by a prefectural government has been transferred to Hiroshima city. Landslides described in the later part of this section mostly occurred in the territory of the city of Hiroshima. The city of Hiroshima (hereafter Hiroshima) is a well-known city as it was the first city to be atomic-bombed in the world. The city was formed in 1889 with a population of 83,387 as one of the first cities in Japan (Hiroshima City Hall, 2015). According to the census, the population of Hiroshima has been increasing since then. Only in the census surveys undertaken in the years of 1947 and 1950 was there a decline in the population. In 1985, the population exceeded one million. In 2015, there were a reported 1,194,304 habitants in Hiroshima (Hiroshima Prefectural Government, 2018).

The development of Hiroshima is un-balanced due to rapid urbanization like many other big cities in Japan. The city has eight wards, and the central ward is Naka ward. The city hall (office of the city government) is located in the Naka ward. The population of Naka ward decreased in the last 40 years; it was 148,192 in 1975 compared to 136,640 in 2015 (Hiroshima Prefectural Government, 2018). On the other hand, the population of its suburb wards, such as Asa-Kita and Asa-Minami have drastically increased. In 1975, there were 83,100 habitants in Asa-Kita and 131,374 habitants in Asa-Minami (Hiroshima Prefectural Government, 2018). After four decades, the former ward currently has 145,018 habitants, and the latter ward has 242,512 habitants (Hiroshima Prefectural Government, 2018). This means that there are many “newcomers” in these suburb wards and most of them do not know the features of the land well.

Physically, the city of Hiroshima can be classified into two areas. The old city, located in the center of the city, has soft ground because the geological strata consists of sand, silt, clay, and gravel. The old city is vulnerable to earthquakes. Conversely, the suburban parts of the city, which are in the northern peripheral of the city, has weathered granite. This area is vulnerable to landslides and debris flow (The City of Hiroshima, 2018). Hiroshima Prefecture, including the city is highly vulnerable to water-induced disasters. Accordingly, a sediment disaster precaution zone is designated by prefectural governments based on the law. This is because Hiroshima Prefecture has the most designated disaster precaution zones out of the 47 prefectures.

Hiroshima is also prone to earthquake risks. In 2001, an earthquake of Magnitude 6.8 occurred in Aki-nada, which is offshore of Hiroshima (The Headquarters for Earthquake Research Promotion, 2004). It damaged Hiroshima Prefecture, including the city. It is estimated that the recovery period from the impact of this earthquake is circa 67 years (The Headquarters for Earthquake Research Promotion, 2004). Although earthquakes are one of the major risks for Hiroshima, water-induced disasters are more common in Hiroshima (The City of Hiroshima, 2018). The city had three major water-induced disasters in the Heisei era (1989-2019) due to heavy rainfalls in 1999, 2014 and 2018. Of the three, the 2014 heavy rainfall was the most significant. It caused 74 casualties, 107 debris flow and 59 landslides in the city (Hiroshima Prefectural Government, 2015). The 2014 rainfall compounded by flash flooding and landslides is the focus for this research.

Flood and Landslide in 2014

According to the Head of the Asaminami Social Welfare Council, who was interviewed:

> *The rainfall was moderate on 19th and 20th August. It was nothing unusual. On the 21st of August, we experienced **unbelievable** amount of rainfall compared to other years from 2000 to 2013. The heavy rainfall was in the early hours of 21st August. Around 1.00 am.*
>
> ***At 2.15 am**: Nishi (west wards) received weather warning.*
>
> ***At 3.15 am**: Asa-Minami received weather warning for evacuation. This warning was not meant for the citizens.*
>
> ***At 4.20 am**: the general public in Asa-Minami received weather warning for evacuation.*
>
> ***Between 2.00 am and 4.00 am**: the landslide took place.*
>
> *There is a big gap between the rainfall and early warnings. This is a big problem. […] People were sleeping at that time. They did not have the information before they went to bed. At 4.30 am people received the warning for evacuation. The Hiroshima City Council was checking the weather forecasts all the time, but*

they did not issue weather alert or evacuation in case they may get it wrong. When they did, it was late […]

Lessons need to be learnt from this event. What is that? It is knowing the fact that prediction can never be right. We cannot rely on predictions alone. Climate change is happening. Erratic weather patterns including heavy rainfall like this one are on the rise. We have a new term for heavy rainfall, which is "guerrilla". We need to prepare for unpredictability by knowing the 'basics', which is our 'locale'. We may know our place, but it is not easy to locate our people because of houses, places and narrow streets. 'Knowing is not enough'. 'Knowing only does not help'. It is about making people know. Such as, what will you do when you know your house is at risk to landslides or floods? (Hiroshima City Council and Head of the Asaminami Social Welfare Council, Hiroshima Shi, 19 July 2016).

According to a local Japanese newspaper (Kyodo, 2014a), the floods and landslides occurred in the early hours of the 20th of August, severely affecting two wards of Hiroshima: Asa-Kita and Asa-Minami (Wang et al., 2015). This disaster was described as 'a high-intensity/low-duration rainstorm' (Wang et al., 2015), resulting in the death of 74 people and several wounded in the process (Fukuoka et al., 2015). 133 houses were completely destroyed, and 296 houses were damaged (Wang et al., 2015). The people in the affected area, which consisted of more than 200,000 people, were advised to evacuate to higher and safer grounds (IFRC, 2014). After this incident, the Japan's Prime Minister Shinzo Abe instructed: "[…] government bodies to make all-out efforts to rescue those affected. […] He [Abe] also issued an order to dispatch 470 members of the Self-Defense Forces to bolster rescue activities in Hiroshima, bringing the total number involved in the rescue effort to about 500" (Kyodo, 2014a).

According to the interview with the representatives of the Ministry of Land, Infrastructure, Transport and Tourism:

the Hiroshima City Council is in charge of evacuation, warning and alert. The Hiroshima Prefecture and the Japan Meteorological Agency (JMA) are in charge of *advisory support. The JMA generates information and it is based on this information, the Hiroshima City Municipality decides evacuations. […].*

The Ministry of Land, Infrastructure, Transport and Tourism is not involved in relief, rescue or search. Only in special cases, we will. We are involved in constructing countermeasures for earthquakes and landslides. In Hiroshima there are 1,672 valleys, only 70 dams. Not enough. Of the 70 dams, 30 are in Asa-Minami and Asa-Keta alone. Deaths could have been avoided in one site, but not in the other. When the landslides occurred in 2014, only one dam could only stop the debris flow and the other two could partially, because they were still under construction. In the other areas where the dams were complete, the landslide did not take place. This is another reason so many deaths took place. Dams were incomplete. […] Putting cameras in these risky valleys are expensive. Therefore, Hiroshima has no cameras in any of the valleys. […]

Asa-Minami ward is very congested. We are building small dams there. […] It is hard for people to accept dams. After 2014, people now pay attention to the projects like ours. This disaster has been a trigger point for people to change their attitude towards dams. […]. The possibility of landslides are very high in Asa-Minami and Asa-Keta wards. The soil is very weak there. Heavy rainfall can easily trigger landslides. If we do not build any house there, there will be no disaster. Who can tell, why not to build? Hiroshima is rapidly growing.

The heavy rainfall took place at a time when people were sleeping on 20th August. Not enough time for evacuation. People were asked to evacuate but roads and streets are narrow and not suitable for evacuation. Because water flows down the streets during heavy rainfall, which makes evacuation absolutely impossible. It is very difficult to say whether early warnings work or not because evacuation is difficult to undertake in narrow and difficult spaces. […] who is right? Wrong is not right. Who is responsible for these deaths? Who is in charge? Everyone is *responsible. It is not just planners, house owners, the Hiroshima council […]. Perhaps everybody!*

Discussion: Inter-Play of Risk, Vulnerability and Complex Perspectives

Risk and Vulnerability Perspectives

The case of Hiroshima and the 74 deaths exhibit an interplay of vulnerability and risk factors, such as: intensity of a hazard, physical and social vulnerabilities and unstable geology.

The intensity of a hazard: the rainfall on the 21th of August was 'unbelievable' (287mm), 2.6 times higher than the recorded average (110.8 mm). The rainfall was labelled as a Typhoon-12 by Dou et al. (2015), and the recorded cumulative rainfall was 287 mm (2.6 times higher than the recorded average 110.8 mm) (Wang et al., 2015). Since the rainfall exceeded more than 200 mm, it was more than twice the monthly average for this area (Wang et al., 2015). The reasons for why these downpours, or locally known as *galila,* are on the rise is ascribed to global warming and climate change. This 'unbelievable' rainfall triggered the flow of 107 debris and 59 different shallow slides (Wang et al., 2015). Therefore, it was difficult to predict and prepare for this rapid onset disaster according to Wang et al. (2015).

The vulnerability of the place and people: According to The City of Hiroshima (2018), 41% of the casualties were the elderly (more than 65 years old) and 59% were not (less than 65 years old). Asa-Minami ward was one of the worst affected wards in Hiroshima, 20.1% casualties were elderly and 79.9% were not (The City of Hiroshima, 2018). Houses in these wards were made out of wooden materials which were on the pathway of the debris flow and situated at the slope and foot of a mountain. 50 out of 74 residents, were living in vulnerable buildings because the residential area is located in a mountainous valley. Furthermore, as mentioned by the representative of the Ministry of Land, Infrastructure, Transport and Tourism above, the dams, which can contain debris flow were incomplete in this ward at that time. As such, the impact was severe.

Unstable geology: the geography, topography and the nature of the soil – being a loose, weathered coarse-granite resulted in creating debris flow with immense momentum (Wang et al., 2015). Furthermore, the weakness of the soil layer was further exacerbated 'by long term land use' (Fukuoka et al., 2015) due to rapid urbanization and poor planning.

Complex Perspective

According to the complex perspective, deaths in disasters are complex because there are a myriad of actors and organizations involved in disaster management. The evidence of this is visible in the narrative of the key informant from the Ministry of Land, Infrastructure, Transport and Tourism: "*Who is responsible for these deaths? Who is in charge? Everyone is responsible. It is not just planners, house owners, the Hiroshima City Council […]. Perhaps everybody!"* Actors in the disaster management systems work in interface with technology. Therefore, a weak organization of the actors can become a fertile ground for disaster management systems to fail in reducing deaths. These failures are analyzed through the analytical tools of a complex perspective (coordination, communication and world views). In doing so, an additional layer of explanation is provided to explain as to why 74 people died in Hiroshima. Before providing evidence for the analytical tools, the disaster management of Hiroshima is described below in order to illustrate the myriad of actors and organizations that were involved. A summary of the main organization involved can be seen in **Table 2**.

<<Table 2 inserted here>>

At the national level, there are *two administrative structures*: The Cabinet Office and the Central Disaster Management Council (Cabinet Office, 2015). The Prime Minister is the head of the Cabinet Office. The Cabinet Office coordinates and sets multi-sectoral disaster management roles. The Cabinet Office also convenes the Central Disaster Management Council. The Council is a consultative and deliberative body.

The National Disaster Management System (DMS): The operation of the DMS is informed by plans developed at different levels of the government (Cabinet Office, 2015). This includes:

- Basic Disaster Management Plan (BDMP), which provides a strategic overview of how to respond to a disaster. It is developed by the Central Disaster Management Council based on the Disaster Countermeasures Basic Act of Japan.
- Disaster Management Operation, which are plans made by each public corporation and governmental agencies based on the BDMP.
- Local Disaster Management Plans, which are developed by each affected Prefecture and Municipal governments according to contextual factors and based on BDMP.
- Community Disaster Management Plan, which is a voluntary plan put together at the community level by households and local businesses (Cabinet Office, 2015).

Emergency Response Mechanism: An Emergency Response Mechanism is triggered when a disaster strikes. This is an information collection and sharing system. When a disaster strikes the national and local governments quickly collect and share information and data about its impacts to other organizations.

National Emergency Coordination System: Normally, the coordination is between the Cabinet Office and the local municipal where the disaster occurs, but when the disaster affects a wider area, the relevant prefectures are involved in the coordination activities (Cabinet Office, 2015). The centers of authority in the coordination system are the Extreme Disaster Management Headquarters at the Prime Minister Office at the national level and the On-site Headquarters for Extreme Disaster Management at the local level.

Municipal and Prefecture Level: The functions of the municipal government involve creating local disaster management plans (Cabinet Office, 2015). The municipal government is responsible for the first response to disasters, which includes setting up a disaster management headquarter, releasing and spreading evacuation alerts to the public and mobilizing emergency units, such as the fire fighters. The functions of the prefecture involve supporting the municipalities' response. Additionally, they coordinate between the municipalities' level and national level. The Municipal government is closer to the people and impact site(s) and therefore, can implement national policies and plans in a way that meets local realities and conditions.

Japan's Early Warning System: The JMA has a 24-hour weather monitoring system (Cabinet Office, 2015). Since 2013 JMA issues official emergency warnings if an emergency or disaster is anticipated to occur (Cabinet Office, 2015). Warnings and advisories are communicated to central and local governments, police and fire departments, media and the public using a wide range of media (e.g. the television, radio, newspapers, phone, internet and loudspeaker vans) (JMA, 2016b). Recently, an online system has been built to improve the use of disaster early warning information and enhance the communication between JMA, national and local disaster management organizations and media (Cabinet Office, 2015). Citizens can use their mobile phones to set up emergency alerts from JMA (JMA, 2015; Tsubaki, 2012).

Coordination and Communication Failures and World Views in Hiroshima

Although Japan and Hiroshima's disaster management system is designed to coordinate and communicate the core information between different sub-systems and actors (Emergency Response Mechanism, Cabinet Office, National Emergency Coordination System and Municipal and Prefecture Level), this did not take place prior to the landslide in 2014. Core information is vital for coordination. But this core information was lacking to instigate an effective disaster response system. This was because, there was no early warning system for landslides in place before the 2014 disaster (Kyodo, 2014b). A few days after the 2014 disaster, the Japanese Prime Minister Mr Shinzo Abe announced the design and development of an early warning system for landslides by the National Government (Kyodo, 2014b). Since the mechanisms to generate core information was lacking, there were no coordinated efforts to evacuate elderly and vulnerable people from Asa-Minami and Asa-Keta wards at least 72 hours prior to the incident. There were also no coordinated efforts between the Directorate General for Disaster Management and the related Ministries and Agencies, including the fire fighters, police, Hiroshima municipality, residents and voluntary organizations for evacuation.

Communication failure: According to DeWit (2014), Japan's climate monitoring system failed to predict the rainfall's consequences of triggering a landslide. This indicates that the monitoring system needs technical advancement to monitor potential consequences of *guerrilla* as well as accurate interpretation of the climate monitoring system in order to assess the severity of a hazard through research and administrative networks (Srivastava, 2009; Ray-Bennett, 2017a, 2017b). The potential risks of this specific disaster could have been better assessed through early preparedness and early evacuation, since the Japan's Ministry of Land, Infrastructure and Transport lists 525,307 areas – well over 30,000 of them in Hiroshima alone are at risk of landslides nationwide (DeWit, 2014).

The JMA has had an 'Emergency Warning System' in place since the 30th of August 2013, for alerting people of impending natural hazards, such as earthquakes, landslides, floods and typhoons (Shimomura, 2014). According to the key informants, the core information was generated between 2.00 am and 3.00 am when people especially the elderly were fast asleep. Furthermore, these warnings did not address the need of disabled people, including visually and physically impaired (Head, Asaminami Social Welfare Council, 19 July 2015). Therefore, this medium of communication was not effective for the elderly because they constituted 41% of causalities in Asa-Keta and 20% in Asa-Minami. This medium of information was also not effective for other vulnerable groups (including women, children and physically challenged), because they constituted 59% of casualties in Asa-Keta and 79.9% in Asa-Minami.

World views: The world views of the at-risk community and that of the Director General for Disaster Management were complacent. JMA had forecast a severe weather warning, but neither the Hiroshima City Council nor the citizens of Asa-Minami and Asa-Keta took proactive measures to evacuate. Evacuation is difficult when the disaster is unfolding due to congested neighborhoods and narrow streets and slopes. The Hiroshima City Council is aware of the risky locales of Hiroshima, yet the response system was not triggered on the 17th or 18th of August to evacuate the elderly, vulnerable and others from Asa-Minami and Asa-Keta. Furthermore, the dams for debris flow were not all complete in these wards. Despite this valuable information being available, no prior action was undertaken.

In the aftermath of the floods and landslides, the Japanese Red Cross Society (JRCS) responded immediately and mobilized relief, resources and deployed medical officers to the impacted areas (IFRC, 2014). The International Federation Red Cross Asia Pacific Zone Office closely monitored this disaster and maintained direct communication with JRCS (IFRC, 2014). Rescue efforts were also conducted by Hiroshima Prefecture's police and firefighters later on (IFRC, 2014).

Kenzo Kanayama, then Hiroshima city's disaster management chief, apologized to the public for a slow response to the emergency after the incident. According to Kenzo Kanayama: "We misjudged our assessment of the disaster, and we were too late in issuing evacuation orders" (Martin, 2014). According to an official from Hiroshima's fire department, "Something went wrong in our analysis (of the situation) [...]. We failed to issue an evacuation advisory ahead of the disaster. Looking back, I believe this is something we need to amend" (Hanai, 2014). Analyzing a dynamic situation can be challenging but since Japan has had almost 1,200 landslides each year in the past decade (The Guardian, 2014), this indicates that the disaster management system was reactionary, as well as dotted with errors of poor decision making and complacency. Above all, the disaster management system did not have an agenda or a 'goal' to 'reduce deaths' or 'save lives' at any cost (Ray-Bennett, 2016, 2017a, 2017b). As such, none of the actors at the local, prefecture and national levels were designed to work towards this goal.

The regulation on risk assessment had been slow too since only 4 prefectures were assessed out of 47 in Japan. Some of the newcomers in the Asa-Minami and Asa-Keta had very little knowledge about the risk to landslides. According to the Head of Asaminami Social Welfare Council, who was interviewed:

> "*it is important for people to know about risks. The government tells whether area is risky or not. Expert and specialists tell whether the soil is loose or not. The information is there, but not fast enough to reach people. This is because of financial reasons. The reason why it is not fast enough because when a house is declared risky, the price value of the house plummets. The regulation is not strict enough for property developers. There is a gap between householders feeling and regulations*.".

The Head of the Asaminami Social Welfare Council of Hiroshima also described a concept of '*hito-goto*' (literal translation: 'their story and not ours') that is detrimental to the disaster management system. *Hito-goto* typifies two sets of mind-sets: one that internalizes the fact that 'it is their story and not ours', and the other also normalizes the fact that 'it is their story and not ours'. Early warnings were generated on time by JMA, although there was a delay in generating 'alert' by the Hiroshima city council. There is also a general understanding amongst the citizens that "When a disaster occurs or is imminent, residents may start evacuating on their own volition, and the mayor of the municipality may also issue an evacuation advisory or order" (Cabinet Office, 2015: 31). According to the Head of the Asaminami Social Welfare Council, despite these warnings and knowledge, the residents of Asa-Minami and Asa-Keta made no efforts to evacuate. According to him, this is because, the internalization mind-set came into play: "*It is not a warning, rather telling us what to do. This warning is not for me. It will not happen to me, rather to them. It is not my story*". The normalization mind-set on the other hand prompts: "*it is not our story because the people of Asa-Minami and Asa-Keta were affected, not us. These are not our stories. These are not lessons for the city of Hiroshima. It is their story*". As a result, people who were not affected by the landslides continued with their business as usual. This mind-set of *hito-goto* is a major barrier for disaster preparedness and disaster education according to the Head of the Asaminami Social Welfare Council (19 July 2015). Disaster preparedness is crucial as it helps to improve situation analysis, planning, pre-positioning, thereby also setting the ground for enhanced resiliency.

Conclusion

According to the complex perspective, deaths in disasters are avoidable. To avoid deaths in disasters (Sendai Framework's first Global Target), it is important to overcome systems failure by further aligning the disaster management system (Ray-Bennett, 2017a, 2017b). A perfect system alignment is neither proposed, nor is it possible in this real world because of people's subjective worldviews, different frames of reference, unique communication structures and cultures. However, an enhanced version of systems alignment, or some accommodation over the issue of reducing deaths can lead to positive outcomes (Ray-Bennett, 2017a, 2017b).

To further align the disaster management system in Hiroshima, it is suggested that the coordination between the 24 designated governmental organizations, ministries and agencies for disaster management (Cabinet Office, 2015) and Hiroshima municipal and residents is improved. The coordination between these actors, organizations and communities must focus on core information to save lives. Core information is vital for the disaster response system. As such, improving early warning systems for landslides is the fulcrum. Simultaneously, enhanced coordination for effective evacuation plans between the local authorities and at-risk communities must also form part and parcel of everyday risk management and mitigation.

To improve communication, different channels need to be exploited, including word of mouth, use of radio/newspapers/TV/mobile text messages, sign languages and social media. It is also important to communicate reliable core information and on time to facilitate evacuation. The messages also have to be simple, clear and people friendly so that elderly, disabled and other vulnerable groups can translate them into necessary actions.

To promote progressive world views, it is important to: shift from reactionary disaster management to proactive disaster risk management; minimize human errors by promoting a 'culture of disaster preparedness'; and promote knowledge and administrative networks to increase the accuracy of the core information by providing lead time for evacuation (Hanai, 2014; Ray-Bennett, 2017a, 2017b; Srivastava, 2009). Political leaders at the highest levels and local leaders at prefecture levels must take the responsibility of setting a 'goal' for the disaster management system to 'reduce deaths' or 'avoid deaths' (Ray-Bennett, 2016b, 2017a, 2017b). Without a goal to reduce disaster deaths for the entire disaster management system, the Sendai Framework's first Global Target cannot be realized.

Lastly, the local municipal, prefecture authorities and voluntary organizations should proactively and continuously engage with communities through disaster education, participation and early preparedness programs, as well as to comprehensively address underlying risks and root causes of vulnerability. Governmental, non-governmental and voluntary organizations must make an effort to shift communities' mind-sets from *hito-goto* to *jibun-no-koto* ('their story to our story') (Head, Asaminami Social Welfare Council, 19 July 2015). A 'culture of disaster preparedness' (Ray-Bennett, 2017b) should promote the 'goal' of reducing death, with the culture of reducing deaths spearheaded by political leaders at national, prefecture and local levels – as mentioned above (UN, 2015; Ray-Bennett, 2017a, 2017b). A culture of disaster preparedness should also promote a 'disaster preparedness day' for everyone. The Hiroshima City Council should lead this as an annual event to educate each and every individual on disaster management, mitigation and preparedness. A disaster preparedness day should sensitize citizens through visits to disaster sites, promoting survivors' stories, involving elementary schools, colleges and universities – amongst other activities. These activities will promote belongingness or *jibun-no-koto* by ushering a new mindset: '*From their stories to … This is our story, our place, our home and our town.'* (Head, Asaminami Social Welfare Council, 19 July 2015). It is through the events and processes such as 'disaster preparedness day' and culture of disaster preparedness that the lives of the deceased will not be forgotten, but rather act as a reminder to improve practices and actions to reduce disaster deaths.

Bibliography

Aalst, M.V., Kellett, J., Pichon, F. and Mitchell, T. (2013), *Incentives in disaster risk management and humanitarian response: Background note for World Development Report*. Overseas Development Institute, London, UK.

Acton, J.M. and Hibbs, M. (2012), “Why Fukushima was preventable”, available at: http://carnegieendowment.org/files/fukushima.pdf (accessed 6 January 2014).

Alberts, D.S. and Hayes, R.E. (2003), “Power to the edge: Command, control in the information age”, available at: www.dodccrp.org (accessed 6 February 2014).

Alexander, D. (1993), *Natural Disasters*, UCL Press, London, UK.

Anderson, H. and Goolishian, H.A. (1988), “Human systems are linguistic systems: Preliminary and evolving ideas about the implications for clinical theory”, *Family Process*, Vol. 27 Issue 4, pp. 371-393.

Ariyabandu, M.M. and Wicramasinghe, M. (2003), *Gender Dimensions in Disaster Management: A Guide for South Asia*, ITDG South Asia Publication, Colombo, Sri Lanka.

Arnoldi, J. (2001), “Niklas Luhmann: An introduction”, *Theory, Culture and Society*, Vol. 18 Issue 1, pp. 1-3.

Bankoff, G. (2001), “Rendering the world unsafe: ‘‘Vulnerability” as western discourse”, *Disasters*, Volume 25 Issue 1, pp. 19–35.

Barnshaw, J. and Trainor, J. (2007), “Race, class and capital”, in D. L. Brunsma, D. Overfelt and Picou. (Eds.), *The Sociology of Katrina: Perspectives on a Modern Catastrophe*, Rowman and Littlefield Publishers Inc, New York, USA, pp.91-105.

Bryant, E. (2005), *Natural Hazards. 2nd edn*, Cambridge University Press, Cambridge, UK.

Cabinet Office. (2015), "Disaster Management in Japan", available at: http://www.bousai.go.jp/1info/pdf/saigaipamphlet_je.pdf (accessed 14 June 2016).

Cannon, T. (1994), "Vulnerability analysis and the explanation of 'natural' disasters", in A. Varley (Ed.), *Disasters, Development and Environment*, John Wiley & Sons, New York, USA, pp .13-30.

Chatterjee, A., Gupta, D., and Jain, N. (2010), "Coordination of disaster response: Potential and challenges from Indian experiences. *Knowledge communication on children in India*", available at: http://www.redr.org.in/uploads/Coordination_of_Disaster_Response.pdf (accessed 4 July 2015).

Channel 4 (2015) "Tsunami: Ten years", ITV broadcast on 10 January 2015.

Checkland, P. (1985), "From optimizing to learning: A development of systems thinking in the 1990s", *Journal of the Operational Research Society,* Vol. 36 Issue 9, pp. 757-767.

Comfort, L.K., Ko, K. and Zagoreck, A. (2004), "Coordination in rapidly evolving disaster response systems: The role of information", *American Behavioural Scientist,* Vol. 48 Issue 3, pp. 295-313.

Davis, I. and Gupta, S.P. (1991) "Technical background paper", in Asian Development Bank (Ed.), *Disaster Mitigation in Asia and the Pacific*, Asian Development Bank, Manila, Philippines.

de Senarclens, P. (1997), "How the UN promotes development through technical assistance", in M. Rahnema and V. Bawtree (Eds.), *The Post-Development Reader,* Zed Books, London, UK, pp. 190-201.

DeWit, A. (2014), “Hiroshima’s disaster, climate crisis and the future of the resilient city”, *The Asia-Pacific Journal*, Vol. 12 Issue 35, pp. 1-15.

DFID. (2006), *How Resilient is Your Business to Disaster,* DFID, London, UK.

DFID. (2012), *Minimum Standards for Embedding Disaster Resilience in DFID Country Offices*, DFID, London.

Dou, J., Paudel, U., Oguchi, T. and Hayakawa, Y. (2015), “Analysis of the landslides in Hiroshima caused by the typhoon-12 based on bivariate sta-tistical landslide susceptibility”, paper presented at Japan Geoscience Union Meeting, 24-28 May, Chiba, Japan.

Eklund, L., and Tellier, S. (2012), “Gender and international crises response: Do we have the data, and does it matter?”, *Disasters*, Vol. 36 Issue 4, pp. 589–608.

Enarson, E. (1998), “Through women’s eyes: A gender research agenda for disaster social science” *Disasters*, Vol. 22 Issue 2, pp. 157–173

Fukuoka, H., Sassa, K. and Wang, C. (2015), “August 2014 Hiroshima landslide disaster and its societal impact”, *EGU General Assembly Conference Abstracts,* Vol. 17, p. 6691.

GIZ. (2012), *Local Flood and Early Warning System*, GIZ Publication, Manila, Philippines.

Glantz, M. (2009), “Introduction”, in M. Glantz (Ed.), *Heads Up!: Early Warning Systems for Climate, Water and Weather-Related Hazards*, United Nations University Press, New York.

Global Emergency Group. (2012), *IASC Real-Time Evaluation of the Humanitarian Response to the Horn of Africa Drought Crisis, Kenya*, Interagency Standing Committee, Virginia, USA.

Grint, K. (2008), "Wicked problems and clumsy solutions: The role of leadership", *Clinical Leader*, Vol. I Issue II, pp. 11–15.

Haque, E. and Zaman, M. (1994), "Vulnerability and responses to riverine hazards in Bangladesh: A critique of flood control and mitigation approaches", in A. Varley (Ed.), *Disasters, Development and Environment,* John Wiley & Sons, New York, USA, pp. 65-79.

Hanai, T. (2014), "Landslides hit Japan's Hiroshima, killing at least 36", available at: http://www.reuters.com/article/us-japan-landslides-idUSKBN0GK06720140822 (accessed 12 July 2015).

Harun-Al-Rashid, A.K.M. (1997), "The cyclone preparedness programme in Bangladesh", *Community Based Approach in Disaster Management*, Asian Disaster Preparedness Center, Bangkok, Thailand.

Herrmann, S. (2009), "Remote sensing", in Glantz M (Ed.), *Heads Up!: Early Warning Systems for Climate, Water and Weather-Related Hazards,* United Nations University Press, New York, USA, pp. 10-11.

Hiroshima City Hall. (2015), "History of Hiroshima. *The City of Hiroshima"*, available at: http://www.city.hiroshima.lg.jp/www/contents/1263790328515/index.html (accessed 7 August 2018).

Hiroshima Prefectural Government. (2015), *The Landslide Disaster on 8.20*, Hiroshima Prefectural Government, Hiroshima, Japan.

Hiroshima Prefectural Government. (2018), "National Population Census", available at: https://www.pref.hiroshima.lg.jp/site/toukei/kokuseityosa.html (accessed on 26 July 2018).

Hudson, H. (2005), "'Doing' security as though humans matter: A feminist perspective on gender and the policies of human security", *Security Dialogue,* Vol. 36 Issue 2, pp. 153-174.

IFRC. (2014), "Information bulletin Japan: Landslides in Hiroshima", available at: http://www.ifrc.org/docs/Appeals/rpts14/IBJPls220814.pdf (accessed 08 July 2016).

Ikeda, K. (2009), "How women's concerns are shaped in community based disaster risk management in Bangladesh", *Contemporary South Asia*, Vol. 17 Issue 1, pp. 65-78.

IPCC. (2012), *Managing the risks of extreme events and disasters to advance climate change adaptation*, *A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK.

Jenkins, G. M. (1969), "The systems approach", *Journal of Systems Engineering*, Vol. 1 Issue 1, pp. 3–49.

JMA. (2015), "About distribution of special alarm concerning weather etc. and eruption by emergency bulletin mail", available at: http://www.jma.go.jp/jma/press/1511/16a/151116kinsoku.html (accessed 24 July 2018).

JMA. (2016a), "Mission of the Japan Meteorological Agency", available at: http://www.jma.go.jp/jma/kishou/intro/gyomu/index1.html (accessed 14 June 2016).

JMA. (2016b), "Criteria for issuance of emergency warnings", available at: http://www.jma.go.jp/jma/en/Emergency_Warning/criteria.html (accessed 21 June 2016).

Kaiser, R., Spiegel, P.B., Henderson, A.K. and Gerber, M.L. (2003), "The application of geographic information systems and global positioning systems in humanitarian emergencies: Lessons learned, programme implications and future research", *Disasters, Vol. 27 Issue 2, pp. 127–140.*

Kalsi, S.R. (2003), "Monitoring and forecasting of tropical cyclones and their associated affects", in H.K. Gupta (Ed.), *Disaster management*, Universities Press, Mumbai, India.

Kamiura, S., Takada, K., Seki, K. (2015), "A risk comparison of snow-related accidents on each prefecture or municipalities", *Journal of Japan Society for Natural Disaster Science*, Vol. 34 Issue 3, pp. 213-223.

Kapur, A. (2010), *Vulnerable India: A Geographical Study of Disasters*, Sage Publications, New Delhi.

Kolen, B. and Hesloot, I. (2012), "Time needed to evacuate the Netherlands in the event of large-scale flooding: Strategies and consequences", *Disasters*, Vol.36 Issue 4, pp. 700-722.

Kyodo, J. (2014a), "Mudslides kill 36 in Hiroshima", *The Japan Times,* The Japan Times Ltd, Japan.

Kyodo, J. (2014 b), "Japan plans development of early warning system for downpours, landslides", *The Japan Times,* The Japan Times Ltd, Japan.

Lalonde, C. (2011), "Managing crisis through organisational development: A conceptual framework", *Disasters*, Vol. 35 Issue 2, pp. 443–464.

Luhmann, N. (1993), *Risk: A Sociological Theory*, Translated by Barrett, R., Walter de Gruyter & Co, Berlin, Germany.

Luhmann, N. (1999), *Introduction to Systems Theory*, Translated by Giligen, P., Polity Books, Cambridge, UK.

Martin, A. (2014), "Japan landslides: Many dead in Hiroshima", available at: http://www.wsj.com/articles/hiroshima-landslides-claim-lives-of-seven-1408508525 (accessed 12 July 2016).

Masys, A., Ray-Bennett, N.S., Shiroshita, H. and Jackson, P. (2014), "High Impact/Low Frequency Extreme Events: Enabling Reflection and Resilience in a Hyper-connected World", *Procedia Economics and Finance*, Vol. 18, pp. 772-779.

Mingers, J.C. (1980), "Towards an appropriate social theory for applied systems thinking: Critical theory and soft systems methodology", *Journal of Applied Systems Analysis*, Issue 7, pp. 41-49.

MLIT. (2008), "About MLIT. *MLIT: Ministry of Land, Infrastructure, Transport and Tourism",* available at: http://www.mlit.go.jp/about/index.html (accessed 8 August 2018)

Moore, R. and Verity, A. (2014), *Hashtag Standards for Emergencies: OCHA Policy and Studies Brief*, United Nations Office for the Coordination of Humanitarian Affairs (OCHA), Geneva, Switzerland.

Neumayer, E. and Plümper, T. (2007), "The gendered nature of natural disasters: The impact of catastrophic events on the gender gap in life expectancy, 1981–2002", *Annals of the Association of American Geographers*, Vol. 97 Issue 3, pp. 551–566.

Ohsugi, S. (2011), "The Large City System of Japan. Papers on the Local Governance System and its Implementation of Selected Field in Japan No.20", available at: http://www3.grips.ac.jp/~coslog/activity/01/04/file/Bunyabetsu-20_en.pdf (accessed 7 August 2018).

Perrow, C. (1999), *Normal Accidents: Living with High-Risk Technologies*, 2nd *edn*, Princeton University Press, Princeton.

Prizza, R. (2007), "The role of coordination in disaster management", in J. Pinkowski (Ed.), *Disaster Management Handbook*, CRC Press, New York,

Ray-Bennett, N.S. (2010), "Multiple disasters and micro-credit: Can it reduce women's vulnerability?: The case of Tarasahi in Orissa, India", *Disasters,* Vol. 34 Issue 1, pp. 240–260.

Ray-Bennett, N.S., Mays, A.J., Shiroshita, H. and Jackson, P. (2015), "Hyper-risks in a hyper connected world: A call for critical reflective response to develop organisational resilience", available at: http://www.preventionweb.net/english/hyogo/gar/2015/en/bgdocs/RayBennett%20et%20al.,%202014.pdf.

Ray-Bennett, N.S. (2016a), "Exploring the meaning of securitisation for "gender and disaster"", in Racioppi, L. and Rajagopalan, S. (Eds.), *Women and Disasters in South Asia: Survival, Security and Development*, Routledge, New York, pp. 277-301.

Ray-Bennett, N.S. (2016b), "Learning from Deaths in Disasters: The Case of Odisha, India. MEI Middle East-Asia Project (MAP) on Humanitarian Assistance and Disaster Relief: Rising to the Challenge?", available at: http://www.mei.edu/content/map/learning-deaths-disasters-case-odishaindia

Ray-Bennett, N.S. (2017a), "Disasters, Deaths and the Sendai Goal One: Lessons from Odisha, India", *World Development*, Vol. 103 Issue 2018, pp. 27-39.

Ray-Bennett, N.S. (2017b), *Avoidable Deaths: A Systems Failure Approach to Disaster Risk Management*, Springer Nature, Switzerland.

Reason, J. (1990), *Human Error*, Cambridge University Press, Cambridge.

Rittel, H.W.J. and Webber, M.M. (1973), “Planning problems are wicked problems. Policy Science”, in Cross, N. (ed.), *Developments in Design Methodologies,* John Wiley and Sons, Chichester, UK, pp. 155–169.

Romo-Murphy, E., James, R. and Adams, M. (2011), “Facilitating disaster preparedness through local radio broadcasting”, *Disasters,* Vol. 35 Issue 4, pp. 801-815.

Schön, D.A. (1983), *The Reflective Practitioner: How Professionals Think in Action*, Ashgate Publishing Ltd, London.

Senge, P. (1990), “The leader’s new work: Building learning organizations”, *Sloan Management Review*, Vol. 32 Issue 1990, pp. 7-23.

Shimomura, K. (2014), *How can We Protect Ourselves from Natural Disasters?: Disaster Prevention Manual for Foreign Residents in Hirakata City*, Hirakata City Council, Hirakata, Japan.

Srivastava, S.K. (2009), “Making a technological choice for disaster management and poverty alleviation”, *Disasters*, Vol. 33 Issue 1, pp. 58–81.

The City of Hiroshima. (2018), *Regional Disaster Prevention Plan*, The City of Hiroshima, Hiroshima, Japan.

The Guardian. (2014), “Hiroshima landslides leave dozens dead and several missing”, available at: https://www.theguardian.com/world/2014/aug/20/hiroshima-landslides-36-dead-hills (accessed 12 July 2016).

The Headquarters for Earthquake Research Promotion. (2004), “Long-Term Evaluation of Seismic Activities in Hyuga-Nada and the South-West Island Chain Area.”, available at: https://www.jishin.go.jp/main/chousa/04feb_hyuganada/s01.pdf (accessed on 26 July 2018).

The National DIET of Japan. (2012), "The Official Report of the Fukushima Nuclear Accident Independent Investigation Commission", available at: https://www.nirs.org/wp-content/uploads/fukushima/naiic_report.pdf *(accessed 7 August 2018).*

Thomson, P. and Penning-Rowsell, E. (1994), "Socio-economic impacts of floods and flood protection: A Bangladesh case study", in A. Varley (Ed.), *Disasters, Development and Environment,* John Wiley & Sons, New York, USA, pp. 81-98.

Toft, B. and Reynolds, S. (2005)*, Learning from Disasters: A Management Approach. 3rd edn,* Palgrave Macmillan, Hampshire, UK.

Tsubaki, R. (2012), "Disaster-related mobile apps from Japan", available at: http://emergencyjournalism.net/disaster-related-mobile-apps-from-japan/ (accessed 21 June 2016).

UN. (2005), "Hyogo Framework for Action 2005–2015: Building the resilience of nations and communities to disasters. World conference on disaster reduction, Kobe, Hyogo, Japan", available at: https://www.unisdr.org/we/coordinate/hfa (accessed 17 June 2018).

UN. (2015), "Sendai Framework for Disaster Risk Reduction 2015–2030", available at: http://www.unisdr.org/we/coordinate/sendaiframework (accessed 17 June 2018).

UNISDR. (2006), "Developing Early Warning Systems: A Checklist. Third international conference on early warning (EWC III), 27-29 March 2006, Bonn, Germany", available at: http://www.unisdr.org/we/inform/publications/608 (accessed 3 July 2018).

UNISDR. (2009), "Making Disaster Risk Reduction Gender-Sensitive: Policy and Practical Guidelines.", available at: http://www.unisdr.org/we/inform/publications/9922 (accessed 4 May 2018).

UNISDR. (2015a), “Making Development Sustainable: The Future of Disaster Risk Management”, *Global Assessment Report on Disaster Risk Reduction*, United Nations Office for Disaster Risk Reduction (UNISDR), Geneva, Switzerland.

UNISDR. (2015b), “Japan provides early warning example”, available at: https://www.unisdr.org/archive/43134 (accessed 22 June 2018).

Varley, A. (1994), “The exceptional and the everyday: Vulnerability analysis in the International Decade for Natural Disasters Reduction. Chapter 1”, in A. Varley (Ed.), *Disasters, Development and Environment*, John Wiley & Sons , New York, USA.

Walker, C. and Broderick, J. (2006), *The Civil Contingencies Act 2004: Risk, Resilience and the Law in the United Kingdom*, Oxford University Press, Oxford, UK.

Wang, F., Wu, Y., Yang, H., Tanida, Y. and Kamei, A. (2015), “Preliminary investigation of the 20 August 2014 debris flows triggered by a severe rainstorm in Hiroshima City, Japan”, *Geoenvironmental Disasters*, Volume 2, pp. 1-16.

Waring, A. (1989), *Systems Methods for Managers*, Blackwell Scientific Publications, Oxford, UK.

Weick, K.E. (1990), “The vulnerable systems: An analysis of the Tenerife air disaster”, *Journal of Management*, Vol. 16 Issue 3, pp. 571–593.

Weir, D.T.H. (1996), “Risk and disaster: The role of communications breakdown in plane crashes and business failure”, in C. Hood and D.K.C. Jones (Eds.), *Accident and Design: Contemporary Debates in Risk Management*, Routledge, London, UK.

Wenger, E. (1998), *Communities of Practices: Learning, Meaning, and Identity*, Cambridge University Press, New York.

Winchester, P. (2000), “Cyclone mitigation, resource allocation and post-disaster reconstruction in south India: Lessons learnt from two decades of research”, *Disasters*, Vol. 24 Issue 2, pp. 18–37.

Wisner, B., Blaikie, P., Cannon, T. and Davis, I. (2004), *At Risk: Natural Hazards, People's Vulnerability and Disasters. 2nd edn*, Routledge, London, UK.

WMO. (2017), “Multi-hazard early warning conference: Saving lives, reducing losses”, available at: https://public.wmo.int/en/media/press-release/multi-hazard-early-warningconference-saving-lives-reducing-losses (accessed 5 March 2015).

Zaman, M.Q. (1999), “Vulnerability, disaster, and survival in Bangladesh: Three case studies”, in O. Smith and S. Hoffman (Eds.), *The Angry Earth: Disaster in Anthropological Perspective*, Routledge, New York, USA.

Notes

[1] In Japan, a ‘ward’ is a subdivision of a city that is large enough to have been designated by government ordinance (Ohsugi, 2011).

[2] “Organisations are social designs directed at practice” (Wenger, 1998: 241). In other words, organizations are combination of institutions (social design) and constellation of practices by different actors, which give life to the organization (Wenger, 1998).

[3] Primary organizations are the first responders. They are also known as Category 1 responders by the Civil Contingency Act in the UK (Walker and Broderick, 2006).

[4] Secondary organizations are decision making organizations at national and state levels.

[5] Tertiary organizations are multi-lateral or global organizations (such as the UN or World Bank).

[6] At the end of 2010, there were 19 major cities in Japan (Ohsugi, 2011).

Table 1: Typology of Organizations and Actors

Organizations	**Actors**
Primary [3]	Category 1 responders and affected community
Secondary [4]	Category 2 responders
Tertiary [5]	Global responders

Table 2: Organization and Actors in Japan

Organizations	**Actors**
Primary	Local municipality, fire service, police service, public, Asaminami Social Welfare Council
Secondary	Cabinet Office, Central Disaster Management, Management Council, Emergency Response Mechanism, Extreme Disaster Management, Prefectures and local level, Japan Meteorology Agency, Self Defense Force, Japan Red Cross
Tertiary	UN, International Federation Red Cross Asia Pacific Office

Appendix 1 Interview Protocols

Table A-1 Interview protocol for the Social Welfare Committee

1) Tell us what happened on 20 August 2014?
2) Where were you at the time of the disaster?
3) What was your involvement on that day?
4) Why did 74 People die in the landslide?
5) Did the community know that there would be heavy rainfall, flooding and a possible landslide?
6) Was there any early weather warning or weather alert issued by the government on that day or a day before?
7) Tell us more about your role in the Tea Party for the volunteers?
8) What does the volunteers do during and after the disaster?

Table A-2 Interview protocol for MLIT and JMA

1) Please tell us a little bit more about your roles and responsibilities for disaster management.
2) How often do you coordinate with the Ministry of Land, Infrastructure, Transport and Tourism in Tokyo?
3) What is ‘it’ that you coordinate and communicate with the above Ministry in Tokyo for disaster management?

4) How often do you coordinate and communicate or meet with the Japan/Hiroshima Meteorology Agency?

5) What happened on 20 August 2014?

6) What role did your department play on that day?

7) Did your department coordinate with the local organisations, voluntary organisation, category one responders (fire fighters, police, self-defence force, trained volunteers) for evacuation?

8) Did the community know that there would be heavy rainfall and a possible landslide? Did your Department play any role in disseminating early warning information?

9) Why do you think 7 people died in Asaminami and Asa-Kita ward?

10) Did you have any ‘goal’ or ‘objective’ set for the management of this event?

11) Do you think your Department could have done more?

12) What are the lessons that your Department has learnt from this event?