DANGER APPROACHING, BUT WILL THEY EVACUATE? HAZARD COMMUNICATION AND PUBLIC SAFETY WARNINGS IN THE REAL WORLD

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1. INTRODUCTION

Mr President, ladies and gentleman.

Experts tell us that severe weather events are on the increase. They say that climate change will cause increased disaster risk. They warn of more frequent and more severe storms, floods, tornados, hurricanes. Other experts warn of disease outbreaks, impending earthquakes and tsunamis, the global threat of terrorism and humanity's dangerous bipolar affair with biological, hazardous chemical and nuclear technologies. Meantime, we are merrily wiping each other out in war, in conflict, and in the more mundane but collectively much more destructive road traffic accidents.

Disaster Management, it seems, is a growth industry.

Some of these hazards we can reduce or prevent, but in terms of certain forces of nature, us humans can do little but just get out of the way. In the case of certain of the technological risks we have manufactured, if something goes wrong, running away is again the most sensible reaction. If more disasters are expected due to climate change and increased industrialisation, more situations should develop where Disaster Management authorities need to issue warning messages to the public regarding protective actions such as sheltering in place, or telling people to evacuate.

The question I want to put to you today is - How confident are we about issuing these warning messages and how confident are we that the general public will comply with the requests in warning messages? And I want to place an emphasis on warning messages regarding evacuation and ask: Have we *got* the procedures written, ready and available? Do we *know* the procedures and do all the roleplayers in the evacuation procedure know their duties and responsibilities? Have we *practiced* our evacuation procedures? Most importantly, if we tell people to evacuate – will they?

On Wednesday 12 September 2007, a rather big earthquake, 8.3 on the Richter scale, occurred off the coast of Sumatra in the Indian Ocean. This is the type of earthquake that can cause tsunami's if it deforms the sea floor in a specific way, and a tsunami warning was duly issued for the countries within a few hundred kilometres from the earthquake. Here in South Africa the SA Weather Service and National Disaster Management Centre also received notice of the earthquake. In the Western Cape, we received a text message from our provincial Disaster Management Centre at 18:50 that evening, telling us that some impact from the possible tsunami may reach the South African coast.

SMS Received, 18:50:58, 12 Sep 2007, from Western Cape Disaster Management

"All Heads of DM Centres: NOT CONFIRMED INFO, Possible threat of a Tsunami. An EQ occurred the Sumatra area in the Indian ocean approx, 2hrs ago, registering 8.3 on the Richter Scale. According to SAWS it might have an effect on wave hights on the South Coast, Southern Cape and to a minor extent Cape Town (Impact presently not known), The estimated time of possible inceased wave higts is between 23h00 to 02h00 (13 Sep 2007) tomorrow. The possible impact on SA still needs to be confirmed by the NDMC, Will keep you posted if confirmed, Schalk 18h24."

About two and a half hours later, we again received a message, this time indicating that the tsunami warning was lifted in Indonesia and that there was no confirmed threat of a tsunami.

SMS Received, 21:23:22, 12 Sep 2007, from Western Cape Disaster Management

"## TSUNAMI~ PLEASE SEE NDMC. MESSAGE~SCHALK ## hi schalk,liz,peter. I just had a call from the saws. They've indicated that warnings have been lifted in Indonesia and minimal disruption has taken place. they will check with Reunion later and notify us of any imminent threats. regards lance"

So all is well that ends well. This was one of those happy anticlimaxes we experience when we know something very bad can happen, and it does not. But still there is the lingering concern – how well would it have gone if we had to order an evacuation?

In the two and a half hour period between the warning and the cancellation a few things happened which are noteworthy:

- Firstly, I tried to follow developments regarding the earthquake on TV.
  - I found good coverage on international news broadcasts from CNN, Sky, BBC World talking about tsunami warnings in the Pacific, but being very unspecific about any far-field threat.
- Secondly, a police officer phoned me from the regional 10111 police control centre, saying that they have been getting calls from the public asking whether they need to evacuate. He also asked how the SAPS would know if evacuation actually needed to take place.
  - I replied that there was no immediate danger and that no warning is being issued. I explained that if we needed to issue an evacuation order we would inform all emergency and law enforcement agencies directly. We would use the media to issue warning messages, and agencies such as Traffic, Metro Police and SAPS who have PA systems in their vehicles to do street-level announcements and go from door to door if necessary.
- Thirdly, I phoned our emergency call-taking centre, 107 and briefed them on the lack of a realistic tsunami threat and asked them to spread the message if the public started phoning about evacuation.
- Fourthly, 107 came back to me and told me that a person had phoned asking whether evacuation from the coast near Muizenberg is necessary, because a lady from his complex was running around, shouting at everyone to evacuate, and then grabbed a few things and evacuated herself from the area in her car – in total distress and very tearful.

I am glad to report that today, and until further notice, buildings and people on Cape Town's coastline were not washed away and are still relatively intact, the tsunami did not happen, and I hope the self-evacuating lady has by now un-evacuated herself.

The incident did however raise questions about early warning and the processes around issuing warning messages. And now I get back to what I asked before: How confident are we about issuing warning messages and how confident are we that the general public will comply with the requests in warning messages? If we tell people to evacuate – will they? Self-evacuating Lady evacuated on the basis of information from the world media with no supporting message from local sources. In fact, there was *no* message from local sources that went out to the public. What can be done to stop her from panicking next time? Can we say that she is an exception and that the general public would be far less eager to pack their bags and leave their homes?

There seems to be little that has been written on this subject in Southern Africa, and similarly not much research has been conducted. It thus appears to be a topic well worth discussing and researching.

2. PROBLEM STATEMENT

This paper is about that ancient reflexive split-second decision in the human species when confronted by danger: Fight, or flight. Run, or hide. Stay, or go. When danger is approaching, what do we need to do to ensure public behaviour that has the best chance of avoiding injury or death? How do we get people to respond to warning messages. This paper is not about managing evacuation, it is about the question: What will make people respond to warning messages? The question we want answered is:

"How do we improve public responsiveness to safety messages?"

3. SCOPE

In order to arrive at some suggestions on improving the responsiveness of the public to safety messages, we will first paint a basic overview of public safety warning messages, and then discuss and analyse problems experienced with public safety warning messages based on an international sample. The final part of the paper will consider the improvement of public safety warning messages for maximum response.

4. PUBLIC SAFETY WARNING MESSAGES: AN OVERVIEW

The City of Cape Town Disaster Risk Management Centre serves the area of the City of Cape Town metropolitan municipality. The area includes Atlantis and Mamre to the North, Cape Point to the South-West, Kraaifontein and Joostenbergvlakte to the East, and Gordon's Bay to the South-East. The Koeberg Nuclear Power Station falls within this area, and presents the City of Cape Town Disaster Risk Managament Centre with considerable emergency planning responsibilities. One of the contingencies that need to be planned for is the 1 in a million chance of a leakage of radio-active gases from the station. In such a case, all resident living within 5km of the station will be evacuated, and down-wind zones up to 16km from Koeberg may be evacuated as well. Use of agricultural produce and open-to-air water sources in down-wind zones up to 80km away from the station may also be banned. It should be noted that evacuation is only one of a range of public protective actions.

The standard operating procedures of the City of Cape Town recognise four categories of operational information dissemination to the public, being Emergency Notification (internal to responding agencies, external to public if required), Situation or Status Reports (internal, external if required), Public Safety Advisories (mainly external, also internal), and verbal response to media enquiries regarding the situation (external). City of Cape Town Disaster Management aims to provide immediate (within 5 minutes) response to media enquiries during emergencies and disasters. (City of Cape Town, 2007)

The main objectives of Disaster Management communications with the media during emergencies and disasters are to facilitate effective and efficient response by all services involved, to create public awareness of hazardous situations and how to avoid or deal with

the hazard, to avoid misinformation of the public by uninformed media and resultant panic, and to instill public confidence in the ability of the services. (City of Cape Town, 2007)

Public education messages can be likened to public safety advisories, but are conveyed when there is no immediate threat. Public education messages can contribute to awareness and preparedness and therefore play a key role in the willingness of populations to respond to warning messages.

4.1 *Public protective actions*

It should be noted that evacuation is only one of a collection of possible protective actions. For example, the City of Cape Town's Nuclear Emergency Plan for the Koeberg Nuclear Power Station lists at least 12 possible protective actions that may be implemented in the highly unlikely case of an emergency at Koeberg:

1. Notification of the public
2. Ad-hoc respiratory protection
3. Protective action zone isolation
4. Sheltering
5. Relocation
6. Thyroid protection (Potassium iodate tablets)
7. Evacuation
8. Analysis and control of foodstuffs
9. Decontamination of persons
10. Controlled use of stored animal feed
11. Infrastructure decontamination
12. Permanent resettlement

Evacuation may refer to Emergency evacuation (the mass movement of persons from a dangerous place due to a disaster), Patient evacuation, Casualty evacuation, or Medical evacuation (wikipedia.org, 1997). For the purpose of this paper we focus on evacuation in terms of the mass movement of persons from a dangerous or potentially dangerous due to a hazard that could have disastrous impact.

Evacuations may be carried out before, during or after natural disasters such as eruptions of volcanoes, cyclones, floods, or earthquakes. Other reasons for evacuation could include military attacks, industrial accidents, nuclear accidents, traffic accidents, including train or aviation accidents, fire, bombings, terrorist attacks, military battles, and viral outbreak (wikipedia.org, 1997).

4.2 *Key elements of early warning systems*

The objective of people-centred early warning systems is to empower individuals and communities threatened by hazards to act in sufficient time and in an appropriate manner to reduce the possibility of personal injury, loss of life and damage to property and the environment. A complete and effective early warning system comprises four inter-related elements, spanning knowledge of hazards and vulnerabilities through to preparedness and capacity to respond. Best practice early warning systems also have strong inter-linkages and effective communication channels between all of the elements.

Figure 1: Four Elements of People-centred Early Warning Systems
Source: UN/ISDR Platform for the Promotion of Early Warning

The four key elements of people-centered early warning systems can be expanded on by adding the aim of each element, and then devising a checklist to indicate sub-elements that need to be in place for the aim of the key element to be reached.

Key Element No	*Key Element*	*Aim*	*Checklist / Key Performance Areas*
1	**RISK KNOWLEDGE**	*Establish a systematic, standardized process to collect, assess and share data, maps and trends on hazards and vulnerabilities.*	1. Organizational Arrangements Established 2. Natural Hazards Identified 3. Community Vulnerability Analysed 4. Risks Assessed 5. Information Stored and Accessible
2	**MONITORING AND WARNING SERVICE**	*Establish an effective hazard monitoring and warning service with a sound scientific and technological basis.*	1. Institutional Mechanisms Established 2. Monitoring Systems Developed 3. Forecasting and Warning Systems Established
3	**DISSEMINATION AND COMMUNICATION**	*Develop communication and dissemination systems to ensure people and communities are warned in advance of impending natural hazard events and facilitate national and regional coordination and information exchange.*	1. Organizational and Decision-making Processes Institutionalised 2. Effective Communication Systems and Equipment Installed 3. Warning Messages Recognised and Understood
4	**RESPONSE CAPABILITY**	*Strengthen the ability of communities to respond to natural disasters through*	1. Warnings Respected 2. Disaster Preparedness and Response Plans Established

Key Element No	Key Element	Aim	Checklist / Key Performance Areas
		enhanced education of natural hazard risks, community participation and disaster preparedness.	3. Community Response Capacity Assessed and Strengthened 4. Public Awareness and Education Enhanced
Cross-Cutting Issue	**GOVERNANCE AND INSTITUTIONAL ARRANGEMENTS**	*Develop institutional, legislative and policy frameworks that support the implementation and maintenance of effective early warning systems.*	1. Early Warning Secured as a Long Term National and Local Priority 2. Legal and Policy Frameworks to Support Early Warning Established 3. Institutional Capacities Assessed and Enhanced 4. Financial Resources Secured

4.2.1 Risk Knowledge

Risks arise from the combination of hazards and vulnerabilities at a particular location. Assessments of risk require systematic collection and analysis of data and should consider the dynamic nature of hazards and vulnerabilities that arise from processes such as urbanization, rural land-use change, environmental degradation and climate change. Risk assessments and maps help to motivate people, prioritise early warning system needs and guide preparations for disaster prevention and responses.

4.2.2 Monitoring and Warning Service

Warning services lie at the core of the system. There must be a sound scientific basis for predicting and forecasting hazards and a reliable forecasting and warning system that operates 24 hours a day. Continuous monitoring of hazard parameters and precursors is essential to generate accurate warnings in a timely fashion. Warning services for different hazards should be coordinated where possible to gain the benefit of shared institutional, procedural and communication networks.

The table below illustrate the information sent by text message (SMS) to Disaster Management officials by the SA Weather Service (SAWS) as part of their severe weather early warning service. This information is not for general public consumption, but is rather a way for the SAWS to communicate possible dangers to emergency services officials who may need to raise preparedness, respond to weather events, or pass warnings to the public. This is a selection of the messages sent between 5 Mar 2007 and 5 August 2007. In most cases one can see a progression in the accuracy of the information as the event approaches, because there is less uncertainty in the SAWS prediction.

Table 1: SAWS severe weather early warning messages

SMS time, date, from	Message
Weather contrasts *Heavy rainfalls and heat wave conditions in one week in the Western Cape*	
08:19:39, 5 Mar 2007, SAWS - CT	*"Heavy falls of rain (>50mm) Garden Route, east Mossel Bay & adj. Little Karoo today (Mon). Rainfall Mossel Bay till 0800 reported 95mm."*
11:46:10, 6 Mar 2007, SAWS - CT	*"Heat wave conditions expected to develop over the western interior of the Western Cape Prov from tomorrow Wed lasting to Friday"*
Fire danger	

SMS time, date, from	Message
Fire danger messages cannot be very specific in terms of area, and the action one can take in response to the information is relatively limited.	
09:59:58, 5 April 2007, SAWS - CT	*"Fire danger RED in places around the Cape Peninsula tomorrow (Fri.)."*
10:34:34, 18 Apr 2007, SAWS - CT	*"Warning: Weather conditions which may lead to runaway fires are expected in places over the Cape Peninsula tomorrow (Thursday)"*
From prediction to observation *Progression shown from a general advisory to time-specific, more focused predictions. Real-time observation of hazardous weather systems is possible*	
13:10:51, 23 Apr 2007, SAWS - CT	*"ADVISORY: Heavy falls of rain (>50mm) expected in places over the SW-Cape on Thurs."*
11:55:50, 24 Apr 2007, SAWS - CT	*"ADVISORY UPDATE: heavy falls of rain including thunder are likely in places over SW-parts of W-Cape late Thu spreading east by Fri am"*
11:45:53, 26 Apr 2007, SAWS - CT	*"Update: Heavy falls of rain (>50mm) likely in places over SW-ern parts of the Western Cape Province from noon Thu. Until Fri morning."*
00:43:08, 27 Apr 2007, SAWS - CT	*"Fair amount of thunder activity in eden/little karoo area. Lots of Thunder activity also to W/NW of CT – updates to follow every 30 min. Johan."*
Heavy falls on the West Coast *Progression shown from a general advisory to time-specific, more focused predictions:*	
12:55:12, 4 Jun 2007, SAWS - CT	*"ADVISORY: Unsettled cold, windy & showery condition likely to persist over W-ern parts of W & N Cape Prov till Saturday."*
14:22:07, 6 Jun 2007, SAWS - CT	*"WARNING UPDATE: Unsettled cold, wet & windy conditions expected to persist until Sun. on W-ern highground areas of W & N Cape Provinces."*
09:11:09, 7 Jun 2007, SAWS - CT	*"Further heavy falls of rain (>50mm) expected in the Swartland, Sandveld and Bokkeveld areas."*
12:07:25, 7 Jun 2007, SAWS - CT	*"Amend weather warning area – heavy rain today over W coast & Adj Escarpment N of Saldanha Bay as well as Namaqualand S of Springbok"*
14:59:39, 7 Jun 2007, SAWS - CT	*"Warning update: Heavy rain intensity over W Coast & Namaqualand & adjacent escarpments should decrease overnight, but good falls again tom Friday afternoon & evening, in the S, may lead to further flood related problems."*
07:33:22, 8 Jun 2007, SAWS - CT	*"Weather update – Satelite and RADAR show potential moderate to heavy rainfalls over W Coast District soon, to last 3 or 4 hours this AM "*
Possible heavy falls become expected heavy falls.	
11:38:06, 22 Jun 2007, SAWS - CT	*"ADVISORY Heavy falls of rain possible in places near the mountains of the western parts of the Western Cape on Monday."*
09:21:26, 24 Jun 2007, SAWS - CT	*"Heavy falls of rain are expected in places near the mountains of the western part of the W Cape tomorrow (Mon).."*
As uncertainty decreases, an advisory becomes a warning becomes a flooding prediction	
11:04:59, 22 Jul 2007, SAWS - CT	*"Advisory: Heavy falls of rain poss. over sw-ern parts of W-Cape Prov. Tues. night spreading to s-coast and adj. int. o-night into Wed morning."*
12:10:32, 23 Jul 2007, SAWS - CT	*"WARNING: Heavy falls of rain assoc with sev Thunderstorms expected over SW Cape tom (Tue) night spreading to S coast and adj mon Wed morn."*
13:07:17, 25 Jul 2007, SAWS - CT	*"WARNING: Heavy falls of rain are possible in places over SW Cape tomorrow (Thu), that can result in localized flooding."*
23:16:04, 26 Jul 2007, SAWS - CT	*"WARNING Isolated severe thunderstorms till Fri 08:00 may cause hail / strong damaging wind on SW coast S of Saldanha & over adjacent mtn area."*
Status reports and operational coordination messages emanating from weather warnings *Situation reports sent to Councillors and roleplayers, and longer to shorter range predictions, with information improving as event approaches*	
05:20:50, 29 Jul 2007, CT Council Support	*"To all Cllrs – Flood relief has been stepped up, City Manager holding emergency meetings No rain expected Mon to Wed. Clearing Drainage systems. Listen to radio and report emergencies to 107 (landline only) or 021-480-7700."*
16:42:36, 1 Aug 2007, CT DRMC	*"The SAWS predicts an 80% chance of btw 20>30mm rainfall anticipated over Cape Peninsula tomorrow and Friday. All services to be on full alert and to respond where necessary. CoCT Disaster Operations Centre (021-597-5000)"*
10:33:59, 2 Aug 2007, SAWS - CT	*"Warning: Very cold, wet, windy conditions expected on highground of W- and N-Cape Prov from tonight (Thu) and tomorrow (Fri)."*
16:53:04, 2 Aug 2007, SAWS - CT	*"CT Metropole weather update: Further 20-30mm rain expected tonight and tom morning. No rainfall for weekend. Next front expected on Monday."*

SMS time, date, from	Message
10:54:29, 3 Aug 2007, SAWS - CT	*"ADVISORY: Heavy falls of rain are expected in the southwestern parts of the Western Cape Province on Monday"*
11:46:00, 5 Aug 2007, SAWS - CT	*"Advisory: Good falls of rain (20-25mm) are expected over W-ern parts of W Cape province tom Mon, mainly from mid-morning."*

For the Disaster Management worker, the first important question related to such an early warning message system which informs officials but not yet the public, is to find the point at which one can start acting pro-actively on the information – communicating it to role players and/or the public. The second question is how to get the information down to the ground – the "last mile".

4.2.3 Dissemination and Communication

Warnings must reach those at risk. Clear messages containing simple, useful information are critical to enable proper responses that will help safeguard lives and livelihoods. Regional, national and community level communication systems must be pre-identified and appropriate authoritative voices established. The use of multiple communication channels is necessary to ensure as many people as possible are warned, to avoid failure of any one channel, and to reinforce the warning message. (United Nations, 2006b:2)

4.2.4 Response Capability

It is essential that communities understand their risks; respect the warning service and know how to react. Education and preparedness programmes play a key role. It is also essential that disaster management plans are in place, well practiced and tested. The community should be well informed on options for safe behaviour, available escape routes, and how best to avoid damage and loss to property. (United Nations, 2006b:2)

4.2.5 Cross-Cutting Issues

There are a range of overarching issues that should be taken into account when designing and maintaining effective early warning systems.

- Effective Governance and Institutional Arrangements
- A Multi-Hazard Approach
- Involvement of Local Communities
- Consideration of Gender Perspectives and Cultural Diversity (United Nations, 2006b:2)

4.3 *Research papers*

An annotated bibliography of 330 research papers compiled by Bandy *et al* in 2004 became one of the principal resources for the writing of this paper. The bibliography was analysed by applying search strings to its contents and then compiling tables recording the recurrence of certain search strings. Each of the 330 annotations were considered in terms of its references to what makes people respond to warning messages. Search strings used include: Offical; Women; Vulnerability; Threat; Closer; Longer resident; Habituation; No relationship; Knowledge; Membership; Multiple; Credible; Protective responses. Where

causal findings were also annotated, they were particularly useful, although 96 of 303 research papers contained no causal findings.

4.4 *Percentages*

In the US, residents of homes that sustained F4 or F5 damage (two highest levels of damage on the Fujitso scale of tornado intensity) in the deadliest of a series of tornadoes that took place on 3 May 1999 were surveyed to determine their responses to the tornado warning, reasons for their responses, and relative injury rates. There were 190 people in 65 surveyed houses at the time that warnings were issued. Television was the most commonly cited source of the warning (89%), followed by a telephone call (37%), sirens (37%), and AM/FM radio (25%), and 55% received the warning from more than one source. Nearly one-half (47%) of the residents fled their homes before the tornado struck. Of those who fled, 65% went to a tornado shelter, of whom 70% ran to the shelter (median distance 30 m) and 30% drove to the shelter (median distance 4.8 km). About one-half (53%) of those who fled their homes left in a vehicle. None of those who fled their homes, by foot or by vehicle, were injured. Of those who stayed in the home, 39% sought shelter in a bathroom, 38% in a closet, 9% in a hallway, and 15% in other rooms. Reasons for not leaving included believing the storm would not strike their house, believing it was too late or too dangerous to leave, having no transportation available, or having not alternative shelter available. Thirty percent of those who remained in their homes were injured and 1% killed. The rate of serious injury was not significantly different for those in a closet (14%), hallway (20%), or bathroom (23%). Tornado preparedness and warning programs should recognize that long tornado warning lead times and street-level television coverage allow residents to make reasoned decisions to minimize risk and that those decisions may include driving out of the path of the tornado. (Hammer & Schmidlin, 2002)

5. PROBLEMS WITH PUBLIC SAFETY WARNING MESSAGES: INTERNATIONAL EXPERIENCE

5.1 *Reasons people don't evacuate when requested*

Research from the United States suggests that evacuation could present problems in the event of a major hurricane in that country. In a 2005 survey, a significant 42% said they would only evacuate if emergency officials ordered them to do so, and 19% said they would probably not evacuate if ordered – including 14% who said they would not leave under any circumstances. Only 38% said they would evacuate ahead of an actual order, with most (21%) saying that they would only leave early if the hurricane was Category 3 or higher. Even among those who live within 10 miles of the coast, 16% said they would probably not evacuate, and among those who have experienced a hurricane, an even higher 20% said they would probably not evacuate. Only 33% of coastal residents would evacuate early, as would only 39% of those who have experienced a hurricane before. (FEMA, 2005)

5.1.1 Experience

Experience with a specific hazard can reduce the likelihood of persons responding to warning messages. The longer a person has lived in a coastal area vulnerable to hurricanes, the less likely they are to evacuate. A hurricane's path is difficult to predict. Forecasters know about hurricanes days in advance, but their forecasts of where the storm will hit are only educated guesses. Hurricanes give a lot of warning time compared to most

disasters humans experience. However, this allows forecasters and officials to "cry wolf," making people take evacuation orders less seriously. Hurricanes can be predicted to hit a coastal town many times without the town ever actually experiencing the brunt of a storm. If evacuation orders are given too early, the hurricane can change course and leave the evacuated area unscathed. People may think they have weathered hurricanes before, when in reality the hurricane didn't hit them directly, giving them false confidence. Those who have lived on the coast for ten or more years are the most resistant to evacuating. (FEMA, 2005)

5.1.2 Traffic

Even if one does have a car, it may not be an efficient means of evacuating. The traffic jams that thousands of motorists experienced in South Carolina while fleeing Hurricane Floyd and Texas while fleeing Hurricane Rita exemplify the frustration of people trying to evacuate. (FEMA, 2005)

5.1.3 Limited social capital

Social capital refers to the connections between people: social networks and the reciprocity and trust within them. The social systems of communities can have a large impact on their ability and willingness to evacuate. Weak social networks within a community can make evacuation difficult. If people don't trust each other, then they are likely to fear that their homes or stores will be looted if they evacuate. Communities that have the physical capital, such as cars, to evacuate everyone may not have the social capital to facilitate sharing these resources. Weak connections with people in other regions of the country also make evacuating difficult: if you don't have friends or family you can stay with, you'll have to find and pay for a hotel room. However, strong social networks within a community can also hinder evacuation: if a person has strong ties to their neighbors but not to anyone outside that small community, they are more likely to stay where they are, with the people they can rely on, rather than evacuate and leave their social network. (FEMA, 2005)

5.2 *Gaps and Challenges in Respect to Response Capability*

The failure to adequately respond to warnings often stems from a lack of planning and coordination at the national and local levels, as well as a lack of understanding by people about their risks. Agencies may not understand their roles and fail to communicate and coordinate effectively. Government may fail to adequately plan for evacuation and emergency shelter for the population. National preparedness plans may not reach the entire population, all of whom need to be aware of their vulnerabilities, ideally having some basic training and rehearsal experience, and the means to take action. Some major gaps and needs include:

- *Lack of multi-agency collaboration and clarity of roles/responsibilities at national to local levels.* Response plans often do not work owing to lack of coordinated reaction among the main actors. The lines of responsibility and authority need to be clear to all to ensure coordination and effective implementation of response plans.

- *Lack of public awareness and education for early warning response.* In many countries, response plans exist but are not known to the public because of weak public information and dissemination capacities. Public awareness is weakened by limited integration of disaster education in school curriculum. In general, the majority of countries do not have school programmes on disaster risk reduction, early warning,

preparedness and emergency response. In countries where such programmes exist, they do not always reach all schools and all children.

- *Lack of simulation exercises and evacuation drills.* Few countries regularly practice their preparedness plans. This is one of the priority challenges to enhancing warning effectiveness. It is difficult to maintain the interest and allocation of resources required for the practice of simulation exercises among the public and authorities, particularly for infrequent hazard events. The key is to keep the population aware of disaster risk.

- *Limited understanding of vulnerabilities and of the public's concerns.* Effective community response to warnings is limited by inadequate understanding of risk. Communities may not understand who is vulnerable and may not adequately relate their response needs to their vulnerabilities. Likewise disaster response planners often do not have a detailed understanding of what triggers the community's reaction to warnings. Often there is no clear process for integrating risk information in emergency preparedness and response planning, and consequently, preparedness plans do not sufficiently take into account peoples' subjective risk perception. If an individual perceives that the cost of heeding a warning outweighs the cost of accepting the risk, the warning is unlikely to induce an effective response. In some situations, it will be unrealistic to rely on people's ability to judge and act to save themselves and therefore necessary to enforce their compliance with regulations in respect to warnings and evacuations.

- *Need for a participatory approach and inclusion of traditional knowledge.* Even where community understanding of risk is widespread, warnings often fail to induce the desired response because the language of the warnings may be too technical or in an inappropriate format to be understood by communities of various backgrounds. This is commonly due to lack of participation of the community, the media and other stakeholders in the planning and development of the warning-response strategy. Through public participation in the development of response strategies, effective traditional knowledge and mechanisms can also be integrated in the formal response strategy, maximizing the chance of compliance. Communities may decide to abandon ineffective traditional practices following such discussions.

- *Need for long-term risk-reduction strategies.* Efforts to mitigate disaster losses through effective response to early warnings are sometimes ineffective because they focus exclusively on warning response rather than inducing long-term risk-reduction behaviour. For example, people living in hazard-prone areas often return after evacuations.

(United Nations, 2006b: 23)

5.3 *Gaps and Challenges in Dissemination and Communication*

- Inadequate institutional arrangements
- Political failure to take action
- Lack of clarity and completeness in warnings issued
- Need to strengthen telecommunication systems and technology, particularly for LDCs
- Failure to address the public's interests and concerns
- Inadequate understanding of vulnerability
- Proliferation of communication technologies and loss of single authoritative voice
- Ineffective engagement of the media and the private sector

- Ineffective integration of lessons learned from previous warnings

(United Nations, 2006b: 19-20)

We will now focus on the third of the bullets above, the lack of clarity and completeness in warnings issued. Often warnings are incomplete because they do not meet essential requirements for effectiveness including:

- brevity,
- clear and uncluttered presentation,
- use of non-technical language,
- identification of areas affected,
- explanation of potential losses and of the chance of the loss occurring within a certain timeframe, as well as
- instructions to reduce losses through response actions.

This is partly because of lack of common standards for developing warning messages within and across countries. It may also be unclear to the public whether the information is a forecast or a warning, as the inherent uncertainty of warnings may not have been appropriately conveyed. Lack of clarity of warning messages is often due to unclear responsibilities about who provides forecasts (of hazards) and who provides warnings (of risks). Often the problem is simply one of insufficient resource and capacity support to midlevel management to provide adequate warnings. (United Nations, 2006b: 19)

Unfortunately the reasons you have just heard comes from one source, and can therefore not be seen as conclusive. In short, we need plenty of other sources that tell us the same thing before we can make clear decisions based on this information. This is why I was delighted to lay my hands on a bibliography of 333 research papers written on hazard communication and warning messages, complete with summaries and listings of causal findings, compiled by Bandy *et al* in 2005.

6. IMPROVING RESPONSIVENESS TO SAFETY MESSAGES

People are more likely to heed and act upon warnings when they have been educated about their risks and have prepared warning-reaction plans. International experience from successful evacuations, such as from Pinatubo volcano in Philippines, Paez earthquake in Colombia, the eruption of Tavurvur and Vulcano in Rabaul, Papua New Guinea, storm surges in Bangladesh, and hurricanes in Florida, USA, show that as a result of sustained prior public education and community preparedness people will evacuate without waiting for official warnings. Consequently, many developing countries are emphasizing public education in schools and awareness-raising campaigns and have integrated disaster education into school curricula. In some countries, where formal disaster risk education programmes are not part of the educational system, a range of government and non-governmental agencies provide disaster risk information to schools, colleges and the general public. (UN, 2006b:21)

The emerging consensus from 330 research reports collected by Bandy *et al* (2004) is that, when a warning message is communicated, before a person will respond to it, that person needs to hear the message, believe the message, understand the message, and personalise the message.

6.1 *Hearing the message.*

The message needs to reach the individual. Here we can discuss the difference between hearing and listening. This is the "last mile". Important factors will include the communications channel, the ability of the authorities who are doing the warning to distribute it effectively.

6.2 *Believing the message.*

The person needs to believe the message. Important factors will be the source of the message and the content of the message.

100 Interviews were conducted to help understand what information needs the public has, including the amount of information and its level of detail, in the case of an industrial hazard. People store, give and utilize information about risk in ways that are highly diversified. **For industrial hazards the preferred messenger of risk-related information is the plant manager.** (De Marchi & Rota, 1990)

Early warnings must be credible and reliable. This applies equally to scientific components, to emergency management structures and other agencies in the system. It is not just a question of believing the message, people have to trust the messenger, too. The pluralistic nature of the new information age does not favour a single, authoritative voice issuing warnings. Rapid advances in information and communication technology (ICT) and the growth of global media have widened public access to early warning information. The decision to take protective action will often be the outcome of negotiation between competing messages and priorities. Informed citizens will make their own, informed choices. They are in a sense consumers of early warning information. (United Nations, 2006b)

- Warnings generated and distributed to those at risk by credible sources (e.g. government, spiritual leaders, respected community organizations).
- Public perception of natural hazard risks and the warning service analysed to predict community responses.
- Strategies to build credibility and trust in warnings developed (e.g. understanding difference between forecasts and warnings).
- False alarms minimised and improvements communicated to maintain trust in the warning system. (United Nations, 2006a)

6.3 *Understanding the message.*

The person needs to understand the message. Important factors will include the style and tone used in the message, the language and vocabulary, the clarity of the communications channel, the speed of delivery.

Being specific is important. We see this in ourselves when we receive a weather warning, the more specific the warning is, the more you can do with it. "Heavy rains expected over Western part of the Western Cape, vs 50-60mm of rains expected between 08:00 and 16:00 on … at …"

6.3.1 Public Awareness and Education Enhanced

- Simple information on hazards, vulnerabilities, risks, and how to reduce disaster impacts disseminated to vulnerable communities and decision-makers.
- Community educated on how warnings will be disseminated and which sources are reliable and how to respond to different types of hazards after an early warning message is received.
- Community trained to recognise simple hydro-meteorological and geophysical hazard signals to allow immediate response.
- On-going public awareness and education built in to school curricula from primary schools to university.
- Mass media and folk or alternative media utilized to improve public awareness.
- Public awareness and education campaigns tailored to the specific need of each audience (e.g. children, emergency managers, media).
- Public awareness strategies and programmes evaluated at least once per year and updated where required. (United Nations, 2006a)

6.3.2 Warning Messages Recognised and Understood

- Warning alerts and messages tailored to the specific needs of those at risk (e.g. for diverse cultural, social, gender, linguistic and educational backgrounds).
- Warning alerts and messages are geographically-specific to ensure warnings are targeted to those at risk only.
- Messages incorporate the understanding of the values, concerns and interests of those who will need to take action (e.g. instructions for safeguarding livestock and pets).
- Warning alerts clearly recognisable and consistent over time and include follow-up actions when required.
- Warnings specific about the nature of the threat and its impacts.
- Mechanisms in place to inform the community when the threat has ended.
- Study into how people access and interpret early warning messages undertaken and lessons learnt incorporated into message formats and dissemination processes. (United Nations, 2006a)

6.4 *Personalising the message.*

The message has consequences for me. I will need to do something in response to the message. Important factors will be the nature and content of the message. (Bandy *et al*, 2004)

People-centred early warning systems rely on the direct participation of those most likely to be exposed to hazards. Without the involvement of local authorities and communities at risk, government and institutional interventions and responses to hazard events are likely to be inadequate. A local, 'bottom-up' approach to early warning, with the active participation of local communities, enables a multi-dimensional response to problems and needs. In this way, local communities, civic groups and traditional structures can contribute to the reduction of vulnerability and to the strengthening of local capacities.(United Nations, 2006a)

Protective response

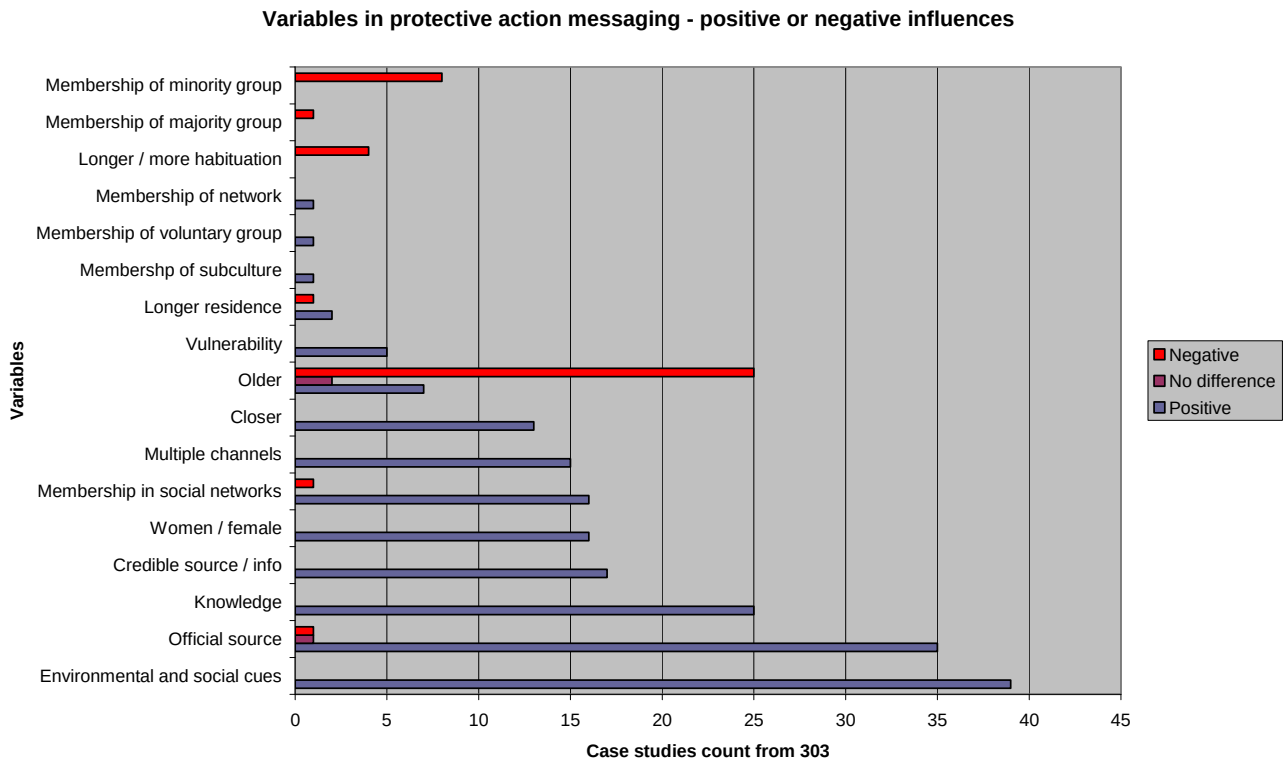
Although this paper presents a desk-based survey of 303 case studies, it is aimed at improving the understanding of the disaster management official, and make the official

comfortable with research, and practical. Abstracts and causal findings from 303 reference publications / articles / papers / research reports were compared and analysed for patterns in a desk-top study over a period of 2 weeks.

- A warning system is more than the narrowly focused alert and notification technology.
- Organizational linkages -- such as those between power plants and off-site organizations -- and the organizational aspects of warning systems.
- Public response to warnings can be analysed by comparing popular myths with what the research has shown actually determines public response.
- Style and content are critical in designing and delivering effective public-warning messages.
- Public response to emergency warnings must be monitored

(Mileti & Sorensen, 1995).

The public is more likely to hear a warning message via the television. If the sender of a warning relays the information via the telephone, the receiver is more likely to believe the message. The public is more likely to respond to a warning message if it includes informative guidance, and/or they are given a long lead time to respond. The more geographical cues a person receives, the more likely they are to believe a warning message. (Hammer & Schmidlin, 2002)



Some studies indicated certain variables have no influence on the likelihood of persons responding to warning messages. The table below provides a list of variables that, according to some researchers, has no link with response to warning messages. The information from the table conflicts with information from the chart above. While the table lists a maximum of 5 references indicating no relationship for certain variables, references from case studies by researchers to support linkages between the variables and response to warning messages mostly exceed 5. 25 references indicate that older people are less likely to respond to warning messages, but the table indicates that 5 references suggest that there

is no relationship between age and the likelihood of a person responding to warning messages.

No Relationship	Number of references
Age	5
previous experience	3
Gender	3
race / ethnicity	3
education	2
Income	2
level of objective risk	2
how geographically	1
probability of incident if high or low	1
age and education	1
education and/or fulltime work status	1
specific and or consistent warning message	1
having moderate resource	1
cost of evacuation	1
Weather	1
family unity	1
size of family	1
geographic proximity	1
Occupation	1
motivation of prior actions	1
perceived risk	1
community integration	1
socio-economic status	1
receiving message from official source	1
false alarms	1
having pets	1
having children	1
Resources	1

The majority of the case study references showing no relationship between variables and response to safety messages are from California.

6.5 *Effective evacuation is a function of effective early warning*

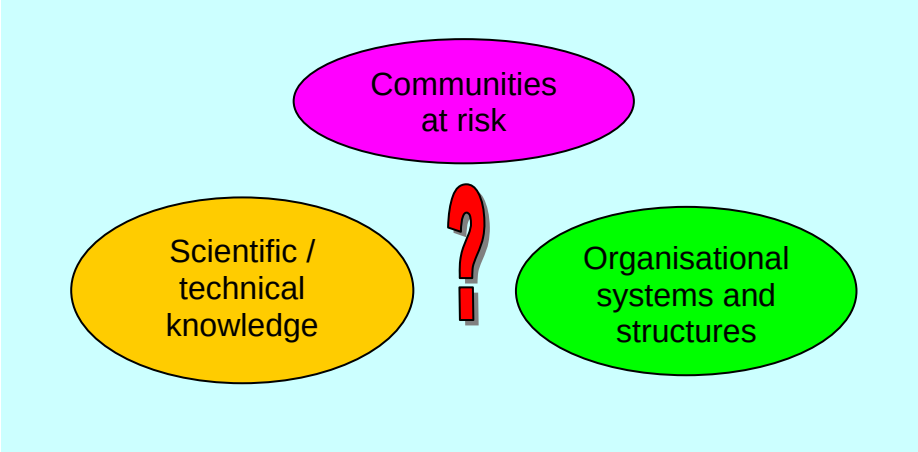
Early warning is a major element of disaster risk reduction. It prevents loss of life and reduces the economic and material impact of disasters. To be effective, early warning systems need to actively involve the communities at risk, facilitate public education and awareness of risks, effectively disseminate messages and warnings and ensure there is constant state of preparedness.

In January 2005, the World Conference on Disaster Reduction adopted the “Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters”. This included clear references to the importance of early warning, and encouraged the development of “early warning systems that are people centred, in particular systems whose warnings are timely and understandable to those at risk (…) including guidance on how to act upon warnings (…)” (para. 17, ii.d.9).

> To be effective, early warning systems must be people-centred and must integrate four elements – (i) a knowledge of the risks faced; (ii) a technical monitoring and warning service; (iii) the dissemination of meaningful warnings to those at risk; and (iv) public awareness and preparedness to act. Failure in any

one of these elements can mean failure of the whole early warning system.

An element vital to all early warning systems is the link between scientific/technical knowledge, organizational systems and structures, and the communities at risk. (United Nations, 2006c)



The effectiveness of institutionalized early warning systems can only be achieved by close cooperation between the agencies running the system and the vulnerable people. Early warning systems need to be adapted to different conditions. The complex structure of large cities for example requires different arrangements than a rural environment. Early warning systems must be 'people- centred': they have to support and empower people in protecting themselves. In order to 'go the last mile', an integrated approach to early warning has to be based on the needs, priorities, capacities, and cultures of those at risk. People at risk must be partners in the system, not controlled by it. (United Nations, 2006c)

Effective early warning systems are people- centred and utilize and develop community capacities, create genuine local ownership of the system, and are based on a shared understanding of needs and purpose. Such initiatives are sustainable, replicable - they can be scaled up – and, importantly they are adaptable and resilient. To implement early warning systems on a sustainable basis multi-annual, long term strategies are needed. What makes a system sustainable under different conditions and contexts needs to be better understood. Early warning systems need to continue to innovate and adapt: not only by developing new technologies but also by continuously reviewing their aims and performance and renegotiating the multiple organizational and community relationships of the system. (United Nations, 2006c)

Early warning pays off. A prerequisite for an effective early warning system is the recognition of its benefit by the general public, policy makers and the private sector. Cost / benefit analysis and related tools help to foster the necessary political engagement and the will to develop and promote early warning as an instrument of disaster risk management. Early warning systems are complex, multi-jurisdictional and multi-disciplinary by nature. Collaboration between the multiple stakeholders involved has to be supported by appropriate legal and
policy frameworks. (United Nations, 2006c)

6.6 *A Multi-Hazard Approach*

Where possible, early warning systems should link all hazard-based systems. Economies of scale, sustainability and efficiency can be enhanced if systems and operational activities are established and maintained within a multipurpose framework that considers all hazards and end user needs. Multi-hazard early warning systems will also be activated more often than a single-hazard warning system, and therefore should provide better functionality and reliability for dangerous high intensity events, such as tsunamis, that occur infrequently. Multi-hazard systems also help the public better understand the range of risks they face and reinforce desired preparedness actions and warning response behaviours. (United Nations, 2006a)

6.7 *And if they won't leave?*

Instead of relying on a "Good Samaritan" policy - the fantasy in New Orleans that everyone would take care of the neighbours - the Virginia rescue workers go door to door. If people resist the plea to leave, Mr. Judkins told The Daily Press in Newport News, rescue workers give them Magic Markers and ask them to write their Social Security numbers on their body parts so they can be identified.

"It's cold, but it's effective," Mr. Judkins explained. (Tierney, 2005)

7. SUMMARY, CONCLUSION AND RECOMMENDATIONS

7.1 *Summary*

The problem statement for this paper was: How do we improve the responsiveness of the public to safety messages? In order to arrive at some suggestions on the matter we first painted a basic overview of public safety warning messages, and then discussed and analysed problems experienced with public safety warning messages based on an international sample. The final part of the paper considered the improvement of public safety warning messages for maximum response.

7.2 *Conclusion*

When a warning message is communicated, before a person will respond to it, that person needs to hear the message, believe the message, understand the message, and personalise the message.

7.3 *Recommendations*

The literature is clear that the four key elements of early warning should be in place before an early warning system can be effective. The four key elements are: Risk Knowledge; Monitoring and Warning Service; Dissemination and Communication, Response Capability and Governance and Institutional Arrangements.

It is also clear that a review of the institutional arrangements for early warning should be undertaken in an effort to optimize it. For example, the role of political elected leaders in hazard communication should be agreed up front.

The illustration below shows how each component of the communication process can be optimized to ensure effective warning message communication. The sender should be official and credible. Multiple channels should be used. The message itself should be clear

and detailed enough, and delivered in the correct language and with the correct style. The receiver should be knowledgeable about the topic of the warning message.

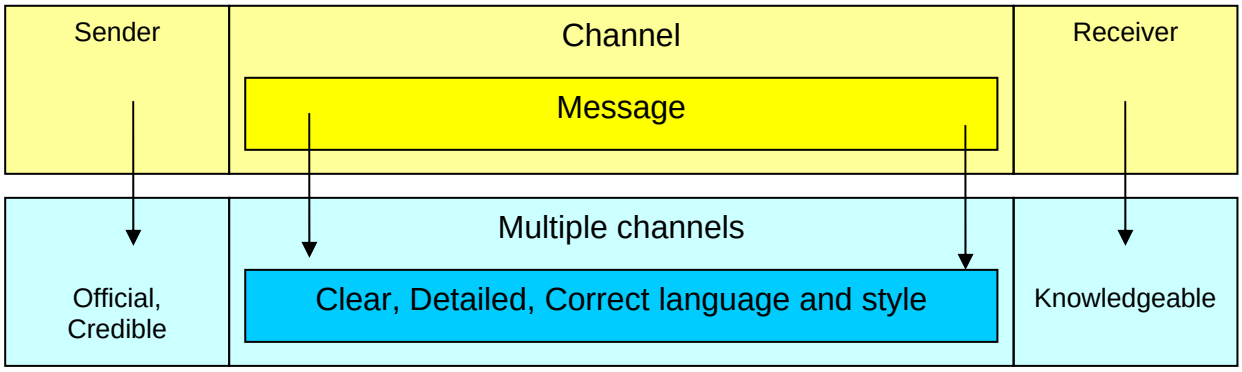


Figure 2: Requirements of effective warning message communication, per component of the communication process

8. ABBREVIATIONS AND DEFINITIONS

8.1 *Abbreviations*

10111	The national number to report police emergencies to the SA Police Service - callers are automatically transferred to the nearest station or regional control centre
107	The Public Emergency Communications Centre for the City of Cape Town, available for all emergency calls within the 021 dialling code area
CoCT	City of Cape Town
CT	Cape Town
DRMC	Disaster Risk Management Centre
EWC III	Third International Conference on Early Warning
FAO	Food and Agriculture Organization
IFRC	International Federation of Red Cross and Red Crescent Societies
ITU	International Telecommunication Union
KNEP	Koeberg Nuclear Emergency Plan
KNPS	Koeberg Nuclear Power Station
NGO	Non-Governmental Organization
OCHA	Office for the Coordination of Humanitarian Affairs of the United Nations Secretariat
SAWS	South African Weather Service
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UN/ISDR	United Nations International Strategy for Disaster Reduction
UNOSAT	United Nations initiative to provide the humanitarian community with access to satellite imagery and Geographic Information System services
UNU-EHS	United Nations University Institute for Environment and Human Security
PPEW	Platform for Promotion of Early Warning
WMO	World Meteorological Organization

8.2 *Definitions*

hazard — a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation (United Nations / ISDR, 2006:2, Global Survey, http://www.unisdr.org/eng/library/lib-terminology-eng.htm)

evacuation — may refer to:

- Emergency evacuation: the mass movement of persons from a dangerous place due to a disaster
- Patient evacuation: the procedure for moving a casualty from its initial location to an ambulance
- Casualty evacuation (CASEVAC): patient evacuation in combat situations
- Medical evacuation (MEDEVAC): evacuating a patient by plane or helicopter

(wikipedia.org, 1997)

risk — together, hazards and vulnerability give rise to risk: “The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable

conditions (United Nations / ISDR, 2006:2, Global Survey, http://www.unisdr.org/eng/library/lib-terminology-eng.htm)

vulnerability the conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards (United Nations / ISDR, 2006:2, Global Survey, http://www.unisdr.org/eng/library/lib-terminology-eng.htm)

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