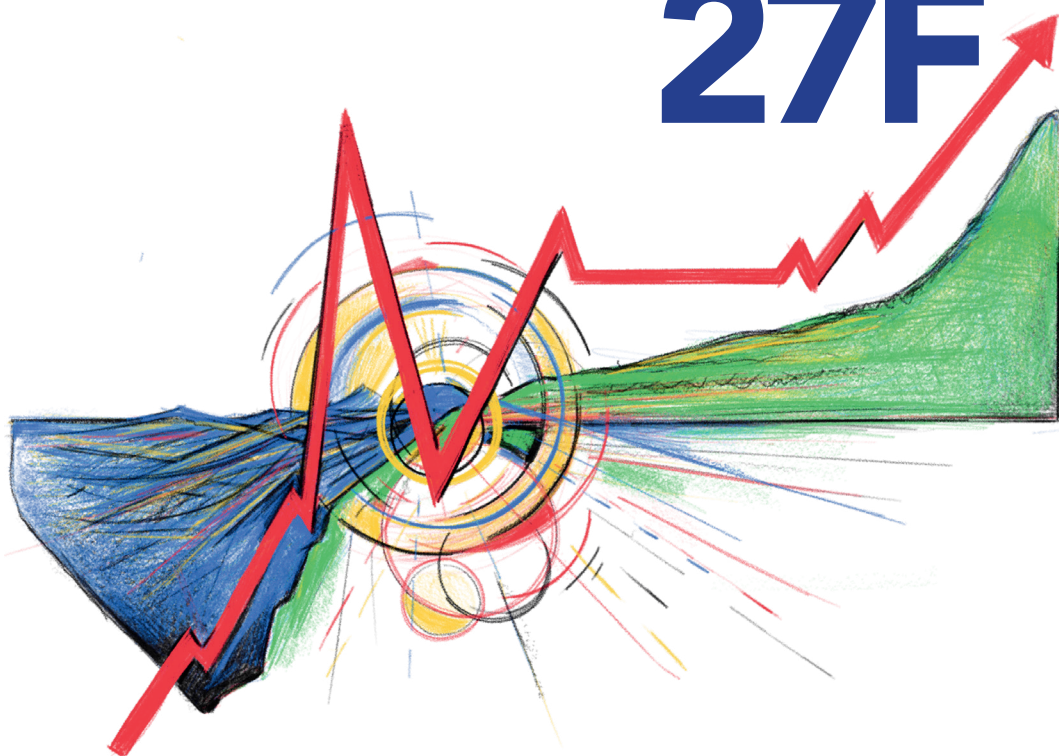EXPLORING THE EARTHQUAKE AND TSUNAMI SUBCULTURE IN GREATER CONCEPCIÓN, CHILE

A CULTURAL ANALYSIS OF
COMMUNITIES' RESPONSE TO
27F

Karen Elisabeth Engel

Propositions

1. Increasing investments in governments' own institutional disaster preparedness will positively affect Greater Concepción's earthquake and tsunami disaster resilience. (this thesis)

2. Economic susceptibility and increasing tsunami exposure make Talcahuano's urban localities sensitive to earthquake and tsunami disasters. (this thesis)

3. Improvisation cannot be successful without preparedness, including discipline and doctrine.

4. Vulnerability to change is necessary for innovation.

5. Seeking a zero-risk society is futile and undesirable.

6. Building on and with local resources is key to ensuring resilience.

7. A collection of self-reliant individuals is not equivalent to a resilient community.

8. Leadership in times of crisis demands a *jazz* state of mind.

Propositions belonging to the thesis, entitled

Exploring the earthquake and tsunami subculture in Greater Concepción, Chile: A cultural analysis of communities' response to 27F

Karen Elisabeth Engel
Wageningen, 12 December 2018

Exploring the earthquake and tsunami subculture in Greater

Concepción, Chile:

A cultural analysis of communities' response to 27F

Karen E. Engel

Thesis committee

Promotor
Prof. Dr G.E. Frerks
Former Professor of Disaster Studies
Wageningen University & Research

Co-Promotor
Dr J.F. Warner
Associate professor, Sociology of Development and Change Group
Wageningen University & Research

Other members
Prof. Dr A.E.J. Wals, Wageningen University & Research
Prof. Dr R.A. Boin, Leiden University
Dr F.K. Boersma, VU Amsterdam
Prof. Dr B.E. Aguirre, University of Delaware, Newark, USA

Exploring the earthquake and tsunami subculture in Greater

Concepción, Chile:

A cultural analysis of communities' response to 27F

Karen E. Engel

Thesis
submitted in fulfilment of the requirements for the
degree of doctor
at Wageningen University
by the authority of the Rector Magnificus,
Prof. Dr A.P.J. Mol,
in the presence of the
Thesis Committee appointed by the Academic Board
to be defended in public
on Wednesday 12 December 2018
at 4 p.m. in the Aula.

Karen E. Engel

Exploring the earthquake and tsunami subculture in Greater Concepción, Chile:
A cultural analysis of communities' response to 27F,
307 pages.

This thesis is dedicated to my family.

To my husband Ivo. Without your love, encouragement, dedication and periodic stern planning interventions this project would never have been completed. I realize you have had to absorb a lot of the stress and frustration that this PhD process has entailed. That cannot have been easy and I'm sorry you have had to do so. At the same time, I'm happy you did. You have supported me all these years and because of that I am now achieving something incredible. Without you none of this would have been possible. I love you.

To my children, Louise and Hugo. Your smiles were all I needed to keep on going.

To my parents, Maria and Paul. You gave me the experiences, intellectual environment and valuative foundations that have made all of this possible.

To my sister, Laura. There when I needed her and always one of my biggest cheerleaders. You would listen and your creative vision for the cover illustrates that you understood and appreciated the work I have done these past few years: thank you.

I love you all and I am heavily indebted to you.

Prologue: Journeying towards a research problem

Looking back, I realize there is a common theme that accompanies me through life: *natural hazards*. I was born in San Juan de Pasto, Colombia. This city is the capital of the department of Nariño which is located in the south of Colombia at the foot of the Galeras volcano at an altitude of 2897 meters above sea level. I was told that 'the locals' would appease us by stressing that whenever the volcano would erupt, the other side of the volcano would be affected. Strangely enough, they said the same thing on the other side of the volcano.

After Pasto we moved to the Netherlands. When choosing a home in Bennekom, my mother made sure it would not be located in a flood plain or below sea-level. My mother, who is Chilean, could never quite comprehend why the Dutch constructed residential homes in flood prone areas. She had seen what high river discharge can do to flood plains. She just could not embrace this Dutch conviction that engineering had tamed the Waterwolf[1], so there was nothing to worry about: you can live anywhere! In flood-plains, below sea-level, in the sea (on land reclaimed from the sea), anywhere! So we always lived above sea-level. Which was nice when in 1993 and 1995 high water threatened nearby locations, like Wageningen. At that time, my uncle, Hein Engel, worked for the Ministry of Transport, Public Works and Water Management on the completion of the Delta Works: the celebration of the 'land lion[2]' subjugating the Waterwolf.

When an opportunity arose to move the family to Chile, my parents took it. We would get to know my mother and her side of the family better. My mother is originally from the dry North, El Norte Chico, but most of her siblings and their families moved to the south; to Concepción, in the late 1960s. We lived in both

---

[1] The term 'Waterwolf' is commonly used throughout Dutch history, literature, and folklore to refer to "the destructive, devouring action of wind-driven water on soft shoreline (TeBrake, 2002)".

[2] Poet Joos van den Vondel wrote the poem Aan den Leeuw van Holland (To the Lion of Holland (DBNL, 2018a)) in which the Land Lion defeats the Waterwolf. This poem was an allegory of the Dutch fight to stop 'water' from 'eating' (eroding) their lands (DBNL, 2018b). It was presented together with Leeghwater's plan to dike and drain the lake Haarlemmermeer. Today, the Netherlands' main airport is located where this lake used to be.

Concepción and Santiago. Even though Chile is ridden with all kinds of natural hazards, from volcanoes to tsunamis, it never preoccupied us. Not even when several times a month the ground would tremble to remind us that a real earthquake would strike. We just did not know when.

These quakes were not considered earthquakes. They were mere trembling. But more on this throughout the thesis. My mother would tell me stories about the tsunamis her families lived through in the North. She stressed it was never a good idea to live on flood plains. She lived in the North where it hardly ever rains, but she would tell me that every so much time heavy rains in the Andes mountain range are so abundant that they would cause rivers to overflow and come down so powerfully that they would take everything in their path and the floodplains were always in their path. At the time, these were mostly stories, but in fact my mother was telling me about the natural environment I was living in and the hazards it encompassed. She was also telling me how to go about these hazards to make sure I would not be affected negatively. She was introducing me to an important part of her culture and a core lesson was: wherever you go, nature rules (*la naturaleza manda*). That specific story was about flash floods in the North; a risk that recently materialized, in 2015 and that caused significant damage.

Every now and then we would discuss the earthquake everyone was expecting: the big one! Approximately every 20 years a big one would strike Chile. Since the last one had been in 1985 in the central region and in 1960 in the southern region, people were expecting something major to hit them. My mother would tell me what to do in case it would hit: get underneath something strong like a table, if possible open the door, and get out as soon as possible to an outside location without electrical wires. The tremors were so often, that I would usually stay in bed assessing whether it was the one that would require me to get outside. Most of the time, this was not the case since tremors would never really approximate M7: a magnitude that poses a real threat. Aside from talking about it, though, nobody was

really worried. The stories were filled with experiences, knowledge to make sense of telluric events and options for protective behavior. So there we were, surrounded by natural might: some 105 active volcanoes, wild fires, earthquakes and tsunamis, flash floods, etc., but oh so calm. After all, we were above sea level.

Time passed and after finishing my Master's degree, I found myself a job as a disaster management consultant in the Netherlands dealing with (large-scale) flooding. This was a challenging job, mostly because most people I worked with were convinced that engineers had reduced the risk of large-scale flooding to such negligible levels that planning for such events was considered unnecessary. After all, our efforts since the 1953 flood disasters had led to the defeat of the Waterwolf! Understandably, this conviction is desirable for such a small country like The Netherlands with its economic and urban core located on lands exposed to major flooding if it were not for the complex technical and organizational system that engineers

Without dikes, the blue part of this map, where the economic heart of The Netherlands lies, would be flooded.

Figure 1 Map of The Netherlands illustrating which areas would be flooded without The Netherlands' water management system

and water management professionals devised (see illustration 1). Also, if you are not convinced that flooding is not an issue, you would not move to a newly built neighborhood at -6m below sea level that is kept dry through a central pumping system and live happily. But apparently, the Dutch, my uncle included, had not been able to convince my mother that she would be OK: that human reason could overpower nature. But she felt confident in Chile. This confidence, though, was not related to people's ability to overcome nature, but rather their ability to live with it, including the hazards it embraces.

Then, on February 27, 2010, the 'big one' hit the south-central regions of Chile: a M8.8 earthquake struck just off the coast and triggered a devastating

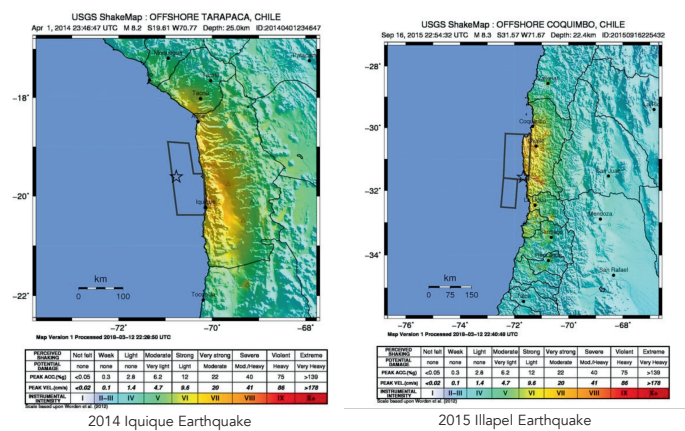2014 Iquique Earthquake · 2015 Illapel Earthquake

Figure 1 Recent earthquakes that hit Chile

tsunami that wreaked havoc on the region's coastline (hereafter 27F, in line with Chilean usage) (BBC, 2010). The event that had been anticipated for so long, had finally come. Even though this event was major, claiming over 500 dead, people missing, millions affected and billions worth of financial damage, people I encountered outside of Chile would remember the Chilean mine rescue in the same year and not 27F.

Chile is now known for being one of the most seismic countries in the world. Even though it was hit by the strongest earthquake ever recorded; a M9.5. Even when I ask people to remember the disastrous events of 2010, they tend to remember Haiti and the Chilean mine workers, but not 27F. Regarding the earthquakes, is this because the impact in Haiti was so much greater even though the actual event in Chile was much more powerful? Similarly, people are generally not aware that even more recently Chile was hit by major quakes, such as the M8.2 quake in 2014 (Iquique earthquake) and the M8.3 one in 2015 (Illapel earthquake). See illustration 2 for a better idea regarding intensity and location of these quakes.

These events were in terms of magnitude greater than the recent M6.9 earthquake that devastated Lombok in Indonesia on August 5, 2018. Again, the events in Chile resulted in minimal impact compared to the Lombok earthquake.

In light of this, I was intrigued and felt it was time to study Chile and the way its communities deal with two of the primary natural hazards they face: earthquakes and tsunamis. I had worked in the Netherlands on the way communities deal with flooding and I reckoned a study into the Chilean context would bear fruits for both academia and practice in how people adapt to inherently hazardous environs.

Table of Contents

List of Figures and Tables

Figures

Tables

Boxes

List of Acronyms

27F	The M8.8 earthquake event that triggered a major tsunami and hit the southern-central region of Chile on February 27, 2010.
GC	Gran Concepción
M	Magnitude
DsC	Disaster subculture
DsCs	Disaster subcultures
CR	Critical Realism
DM	Disaster management
DRR	Disaster risk reduction
UN	United Nations
DRM	Disaster risk management
UNISDR	United Nations secretariat for the International Strategy for Disaster Reduction
ISDR	International Strategy for Disaster Reduction
PTWS	Pacific Tsunami Warning System
THRUST	Tsunami Hazard Reduction Utilizing Systems Technology
GOES	Geostationary Operational Environmental Satellite
NASA	National Aeronautics and Space Administration
ACCEMAR	Guidance for local officials to deal with tsunamis or maremotos in Spanish and which is based on the methodology ACCEDER: Alert, Communication/ Information, Coordination, preliminary Evaluation, Decisions, complementary Evaluation, Reevaluation of plan.
LTWS	Local tsunami warning system
ITWS	Institutional tsunami warning system
ITIC	International Tsunami Information Center

Chapter 1:   Introduction

Communities have different means at their disposal to deal with threats and opportunities inherent to their environment. These means develop over time and become important cultural products. The collection of cultural products cultivated in response to repeated experience with natural-hazard-induced disasters are known as *disaster subcultures* (DsCs). These DsCs are relevant because they considerably shape communities' vulnerability or potential for (positive or negative) transformation.

Central to DsCs is the idea that natural hazards are as much "agents of cultural formation as they are physical events. (Bankoff, 2001, p. 13)" In addition, a 'practical' approach to culture is inherent to the concept. Interest in DsCs implies an appreciation of cultures' pragmatic and instrumental value to societies. This approach approximates Schein's (1999, p. 43) conceptualization that cultures are "problem-solving tool[s] that enable individuals to survive in a particular environment" (Schein, 1999, p. 43). The approach adhered to throughout this dissertation additionally recognizes that technology drives culture and that cultural systems are thoroughly technological. In fact, throughout this dissertation 'culture' is considered *essentially* technological. Dubbing culture 'technological culture' is consequently deemed redundant and is therefore done minimally throughout this dissertation.

This dissertation is about DsCs. More specifically, a DsC lens was used to capture the contextual realities from which resilience and vulnerability emerge. Because understanding disaster vulnerability and risk requires an understanding of both constraints and capabilities, 'resilience' complements the conceptualization of 'vulnerability'. By doing this it is possible to move beyond a victimization discourse and towards an agency and capacity dominated one. In this sense 'resilience' "inspires a 'can-do' attitude as it recognizes communities as active problem-solving

Figure 1-1 Cases in The Netherlands: Borgharen and Itteren

agents that conceive and cultivate mechanisms that allow them to inhabit and flourish in hazardous places" (Engel, Frerks, Velotti, Warner, & Weijs, 2014, p. 862).

This dissertation is founded on two qualitative studies. One was done in the Netherlands. It was more small-scale and had the specific purpose of ensuring that the conceptual lens and approach would be suitable for the main research endeavor in Chile. It was important to make sure that the approach envisioned would be applicable in another context than it had been developed in, i.e. the United States. Also, assurance of its contemporary relevance and ability to produce novel insights needed to be confirmed. This is why the main study preceded a study into two parishes in the
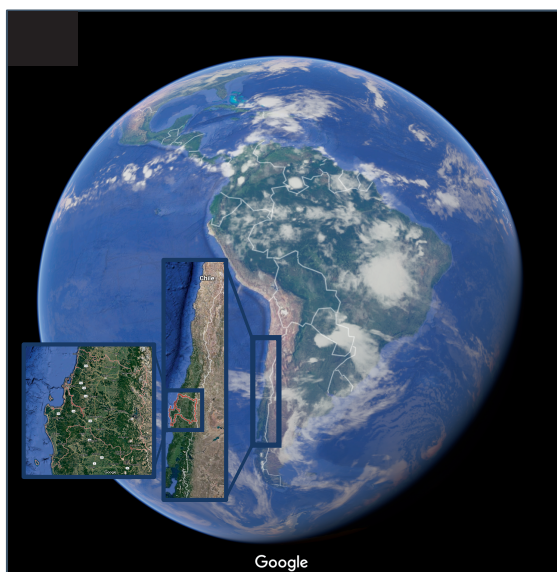
Figure 1-2 Cases in Greater Concepción, Chile: Hualqui and Talcahuano

Netherlands, namely Borgharen and Itteren (see Figure1-1). Both communities are

in the south of the Netherlands and deal with recurrent fluvial flood events. When this study confirmed the suitability of the approach, it was possible to move on to the primary study into the GC. In GC, the cases were Hualqui and Talcahuano (see figure 1-2). The former faces recurrent (major) earthquake events and the latter (major) earthquake/ tsunami events.

1.1 27F and Opportunities for Research

USGS ShakeMap : Maule, Chile
Feb 27, 2010 06:34:14 UTC   M 8.8   S35.91 W72.73   Depth: 35.0km   ID:20100227063414

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	<0.02	0.1	1.4	4.7	9.6	20	41	86	>178
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Worden et al. (2012)

Figure 1-3 USGS shakemap showing Greater Concepcion's location, perceived shaking and instrumental intensity

On February 27, 2010, an earthquake of moment magnitude (Mw) 8.8 triggering tsunami waves struck the south-central regions of Chile. Impact was significant since it affected six of the 15 Chilean regions in which approximately 75% of the Chilean population resides[3].

For GC, the second largest conurbation after Santiago (see figure 1-2 for location) which was one of the most heavily affected areas (see Figure 1-3 for more information on the earthquake's intensity in GC), 27F was a reminder that 1) powerful earthquake/ tsunami events are not just in the past, but are one of the few certainties they have about their future and 2) despite everything they have learned and do to limit their communities' vulnerability to such events, they are still vulnerable.

---

[3] In terms of impact there are no precise data for 27F. Different (governmental) organizations produced competing statistics. In some cases, impact was even inflated to ensure a greater share of reconstruction resources (Sehnbruch , Agloni, Imilan, & Sanhueza, 2016, p. 28).

In addition to the mayhem disasters are known for, they bring opportunities: "Disasters lay bare the fundamental features of society and culture, also those that have contributed to a disaster unfolding. This is why disasters are often considered 'natural laboratories or crises revelatrices' (Oliver-Smith, 1996, p. 303)." Phenomena like earthquake/ tsunami events materialize risks and as they unfold disaster vulnerabilities become apparent and opportunities for addressing these emerge. When this investigation was envisioned, GC had just been struck. It was clear that the recovery should encompass a 'bounce forward' (Manyena, O'Brien, O'Keefe, & Rose, 2011) rather than the preservation of undesirable patterns of vulnerability. Consequently, taking advantage of this opportunity to learn about people's experiences of vulnerability vis-à-vis earthquake/ tsunami events that 27F exposed was imperative.

1.2 Research purpose and questions

The primary area of study was GC. However, to ensure a fitting approach and conceptual lens for this research endeavor it was preceded by a study into Borgharen and Itteren, two Dutch communities in the province of Limburg facing repeated fluvial flood events. The purpose of this study was to make sure that the DsC approach and lens 1) still had contemporary relevance, 2) could be applied outside the context in which it was developed, i.e. the United States, and 3) would produce novel insights. On the basis of this it would be possible to finalize the decision to employ this approach and lens to the main study. The study confirmed that DsC as approach and lens would be fitting for the envisaged research effort in GC. In chapter 5 and chapter 9 this is discussed more in detail. The study furthermore established that the cultural perspective would benefit from a technological culture perspective. This is elaborated more in detail in chapter 4.

The *purpose* of the main study was to learn more about earthquake/ tsunami vulnerability in GC by uncovering, understanding and describing the earthquake/ tsunami disaster subculture that people's experiences of 27F exposed. To increase

the research's relevance, but more importantly to make sense of my findings and the complex nature and interconnectedness of the concepts involved, I opted for a cultural perspective that ensures a comprehensive and rich but also a systematized picture. Central to this study, and therefore this dissertation, were the Questions in Box 1-1.

Box 1-1 Central research questions

Question 1: What can we learn from applying a disaster subculture lens to people's 27F experiences in Greater Concepción about their earthquake/ tsunami vulnerability?

Question 1.1: What do people's 27F experiences reveal about an earthquake/ tsunami disaster subculture when applying the disaster subculture lens?

Question 1.2: What do people's 27F experiences reveal about their earthquake/ tsunami vulnerability?

Question 1.3: How can exploring earthquake/ tsunami disaster subculture enhance our understanding of earthquake/ tsunami vulnerability, and in particular capacity of response?

Question 1.4: How can a technological culture perspective enrich our understanding of the prevalent disaster subculture and associated earthquake/ tsunami vulnerability experiences?

Question 1.5: What insights about earthquake/ tsunami vulnerability that people in Greater Concepción experience, derived from applying the disaster

subculture lens and the technological culture perspective, can contribute to disaster risk reduction?

1.3 Outline

This dissertation sets out to present this study and its findings, but more importantly to answer the central research questions. To do this, I firstly introduce and elaborate on the research design. This begins with some insights on the philosophical underpinnings. This is relevant to understand some epistemological and ontological considerations that have shaped the design of this study, but more importantly the findings and conclusions. Central is the appreciation of the world as being both 'real' and 'constructed'. This study allies with Critical Realism (CR). This means that it is based on the idea that there is an independent world out there, but that this world is difficult to grasp since our knowledge is relative and our beliefs, including knowledge and facts, are socially constructed and fallible. To try and move beyond the empirical, i.e. socially constructed, to the actual and real, thick and holistic pictures of the empirical are necessary. One objective of this study is to contribute to a holistic picture of vulnerability so that the findings can contribute to the approximation of the real and actual vulnerability to earthquake/ tsunami disasters that people in GC experience. Because people's exposure and sensitivity is real. Also, when it comes to vulnerability vis-a-vis natural hazards the material and the natural cannot be abstracted out since natural-hazard-induced-events emerge from the convergence of the social, technical and natural. Similarly the concept of 'emergence' needs to be fully appreciated, especially when it comes to issues of vulnerability and resilience. Resilience for instance emerges from more basic powers and properties but cannot be reduced to them: the whole is more than the sum of its parts. This understanding is key and is facilitated by taking a CR approach. Section 2.1 elaborates more on the CR underpinnings of this investigation. Furthermore, CR manifests itself throughout the dissertation. After the philosophical underpinnings

the research paradigm and the strategy for inquiry are elaborated upon in section 2.2 and 2.3. To get the holistic picture of the empirical one has to examine experiences. Since experiences cannot be measured and have to be understood a qualitative research was most fitting. In line with this paradigm I opted for a case-study strategy for inquiry. This strategy was particularly suitable because of the study's exploratory nature. Because the experiences that are central to this study could be sensitive because they would lay bare personal and societal vulnerabilities, but more importantly could be painful because of lives lost for instance, I chose to select respondents purposeful sampling. The final pool of respondents was varied and included mostly community members, but also emergency-related professionals, authorities, and academics. The strategies used for validating the findings were triangulation, member checking and prolonged time in 'the field'. The findings are based on 13-months of field research in GC.

Chapter 3 introduces and elaborates on the conceptual building blocks of this study, namely the concepts 'vulnerability' and 'resilience'. This study aims to understand more about vulnerability to earthquake/ tsunami events in GC. Like so many concepts there are numerous definitions, so it's a must to clarify which one shapes this investigation. The same holds for resilience. It is worthwhile noting that vulnerability is conceptualized as 'potential for change'. It is subsequently not considered negative per se. In fact, it's claimed that vulnerability can be positive. A more thorough discussion can be found in section 3.2. The same holds for 'resilience' which is discussed in section 3.3. My stance on resilience is that it is not intrinsically positive. It is an ability that can have positive *and* negative impact. Also, it is important to not mistake resilience for either stability or resistance. Adaptiveness and the acceptance of change should be dominant in any conceptualization of resilience. To enable the answering of the last question, DRR is discussed in section 3.4. Answering this question brings concrete opportunities for stimulating positive change in terms of vulnerability to earthquake/ tsunami events in GC.

To capture, make sense and systematize the findings conceptually I opted for a 'cultural perspective'. Humans adjust to their environment through sociocultural systems. This is why I opted for a 'cultural perspective'. Since I'm concerned with the way communities adjust to repeated natural hazards, I focused on DsCs which are the sociocultural systems specifically cultivated to deal with repeated disasters. From a scientific point of view, 27F was an opportunity. Disasters reveal how successful societies have been at adjusting by laying bare vulnerabilities. They are unique opportunities to peruse the functioning of a DsC. This is why I decided to use a DsC lens to investigate earthquake/ tsunami vulnerability in GC after 27F. Since my interpretation of cultural includes the idea that cultures are essentially technological, section 4.1 elaborates on this. Section 4.2 on the other hands dives into the DsC lens that was used to narrow down and focus the studies in GC.

Chapter 5 to 8 are the articles that were produced within the framework of this study. Chapter 5 is the result of the preparatory study into Borgharen and Itteren. Central to this study was determining the value of DsC as a concept and lens. This chapter includes a discussion on the role of culture and DsC in disaster management (DM) and resilience as well as a thorough presentation of DsC as a conceptual framework. A number of relevant observations were made throughout this study. First, I determined that the had contemporary relevance even when applied in a context different than the one it was developed in. Second I learned that as a framework and lens it can lead to noteworthy findings. Central to this study was the observation that DsCs shape vulnerability and alterations to DsCs can have important ramifications for the vulnerability that communities experience.

Chapter 6 seeks to answer question 1.1 and also goes into question 1.2. To do this it presents the investigation of the DsC in GC. Findings reveal a comprehensive DsC populated by both tangible and intangible tools and characterized by a mix of local and scientific knowledge-based tools and techniques. The DsC provides important E to deal with recurring (major) earthquake/ tsunami

events. Communities are able to resist most quakes and respond appropriately to the ones that they cannot.

Both Chapters 5 and 6 reveal findings that enable me to answer question 1.4. They reveal important findings that would not have been possible if technological culture would not have been included in the research. For instance, Chapter 5 reveals how the introduction of new techniques leads to important changes to the investigated DsC which could have important consequences to the communities' vulnerability. Similarly, Chapter 6 reveals insights that illustrate the technological essence of culture, but more importantly it demonstrates how mixing scientific and local knowledge as well as tangible and intangible tools and techniques can lead to effecting DsCs that enable *both* resistance and adaptability.

Chapter 7 is important for the answering of 1.2 and 1.3. It presents one of the primary findings of the investigation into vulnerability in the wake of 27F. Early on I learned that GC includes a group of people that deserve specific attention for the precarious situation the 27F tsunami left them in. They are dubbed 'the middle' because they are neither rich nor poor. They are considered and perceived as self-reliant, also in the wake of a disaster. The tsunami event, revealed however they are not. Today, because of a poverty-bias and the desire of these households to be perceived as self-reliant and capable they find themselves in a prolonged recovery process as their access to relevant resources is very limited. The respondents included in this study are economically fragile and this has enhanced their sensitivity to similar future events. This chapter goes into issues of earthquake/ tsunami vulnerability and presents some surprising but important findings that need addressing for disaster risk to be reduced sustainably in GC.

Chapter 8 proposes an 'after-action' resilience scheme to evaluate localities' response to disaster. This allows us to specifically look into capacity of response and subsequently answer question 1.4. Such a scheme would allow one to determine levels and types of resilience emerging in response to an event. In this article two

communities in Talcahuano are explored to determine the type of resilience that emerged in response to 27F. Interestingly, it becomes apparent that impact was similar, but the responsiveness was not. The urban case turned out susceptible whilst the rural case was quite resilient. The urban case's susceptibility is related to the findings in Chapter 7. This chapter presents and elaborates the resilience approach that is central to this study, but more importantly provides a scheme that an be used to appraise localities' actual resilience in the wake of an events. This is useful because it makes insights into communities' capacity of response possible and thus vulnerability possible.

Chapter 9 includes the findings by answering the questions one by one. In addition some critical issues are discussed. Section 9.3 goes into a number of opportunities for advancing disaster risk reduction. These opportunities emerged from the study and the findings and together answer the last research question, question 1.5. Chapter 10 concludes the dissertation and the Epilogue concludes the thesis by reflecting on the endeavor as a whole. It has been a hell of a ride and definitely worth it.

Chapter 2:   Research design

"Predictive theories and universals cannot be found in the study of human affairs. Concrete, context-dependent knowledge is, therefore, more valuable than the vain search for predictive theories and universals" (Flyvbjerg, 2006, p. 224).

2.1 Philosophical underpinnings: Critical realism as my ally

The design of one's research is highly dependent on the researcher's ontological and epistemological premises. Epistemology refers to the question of knowing: what is (or should be) regarded as acceptable knowledge in a discipline and ontology refers to questions of being. Research leaning more towards a positivist epistemology, would seek to discover objective truths about the world 'out there' by reducing ideas into a small and discrete set of ideas (variables that make up the hypotheses and research questions) that can be tested (Matthews & Ross, 2010). The underlying ontological premise, an objectivist one, being that there is an objective social world that can be discovered through the use of (objective) scientific methods that are generally borrowed from the physical sciences.

More interpretivist approaches, however, believe that the subject matter of social sciences is fundamentally different from that of the natural sciences so the study of the social world should be as well. A common ontological position that is associated to interpretivist approaches is constructionism which is often referred to as constructivism (Matthews & Ross, 2010). This position asserts that social phenomena are produced and continuously revised by social interaction. Whatever knowledge is produced; it is intermediate and represents the researcher's version of social reality. There are various constructivist variants (Schmidt, 2001). The more extreme approach considers reality a mental construct. According to Murphy (2002, 44) this is a naïve form of social reductionism that "ignores and obscures what is not socially constructed but instead created by the dynamics of nature" (Murphy, 2002,

p. 44). This tendency to "subsum(e) nature into history and thus fail(…) to conceptualize the biophysical environment as an independent causal force" has been criticized (McLaughlin & Dietz, 2008, p. 103). More mild variants do not deny materiality or dynamics of nature as independent from conceptions, but do ignore it throughout research (Murphy, 2002, p. 44). Then, "mild in principle becomes extreme in practice" (Murphy, 2002, p. 44). Despite this, constructivism has made important contributions. In disaster research for instance, constructivism has been key to understanding the role that agency and culture play in producing differential vulnerability throughout societies. Similarly, constructivist research has shown that disaster victims are not merely victims, but instead active agents (McLaughlin & Dietz, 2008).

This research is allied with critical realism (CR) which in my view enables a unique path through the middle and resolves a number of dualities that have caused tension when studying phenomena that emerge from the juncture of the natural, social, and material world (Murphy, 2002, p. 44; Danermark, Ekström, Jakobsen, & Karlsson, 2002) such as natural hazard induced disasters (McLaughlin & Dietz, 2008). Too often, social scientists limit their purview to socio-cultural phenomena and abstract out the material and natural. This is particularly troublesome for disaster studies which deals with events that emerge from the convergence of the social, technical and natural. This work is therefore premised on "a commitment to the reality of an external world, even though the beliefs about ('knowledge' of) that world are conceded to be imperfect" (Campbell, 1974, p. 141). By taking this approach, I hope to attain a more holistic exploration and ensure that aside from investigating people's experiences causative mechanisms of what is experienced and observed are taken into account (Walsh & Evans, 2013). Chapter 5, for instance, explores the experience of vulnerability to earthquake/ tsunami events of households that I identified as the 'emerging middle'. Literature generally does not deem these households vulnerable since they are considered to have sufficient access to

resources. Qualitative research into my cases revealed, however, that they are significantly vulnerable (high sensitivity and low capacity to cope) and that this vulnerability is related to underlying structures, such as society's neo-liberal foundations.

Here I would like to convey that due to time constraints of the study and the need to make use of the window of opportunity that the wake of 27F entailed, this study focused mostly on exploring 27F experiences and referred to underlying structure where possible. Future endeavors may want to focus even more on exploring the causative mechanisms underlying these experiences.

Critical realism or critical naturalism for the social sciences was developed by Roy Bhaskar (1975, 1978, 2011, 2015, 2017) in an attempt to resolve a number of dualisms that plagued social sciences (examples of prevalent dualisms: mind/ body, the structure/ agency, behavior/ materiality, theory/ practice dualism, and fact/ value). Like more interpretivist positions, CR recognizes that the natural and social world are different and one should therefore not make the same assumptions: "[s]ocial structures, unlike natural structures, do not exist independently of the activities they govern" and "they do not exist independently of the agents' conception of what they are doing in their activity" (Bhaskar, 2011, p. 61). At the same time, CR's ontological position is that there is a world out there of intransitive objects (for more detailed information about this world and its essence, see Box 2-1). Take the social world, for instance, even though social structures depend on agency for their reproduction, once they exist they become real, enduring, essentially mind-independent, and pre-exist agency. Take the structure of language. Without it people cannot engage in the act of speech, however if it is not reproduced it will seize to exist. Unlike Giddens' structuration theory that also recognizes the co-existence of structure and agency, CR recognizes time as an important dimension. The past lives on in structures: "We are living in a world, which largely we have not

created, and that means it is very difficult, unfortunately, for us radicals to transform the world in the way we want to" (Bhaskar, 2017, kindle loc. 547).

Box 2-1 The multi-tiered world

The world 'out there' can be considered multi-tiered and made up of structures or mechanisms on the one hand and events and their conjunctions on the other (Bhaskar, 2017). The layer that we readily perceive is the 'empirical' world. This world consists of our experiences and are essentially the effects and thus the 'evidence' of pre-existing causal tendencies, not causal certainties. The cause-effect relationship is considered multidimensional (not linear) and therefore difficult to grasp. The second layer is the world of 'the actual'. This world includes events, that we have or have not experienced, and our experiences. The idea behind science is to record what we see in the world of the empirical and to seek and identify all possible events in the world of the actual to arrive at an understanding of the causal tendencies or mechanisms that help explain these events and give us a glance of the world of the 'real' (Barron, 2013, p. 120).

Central to this multi-tiered view of the world is emergence. One has an emergent power or property which is unilaterally existentially dependent on the more basic power, property, or feature. This means you do not have the one without the other. Take the mind as an example. The mind is an emergent power of matter (body) and you do not have a mind without the body. The emergent power is taxonomically irreducible to body and can therefore not be reduced or unpacked in terms of the properties of the basic power, property, or feature. A mind encompasses motives intentionality, reason, plan, purpose and all this cannot be reduced to properties of bodies. So the whole is more than the sum of the parts. The emergent power is causally irreducible to and efficacious in the realm of the basic power; the emergent power intervenes at the other levels and so when a body is complemented with a mind, it changes. The bodies change with a mind.

This is the way we intervene for instance when it comes to disaster risk reduction. Our actions produce changes in the material world. For this study, emergence is particularly important to understanding issues of vulnerability and resilience. Both are considered emergent properties of a system.

There are few (critical) realist attempts to studying vulnerability, one of the few being Watts and Bohle's *Hunger, Famine and the Space of Vulnerability* (1993). This limits how we appreciate the phenomena we study. For vulnerability, for instance, we can only study the empirical world, or manifestations of vulnerability. But we should not be satisfied with the mere investigation of the empirical, but seek to go deeper and understand what lays beneath. In light of vulnerability, questions should be directed at what structures, dynamics and properties allow for it to emerge.

2.2 Qualitative research paradigm

Qualitative research is more than just the absence of numbers: "[q]ualitative research is a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem" (Creswell, 2009, p. 4).

With CR as my ally, the objective of this study is to uncover unique experiences of individuals, but to go beyond that and use the examination of experiences to learn more about underlying social structures and the way these are related to individual agency. Since the way people experience the world and give meaning to these experiences remains central to learning more about 'the (social) world' and uncovering underlying mechanisms, *qualitative research* seemed most fitting. As Bhaskar (2015, p. 46) stresses "meanings cannot be measured, only understood."

To explore the empirical, I aimed to identify, document and explore the empirical manifestations of people's vulnerability to earthquake/ tsunami events in the wake of 27F. Because of practical time constraints and the need to 'take

advantage' of the 27F aftermath, the emphasis would be on the empirical and less on moving towards the 'actual' or the 'real'. Furthermore, since exploring the empirical entails the examination of experiences and interpretations, the contributions of the participants of this study were fundamental (Creswell 2009, p.8). So like most qualitative work, "the meaning that the participants [held] about the problem or issue, not the meaning that the researchers bring to the research or writers express in the literature" (Cresswell, 2009, p. 175) was leading.

Here it is good to note that most qualitative work is based on a constructionist or phenomological ontological position: "social properties are outcomes of the interactions between individuals, rather than phenomena 'out there' and separate from those involved in its construction" (Bryman, 2008, p. 666). For humans, reality is not something separate from its appearance (David & Sutton, 2004, p. 38). In this sense, this study is different. Taking the CR position means appreciating that there is an independent world out there. Really grasping it is however difficult, because our knowledge is relative and our beliefs are socially constructed and fallible. We do however have to try and move beyond the empirical towards the actual and the real. The first step is, however, gaining thick and holistic pictures of the empirical.

Another reason for opting for a qualitative approach was because of this study's explorative nature. At the time when the study was designed there were few studies looking into the matter of vulnerability vis-à-vis earthquake/ tsunami events in GC from a cultural perspective. Since qualitative research is more related to exploration and induction (Bryman, 2008, p. 366; Creswell, 2009, p. 175; David & Sutton, 2004, p. 35), rather than deductive testing of preconceived theories, I felt a qualitative research would be more appropriate (David & Sutton, 2004, p. 77).

2.3 Strategy for inquiry

"[S]ometimes we simply have to keep our eyes open and look carefully at individual cases—not in the hope of proving anything, but rather in the hope of learning something!" (Hans Eysenck, 1976, in Flyvbjerg, 2006, p. 224).

Since I was looking to go in-depth into the experience of earthquake/ tsunami vulnerability as it unfolded and revealed in the wake of 27F (from 2010 to 2015) I opted for 'case-study' as this study's strategy for inquiry (Yin, 2018, kindle loc. 809-810). Case study seemed also appropriate because of the study's exploratory nature (Creswell, 2009, p. 26). Even though case studies are appropriate for various types of research, including explanatory and descriptive types, case studies have always been considered especially appropriate for exploratory studies.

To go 'in-depth' into 27F experiences field research would be indispensable. As a result, the research design included over a year of 'field-work'. This year was divided into three periods. Two six months periods and one one-month period. Doing it in three periods helped to intermittently reflect on the data collected and assess what additional data would be relevant. It also helped to 'breath'. Data collection in 'the field' is continuous, especially when it comes to cultural matters.

Regarding the cases, before going into 'the field' in Chile, cases were selected on the basis of available information, mostly literature. It was decided that the research would focus on four cases in the Biobio and/ or Maule region in Chile. The idea was that by studying four different cases more insights would be generated about the way the natural, social, and material overlap when natural hazard induced disasters unfold. The final case selection was done in 'the field'. This is when I got a better idea of what cases would be most suitable and also, just as important, would be more feasible.

In 'the field' I decided that GC would be my area of interest, but that due to practical constraints the focus would be on two localities in the town of Talcahuano:

one rural and one urban one. I believed that even though they experienced the same event, the people would have different vulnerability experiences because they would have access to different resources. Because GC includes towns that are not exposed to tsunamis and thus did not experience one, I chose to complement the research into Talcahuano with a more small-scale investigation into Hualqui: a more in-land town with also rural and urban localities. Here I would do a similar investigation to learn more about the experiences of vulnerability vis-à-vis earthquakes and to see whether such experiences were significantly different depending on the rural or urban character of the locality. More elaborate information on these the cases embedded in Talcahuano can be found in Chapters 5, 6, and 7.

The participants were selected through purposeful sampling, in particular snowball sampling which "yields a study sample through referrals made among people who share or know of others who possess some characteristics that are of research interest" (Biernacki & Waldorf, 1981, p. 141). This method was particularly fitting because the aftermath of a disaster is a sensitive topic, especially to those directly affected. However, the referrals between people enabled me to get an idea of the participants and their experiences before I engaged them and it allowed for the participants to feel increasing trust in me and my intentions and therefore feel safe and comfortable enough to discuss a part of their lives that was difficult and unveil their vulnerability. To get the 'ball rolling' I drew upon my existing professional and personal network and experience in Chile in the field of DM and built on an already established network. For more information on how my previous experience with Chile was beneficial to this study, please refer to Box 2-2.

Box 2-2 The benefits of a bicultural background for research

When it comes to studying culture, Krüger et al. (2015, p. 3) note that the people doing the analysis are often either outside of 'it', i.e. the community being studied, or too immersed. In this case, I felt that I was able to take proper advantage of the fact that I am both Dutch and Chilean. My mother is Chilean, I lived in both Santiago and Chile as a teenager, I completed my secondary education in Chile, my Master's thesis was on Chile and I continue to have strong bonds with the country and its people. This helped me to have an existing personal and professional network, but more importantly it helped me to be sufficiently 'in' and 'out' to *question* and *appreciate* cultural matters. This helped me to be enough 'in' to increasingly understand people's experiences. Furthermore, I speak 'Chilean' Spanish. This allowed me to forge relationships based on trust, for participants to feel comfortable enough to convey their experiences, including those exposing their vulnerabilities and of course to understand fully my participants' experiences. At the same time, I was also a bit 'out' because of my 'Dutchness': I look more Dutch than Chilean, speak fluent Chilean Spanish but a slight Dutch/ English accent is sometimes noticeable, and I lived most of my life outside of Chile. This distance allowed a different kind of reflection and opened up opportunities for information that otherwise, if I had been fully Chilean, would have been more difficult to attain.

This study included over 150 (formal) participants. This excludes individuals that contributed to this study in a more informal way or more indirectly. I was able to for instance observe and partake in various meetings. Because of the type of people involved in these meetings, they were very beneficial. So indirectly, these people provided me with important data for my study. In fact, since I was completely immersed in GC, almost every interaction was useful to the study. They contributed greatly to learning more about the dynamics and nature of the prevalent culture,

disaster subculture and people's vulnerability. All throughout this study, people and participants in particular were responsive to the research and keen to share their experiences and insights. They were, however, often surprised that someone was interested in what they had to say. Most interviews were individual semi-structured interviews. Fifteen percent, however, were more in-depth and prolonged interactions aimed at more thorough understanding of the context and the participants' experiences (see Fig. 2-1).

Overall, the pool of participants was varied. Most of the participants were from GC, but to get an idea of the geographical reach of for instance the disaster subculture that I explored there I also reached out to other regions (See Fig. 2-1). Furthermore, since the country is centralized to learn more about the state's role a visit to Santiago was necessary. Lastly, the majority of interviews were with community members. I was looking for their experiences. I complemented this with a number of interviews with professionals, scholars, policy- and emergency-oriented professionals, and participants from authoritative institutions (see Fig. 2-1). In addition, immersion led me to partake in various types of scholarly, policy-oriented, and professional meetings to observe, but also to share my observations as a researcher   and   professional.
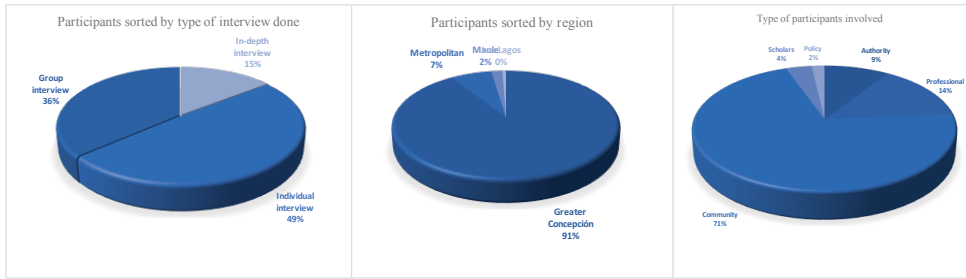
Figure 2-1 Interview and participant statistics

The strategies used for validating the findings were *triangulation, member checking and prolonged time in 'the field'*. The idea of triangulation is that the same themes come out of different sources. Member checking refers to taking the findings to the participants and see if they are accurate. Prolonged time in 'the field' allows

the researcher to get in-depth understanding of the phenomenon under study and lends credibility to the narrative account. The more experience the researcher has with the participants in their context, the more accurate or valid the findings will be (Cresswell, 2009).

The overall research process, like most qualitative studies, was emergent and flexible (Creswell, 2009, p.4). Because the experiences were central, it was difficult to define what I would study beforehand. In terms of setting, qualitative research prefers a natural one. Data was thus collected by me and 'in the field': "qualitative researchers seek to understand the context or setting of the participants through visiting this context and gathering information personally (Creswell, 2009, p.8 & 175). Data was collected through the examination of multiple qualitative resources. The primary sources would be interviewing and observation, but also document review, audio-visual sources and participation would be part of the study. In addition, I did not rely on questionnaires or instruments developed by other researchers and I tried to be mindful that my research is colored by my own experiences, background and historical and social perspective.

Since the aim was to learn more about people's experiences the interview questions were generally semi-structured and included mostly open-ended question. The idea was to let the participants lead the conversation and take me to wherever they felt I needed to be taken regarding certain topics. It would be up to me to keep the conversations 'on-topic', i.e. concerning matters relevant to vulnerability to earthquake/ tsunami events and 27F.

Data was recorded through field notes, interview notes, taped interviews, and video. Data sharing was done through peer-to-peer sharing because the raw data is context-dependent and can therefore not be transferred without any specific contextualization. Also, the data includes sensitive data which was promised to be kept confidential. They are personal accounts that lay bare vulnerabilities, not just societal, but also personal. The integrity of the data and especially these accounts

need to be protected. The ATLAS.ti software package was used to assist the data analysis.

Chapter 3: Conceptual guidance

Central to this work is the purpose to uncover, understand and describe the experienced *vulnerability* of communities in GC vis-à-vis earthquake/ tsunami events that 27F exposed. To do this increasing understanding of the concept of a number of concept is relevant, in particular vulnerability and resilience. This chapter will elaborate on these. First, however, some selected approaches to disasters are briefly discussed. What are disasters and what do they expose? Then I will elaborate on vulnerability and resilience and the approaches I aligned with and which inform the analysis of the cases and therefore shape the findings. I will also briefly discuss disaster risk reduction (DRR) because it comes back in the cases, but more importantly is necessary for answering the last research question. This will be done in the discussion in section 9.3.

3.1 Approaches to natural hazard induced disasters: are these disasters natural?

Three distinct traditions can be differentiated when it comes to studying disasters. One of the more dominant traditions is known as *the agent-specific approach* or *the hazard paradigm*. This approach is heavily influenced by the earth sciences, has a strong focus on hazards, and understands geophysical agents to be the source of disasters. Associated with this approach are Burton and Kates (1964) and Burton, Kates, and White (1978). The characteristics of the agent, such as magnitude, frequency and speed of onset, determine impact. From this perspective, societies are seen as passive victims whose responses are mere "reactions to, and at the mercy of, the natural environment" (McEntire, 2004). Disaster vulnerability is therefore considered the function of exposure to an external geophysical agent and human weakness. Its popularity seems to come from its ability to work with easily measurable proxies (McLaughlin & Dietz, 2008).

Another tradition considers disasters to be social phenomena. Allen Barton (1969) for instance saw disasters as collective stress situations that occur "when many members of a social system fail to receive expected conditions of life from the system" (Barton, 1969, p. 38). Similarly Quarantelli (2005) argued that disasters represent vulnerability and they thus reflect "weaknesses in social structures or social systems" (Quarantelli, 2005, p. 345) and Russel Dynes (1998, p. 13) defined disaster as "occasions when norms fail, causing a community to engage in extraordinary methods" (Rodriguez, Quarantelli, & Dynes,, 2007, kindle loc. 496). Normality tends to be referenced to underscore that vulnerability lies within social structures. Other scholars in this tradition are Uri Rosenthal (1998), Dennis Mileti (1999) and Arjen Boin (2005).

Since geophysical agents are the source of disasters, societal solutions should be aimed at controlling these. Examples are domesticating environmental wilderness through monitoring geophysical processes, controlling and containing geophysical agents, avoiding exposure through location choices, ensuring adequate construction of the built environment and planning for enhanced emergency operations (Hewitt, 1995; McEntire, 2004; Rodriguez et al., 2007, kindle loc. 446). The models that can support these interventions are generally geophysical, technological and (formal) organizational ones and the principal actors are administrative authorities, formally educated professionals and scientists. They are the clear-thinking actors with the right kind of knowledge and resources. Central to an effective response to a disaster is therefore that the populace listens to these actors and obeys their instructions.

Intrinsic to this frame is the nature/ culture dichotomy as well as an adversarial relationship between nature and culture. The human system finds itself in the middle of a hostile natural environment: "…nature is the cause, the condition, and the propelling force that damages, destroys, and kills" (Phillips, 2010, p. 7). Every time a hazard is activated, the dominance of this view is revealed. Media use imagery that reinforces the idea that natural forces continuously destroy human achievements and that human efforts can and should prevent or, at least, control attacks by external natural forces (See Fig. 3-1).
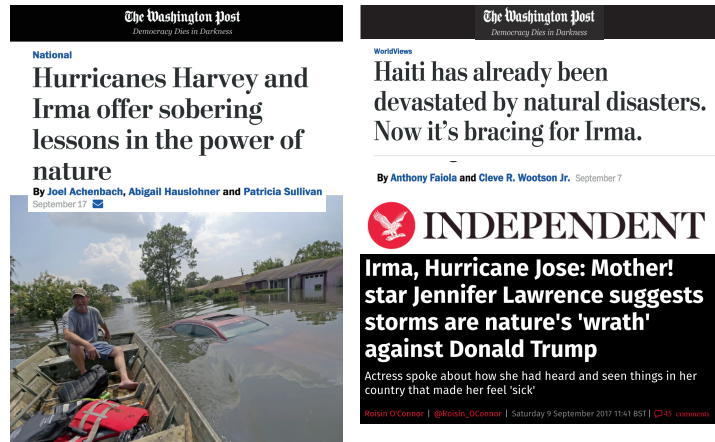
Figure 3-1 Headlines illustrating the agent-specific approach

This perception of disasters is in line with the Enlightenment ideas of human emancipation and self-realization as asserted by philosophers such as René Descartes and Francis Bacon. As Descartes claimed in his Discourse on Method, we can "render ourselves the lords and possessors of nature" (Descartes, 2003) by applying human reasoning. Nature is fallen, evil, violent and disorderly, i.e. one of the tyrannies from which the human realm, through reason, has to emancipate itself (Hoffman & Oliver-Smith, 2002, p. 31). Continuing this line of reasoning, we must conclude that nature is malleable and can be subjugated and brought into line with human purposes. An example of this approach can be found in the Dutch approach to flooding. Dealing with flooding in the Netherlands is equivalent to fighting the water; to 'taming' the water. The principal aim is thus to reduce the probability of a flood taking place to negligible levels through technological interventions like flood surge barriers, dykes and pumping stations.

The main critique of these agent-specific perspectives is their "neglect…[of] the social, economic and political factors that shape the finer mosaic of exposure to and impact from environmental threats" (McLaughlin & Dietz, 2008, p. 100) and the underlying processes (Adger, 1996; Cutter, 1996; Wisner, Blaikie, Cannon, & Davis, 2004; McLaughlin & Dietz 2008). It does not address the role individuals and communities play in producing vulnerability, livelihoods and coping strategies to deal with threats (Lambert, 1994) and people are subsequently conceptualized as passive bystanders or victims exposed to exogenous forces to society (Bankoff, Frerks, & Hilhorst, 2008; McLaughlin &Dietz, 2008). Furthermore, there is an overemphasis on the uniqueness of disastrous events thus neglecting routine social processes that produce and reproduce differential vulnerability between individuals and social groups (Hewitt, 1995; McLaughlin & Dietz 2008).

Critics of the agent-specific approach wanted to break with the technocratic attitudes that defined the relationships between human societies and their environments (Bankoff et al., 2008, p. 1). From their perspective, disasters are not purely physical occurrences requiring technological solutions. Instead they are seen as the result of human action or the 'actualization of social vulnerability' (Lewis, 1999, p. 8). This approach was labeled the *vulnerability approach*. Vulnerability is defined as "the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural disaster" (Wisner et al, 2004, p. 11). Central to this approach is the idea that "hazards might be natural, but disasters [are] not (Bankoff et al., 2008, p. 25)." In line with this, solutions are sought throughout society. As opposed to controlling natural hazards, endeavors aim to look at what in fact makes communities unsafe. This means however, that social changes have to take place for disasters to be prevented (McEntire, 2004).

This approach has become more and more prominent throughout the social sciences. It is accompanied by the "common belief that development and disasters

have an extremely close and complex relationship (McEntire, 2004)." Poverty can for instance move people to live in hazardous areas, occupy unsafe structures and work in dangerous occupations. Since societal factors are considered determinant for disaster impact, these are deemed key to any vulnerability related study. Lastly, time is an important dimension: "Disasters actualize vulnerability, but vulnerability is always in the making" (Frerks, Hilhorst, & Moreyra, 1999, p. 9). Over time, social processes produce disparate exposure to disaster risk. Some people are therefore more prone to experience disaster impact than others. Disparities are a function of societal power relations that shift and change (Bankoff et al., 2008, p. 2). Vulnerability is consequently not static but rather ever changing, dynamic and complex. It is a continuously emerging quality of complex social relations and processes. A central question this approach tries to answer is 'how do individuals and groups find themselves in vulnerable situations?'

Like the agent-specific approach, this approach encompasses a nature/ culture dichotomy. The focus is however more on culture because vulnerability is perceived to be largely determined by the human system, rather than the natural environment. Furthermore, the vulnerability paradigm distinguishes between voluntary and involuntary risk taking. A voluntary risk encompasses personal and group choices to take specific risks. Involuntary risks on the other hand come from social orders and actions that place people at risk or deprive them of defenses and resources to cope with the adverse effects of hazards they face (Hewitt, 1995).

It is important to note that 'vulnerability' within this approach is often also labeled *social vulnerability* because it stresses that the condition of a society determines whether a hazard will result in a disaster or not (Cannon, 1994, p. 13) and that this condition reflects the daily conditions of a society (Wisner & Luce, 1993; Gaillard, 2007). From this perspective, vulnerability is the function of a number of factors, namely demographic, social, cultural, economic and political factors, that interact in systemic and causal directions (Watts & Bohle, 1993; Wisner et al., 2004).

A central definition of social vulnerability is the one provided by Wisner et al. (2004, p.11): vulnerability refers to "the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of natural hazards." Even though this approach tries to move away from a focus on physical agents, it does take vulnerability to be determined by exposure.

When this approach was just developed, communities and their members were also considered victims whose fates were determined by the social order they were part of (Hewitt, 1995). The focus was on structure and agency was largely neglected. This has since been criticized and today agency is increasingly recognized and people are more often than not positioned as active, creative and alert: "People are not passive bystanders or victims. People have the capacity for self-protection and group action and this enables them to counter processes that generate vulnerability by people resisting, avoiding, adapting to those processes and to use their abilities for creating security, either before a disaster occurs or during its aftermath" (Wisner et al., 2004, p.14). This development has been accompanied by concepts like 'capacity' (Anderson & Woodrow, 1998; Cannon, Twigg, & Rowell, 2003; Wisner et al., 2004), 'resilience' (Timmerman, 1981; Walker, Holling, Carpetner, & Kinzig, 2004; Manyena et al., 2011) and adaptive capacity (Adger & Vincent, 2005; Adger, 2006; Folke, 2006). Scholars have repeatedly argued that "even the most downtrodden and impoverished persons are, and to live at all must be, active, intercommunicating, socialized and socially responsive beings…[that] have huge untapped abilities as well as a capacity to survive …" (Hewitt, 1995). This led to new definitions of vulnerability that included such concepts as sensitivity and resilience: Vulnerability is the function of "1) exposure--the degree to which a human group or ecosystem comes into contact with particular stresses, 2) sensitivity--the degree to which an exposure unit is affected by exposure to any set of stresses and 3) resilience--the ability of the exposure unit to resist or recover from the damage associated with the convergence of multiple stresses" (Clark et al., 2000, p.2).

In light of culture, the vulnerability approach has been more accommodating. As Hewitt (2015, kindle loc. 2746) notes, "[i]f it is mentioned, culture is often seen more as an impediment to understanding and effective action." The *biophysical perspective* tends to perceive culture more as a difficult uncontrollable aspect of reality rather than a key dimension for understanding matters of susceptibility and capacity. The vulnerability approach, however, embraces culture more actively. From this point of view, culture is considered to be one of the social structures from which vulnerability emerges and as such key to managing vulnerability (Dombrowsky, 1981; Oliver-Smith & Hoffman, 1999; Bankoff, 2003).

As will become clear in section 3.2 I align with the 'vulnerability approach', but like Clark et al. (2000) find it essential to ensure that agency is acknowledge and appreciated. People and communities are always actively accommodating to (natural) hazards in order to adjust to their environment and make sure they can take advantage of opportunities these environments encompass.

3.2 Vulnerability

As a concept, vulnerability has been used in many research traditions. Vulnerability comes from the Latin verb vulnerare ('to wound') and it is commonly used to refer to "being prone to or susceptible to damage or injury" (Wisner et al. 2004, p. 10). There are, however, a great variety of definitions (for an overview of definitions see Birkman, 2006). But like so many concepts, there is no consensus. Consistent throughout the literature is, though, that it is a
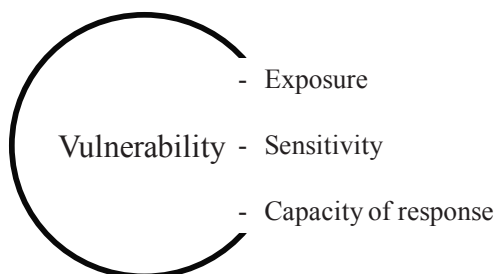
Vulnerability
- Exposure
- Sensitivity
- Capacity of response

Figure 3-2 Illustrating vulnerability and its properties

multidimensional issue (Clark et al., 2000: 2) involving exposure, sensitivity, and the ability or capacity of response (see Fig. 3-2). Central here is a conception of vulnerability that is in line with this one: *vulnerability as a system's potential for*

change or transformation (Gallopín, 2006), positive or negative, which emerges from a system's exposure, sensitivity and capacity of response.

Exposure

Exposure refers to the degree to which a system is in contact with particular perturbations (Clark et al. 2000; Gallopín, 2006). It is relational since it is an attribute of the relationship between the system and the perturbations at hand. In this sense, it is more an 'external' component (Chambers, 1989). Communities in GC, for instance, are regularly confronted with telluric events of different magnitudes. It is this interface which is relevant when concerned with disaster risk (more on GC exposure in Box 3-1). Because of exposure's external nature, Gallopín (2006) argues for the externalization of exposure from vulnerability. Exposure is more "an attribute of the relationship between the system and the perturbation rather than of the system itself …[that] is revealed when the system is exposed to the perturbation (Gallopín, 2006, p. 296)." Even though I left exposure as an element of vulnerability, I agree with Gallopín that it could be useful to externalize it. Mostly because this would prevent one from considering just known disturbances when looking into matters of vulnerability. One would have one vulnerability map that would be used to discuss different scenarios and thus different forms of exposure (Gallopín, 2006, p. 297).

Box 3-1 Chile and Greater Concepcion geological information

Chile is located in the Pacific Ring of Fire at the intersection of three tectonic plates (the Nazca Plate, the South American Plate, and the Antarctic Plate) and is therefore extremely seismic with "a magnitude 7 every five years, and a magnitude 4 occurring five times a week (EERI, 2010, p.6)." In addition, because the fault between the Nazca and the South American Plate goes right along the Chilean coastline, earthquakes are frequently right off the coast of Chile and thus regularly trigger tsunamis. Tsunamis are not as frequent as earthquakes, but they are continual.

Since Gran Concepción is located along "the younger portion of the 5000km subduction zone, where the Nazca plate dives fast with a stronger coupling (tight sticking that causes strong friction between the two plates) with the overriding plate" (Aon, 2010, p.4), it is more often struck by strong earthquake/ tsunami events than other areas.

https://pubs.usgs.gov/gip/dynamic/fire.html

https://pubs.usgs.gov/gip/dynamic/slabs.html

Sensitivity

Exposure and sensitivity are often considered as one. While related, sensitivity refers to the degree to which exposure to disturbances affects the system at hand (Clark et al., 2000; Gallopín, 2006). Sensitivity can thus be evaluated on the basis of the amount of transformation that a system is subject to due to some disturbance. The actual transformation will be a function of vulnerability and the properties of the perturbation. Sensitivity is an 'internal' component of vulnerability and exists prior to a perturbation. Even though a system is sensitive, the degree of transformation can be limited through capacity of response.

Capacity of response

Capacity of response refers to a system's "capacity to adjust to a disturbance, moderate potential damage, take advantage of opportunities, and cope with the consequences of a transformation that occurs (Gallopín, 2006, p. 296)." Various authors prefer to distinguish between long and short term adjustments for resilience. Short term adjustments are for instance often labelled coping capacity (while more long-term adjustments are considered adaptive capacity or potentiality (Watts & Bohle, 1993).

Both sensitivity and capacity of response are embedded in complex social relations and processes. Such relations and processes render some people more vulnerable to disasters than others. A focus on the 'social' is also known as a focus on 'social vulnerability'. Such a perspective stresses that "[v]ulnerability is the outcome of socio-economic processes...[that] builds up gradually over time but varies immensely through rapid variations in economic, environmental or social conditions [...]" (Bankoff et al, 2008, p. 6). Wisner et al. (2004) developed an influential analytical model, the pressure and release model, that looks specifically into social vulnerability. Central to this model is the idea that "vulnerability is rooted in social processes and underlying causes which may ultimately be quite remote from the disaster event itself" (Wisner et al., 2004, p.50). The underlying causes are also referred to as root causes and entail limited access to power, structures and resources as well as the ideologies that affect political and economic systems. Because of these root causes are generally remote from the actual disaster they are not always appreciated enough.

Positive vulnerability

It is common to depict vulnerability in negative terms, such as Adger's (2006) definition: vulnerability as "the susceptibility to be harmed...[or] the degree to which a system is susceptible to and is unable to cope with adverse effects (Adger, 2006,

p. 269)." Gallopín (2006, p. 294), however, proposes a definition that opens up the possibility of viewing vulnerability also in a positive light, namely vulnerability as susceptibility to change: more specifically as "a potential for a change or transformation of the system when confronted with a perturbation…" This is a promising conception of vulnerability that opens up appreciation for transformability and innovation. Certain systems would benefit from transformations. Communities suffering chronic poverty would, for instance, benefit from systemic change leading to the eradication of poverty. Similarly, the collapse of an oppressive regime might also be worthwhile (Gallopín, 2006, p. 295). Bijker, Hommels, and Mesman (2014, kindle loc. 369-370) also argue for a more positive take on vulnerability as potential for change. They contend that vulnerability "goes hand in hand with openness to change and willingness to engage with the uncertainties that are associated with learning and innovating" (Bijker et al. 2014, kindle loc. 368) and that a certain degree of vulnerability is even "necessary to create space for learning and adaptation in a society (Bijker et al., 2014, kindle loc. 370). In other words, addressing vulnerability from this point of view "may yield a more flexible and resilient society than one that tries to avoid all vulnerabilities" (Bijker et al., 2014, kindle loc. 255-256). Throughout this work a similar approach is taken. Vulnerability is considered an emerging property of a system, a potential for change/ transformation and a function of that system's exposure, sensitivity and capacity of response. It exists prior to a disturbance (see Box 3-2 for elaboration on types of disturbances that can impinge on a system) and is related to past exposure to disturbances.

Box 3-2 Perturbations, stress, and stressors (Gallopín, 2006)

❖ Perturbations are spikes in pressure that go beyond the variability that a system is used to.

❖ Stress is a continuous or slowly increasing pressure that tends to remain within a system's normal range of variability.

❖ Stressors are the source of stress and can be internal (e.g., effect of a genetic disease on a person or of a civil war on a population), external (e.g., effect of a hurricane on a community) or both (e.g., effect of drought in a country with civil war), depending on the scale at which a system has been defined.

3.3 Resilience

Throughout this study, resilience is considered an attribute of vulnerability tightly linked to capacity of response. It is a systemic quality that manifests in the face of (unexpected or unpredictable) change and refers to a system's ability to absorb and adapt such change and maintain integrity (Walker et al. 2004). It reflects a system's ability to learn, self-organize, adapt, take advantage of opportunities, access resources, and maintain a degree of internal control over variability. The best measure is the magnitude of a disturbance it can sustain before changing structurally. For human systems, resilience emerges from collectivity (Engel & Engel, 2012). It represents more than the sum of its individual parts.

I have chosen to align myself with scholars that view resilience as a property: an ability that manifests itself at the moment of the impact but that was already there…it is a potential, revealed through the impact" (Reghezza-Zitt, Rufat, Djament-Tran, Le Blanc, & Lhomme, 2012, p. 4). Such a perspective makes prospective and preventive interventions possible: "if we think upstream of the crisis, we can seek

improving the resilience of a system in order to enable it anticipating disruptions, preparing and coping" (Reghezza-Zitt et al., 2012, p. 4). In light of vulnerability, there are three approaches to resilience that can be distinguished in the disaster literature: 1) resilience as the flipside of vulnerability (Folke et al., 2002) resilience as a process overlapping vulnerability (Norris et al., 2008) and 3) resilience an attribute of vulnerability (Gallopín, 2006). The idea that resilience is the flipside of vulnerability is troubling. First because it opens up the possibility of circular reasoning (Klein, Nichols, & Thomalla., 2003, p. 404): "a system is vulnerable because it is not resilient; it is not resilient because it is vulnerable." This does not mean that resilience is not related to vulnerability. They are, just not symmetrically (see Fig. 3-3 for an illustration of their relationship).
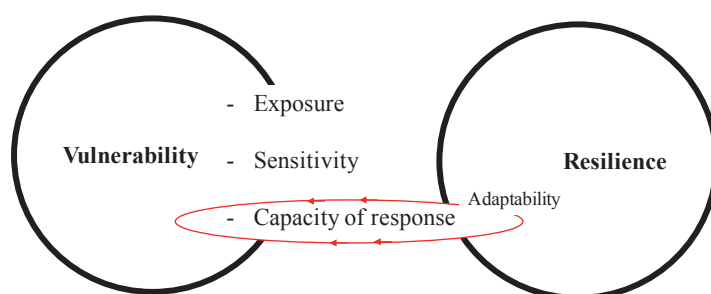
Figure 3-3 Illustrating the relationship that vulnerability and resilience share

As Gallopín (2006, p. 300) illustrates, the flipside of vulnerability would be more "the capacity to maintain the structure of the system against perturbations, even if its resilience is overcome" or robustness. A system would then be resistant. This debate concerning resilience and resistance is an important one. Those who would consider resilience the flipside of vulnerability tends to amalgamate resilience and resistance and consider them synonyms. Persistence encompasses then strength and stiffness (Reghezza-Zitt et al., 2012). This approach would consider resilience equal to insensitivity. Norris, Stenvens, Pfefferbaum, Wyche, & Pfefferbaum (2008,

p. 132) take this position and claim that resistance would be the ideal outcome of a resilience strategy since it would have meant that resources would have blocked the stressor and there would be virtually no dysfunction. A resistant system is, however, most likely low on resilience since it is exposure to perturbations that builds resilience. In a certain way, a system can be resilient because it is vulnerable; there can only be resilience if there is impact, disruption, which analytically means vulnerability (Reghezza-Zitt et al., 2012). This is why scholars like Gaillard (2007), Bankoff (2007), Mayunga (2007), Manyena (2006, 2012, 2014), Dynes (2005), Cutter, Burton, & Emrich (2010), Paton and Johnston (2001) and me, opt for an approach that appreciates resilience as an attribute of vulnerability: "resilience relies on a capacity to adapt and implies flexibility and plasticity where resistance implies opposition and stiffness" (Reghezza-Zitt et al., 2012, p.6). Central to this is human ingenuity and intelligence (more on this in Box 3-3).

This debate is linked with the resilience/ stability debate. Resilience from this point of view is the ability to return to equilibrium and is thus measured through the system's speed back to equilibrium. This is what is also known as 'engineering resilience'. Increasing stability however can lead to increasing sensitivity to even the smallest change (Gunderson & Holling, 2002, kindle loc. 1019). Such systems prefer sophisticated internal connections to ensure a future that is "more predictable and less driven by uncertain forces outside the control of the system" (Gunderson & Holling, 2002, kindle loc. 998). This leads to more internal regulation and control and more stability. This can, however, at the same time lead to rigidity and a loss of overall adaptive resilience. In other words, increasing resistance and stability can lead to increasing vulnerability to unexpected changes, i.e. to decreasing resilience. This is interesting because this suggests that successful resistance oriented approaches might lead to increasing vulnerability to unexpected shocks.

Against this background surviving in the face of hazardous and uncertain futures might require more collective learning from errors and experience in coping

with adversity than investments into increasingly controlled environments that enable stability and growth for a while but also seriously increase vulnerability to change (Douglas & Wildavsky, 1982, kindle loc. 2256). As Douglas and Wildavsky put it, "[w]hen the one sure thing is that we won't be able to predict important difficulties that the nation will face in the future, diversity and flexibility may be the best defences (1982, kindle loc 2269)."

This is why ecological resilience is more fitting and part of this work. Ecological resilience refers to adaptive resilience or a system that is able to maintain its function and essential structures through different states of stability. This is particularly interesting for human systems (see Box 3-3)

Box 3-3 People's potential for a higher level of self-organization

What is unique to human system's is people's ability to make sense and bestow meaning. This is very powerful as it allows a divorce from time and space. This facilitates a higher level of self-organization. In case of a disruptive event people can "consciously maintain the notion of integrity and identity while becoming disorganized at lower levels of self" (Gunderson and Holling, 2002, kindle loc. 2364). Interestingly, most structures that constrain and motivate people are their own productions. People tend to forget this, but unlike laws that govern biophysical systems, social laws for instance, are constructed and mutable.

Increasing instability would thus enable increasing resilience (Handmer & Dovers, 1992; Reghezza-Zitt et al., 2012; Gallopín, 2006). Such an approach departs from the desire to look for increasing stability and rigidity and embraces the reality that 'things change'—"things change—and to ignore or resist this change is to increase our vulnerability and forego emerging opportunities" (Walker & Salt, 2006, p. 209). As Dovers and Handmer already argued in 1992, it is important to part with the zero-risk 'mentality' that continues to govern day to day life in various western

countries: sustainability requires "abandoning the generally fruitless search for stable systems (which assumes high levels of information and system and subsystem control in the face of low levels of change), towards evolving resilient systems capable of adaptation (p.276)." Disasters cannot be prevented since hazardous events even those that are recurrent and we have proactively prepared for "will involve unexpected forms, magnitudes, or locations" (Zhou, Wan, & Jia, 2010, p. 22) that we most likely cannot resist and will require resilience. Also, a degree of vulnerability is essential if a system is supposed to learn, innovate and progress. Resilience, however, should be managed and adaptability is subsequently essential.

Resilience's popularity revisited

Over the past decade the concept 'resilience' has gained popularity. The United Nations (UN) 2030 agenda for sustainable development, for instance, seeks "to promote sustainable tourism, to tackle water scarcity and water pollution, to strengthen cooperation on desertification, dust storms, land degradation and drought and to promote resilience and disaster risk reduction" (UN, 2015, p. 9). 'Resilience' is not, however, a new concept and Alexander (2013, p. 2710) shows how "resilience (resiliency, resile) has a long history of multiple, interconnected meanings in art, literature, law, science and engineering." Most uses stay close to the Latin root 'resiliere', i.e. jumping back, and emphasize the capacity to 'bounce back', adapt to, cope, withstand, resist and recover from adversity (Bruneau et al., 2003; Aldunce, Beilin, Handmer, & Howden, 2014; Norris et al., 2008). Still, there is no agreed upon definition (for an overview of resilience definitions see Brand & Jax, 2007, Bahadur, Ibrahim, & Tanner, 2010, Norris et al., 2008, Aldunce et al., 2014)

The concept's strength is threefold. Firstly, it acknowledges that communities and their people are not passive bystanders. Secondly, it enables one to focus on potential for action instead of just potential for harm. This was a welcome change in light of the complexities encountered when trying to reduce vulnerability when root

causes are so entrenched and difficult to target (Sudmeier-Rieux, 2014). Thirdly, its "semantic ability to represent a readily recognizable concept" (Bahadur et al., 2010, p.4) has been a binding force (Sudmeier-Rieux, 2014). It has made it possible for different scientific disciplines and communities of practice to work across silos by providing a common analytical approach. In this sense, 'resilience' is a 'boundary object' or a scientific object that is malleable enough to be used across disciplinary borders, but robust enough to maintain a common identity across sites (Brand & Jax, 2007). The beauty of boundary objects for academic and policy sectors is their malleability because this is what makes bridging gaps between for instance science and policy possible and what makes them effective communication tools.

Caution is needed though, as the use and meaning of boundary objects can become so ambiguous that the concept at hand can lose its structure. Regarding 'resilience' Brand and Jax (2007) point out that the blending of descriptive and normative aspects of resilience is becoming problematic. For instance, resilience is being pursued as a good in itself. The question is, should it be perceived as such when it has repeatedly been stressed that 'resilience' is "not an ideal in itself " (Gunderson & Holling, 2002, kindle loc. 755-756). Resilience is about maintaining a system. But what if the system needs fundamental changing? Then resilience can be a major impediment: "resilience may be important to support and maintain systems in a desirable state, [but] it may also maintain a system in an undesirable state, making recovery or transformation difficult (Weichselgartner & Kelman, 2015, p. 253)". This is what Mitchell and Harris (2012, p. 5) have dubbed the 'dark side of resilience'. As Klein et al. (2003, p. 41) already remarked over a decade ago, "there is an unrelenting devotion to using the concept and an unquestioning, almost naïve acceptance that resilience is good and must be promoted, irrespective of the potential risks to society." For some this points at the pursuit of a specific, possibly undesirable, agenda that promotes the status-quo or the implementation of a political project aimed to serve just a few. As Reghezza-Zitt et al. (2012, p. 16) argue,

"in promoting a 'bouncing-back' [strategy], leaders favor a social and political status quo; in presenting the crisis as an 'opportunity to improve things', they make use of a powerful legitimating instrument for their choices and actions." It is key that we recognize that 'resilience' can also be 'bad' when it brings back those things that were flawed or harmful and allowed for a disaster to occur in the first place. It is imperative to remain critical, especially when a concept has become the new buzz-word. Some additional 'words of caution' that I consider relevant are presented in Box 3-4.

Box 3-4 A word of caution about resilience

Here I would like to address the fear that an interest in system resilience diverts attention from the root causes of gross vulnerability realities (Frerks, Warner, & Weijs, 2011). I do not believe this is the case. Resilience provides a conceptual lens to look at multi-tiered system responses. Resilience emerges and manifests itself in response to stress. Appraising resilience should thus involve an analysis of the mechanisms that underlie it at different levels. Just like one would look for causal structures of vulnerability or root causes, studies should be aimed at investigating the causal structures of resilience. To do this, however, it is important to beware of a normative approach to resilience.

Also, resilience should not be seen as an argument to maintain these or a political tool for the achievement of elite political objectives. Neither should it be seen as a way to dissolve government's responsibility to ensure communities' wellbeing in the midst of hazardous events. As Mascarenhas and Wisner (Wisner, Gaillard, & Kelman, 2012, kindle loc. 1909-1918) puts forward, "[t]here are still functions that governments are expected to carry out as a matter of international norms and popular perceptions of legitimacy". Governments have relevant resources and a responsibility because they tax and raise revenues from their citizens. States might be less powerful and omnipotent than a few decades ago,

but they are still central players because of their control of critical resources: "the most effective forms of governance require both social networks and a strong state" (Pierre & Peters, 2005, p. 2).

Adaptability

More and more communities inhabit inherently hazardous environments because of the opportunities they bring. Coasts and rivers are great for fishing and farming, while valley and volcanic soils are fertile (World Bank, 2014, p. 8). This means, however, dealing with hazards. Research has shown that communities do this with different levels of success (Anderson, 1965; Anderson, 1968; Schneider, 1957; Bankoff, 2013; Engel et al., 2014) and as Oliver-Smith (1996) points out, disasters tend to expose how successful a society has been at adapting: "disasters signal the failure of a society to adapt successfully to certain features of its natural and socially constructed environment in a sustainable fashion" (Oliver-Smith, 1996, p. 303). As Box 3-5 reveals, adapting is not the same as adaptness or adaptability.

Box 3-5 Adaptness vs adaptability (Gallopín 2006, p. 300)

Adaptness and adaptability are not the same. Adaptness is a state of being adapted while adaptation is a capability necessary to achieve adaptness. A species might be highly adapted to a stable environment, but have little capacity to adapt to others or changes in its environment. What is specific to human systems is that they can become better adapted by improving their condition in their environment through learning and technological progress.

Natural hazards thus remain important tests to communities' limits, ingenuity, and "the adaptive resilience of a community within its total environment" (Oliver-Smith & Hoffman, 1999, p. 17). But "[p]eople's adaptive capabilities have made it

possible not only to persist passively, but to create and innovate when limits are reached" (Gunderson & Holling, 2002, kindle loc. 451).

This is what is referred to as adaptability. Adaptability is the capacity of a community's members to influence and manage their community's resilience and "can be defined as the capacity of any human system from the individual to humankind to increase (or at least maintain) the quality of life of its individual members in a given environment or range of environments" (Gallopín, 2006, p. 300). It lies with a communities' members and is largely the function of people's sense-making ability, intelligence and creativity. It is for instance intelligence that allows people to go beyond copying objects of the environment and "take...account of the way in which more effective and more profitable relations with these objects may be established in the future" (Hickman, 2001, p. 55). Similarly, it is our creativity that enables the reordering of existing elements and the achieving of novel solutions to problems that were previously unforeseen (Kendra & Wachtendorf, 2002, p. 2). Sometimes, however, transformability is required. See Box 3-6 for more on transformability.

Box 3-6 Transformability

When a system is untenable transformability or "the capacity to create a fundamentally new system…to create untried beginnings from which to evolve a new way of living" (Walker et al., 2004, p. 3) becomes relevant. This is easier said than done. New variables need to be actively introduced or allowed to emerge and the results and effects are unknown.

Appraising resilience

Depending on a community's choices different forms of resilience emerge. Dovers and Handmer (1992, p. 270) identified three: resilience through resistance and maintenance (form 1), resilience through change at the margins (form 2) and resilience through openness and adaptability (form 3). Form 1 emerged from mechanics in 1958 and has since then been a very common approach to resilience. In fact, it is considered the basis for the modern use of the term 'resilience' in civil protection (Alexander, 2013, p. 270). Central to this 'resistance' approach are fail-safe designs and optimal performance and appraisals tend to look at a community's "resistance to disturbance and speed of return to the equilibrium" (Gunderson & Holling, 2002, kindle loc. 653). The Dutch approach to dealing with coastal flooding is an example of such an approach. Since 1952 the aim of the Dutch government is to never again be affected by a flood disaster. To realize this, they have invested in substantial engineered solutions: 'the Waterwolf' would be defeated through a fail-safe design and optimal performance of complex technical systems (Chapter 5 is dedicated to the way the Dutch and in particular two communities dealing with recurrent risk of riverine flooding have adapted to deal adequately deal with flooding). This type of resilience is generally measured by a community's ability to resist disturbances and their ability to quickly return to an equilibrium (Gunderson & Holling, 2002, kindle loc. 653). According to Walker et al. (2004) this form of resilience is most appropriate for systems with low uncertainty and can in fact be counterproductive for complex adaptive systems, such as communities, that do not change in a predictable, linear, incremental fashion: "We are all part of linked systems of humans and nature...these systems are complex adaptive systems...a traditional command-and-control approach to managing resources usually fails to acknowledge the limits to predictability inherent in a complex adaptive system" (Walker & Salt, 2006, kindle loc. 222). As a result, complex adaptive systems would benefit more from form 3 type approaches to resilience that embrace variability.

Evaluating resilience from this point of view would require determining the magnitude of disturbance that a community can absorb before losing its integrity and changing systemically.

Since resilience is a potential that manifests in times of stress and is related to a system's response and damage, Bellingham et al. (1995) came up with a scheme that can be used to look at resilience post-event. I found this scheme to be practical and have therefore applied it to my cases in GC. Two of these post-event resilience analyses are presented in Chapter 7.

3.4   Disaster Risk Reduction

Disaster subcultural elements are manifestations of adaptability. They are adaptations communities have made to cope with recurrent hazards and accommodate in the environment they inhabit. Adaptability, i.e. managing resilience, is very specific to human systems and involves creativity and intelligence. What is also specific to human systems is the ability to be both reactive and *proactive*. Adaptability thus involves both coping with contingences and improving conditions. This study looks specifically at DRR. The reason why DRR is considered is because it is a technology that is specifically aimed at dealing with recurrent hazards. Throughout the study I tried to be attentive to ways that DRR efforts could be supported with my findings. In the discussion, some recommendations derived from this study are presented as research question 1.5 is discussed.

Risk is a curious concept. As Cardona (2003, p. 47) argues, "[i]t represents something unreal, related to random chance and possibility, with something that still has not happened. It is imaginary, difficult to grasp and can never exist in the present only in the future. If there is certainty, there is no risk". While the 20th century has been characterized by a focus on the probable negative outcomes of events, the 17the century defined risk as "the probability of an event occurring, combined with an accounting for the losses and gains that the event would represent if it came to

pass". In the 19th century, risk referred to the opportunity cost for the creation of wealth. The dominant ethos of the time was reflected in the proverb 'nothing ventured, nothing gained' (Dake, 1992, p. 22). Throughout this study, the 17th century definition of risk will be leading. This is in line with the vulnerability approach that is leading and that enables both a positive and negative interpretations of vulnerability. This is useful if we want to get over the 'zero risk' logic. Life is full of risk. Zero risk is impossible and seeking it will be futile. More importantly, risk and vulnerability test our ingenuity and creativity and make adaptation, innovation and ultimately progress possible.

Disaster risk is on the rise. Not because there are more hazardous events, but because of more exposed communities. Disaster risk refers to the probability of a disaster taking place. It is essentially a function of the probability of a hazard affecting a system adversely and the degree and nature of the vulnerability of the system at hand: "[h]azard and vulnerability are mutually conditioning situations and neither can exist on its own" (Cardona, 2003, p. 38). Disaster risks are not new, but what has changed are the origins and sources of risk and the degree to which disaster risk is accepted. In my Chilean cases, for instance, the past decades have seen increasing exposure as tsunami-exposed lands are more and more being used for residential purposes. This clearly increases disaster risk.

Worldwide it has been agreed upon that disaster risk should be reduced and disaster risk reduction (DRR) has become a global priority. Its importance is underscored by the establishment in 1999 of the United Nations International Strategy for Disaster Reduction (UNISDR), a dedicated secretariat mandated to facilitate the implementation of the International Strategy for Disaster Reduction (ISDR). Three World Conferences on Disaster Risk Reduction have been held and each resulted in a new strategy towards increasing disaster risk reduction (See Table 3-1 for overview conferences and strategies).

Table 3-1 Disaster risk reduction conferences held and strategies agreed upon

Year, Place	Strategy
1994, Yokohama	Yokohama Strategy for a Safer World
2005, Kobe	Hyogo Framework for Action
2015, Sendai	Sendai Framework for Action

The first in 1994 resulted in the Yokohama Strategy for a Safer World. The second one was in Kobe and resulted in the Hyogo Framework for Action (Box 3-7). The third conference was in Sendai in 2015 and resulted in the Sendai Framework for Disaster Risk Reduction 2015-2030. Even though most attention goes to catastrophic disasters, "[a]ccumulated losses from small-scale, highly frequent and localized disasters are similar in magnitude to those of major catastrophes" and these subsequently need as much attention. This is particularly the case in low and middle-income countries (Surjan, Kudo, & Uitto, 2016, p. 40).

Box 3-7 The Hyogo Framework for Action (HFA) and the Sendai Framework for Disaster Risk Reduction

To systematize and assist DRR efforts, the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters (HFA) was launched. This was the first plan outlining what is required from different sectors and actors to reduce disaster losses. In 2015 it was succeeded by The Sendai Framework for Disaster Risk Reduction.

While DRR is a policy objective, disaster risk management (DRM) encompasses the processes that should realize this objective (see Fig. 3-4). Even though DRR and DRM are often used interchangeably, I believe clarity is enhanced when this distinction is made. Throughout this volume DRR will refer to the policy objective and DRM to the processes aiming to attain this objective. DRM will mostly come back in the Chapter 9 when research question 1.5 is answered.
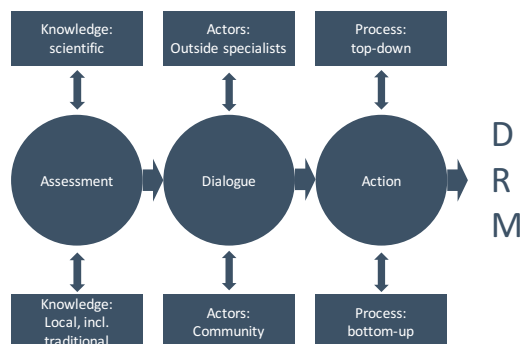
Figure 3-4 Integrated disaster risk reduction framework (Wisner et al., 2012, kindle loc. 842)

Wisner et al. (2012) defined DRM as "the process of understanding, analyzing and managing the causes and origins of disasters and the risks that accumulate and lead to disasters" (Wisner et al., 2012, kindle Loc. 839). Because of the advancement in scientific and technological know-how it has become possible to systematically study hazards. Vulnerability however is much more dynamic and therefore difficult to comprehend and address (Surjan et al., 2016, p.38). The following activities belong to DRM (Greve, 2016, p. 14):

1. Prevention—mechanisms aimed at avoiding existing and new disaster risks. An example is the relocation of people and assets away from a hazardous area. While such measures are considered less costly than dealing with disasters, they are not always plausible and thus when implemented not always successful.

2. Mitigation—Limiting adverse impact of hazard induced events through structural mechanisms such as flood defenses, and strict land use and building codes.

3. Transfer—Formal or informal shifts of financial impact of a hazard-induced event from one party to another whereby the affected actor gets resources from another party after the disaster has taken place, in exchange for ongoing or compensatory social or financial benefits provided to that other party (Preventionweb, 2018). An example is insurance.

4. Preparedness—Knowledge and capacities of governmental, professional and community actors to effectively anticipate, respond to, and recover from the impact of hazard-induced events or conditions. Examples are early warning systems, evacuation routes, emergency management mechanisms, disaster governance, etc. But also 'livelihood' or the command of relevant actors over resources that can be used or exchanged to address needs (Wisner et al., 2004, p. 12). Central to preparedness are efforts aimed at capacity building and ensuring responsible governance to ensure communities are able to minimize or absorb adverse hazard-induced impact.

Disaster (or emergency) management refers to the processes aimed at ensuring an appropriate, efficient and timely response and recovery following a disaster (Carreño, Cardona, & Barbat, 2007). Effectiveness depends on the degree of preparation of the responsible institutions, whether formal or informal, and implies adequate organizational abilities, capacity and plans to address disaster impact (Carreño et al., 2007). Mitigating efforts that reduce the probability of a hazard resulting in a disaster are considered part of DRM rather than DM. Governance is an important dimension of DRM. More on this can be found in Box 3-8.

Box 3-8 Governance

Governance is noteworthy in light of this study because 1) it is part of current academic and political debate whether governance models should be altered to ensure greater community capacity to deal with hazards, 2) the cases are founded on a neo-liberal political model that is influencing more and more DRM governance models in the world, and 3) because governance is also a technology that can enable but also hinder (immediate and long-term) capacity of response.

Regarding disasters, governance the following questions are relevant: who should do what? What is the role of the government and to what extent should tasks and responsibilities lie with community actors and/ or individual citizens. It has been widely documented that local residents are the real 'first responders', but does this mean that the government has no responsibility there? Some scholars argue for instance, that governments are using notions like 'resilience' or 'self-sufficiency' to limit their own responsibilities in light of DRR (Frerks et al., 2011). As Mascarenhas and Wisner (Wisner et al., 2012, kindle loc. 1909-1918) puts forward, "[t]here are still functions that governments are expected to carry out as a matter of international norms and popular perceptions of legitimacy". Mascarenhas and Wisner argue, governments have relevant resources and a responsibility because they tax and raise revenues from their citizens. A part of that should go to reducing disaster risk. Does this happen? Does decentralization, as part of good governance, mean that resources flow down from the center at the same rate as mandates and responsibilities (Wisner et al., 2012, kindle loc. 1909-1918)?

Governance is also highlighted because of the neo-liberal governance model shaped by the constitution that Pinochet put in place in 1980 in Chile (Arana, 2016) that shapes the cases and because one of the major criticisms of the resilience approach is its co-option into a neoliberal governmentality. According to Welsh (2014, p. 19) for instance, resilience discourses are "situated in, and help

reproduce, broader neoliberal practices of security that shift from state-based to society-based conceptions of distributed risk and reaction". In Chapter 6 my findings regarding the neoliberal system and its effect on vulnerability of some households are discussed in more detail. The overall finding regarding this criticism will however be receiving more attention in the discussion. The questions are: Is resilience nothing more than a neo-liberal agenda? Is resilience promoted by a skeletal government? Should resilience be discarded because it is co-opted by neo-liberal agendas?

Chapter 4:   A cultural perspective

Disasters are "symptomatic of the condition of a society's total adaptational strategy within its social, economic, modified, and built environments" (Oliver-Smith, 1999, p. 25). They reveal the success of a people's adaptation to their environment, including the (natural) hazards embedded in these. Adaptation refers to the different strategies individual, communities and societies develop and opt for to cope with the conditions of their environment and prosper. Against this background I follow Oliver-Smith (1999, p. 25), that "[t]he sociocultural system is … the primary means by which a human population adjusts to its environment" and placing this system in the spotlight will enable one to learn more about the vulnerabilities that made 27F possible. There is just one amendment to this argument that I would like to make and that is to add 'technological culture' into the mix. Not 'technological culture' as is often used to refer to public understanding of science or 'technical literacy' but rather as the representation of one of this work's underlying assumption that "[t]oday's societies are thoroughly technological, and all technologies are pervasively cultural" (Bijker, 2009, p. 607). Similarly Van Loon (2002) points out that 'technological culture' "[…] highlight[s] that the modes of inhabitation and signification (culture) that make up our world are technologically mediated" (p. 9).

When it comes to disaster vulnerability, it is still too often conceptualized from either a social or technical system's perspective, or at most a combination of both. This, however, does not do justice to the pervasive effects both systems have on each other: [c]ultures are technological cultures because technology plays a crucial role in constituting them" (Bijker, 2006, p. 2). Technologies are not just used; they actively shape our societies as well. Take a technological malfunction for instance. One simple technical failure can have extensive impact on the functioning of society. The power outage in the Amsterdam region of January 19, 2017, for instance. People function based on the assumption that there will be electricity to facilitate their lives. When, however, this is not the case, chaos ensues and damage is significant. In light

of this I agree that culture is not an exclusively human achievement (Van Loon, 2002). The cases presented in this book, particularly in Chapters 5 and 7, reveal how mechanisms fostered to control the environment, can in time come to shape people's circumstance in a not always foreseen or desirable ways. Cultures emerge from a space where the human, technological, and the 'natural' converge.

4.1 The 'technological culture' perspective

Means for adaptation are embedded in socio-technological-cultural systems. When it comes to technology I do not refer to technological artifacts or systems. Instead I mean "[t]echnology in its most robust sense [that] involves the invention, development and cognitive deployment of tools and other artifacts, brought to bear on raw materials and intermediate stock parts, with a view to the resolution of perceived problems" (Hickman, 2001, p. 12). It is technology that "establishes and maintains the stable technical platforms—habitualized tools, artifacts, and skills—that allow us to continue to function and flourish (Hickman, 2001, p. 12)" and adapt to often hazardous environments (see Box 4-1).

Box 4-1 Technological artefacts, tools and techniques

Technology vs technical artefacts and tools

Technology is often used to refer to tangible artifacts or tools, such as computers or cars. While such artifacts and tool have emerged from technological processes to which technology was central, they are artifacts or tools that at the stage they are at require little to no inquisitive activities.

Intangible techniques

Artifacts, tools and techniques can be both tangible and intangible. Ellul (1967) shows, for instance, that organization is "technique applied to social, economic, or administrative life [1976.] "Organization is the process which consists in assigning appropriate tasks to individuals or to groups so as to attain, in an

efficient and economic way, and by the coordination and combination of all their activities, the objectives agreed upon (Sheldon cited by Ellul, 1967, p. 11)." This leads to the standardization and the rationalization of economic and administrative life (Ellul, 1967). The skill of using internet or pi is also less tangible than for instance a mallet or chisel.

These stable platforms make up our cultures, or rather our technological cultures, and are powered by technology. So strictly speaking adding technological to culture is not even necessary because cultures are intrinsically technological. But, to remind the reader that this work is based on the idea that technology drives culture and cultural systems are thoroughly technological the concept 'technological culture' will be central to this cultural approach (see Box 4-2).

Box 4-2 'Technological Culture': Technology powering cultural production

Cultures emerge over time from social processes. These processes are intrinsically technological because they are *cognitive*, essentially *problem-solving,* and directed at finding opportunities through innovative uses of the available plethora of tangible and intangible techniques, tools and artifacts *for community-relevant-problems.* Similarly technological development is essentially social: "[r]elevant social groups are carriers of that process" (Bijker, 1995, p. 48).

The stable platform that technological culture provides is important because it grounds action on a reliable foundation. If every daily activity would entail cognitive and innovative action, life would be exhaustive and in fact rather unproductive. To make this point I would like to refer to the parable cited by Koestler (1968, p. 205) and Engel (1997, p.1): 'When the centipede was asked in which order he moved his hundred legs, he became paralyzed and starved to death because he had never thought of it before and had left his legs to look after themselves.' The centipede

had depended on habitualized action or practices to live. As soon as it started cognitively engaging, life became more complicated. For cultures, this is similar. To live collectively and have room to engage with novel problems, a reliable base is necessary. Chapter 6 in particular illustrates this. Earthquakes are such recurrent phenomena for the communities studied that over time stable platforms of technologies have emerged that allow them to live life undisturbed despite the continuous telluric movement. But even when more extraordinary quakes are felt, cultural means are there to turn to and provide a certain kind of 'stability' that enables people to respond fittingly and communities to respond resiliently. The latter, resilient communities, is discussed mostly in Chapter 7.

It is important to note that environments, circumstances and values change. This means that over time the plethora of tools and artifacts that technological cultures provide can become inadequate or insufficient. When this happens, technology is turned to in order to secure new techniques, tools or artifacts and restore equilibrium: "[t]echniques are part of the equilibrium that makes life orderly and predictable...[t]hey are the stable platforms on which we live our lives. But it is technology that we use to tune up and renew our techniques" (Hickman, 2001, p. 12). Through technology we "alter environing conditions [...] to accommodate ourselves to those conditions" (Hickman, 2001, p. 46)—we adapt. Fundamental to this is intelligence and creativity. It is our intelligence that allows us to go beyond copying objects of the environment but rather allows us to "take...account of the way in which more effective and more profitable relations with these objects may be established in the future" (Hickman, 2001, p. 55). But aside from that it is our ability to be creative that allows us to reorder existing elements and find novel solutions to problems that were previously unforeseen (Kendra & Wachtendorf, 2002, p. 2). In fact, creativity drives innovation. As Engel and Engel (2012) underline, "an 'innovation' is very often not 'new', in the sense of not known, but in fact involves a different way of combining, i.e. making sense of, already known components…" (p.

138). Taking the technological culture perspective allows appreciation hereof. In fact, doing this study allowed me to identify and document numerous instances where creativity and intelligence converge into means to ensure survival and progress in the face of a persistent threat.

But specifically, what do you see when you apply this 'technological culture' lens? First, one will see cultures as lively collections of continuously networking (human and non-human) components, instead of collections of idle human commodities. It will become apparent that even though humans and technologies are not the same, they affect each other and understanding the effects will provide novel insights. Throughout the cases, one will see how assemblages of knowledge and capacities can enable people to survive powerful tsunami events and how hierarchical (see Chapter 6) and complex sociotechnical warning systems act debilitating and place people in harms way when it comes to rapid onset hazards (see Chapters 6, 7, and 8). Secondly, this lens sheds light on communities' creativity, intelligence and ability to learn and innovate to secure adaptation in a changing environment. Chapters 4 and 5 provide rich pictures of the technologies that have emerged over time for these communities to cope with recurrent hazards. By applying the technological culture lens it is possible to recognize how intelligence, creativity, and ability to collectively problem-solve allow communities to adapt. How successful culture are, varies, however. This is where power comes in. The idea is sometimes presented that the selection of innovations is a neatly, transparent and fair process. Maybe even a 'natural selection'. This is not the case. For instance, innovations in a particular field often occur within a community of practice. Such communities of practice can be protective of their status-quo and hamper real innovations and subsequent change to come about. Or they can force changes that are not necessarily desirable. In Chapter 4, for instance, the Dutch water management sector enforces important changes to the flood management system of two small communities that could have far-reaching consequences. Similarly,

Chapter 6 reveals how the top-down inclusion of an internationally renowned socio-technical warning system malfunctioned and led to numerous deaths because it was improperly incorporated into the prevailing technological culture.

Box 4-3 Stabilization and standardization

Technological processes are social processes in that people determine largely how they unfold. Part of this process is obtaining an end-result. This is what is known as closure and stabilization and which leads to standardization. The phase of the process is power-play. Groups compete and one wins. It does not however have to be the end. As one process closes, another one can be triggered, lead to another group's triumph and the adoption of another technological product.

The importance of closing processes is stabilization and 'standardization'. Because this is when problems are resolved so that at the time of utilization the use of cognition is limited to non-existent.

Which innovation stabilizes (see Box 4-3 for more on stabilization and standardization of techniques and tools) depends on social processes and the relevant actors that govern those processes. As Bijker (1995, p. 270) stresses, "machines 'work' because they have been accepted by relevant social groups." 'Machines' can be replaced by any system, tool, artifact, technique, etc. If relevant people do not accept something, even if it is considered the solution to all their problems, it will not work—it will fail. This is what will be illustrated also in Chapter 6, but discussed more in detail in the discussion chapters. This takes us to the third opportunity that this lens brings, and that is to determine 'relevant actors' and strengths and weaknesses of technological cultures that these actors allow.

4.2 Disaster subculture: narrowing the lens

Cultures are characterized by an internal heterogeneity, i.e. the existence of different subcultures. Subcultures emerge when a specific issue(s) of a group of people cannot be satisfactory resolved by the wider established culture (Cohen & Short, 1958; Bankoff, 2003; Gelder, 2005; Gaillard et al., 2008; Bankoff, 2013; Engel et al., 2014; Krüger et al., 2015; Bankoff, 2015): when "individuals sense in one another like needs, generated by like circumstances, not shared generally in the larger social system" (Gelder, 2005, p. 54) they will come together and restructure, re-create and modify their culture to address their like needs. An important concern that has moved communities to 'problem-solve' has been recurrent natural hazards, such as floods (Engel et al., 2014), earthquakes (Marín et al., 2010) or tsunamis (Gaillard et al., 2008). Because different localities, even within a nation, face different hazards and different communities hold different values, different communities require different subcultures: the "wider cultures that cover larger geographical areas […] are generally unable to provide all its members with an exhaustive assortment of appropriate hazard-related solutions" (Engel et al., 2014, p. 826). Also, hazards do not strike every day. As a result "most readily available solutions and habitual modes of actions that the wider culture contains, are often insufficient, and unique adaptations of the 'common' are required" (Engel et al. 2014, p. 863). Such shortcomings push communities experiencing recurrent disasters to develop cultural elements that allow them to effectively deal with future adverse events and reduce the disaster risk that they pose to them. Subcultures that emerge from recurrent hazard-induced disaster experiences are also known as disaster subcultures.

Even though some might argue that disaster subcultures are blueprints for behavior, I do not. I agree with Fine and Kleinman who stress that "culture usage consists of chosen behaviors" (1979, p. 12). In other words, people possess agency to change or renegotiate their behavior in the face of subcultures and thereby redefine the subculture itself. However, while change is necessary and possible,

culture and subcultures do provide stability: they provide a platform of socially accepted solutions and reduce the need to continuously cognitively deal with recurrent challenges, i.e. a *platform of techniques, tools, tangible and intangible, and artifacts that is engendered and improved over time to ensure coping with a recurrent hazard and subsequently survive, prosper and grow within one's inherently hazardous environment.* Box 4-4 provides more insights into the technological dimensions of DsCs. Particularly in time of disasters, having such an established platform enables people to cognitively engage with more pressing emerging concerns. Central to disaster subcultures is learning. Communities are able to preserve lessons from previous experience have disaster subcultures.

The first scholar to put forward 'disaster subcultures' was Moore (1964). He used it to refer to "those adjustments, actual and potential, social, psychological and physical, which are used by residents of [hazardous] areas in their efforts to cope with disasters which have struck or which tradition indicates may strike in the future (Moore, 1964, p. 195). Since then however, various scholars, such as Anderson (1965), Wenger and Weller (1972, 1973), Wenger (1978), Turner (1982), Granot (1996), Engel et al. (2014), and Bankoff (2015) have utilized the concept. The most elaborate conceptual framework is by Wenger and Weller (1972, 1973) which they elaborated on the basis of literature studies of disasters, mainly in the United States. They firstly argued that for a disaster subculture to emerge three conditions should be met: 1) a community is faced and acknowledges a recurrent threat, 2) the focal agent allows for a forewarning and 3) the impact of the focal agent is salient to different segments of the community at hand (Wenger & Weller 1972). According to Turner's (1982) research into southern California's earthquake disaster subculture, it is not necessary to have periods of forewarning for a community to develop a disaster subculture (p. 208). Then to describe the disaster subculture, they identified subcultural themes:

❖ Valuative elements: What is important and worthwhile?

❖ Normative elements: What is desirable behavior?

❖ Beliefs: What are tenets regarding the focal agents and its possible impact and what are resulting attitudes.

❖ Knowledge: What do people know of the focal agents and its possible impact? Do people know warning cues?

❖ Technology: Have communities developed complex technical artifacts that facilitate their survival in light of the focal agent? For instance, are there sophisticated methods of detection and warning.

❖ Patterns for intra- and inter-organizational response: Are their predetermined forms of joint response within the community and between the community and outside actors, such as for instance outside experts?

❖ Socialization mechanisms: Are there forms of enabling community members and new community members to become part of the disaster subculture?

Aside from identifying elements to describe disaster subcultures, they also identified dimensions along which different subcultures could be compared. First, is a disaster subculture manifest or latent. Are its elements visible on a daily basis, even for strangers, or do they only surface in times of disasters? The second dimensions regards the degree to which the themes 'apply en masse to individuals as contrasted to their more specialized application to the community's organization' (Wenger & Weller, 1973, p. 3). This dimension is also referred to as the individual-organizational dimension and allows comparison between more organized or more individualized disaster subculture. The third dimension is the instrumental/ expressive dimension which enables comparison of disaster subcultures that are more focused on instrumental elements such as 'those normative, technological, valuative, knowledge and resource components that are related to preventing, predicting, controlling and

responding to the physical impact of the disaster agent' rather than the more expressive elements like values, beliefs, legends and myths (Wenger & Weller, 1972, p. 4). The fourth and last dimension is the narrow/ broad scope dimension. Is the disaster subculture limited to a small-scale community on a flood plain or is it broader in scope and does it include various neighborhoods and both formal and informal organizations?

The more developed the disaster subculture, the more normalized are the elements and the more space is opened up to deal with emerging issues. The problem is however, that normalization can also lead to dismissal of hazards as threats and lack of awareness which can in turn lead to decreasing preparedness and responsible responses in case a hazard risk materializes.

Box 4-4 The pervasiveness of technological systems in cultural ones

Technological systems are often considered *the* solution to natural hazard related 'problems'. For instance, seismic sensor systems, tsunami warning systems, building codes, storm surge barriers are a few of the technological systems that communities have opted for to reduce disaster risk. This movement reflects the trust societies have in man-made systems and the idea that the natural environment can be controlled through human reason. It is also a good example of the pervasiveness of technological systems when it comes to the way communities deal with hazards or disaster subcultures. The western parts of The Netherlands have for instance, displayed a developed disaster subculture characterized by high levels of trust in complex organizational/ technological systems to prevent large-scale flooding. After the 1953 flood disaster the Dutch proclaimed: "never again!" and so, through engineering and organizational system they believe to have reduced flood disaster risk to negligible levels and people are told it is no longer an issue. Since trust in the authorities and engineers is high, development in flood prone areas has continued and today the socio-economic

heart of the country is located in the most flood prone areas and levels of preparedness are low because the low probability of such an event taking place is considered negligible. The problem with this is that systems can fail, even when the probability is low. Also, the systems in place are constructed on the basis of the past but without knowing what the future will bring. So today, in light of for instance climate change, one might wonder whether the flood disaster risk is indeed so negligible and whether it would not be advisable to complement the prevention and mitigation measures with more preparedness, response and recovery ones.

In Chapter 4 the disaster subculture framework is applied to two Dutch communities to show how it can be used to identify and describe disaster-specific cultural resources in a context other than the context in which it was developed. Chapter 6 builds on this work and applies it to the Chilean context, more specifically GC. Findings do not only regard the conceptual framework, but also the vulnerability that people in GC experience vis-à-vis earthquake/ tsunami events that was revealed in light of 27F is presented.

Chapter 5: Flood disaster subcultures in The Netherlands: the parishes of Borgharen and Itteren[5]

5.1 Abstract

The Netherlands knows a persistent threat of flooding. To adapt to this dangerous reality, the Dutch have cultivated what disaster research literature has labelled 'disaster subcultures' or a set of cultural (tangible and intangible) tools to deal with the recurrent hazard. While there is abundant attention for the way the Dutch 'coastal' and 'low-lying' communities deal with the recurrent threat of (coastal) flooding, less is known about the way the Dutch 'high-lands' deal with the yearly threat of (fluvial) flooding. This article presents the findings of an explorative research endeavor (2011–2013) aimed at discerning if the disaster subculture concept has contemporary relevance in the Netherlands, particularly with respect to flooding, and if so, whether applying this lens would reveal more about the nature of existing disaster subcultures. Because less is known about the Dutch 'high-lands,' we chose to look into the existence and attributes of disaster subcultures in the parishes Borgharen and Itteren, which experience a systematic threat of flooding. Our findings suggest that the disaster subculture lens is valuable as it enables the empirical appreciation of disaster subcultures, even in a small country like the Netherlands, and it unveiled elements of these neighboring parishes' flood reality that otherwise might have gone unnoticed and that seem central to understanding these two parishes' levels of vulnerability and resilience. It is our contention that the concept 'disaster subculture' makes a greater understanding possible of the cultural

context from which vulnerability and resilience to specific and recurrent threats emerge.

5.2 Introduction

Communities living in hazard-ridden or disaster-prone areas develop an array of coping mechanisms as well as more deeply embedded practices to deal with threats and opportunities their environments encompass, resulting in specific disaster subcultures. The Dutch occupy a risky region and flood disasters have historically played a significant part in the development of their culture. The historian Simon Schama for instance, speaks of the Dutch having a 'Christianized diluvian culture' (1987: 45).Similarly, Petra van Dam (2012) illustrates how from 1600 to 1953 parts of the Netherlands developed an 'amphibic culture' to ensure continued inhabitation of flood-prone areas. While Schama highlights the role of flood *disasters* in the development of Dutch culture, both recognize that floods are 'agents of cultural formation as much as they are physical events' (Bankoff 2001: 13) in the Netherlands.

The assemblage of cultural practices that over time emerges in response to recurring disasters has been identified as 'disaster subcultures' (Moore 1964; Wenger and Weller 1972, 1973; Anderson 1965; Anderson 1968). This concept was put forward in the 1960s and 1970s to shed light on the complex but intricate relationship between the human and natural world. Since then the notion has often been referred to (see for instance Gaillard et al. 2008 or Marín et al. 2010), but remains underemployed conceptually (Granot 1996; Bankoff 2003).

When reading this literature, we wondered whether this concept would have a contemporary relevance in the Netherlands, particularly with respect to flooding, and if so, whether the application of a 'disaster subcultures lens' could reveal more about the nature of existing disaster subcultures. In addition, we were curious to find

out whether this lens could be applied in another context than it was developed in and if doing so would result in valuable findings.

In light of this we designed an explorative Dutch/American research venture into two parishes in Zuid-Limburg, namely Borgharen and Itteren, that are located close to the Belgian border along the river Meuse. We chose these parishes because they are part of the Dutch 'high-lands'. Most studies have looked at the presence of flood cultures along the North Sea Basin (see Franz Mauelshagen (2007, 2009) on the German North Sea Coast, Greg Bankoff on the English 'Lowlands' (2013), and Petra van Dam (2012) on the North Holland region of the Netherlands) and focused on how the Dutch 'low lands' and 'coastal' communities have adapted to coastal flooding resulting from storm surges. However, less is known about possible disaster subcultures in the Dutch 'highlands' where, unlike other parts in the Netherlands, *fluvial* floods are a recurrent phenomenon. This study fills a knowledge gap in this connection.

The fact that culture is continuously in the making merits a historic perspective. An in-depth historical study is, however, beyond the scope of this article, as we choose to focus on the application of the 'disaster subculture' concept to these parishes, but we do incorporate past experiences as shared by our respondents and available documentation.

Data collection was carried out in 2011, 2012 and 2013 and relied on document analysis, participant observation, focus group discussions and in-depth interviews with inhabitants and disaster management professionals. For the analysis of our findings we used concepts and ideas derived from disaster subculture literature (Moore 1964; Wenger and Weller 1972; 1973; Anderson 1968; Turner 1982). The study revealed that the two communities show distinct characteristics in terms of disaster subcultures.

This article presents the findings of this study. By presenting this data we illustrate how the Netherlands knows distinct disaster subcultures and how applying

the 'disaster subculture lens' made it possible for us to uncover elements of these two parishes' flood reality that otherwise might have been overlooked. We for instance identified local constraints and capacities for dealing with disaster threats and captured important contextual realities from which degrees of vulnerability and resilience emerge. Cognizance of disaster subcultures can be very helpful to local disaster managers and authorities who wish to build on existing capabilities and reduce enduring vulnerabilities. This moves us to also argue for the reappraisal of 'disaster subculture' as a conceptual tool.

To make our argument and position our findings we first introduce the notions of culture, resilience, subculture and disaster subcultures. We then present the disaster subculture framework as developed by Wenger and Weller (1972; 1973) and use this framework to depict the disaster subcultures of the parishes Borgharen and Itteren in the Netherlands. We discuss how recurrent high-water threats and flooding have affected both Borgharen and Itteren and how these communities have dealt with this recurrent phenomenon. In the last section, we present our conclusions.

5.3 The Role of Culture and Disaster Subculture in Disaster Management and Resilience

Culture

The classic definition by Tylor (1871) describes culture as "[t]hat complex whole which includes knowledge, belief, art, morals, law, custom and any other capabilities and habits acquired by man as a member of society" (Tylor 1871). To societies, culture has a pragmatic and instrumental value as they are essentially "problem-solving tool[s] that enable individuals to survive in a particular environment" (Schein 1999: 43) and entail "the sum total of all the shared, taken-for-granted assumptions that a group has learned throughout its history" (Schein 1999: 29). In other words, cultures encompass strategies and practices that communities

turn to when dealing with problems and opportunities they encounter in the short or long term.

One key practice to ever more societies these days is *disaster management*. Disaster management includes all preventive, mitigating and responsive measures that are taken to prevent or reduce disasters and dealing with their consequences. It usually comprises local, largely informal mechanisms that evolved over time, as well as modern institutionalized mechanisms that are often professionalized and carried out by governmental bodies. As any practice, disaster management requires its practitioners to be aware of the wider culture in which it is rooted and the cultural themes it embraces: Disaster management should be working with and within cultural frameworks.

Resilience

While the past decade has seen more studies into the interface of disasters and cultural practices (amongst others Bankoff 2001, 2003, 2007, 2013; Gaillard 2007, 2008; Granot 1996; Mauelshagen 2009; Oliver-Smith and Hoffman 1999; Hoffman and Oliver-Smith 2002), there is still too little fine-grained local research as to how cultural complexities play out when disaster strikes. However, the recent emphasis on resilience has put the social, organizational and cultural capabilities of local communities center stage again. Since the 1970s, several disciplines have adopted the concept of resilience to address 'the capability and the ways people deal with crises and disasters' (Gaillard 2007: 523). In fact, the notion of resilience has rapidly gained popularity in the field of disaster studies and emergency management as an effective and efficient way to reduce prevailing vulnerabilities and thereby the risk of disaster (Cutter et al 2009; National Research Council 2011; Norris et al 2008; Ritchie and Gill 2011; Velotti et al. 2013). In relation to earlier paradigms in disaster studies, the resilience approach moves beyond the vulnerability and victimization discourse toward agency and capacity (Hewitt 1995: 325; Bankoff et al.

2004: 34) and from short-term coping towards longer-term adaptation and innovation. It focuses on process rather than being a static state of affairs.

While 'resilience' remains an object of conceptual debate, there appears to be consensus that community resilience embraces an emphasis on communities' capacities to overcome the impact of a hazardous event. In that sense, it inspires more of a 'can-do' attitude as it recognizes communities as active problem-solving agents that conceive and cultivate mechanisms that allow them to inhabit and flourish in hazardous places. Additionally, a resilience approach accepts that 'exposure to hazards and adversity can engender growth and development' (Engel and Engel 2012: 136). In this sense, it brings back a conception of risk that was introduced in 17th century Europe with the development of probability theory: risk as "the probability of an event occurring, combined with an accounting for the *losses* and *gains* that the event would represent if it came to pass" (Drake 1992: 22).

Subculture

The term 'subculture' was introduced in the early 1940s to indicate the internal heterogeneity of societies. Subcultures develop when problems cannot be satisfactory tackled by a wider established parent culture (Cohen and Short 1958; Gelder 2005; Gaillard et al. 2008: 30). Like cultures, subcultures encompass physical and visible components (artefacts and behaviours) and 'ideational' components (values and norms). Furthermore, subcultures are dynamic as a result of their members continuously interacting with others in society (Fine and Kleinman 1979) and subcultures' referents are varied since normative systems can be differentiated on the basis of factors such as religion, language, diet and moral values (Yinger 1960; Gordon 1947; Gelder 2005).

The usefulness of 'subculture' as a concept can be overshadowed by some shortcomings. For instance, since the concept has been widely used, it is at risk of becoming 'little more than a 'catch-all' term' (Bennett 1999: 605). Also it is

sometimes solely associated with 'a determinate and often deviant relationship to a national dominant culture' (Bennett 1999: 605). Furthermore, there is a tendency to see subcultures as 'an aggregate of persons (such as youth) or a collectivity (such as a gang)' (Fine and Kleinman 1979: 2). This has led to the neglect of some important aspects, such as beliefs, practices, internal identity variations and change. If carefully used, however, with awareness for its shortcomings, the concept can help highlight important differences between groups in practice.

Disaster Subculture

A common misconception is that disasters are unique and exceptional events. This is not the case (Alexander 1999). Experiencing recurrent disaster pushes communities to develop cultural strategies and practices to deal with these adverse events and ensure increasing levels of resilience. Since hazards vary per locality, different groups face different potential disasters. Subsequently, wider cultures that cover larger geographical areas, such as for instance a Dutch culture that should cover the complete Netherlands' territory, are generally unable to provide all its members with an exhaustive assortment of appropriate hazard-related solutions.

In addition, hazards generally do not strike on a daily basis. Therefore, readily available solutions and habitual modes of actions are often insufficient and unique adaptations of the 'common' are required to deal with recurrent hazards. Over times this leads to a specific local subculture encompassing adaptive strategies that enable the community at hand to survive within hazardous environments. Moore (1964) first put forward the notion of *'disaster subcultures'* to refer to these subcultures and shed light on 'those adjustments, actual and potential, social, psychological and physical, which are used by residents of [hazardous] areas in their efforts to cope with disasters which have struck or which tradition indicates may strike in the future' (Moore 1964: 195). Since then, various scholars like Anderson (1965), Wenger and Weller (1972, 1973), Wenger (1978) and Turner (1982) elaborated the concept as a tool to identify

subcultural themes that are embedded within a larger culture and conceived in response to repeated experiences of disasters.

Even though disaster subcultures consist of coping mechanisms that communities have historically found adequate, it is important to note that they can become a debilitating factor when conditions change (Wenger and Weller 1972; Kuhlicke et al. 2011). For instance, in New Orleans during both Hurricane Betsy (1965) (Forrest 1979) and Hurricane Katrina (2005), the community's response was ineffective because they were confronted with another disaster agent than the recurrent agent. Their disaster subculture was directed at hurricanes and was not suitable for large-scale flooding. Another concern can be the generation of a defiant attitude towards a disaster agent due to the perceived effective containment of this agent (Wenger and Weller 1972: 2). Such an attitude can lead to what is known as the safe paradox (Burby 2006) or the levee effect (White 1945): a skeptical attitude toward warning signals or the underestimation of a threatening situation due to an increased feeling of safety. In the insurance business, this is refered to as a 'moral hazard': "the situation when an insured party has lower incentive to avoid risk because an enhanced level of protection is provided" (Interagency Floodplain Management Review Committee 1994: 180). In some countries like the United States, there are concerns that governments are creating a 'moral hazard' by providing a range of protective flood plain activities. Such a defiant attitude can also be observed in the Dutch context, particularly since after 1953, the Delta works promised full safety. This has from time to time turned out to be debilitating factor, for instance in the province of Zuid-Limburg during the 1993 flood (Rosenthal et al. 1998; Engel 2011).

5.4   A Disaster Subculture Framework

The discussion below is to a significant degree indebted to the work of Wenger and Weller that is based on literature studies of disasters, mainly in relation to the United States. This work provides us a conceptual framework for disaster

subcultures that outlines firstly three key *conditions* that should be met for a community to start cultivating a disaster subculture, namely 1) a community should face and acknowledge the existence of a recurrent threat, 2) the focal agent should allow for a period of forewarning and 3) the impact of focal agents should be salient to different segments (various status levels) of the communities (Wenger and Weller 1972). With respect to the second condition, it is important to note that Turner's (1982) research into southern California's earthquake disaster subculture showed that even though earthquakes do not have periods of forewarning, communities facing them do in fact develop subcultures (1982: 208).

The framework also encompasses concrete *subcultural themes.* This framework includes *valuative* elements that define what is important and worthwhile when a hazard strikes and *normative* elements that outline desirable behaviour in relation to the hazard at hand. For instance, how should one respond to the possibility of the hazard striking in a short period of time? How should such a threat be interpreted and what actions should it trigger? In addition, there are *beliefs* that encompass tenets concerning the hazard and its possible consequences. For instance, community members might believe that certain areas are safer than others or that they have the capability of controlling the hazard to such an extent that it is no longer a threat. Beliefs such as the latter can result in specific attitudes. For instance, a firm belief in a community's ability to control the hazard they face can lead to a 'defiance of nature' attitude. Communities furthermore develop *knowledge*. Knowledge is related to a community's awareness, levels of information and the active application of available information. For instance, previous hazard experiences can enable communities to know possible warning cues and subsequently initiate timely protective behavior. Aside from such ideational elements, the framework also recognizes the role of *technology* or complex technical artifacts. A community could for instance develop sophisticated methods of detection and warning. Lastly the framework encompasses *patterns for intra- and*

inter-organizational response and *socialization mechanisms*. The former encompasses for instance disaster plans and routine response, while the latter allow for the preservation of the different these that make up the disaster subculture. Formal and informal mechanisms of socialization serve to engage newcomers and equip them with requisite knowledge and other cultural elements. According to Wenger and Weller "[t]he true indication of the existence of a disaster subculture ... is the perpetuation of successful patterns of adaptation to the disaster context through socialization" (1972: 1).

As Wenger and Weller (1972) underline, no disaster subculture is the same. Since every community experiences hazards and disasters differently, draws different lessons, and finds unique ways to deal with the particular perils and opportunities of their environment, the different subcultural themes will acquire different properties. Variations in subcultures are interesting because they enable comparison. As such Wenger and Weller (1972) have identified some dimensions along which comparisons are possible. The first is the *manifest/ latent dimension.* Fully developed latent disaster subcultures for example can "have institutionalized their mode of response to the point where they view events such as floods as simply nuisances, or possibly even look forward to the flood period as a time of 'carnival' (Wenger and Weller 1972: 2), while there are other highly developed disaster subcultures that shine through the dominant culture on a daily basis. Such communities have normalized their disaster experiences into their familiar manifest culture (Anderson 1968; see also Schneider 1957). Another dimension concerns the degree to which the disaster subcultural themes "apply en masse to individuals as contrasted to their more specialized application to the community's organization" (Wenger and Weller 1973: 3). In other words, to what extent do these themes influence individual and organizational behavior? This is the *individual-organizational dimension.* Another dimension is the *instrumental/ expressive dimension*. Are the dominant themes of a subculture more instrumental or expressive? Instrumental traits are "those

normative, technological, valuative, knowledge, and resource components that are related to preventing, predicting, controlling, and responding to the physical impact of the disaster agent", while expressive traits often refer to norms, values, beliefs, legends, and myths concerning disaster and the relationship between the community and the disaster agent (Wenger and Weller 1972: 4). Lastly, we have the *narrow/ broad scope dimension*. Is a disaster subculture narrow in scope and thus limited to small-scale communities in, for example, flood plain or island neighborhoods? Or is the disaster subculture broad in scope and does it extend throughout a large-scale community, including various neighborhoods and both formal and informal organizations.

Even though the different conceptual endeavors have positioned disaster subcultures as a blueprint for individual and group behavior, we do not feel comfortable with such a statement. As Fine and Kleinman stress, "culture usage consists of chosen behaviours" (1979: 12). Disaster subcultures can encompass forces directed at determining or constraining options for individuals or groups, but the latter always possess agency to change or renegotiate their behavior in the face of these subcultures and thereby redefine the subculture itself.

In the next section, we apply the prevailing disaster subculture framework on a specific Dutch case to learn more about the way the Dutch highlands have lived with water and recurrent flooding, and then to discuss the usefulness of this US-based framework in a European context.

5.5   Disaster Subcultures in the Netherlands: Borgharen and Itteren

Flood Safety in the Netherlands and Limburg

Since the (coastal) storm surge disaster of 1953 (Gerritsen 2005), safety standards and flood management measures have been tightened and large infrastructural protection works have been executed. The principal idea was to reduce the probability of flooding to (negligibly) low levels in areas where impact of

coastal or riverine floods was expected to be greatest (Van der Most and Wehrung 2005: 192). This resulted in protection against a 1/10,000 years flood for large parts of the Netherlands' low lands, i.e. the area in which Amsterdam, The Hague, Rotterdam and Schiphol are located and in which 65% of Dutch GNP is produced (Inspectie Verkeer en Waterstaat 2006: 4). Areas that were more thinly populated, where the impact of flooding was expected to be much less, received lower levels of protection (Van Slobbe et al. 2013: 1468), with a minimum of a 1/250 years flood.

Since the province Zuid-Limburg lies in a relatively thinly populated, gently sloping river valley with most of the land higher than the rivers, the Dutch government did not include this province in the wider Dutch flood safety scheme determined by the Dutch *Waterwet* (Water Law). Therefore, Zuid-Limburg enjoyed the liberty of designing and implementing its own flood protection approach that has historically differed considerably from the rest of the Netherlands, with protection only up to 1/50 years (fluvial) flooding.

However, in both 1993 and 1995, after continuous, heavy precipitation, the province was hit by widespread (fluvial) flooding. The speed and magnitude of the flood surprised both the emergency services and the citizens (Rosenthal, et al. 1998; Van Heezik 2006: 100). In 1993, approximately 10% of the province's territory was flooded (Rijkswaterstaat 1994), and in 1995, one third of the total yearly discharge of the Meuse was discharged in only 11 days (Rijkswaterstaat 1995: 15). In response to both floods, the Minister of Transport, Public Works and Water Management established the Meuse Flood Disaster Emergency Committee "with the instructions to research into how the consequences of such flooding could be addressed in this part of the country" (Hallie en Jorissen 1997: 364). The principal idea was to reduce water levels at high discharge by widening and deepening the Meuse (1997: 364). After the 1995 floods, the implementation of this project called the *Maaswerken* (Meuse Works) was accelerated.

The *Maaswerken* represent a changing flood management paradigm in Zuid-Limburg. While before flood prevention measures were not part of the landscape and flooding was largely accepted, now levees surround vulnerable populated areas and the general populace is told that floods will not be part of their future anymore, despite the fact that the safety norm still remains comparatively low (1/250) and flooding may even be a necessary measure in order to ensure the safety of more densely populated areas downstream. The delusive perception that the flood risk will be reduced to almost zero and that flooding will no longer be part of Zuid-Limburg's future is now settling. However, the reality is different, as the following cases of Borgharen and Itteren show.

Flooding in Borgharen and Itteren: A Recurrent Phenomenon

The parishes of Borgharen and Itteren are, almost on a yearly basis, confronted with high-water and the threat of (fluvial) flooding. Even when high-water does not result in the flooding of the parishes as such, the communities may still get cut off from the outside world and get isolated. The parishes, with populations of 1810 and 983 respectively, are enclosed by two waterways: the river Meuse and the Juliana Canal. The Juliana Canal is a tributary of the Meuse that was built in the beginning of the 20th century to bypass an unnavigable section of the Meuse and connect the industries of the south with the ports of the Rhine delta (Rijkswaterstaat; Van Heezik 2006: 43) (Fig.5-1).

The Meuse is the primary source of flooding for Borgharen and Itteren. It flows from its source on the French Plateau de Langres, via the French Ardennes and Liege (Belgium) into the province of Zuid-Limburg. Because the Meuse is a rain river, her discharge is largely determined by precipitation and the saturation levels of the soils, and thus very changeable. Discharge levels vary from 25 m³/s to 3120m³/s (December 1993). Since in Belgium the Meuse comes from substantial heights and the stream bed is rather impermeable, the speed with which substantial discharges

can flow towards the sea can be great: Most water from the Belgian Ardennes can be in the Netherlands in half a day (Rijkswaterstaat 1995: 7-9).

Figure 5-1 Map of Borgharen and Itteren (from google maps)

The greatest fluvial floods that Borgharen and Itteren have experienced were in 1926, 1993, and 1995 (Rijkswaterstaat 1995: 12). The most recent flooding was in 2011. Both parishes faced alarming water heights and unprotected lands, including several farms, were flooded and isolated. A small number of individuals identified as being vulnerable were evacuated. Even though most inhabitants are used to high-water and flood events, for some, mainly new residents that have no experience with flooding, these situations can be traumatic and stressful.

In the past, people would live on high grounds and would only cultivate the lower lying lands. Whenever the river would creep outside its banks, this would not

be catastrophic since people would reside safely on higher grounds. This changed in the eleventh century when the population increased and the higher grounds became too small to host all residents. This is when fluvial floods were described for the first time (Rooijendijk 2009: 216-217). Since then, floods and high-water events are recurrent phenomena. To residents from Borgharen and Itteren they are part of the past, present and future. This is strikingly different to the rest of the Netherlands for which the central government ensures high levels of flood safety and flooding is generally not perceived as a risk to be concerned about anymore.

With respect to the three conditions to foster a disaster subculture (see Sect. 2.4 above), both Borgharen and Itteren meet all three of them. Firstly, both parishes face a recurrent threat of flooding that is fully acknowledged. Most if not all residents of these parishes have either actual recent experiences with flooding in for instance 1993, 1995 and/or 2011 or know about it from stories, governmental communication (Gemeente Maastricht 2011) and/or media reports. As a recently interviewed, 96-year old resident of Itteren told the local newspaper De Limburger: "high water levels are no fun, but you get used to it" (Maas 2012:1).

Even in light of Turner's (1982) study perhaps not essential, both parishes also meet the second condition, namely that fluvial flooding allows for a period of forewarning. Threatening water levels of the Meuse originate in either France of Belgium and can subsequently, albeit with significant margins of error, be monitored. Lastly, the third condition is met. The impact of the focal agent is indiscriminate and salient to all segments of both communities. For instance, when high-water reaches alarming levels, all residents are isolated and nobody can enter or exit without military assistance. This is not to say that the effect is exactly the same for everyone. In the past some houses were built at a higher elevation than others, while the recently established levee system has left a number of inhabitants outside and unprotected.

Borgharen and Itteren: A Description of Two Disaster Subcultures

Comparing the two communities, Itteren seems to enjoy a more intimate relationship with water and in particular the Meuse than Borgharen. This relationship is accompanied by positive ideas concerning both. Rather than foes, both water and the Meuse seem to be perceived as a friend; a sometimes disorderly neighbor. The community of Borgharen on the other hand seems to have a more reserved and detached relationship with water and in particular the Meuse (Table 5-1)

Table 5-1 Comparative table-Borgharen and Itteren Subcultures

Elements	Borgharen	Itteren
Valuative and normative elements	Solidarity	Solidarity
Beliefs toward water and Meuse	A hazard to be dealt with from time to time.	Friend and sometimes disorderly neighbor
	Both communities have strong beliefs of self-sufficiency that leads towards an aloof relationship with outside authorities with respect to issues concerning the Meuse.	
	Borgharen accepts particularly high-water emergencies as part of their reality. However, when it comes to flooding from time to time an 'attitude of defiance' shines through.	Strong attitude of acceptance. High-water and flooding is part of their past and will be part of their future. The Meuse will come to visit from time to time.
Symbols	Hardly any symbols of (past) flooding available throughout the public space.	Presence of symbols throughout public space, including poem in which attitude of acceptance is expressed.
Knowledge	The main source of knowledge is the river: understanding of the river derived from the communities' historic interaction with it. Since the people from Itteren seem to have a closer relationship	

	with the Meuse, their knowledge and understanding seems to be greater than in Borgharen. Still in both parishes knowledge is present.	
Technology	Architecture and structural levees. While some houses represent mitigating architecture, several do not represent any awareness of possible flood events.	Architecture, flexible levees, structural levees and pump stations. The greater part of the parish physically emanates a lifestyle that includes possible flooding.
Patterns for intra and inter-organizational response	Joint community response supported by flood risk management professionals that have specific flood plans. In Borgharen however, the joint response is more structured and predefined than in Itteren. Itteren has chosen to rely more on emergent structures rather than a predefined one, so as not to take away people's own initiatives.	
Socialization	Stories, information from local authorities, experience, DVD, pictures	Stories, information from local authorities, continuous presence of symbols and technique, movies, pictures.
Degree of manifestation (manifest or latent)	Latent	Manifest
Degree of influence on disaster behavior	High degree of influence on disaster behaviour. In Itteren also high degree of influence on more daily personal choices. In addition to the disaster subculture having en masse influence, there are also specific formal organizations that are guided by it.	
Instrumental or expressive traits	Mainly instrumental, but also some expressive. Expressive mainly in the form of norms, values and stories.	Instrumental and expressive. More than Borgharen also expressive. Manifest symbols, stories, and art.
Scope (narrow/ broad)	Narrow, but including both formal and informal organizations within and outside flood-prone parishes.	

Valuative and Normative Elements: Solidarity

Over time, both communities have learned that in the case of flooding solidarity is most important. In this sense, "the joint fight against water produces a bond that cannot be found anymore in many communities"[6] (Interviews Borgharen 2011). Solidarity becomes apparent in different ways. For instance, Itteren knows an important core of families that have lived there for generations. These families know each other and regularly visit each other. Because of this, during high-water or flood events, people know who require special needs and the latter stay calm because they know that someone will come to help them (Interviews Itteren 2013). Solidarity is not just viewed as an asset the parishes possess, but also as an important value and norm that has enabled them to effectively engage with their environment.

While both parishes seem to enjoy considerable solidarity on a day-to-day basis, when water levels are high and flooding impending levels of solidarity peak. The first thing people do is run out and help each other get their household effects up on trestles or to the first floor. Then when everything is secured, people come together in those houses that lie higher and are thus less affected. Families come together and "cafés are full, cosy and fun" (Interviews Itteren 2013). Children build rafts, play and come back home all wet (Interviews Borgharen 2013). People in both parishes compared high-water and flood events with a fair and one 93-year-old lady from Itteren told us how she would never evacuate since she would never want to miss the water and the conviviality and coziness these events entail. She happily tells us how in 1993 she and her son would cook dinner in the kitchen with their wellies on in 48 cm of water. Children who had moved away would come back because "high-water is fun and exciting" (Interviews Itteren 2013). It is important to note that the positive perception of flooding enables a more speedy recovery than in areas where floods are deemed traumatic and devastating. The inhabitants do not see

[6]Translated by Karen Engel from Dutch.

themselves experiencing continuous disaster, but rather a recurrent inconvenience that even may have some characteristics of a fair.

The existence of strong social bonds, particularly in times of high-water, is not new. Before approximately 1950 Borgharen boasted 23 cafés run by stay-at-home wives. These cafés enabled bonds to be forged and preserved and during floods served as open living rooms (Interviews Borgharen 2011). Mutual help was also traditionally part of daily routine. Those families owning the few ovens in the village would make bread for those who did not have one. In Itteren, the whole parish would help each other to slaughter pigs for winter, going from one house to the next (Interviews Itteren 2013).

Both community members and local authorities actively try to promote community solidarity. For example, solidarity is explicitly put forward by the municipal authorities as worthwhile and desirable. In other words, aside from people spontaneously coming together, there is also an institutionalized expectation for them to do so. The municipal instructions emphasize how in the past both communities have shown substantial levels of solidarity during high-water and floods and how authorities expect this will also be the case in the future (Gemeente Maastricht 2011: 1).For example, the instructions provided by the municipality of Maastricht tell the inhabitants to:

- ❖ "Talk to neighbors and find out whether certain neighbors would require specific attention.
- ❖ Keep in touch with neighbors.
- ❖ Inform neighbors of updated information if necessary.
- ❖ Discuss with neighbors to ensure that everyone receives the help they require.
- ❖ Help people without upper floors.
- ❖ Assist Parish Council members with their coordination and communication tasks. (Gemeente Maastricht 2011)"

The local parish council of Itteren also strongly relies on solidarity and even decided against a specific community flood disaster response organization because

they felt that this would thwart the more spontaneous community organizations that currently emerge in such situations. In their view, having such a specifically tasked organization would only lead to people absolving themselves of their (community) responsibilities in case of flooding (Interviews Itteren 2011, 2013; Velotti et al. 2011: 8).

Beliefs

While water is a unifying force to both communities, their relationship with it is different. For Borgharen the relationship seems more reserved and detached. Water is a hazard to be dealt with from time to time and is more often referred to as an enemy or possible threat. To people from Itteren however, the Meuse is a relished neighbor: "...everything we have is thanks to the Meuse...[and] when it rains in France, we know we get company" (Heijnen 1996).

In our interviews (Interviews Borgharen and Itteren 2013) people also mentioned the economic dimension of the river in the past. Tow-boats passed the Meuse and stopped at Itteren to change and feed the horses. There was also fishing on eel and some families engaged in the cutting of twigs and reed to weave baskets that were used in the mines and ceramic industry for transport and packing. One respondent mentioned that the Meuse had brought the Jerusalem artichoke from France. The Meuse was under normal situations seen as something beautiful. Children played along the Meuse and learned to swim; adults recall how they walked along it with their first girlfriend, and even at an old age many like to stroll along the river.

When reminiscing about previous high-water and flood events, members of both communities generally recall pleasant memories. People would tell us how their children enjoyed driving in an army truck, how people would take advantage of their (forced) time off from work or the daily 'crisis-meetings' at the local bar. To most, high-water and flood events were important moments of togetherness in which old family rivalries (temporarily) dissolve and people are driven by a sense of

togetherness. So while people from Borgharen are a bit tenser in their relationship with the water, overall sentiments seem more positive than negative. This leads us to believe that in neither community the river is considered a serious threat. In fact, it seems that high water and floods are seen "as a social moment during which the community comes together to support each other" (Velotti et al. 2011).

This attitude seems to be related to the prevalent belief of 'community self-sufficiency'. People from both communities feel ready and able to overcome such events. They know exactly how to build and organize their houses to mitigate impact. One house in Itteren has for instance a drain in the middle of the living room which the owner can open to empty his living room when the water is down. Also several families have invested in collapsible trestles. Another respondent from Borgharen told us how everything on the ground floor is mobile and can be brought up in a timely fashion. There is always timely help from neighbors (even those who have not been on speaking terms for ages), friends and relatives. Today with increasing electrical appliances and luxury goods, costs may be higher, but both communities are sure that they are capable of recovering quickly. This belief makes them somewhat aloof and critical towards any authority figure from outside their parish trying to tell them what to do with respect to the Meuse (Interviews Borgharen and Itteren 2011). Borgharen's Parish Council for instance, installed an informal organization comprising 'block leaders[7]' to respond to high-water or floods as a result of the, in their eyes, inadequate governmental response to the 1993 flood event (Interviews Borgharen 2011).

Our findings show that members of both communities believe that their experience with flood events has enabled them to develop coping mechanisms ranging from 'reading' the environment and the early warning signs their

---

[7] In Dutch: 'Blokhoofden'. The structure in Borgharen was inspired by the civil protection system the Netherlands used to have when the 1952 Civil Protection Law or 'Wet BeschermingBevolking (BB)' was still in force. Central to this law was a civil protection organization based on volunteers. Society was divided into block groups (In Dutch: blokploeg) that were led by block leaders (blokhoofd).

environment provides, to vertical evacuation, and that there is no need for them to evacuate out of the village. For instance, in Itteren the majority of houses have their first floor as high as, or higher than, the highest flood levels reached before the house was built (Velotti et al. 2011: 6). This enables them to stay in their houses when the parish is flooded. Furthermore, this makes recovery quicker as most private goods remain untouched by the water. Interestingly enough, even before 1993 people from Itteren would build their houses higher, even though municipal regulation permitted the ground floor of newly constructed houses only to be 10 cm above street level. Ten centimeters is however far too low in Itteren's experience with flooding, so residents would find ways to add sometimes over 50 cm to this level. In Borgharen architectural adjustments are less prominent than in Itteren. There are for instance a number of houses with just one floor. Overall however, both communities are not afraid of flooding and feel experienced, prepared and knowledgeable enough to cope self-sufficiently.

Even though this belief of 'community self-sufficiency' tends to a standoffish and critical attitude towards authorities, it seems to be encouraged by local authorities. Official communication to the residents of Borgharen and Itteren emphasizes how the local government considers them self-sufficient enough to cope with high-water and flood events. In fact, such communication stresses how they are responsible for their own safety and will only receive assistance when in dire need because of a special needs situation. People are expected to help themselves and each other and not expect assistance from authorities. For instance, people that occupy houses with more than one story that are not in the vicinity of levees are advised to stay in their houses unless informed otherwise and take in people with houses with only one story or close to levees.

While on paper official expectations regarding community self-sufficiency seem consistent, our findings suggest that in times of flooding officials might act differently. In such a case, authorities may expect a blind obedience that neither

community will provide. In fact, the members of both communities will act in accordance to their own decision-making process which may or may not include directives provided by authorities. An important reason for this is the common idea that authorities from outside the parishes have no true understanding of the reality the parishes experience and are thus unable to provide adequate counsel in whatever situation. Subsequently, they are on their own.

An underlying subcultural theme seems to be a prevalent attitude of acceptance: "Itteren is a Waterhole, Governed by the Water Wolf" (Heijnen 1996)". Flooding is part of the everyday life: "...in my lifetime the water has come into my house six times. I'm used to that. In Itteren, we are all used to the Meuse. The street has been flooded numerous times, but nobody cared...[and] in the future the water shall continue to come often" (Heijnen 1996). Here we must however note that the impact of flooding has increased over the years in both parishes. While in the past mere 'farmer furniture' was in harm's way when the Meuse visited, today we find first floors with luxury items such as parquet flooring, TVs and freezers that cannot endure in long-lasting water. Still however, it is accepted that living in Borgharen and Itteren means living with water.

In addition, the authorities convey that despite the recent levees, the *Maaswerken* and a subsequent reduced risk of flooding, water remains an important force to be reckoned with. The inhabitants of Borgharen and Itteren realize this and have subsequently no illusions of a flood free future. In fact, they are well aware that the establishment and development of the levee system has in fact enhanced the possible impact of flooding. The levee system has made both Borgharen and Itteren into so-called 'bathtubs'. If water does surpass the levees "[people from Borgharen and Itteren] will really be able to swim" (Heijnen 1996). Moreover, once the water has entered the protected area with great force, it cannot get out as easily, as it is blocked by the levees (Interview Rijkswaterstaat Maastricht 2012; Interview Water

Safety Expert 2012; Interview Waterschap Roer en Maas 2012; Gemeente Maastricht 2006a).

While this attitude of acceptance is most dominant, from time to time, governmental authorities also spread messages that hint at an 'attitude of defiance'. Local authorities communicate that "in 2025 high-water will no longer be an issue" (Interview Municipality of Maastricht 2012) and residents of Borgharen and Itteren will subsequently no longer have to worry about flooding. Therefore, when the *Maaswerken* are completed the current attitude of acceptance could be replaced by an attitude of defiance of nature. With the termination of the *Maaswerken* the 'waterwolf' will have been tamed.

Our findings suggest that this attitude of defiance is generally more present among local authorities that deal with water safety issues, than with the inhabitants of Borgharen and Itteren. While this attitude of defiance seems to have strengthened due to the different flood reduction projects, it was already there in 1993. For instance, in 1993 local authorities ignored obvious signs that pointed at critical water-levels, including Belgian television stations showing images of floating caravans, Belgian government officials speaking of a deluge (Engel 2011, Rosenthal, et al. 1998) and formal warnings from the Ministry of Public Works and Water Management. The different signs were received with disbelief by local authorities. This attitude eventually led to an overall tardy and poor governmental response to what is today known as one of the most severe flood events of Dutch recent history.

Symbols

The primary difference we encountered between the disaster subcultures of Borgharen and Itteren has to do with symbolism. When walking through Itteren one is continuously reminded of the water threat through, for instance, flexible flood walls, signs indicating past flood levels, and a work of public art: a boat at the height of the [1993] flood, which would float should the water ever reach that level again (Velotti et al. 2011: 6).

Figure 5-2 2Itteren symbols: Boat at the height of the last major flood in 1993

There is also a reading table with a poem about the Meuse River (Herberghs 2004) that conveys the attitude of acceptance characterizing the parish. In the poem, the river Meuse is portrayed as a kind, old woman, who from time to time loses her wits, escapes her embankments and leaves the people of Itteren in disarray. In the last paragraph of the poem the people of Itteren forgive the Meuse for her quirky and whimsical nature, since the river is essentially kind; they straighten out the disarray and continue with their ordinary activities like reading the newspaper.

Figure 5-3 Itteren symbols: Flexible flood walls

In contrast, when walking through Borgharen one is hardly confronted with the proximity of the Meuse. The levee system hides the river from view as opposed to Itteren where the banks of the river are made accessible and are sometimes included as backyards of houses located along the river. In Borgharen there are also less signs of past flood levels.

We believe that this different use of symbolism represents the different relationship both parishes enjoy with water. For instance, through the use of symbols, Itteren has made water and the Meuse a part of their daily life. It seems that through the use of these symbols throughout their public space, they have to some extent 'normalized' disasters and subsequently integrated disaster experiences into the community's daily manifest culture. From our findings, we believe that this process of normalization (Anderson 1968) is related to a more dominant attitude of acceptance in Itteren than in Borgharen. Especially when speaking to people from Itteren, the Meuse seems to have a special place in their hearts. They did not speak of a threat or a disaster, but rather spoke of 'water coming in', water 'visiting', and more often acknowledge all the good that the Meuse has brought to them. We

believe that this might be because Itteren kept its agrarian outlook longer and stayed closer to its environment than Borgharen. While today there are less and less farmers, it has only been a few decades that the agrarian character has started to fade in Itteren. Being largely farmers and having lived from their natural environment (fishing, agriculture, stock raising) has meant that they found ways to deal with both the perils and opportunities their environment had to offer. Throughout our research it became clear that people from Itteren love and respect their environment, while in Borgharen, the environment seems more of a reality to deal with. We felt more of a reserved relationship as opposed to the emotional attachment observed in Itteren. Subsequently, in Borgharen most subcultural themes are irrelevant in 'peace time' and thus stay latent, but in 'war time' they come to the surface and fulfill their purpose.

While historically both parishes were agrarian (Habets 1872), the arrival of the ceramics industry in Maastricht in the 19th century moved Borgharen residents away from agriculture and closer to the industries of Maastricht. From then on, Borgharen would know more and more day laborers and basket weavers for the ceramics industry (Interviews Borgharen 2011). This moved the parish and its residents closer to the city and away from the land and the water. Since the 1960s this development appears to have intensified, when Borgharen got marketed as a suburb that offers pleasant and affordable living and a short commute to employment opportunities in the city of Maastricht. This has led many outsiders to settle in Borgharen. Itteren on the other hand knows an aging population as young people move away and the older generation stays behind. While an aging population has various drawbacks, in light of disaster knowledge they have considerable more expertise and coping capacity (Fig. 5-4, 5-5).

Figure 5-4 Access and approximation of living space to the Meuse.

Figure 5-5 Symbols of past flood events on house walls

Knowledge

Central to both the disaster subcultures of Borgharen and Itteren is a substantial body of knowledge concerning the environment they inhabit. Again, we find this knowledge more in Itteren than in Borgharen, but still locals from both parishes know their environment. Representatives from both communities and the local authorities revealed the importance of being able to read the environment, in particular the Meuse River, for warning signs and to determine in a timely fashion which actions should be carried out. Also local authorities, in particular those with

extensive high-water and flood experience, stressed the importance of 'reading the river'. They emphasized that scientific knowledge is valuable but that information attained directly from the river is key to determining any appropriate course of action.

To the communities of Borgharen and Itteren, the most important knowledge comes directly from the river. In the past, residents would look at the Meuse and know what to expect: "if the Meuse reaches this level at that fence, we will be dealing with high-water" (Interviews Borgharen 2012). To read the river, artifacts like fences, steps and water-level gauges were used. In particular, the water-level gauge at Borgharen was central. This gauge was situated visibly and close to both parishes, enabled community members to independently interpret the river, generate possible high-water and/or flood scenarios and determine which actions to take in light of their predictions. Furthermore, the water-level gauge made it possible for local authorities and community members to speak the same language with respect to high-water and/or flood levels and to coordinate their activities, even when direct communication was impeded. For example, the governmental flood instructions pamphlet provided both communities with suggested actions that were dependent on water-levels measured at the water-level gauge at Borgharen. The pamphlet informed both parishes that at a water-level of 45.00 meter at the Borgharen gauge, the access roads to Borgharen and Itteren will be closed and cars should be parked outside the parishes and at 45.20 meter the parishes cannot be exited anymore (Gemeente Maastricht 2006b). This meant that everyone was referring to the same standards, even with respect to the 'technical' water data.

Today however, the *Maaswerken* have changed the regime of the river and the water-level gauge at Borgharen is deemed unreliable. As a result, actions are prescribed on the basis of another gauge at the parish of Sint Pieter. This change led to substantial resistance in Borgharen and Itteren, since its impact is significant. First and foremost the communities cannot see the gauge, thus they will become

dependent on others to interpret the river, provide them with possible high-water and/or flood scenarios and determine which actions to take. Additionally, they will have to rely on tools like the internet or phones which are significantly vulnerable in times of high-water and flooding, to receive relevant data concerning the river. Essentially, the foundations of both communities' disaster subcultures and coping practices are disintegrating and this could be debilitating for future self-sufficiency in light of the flood risk both communities will continue to face, even when the *Maaswerken* are done.

Technology

Before the floods of 1993 the primary technical measures were architectural measures, particularly in Itteren. Most of the houses in Itteren have stairs to their first floor. The first floor would be built at least higher than previously encountered water levels (Fig. 5-6, 5-7).

Figure 5-6 Itteren Architecture: Flood adaptation to houses

Farmers living in Itteren would even have vertical evacuation locations for their animals. This is in contrast with the majority of houses in Borgharen. Some older houses still have higher first floors, but the majority does not. The majority of houses are typical 1970's architecture, including bungalows and houses with underground parking places (Fig. 5-7).

Figure 5-7 Architecture: houses vulnerable to flooding

Since 1993 and the call for increasing flood protection levels, technical measures like levees and pumps, are becoming more dominant and visible in the landscape. This hints at a shift towards a greater emphasis on preventing flooding through engineered safeguards, similar to the north and the west of the Netherlands. In light of this, our research findings point at a possible challenge this shift could bring about. Firstly, we see how the increasing use and importance of highly sophisticated tools to deal with flood risk is distancing the community from the river

and rendering the prevailing disaster subculture and local coping mechanisms, inept. We also see the risk of the so-called safe paradox arising. This paradox is prevalent throughout the Netherlands where technical preventive measures taken entail indeed a safer system, but are simultaneously increasing the vulnerability of communities as they are less aware of and prepared for disaster threats (Engel and Trainor 2010).

Here we would like to note that we perceive a level of co-construction between the natural (Law 2009), technical and socio-cultural realm. For instance, communities' risk perception seems closely linked to the way communities perceive nature as well as their proximity and understanding of the technological means utilized. The close proximity of the Meuse to Itteren as well as their techniques to read and interpret nature result in a specific level of risk awareness as well as the existence of technical as well as socio-cultural capacities that enable the mitigation of damage in case flood events take place. A similar co-construction between these three realms we find with respect to beliefs, symbols and knowledge. For instance, the belief in self-reliance could hardly exist if those communities did not feel secure in their knowledge and expertise to interpret their environment and develop adequate knowledge, effective practices and techniques to deal with the perils of their habitat. In light of this, a focus on material-semiotic relationality is appropriate for the further analysis of such cases (Law 2002; 2009).

Patterns for Intra and Inter-Organizational Response

The recurrent threat of high-water and flooding has led to the development of a flood preparedness and response system at both a municipal and community level. At the municipal level, there are interdisciplinary flood plans outlining the various responsibilities and tasks at certain levels of threat. The plans are primarily developed by local authorities, but input is provided by both Parish Councils. Currently, the levels of threat are based on the cubic meters measured in the Meuse. This creates a problematic situation since community instructions were earlier based

on water-levels in meters. During the last high-water event, this created an unfortunate situation since information regarding the high-water threat was provided in cubic meters rather than water-levels and this meant that community members did not understand the information and did not know what to do.

Furthermore, the patterns for intra and inter-organizational response are largely defined by previous experience. Unlike in other parts in the Netherlands, professionals and local authorities remain within their organizations for many years. This enables them to generate necessary knowledge and expertise as well as a network of relevant partners. Partners of the Dutch local authorities, for instance, include relevant German and Belgian counterparts. Such international networks are not just useful to receive timely warning information, but also to increase response capabilities. The Dutch local authorities for example are not in the possession of boats that can withstand strong water flows, but German civil protection authorities do have these. Therefore, generally during high-water, German crafts are used for evacuation purposes (Velotti et al. 2011). Interviewees feel that this joint preparedness and these international networks enable an apt response to high-water and floods.

With respect to the community level, there are social structures in place. Borgharen's parish is divided into blocks and each block has a coordinating block head. Itteren does not have such a pre-arranged structure, but relies on emergent social action during any event. Most habitants have lived in Itteren for many years and have experience with high-water and floods. Itteren relies on these people whenever necessary. They express the confidence that, whenever there is a flood, the Itteren community will effectively react in a joint fashion.

Socialization

Any subculture requires a socialization process. In Borgharen and Itteren three socialization processes can be identified. The first process is socialization done through organized sessions in which available knowledge, experience and expertise

necessary to cope with high-water and flood events is shared. This type of socialization is more common with the local authorities.

The second socialization process is more common throughout the communities and entails essentially what the Dutch would call 'being thrown into the deep'[8]. Central to this socialization process are stories and actual high-water and flood experience. Newcomers are told stories about past experiences, and they receive information from the local authorities, but the socialization process is really completed when actual high-water or flooding is experienced. For instance, one interviewee knew about high-water and flood events 'theoretically', but only started looking into ways of coping with high water and flooding after his cellar flooded (Interview General Practitioner Borgharen and Itteren2012). Similarly, another interviewee told us she had been living in Borgharen for over seven years and she had heard many stories, but real understanding and knowing what high-water and flooding in fact meant to her and her family occurred in 2011 when she was surrounded by water and could only leave her residence, with her child, on a tractor (Interviews Borgharen 2012).

5.6 Variations of Subculture by Manifestation, individual/organizational influence, Instrumental/ Expressive Traits, and Scope

If we compare the two disaster subcultures that we have discerned throughout our research, we have to conclude that Borgharen's disaster subculture is more latent than Itteren's disaster subculture. Even though Borgharen has a disaster subculture, it does not become apparent until one explicitly looks for it or it becomes manifest as a result of flooding. Itteren's disaster subculture includes manifest instrumental and expressive traits, such as remembrances of past floods, art and poetry throughout the public space and instrumental objects, such as pump stations and

---

[8] Being thrown into the deep refers to children learning how to swim. Children generally begin in shallow waters and then go onto more deep waters. Being thrown into the deep refers to the idea that a good way of quickly learning how to swim is essentially being thrown into deep waters from the start.

'flood-proof' architecture. Borgharen's disaster subcultural traits are much more instrumental, although also some expressive traits can be found. For instance, what one immediately can notice are the levees (kades) to prevent Borgharen from flooding. For the rest, the disaster subcultures become for the most part apparent when high-water or flooding takes place and people show their knowledge and experience to act within the developed disaster subculture.

In both parishes the disaster subcultures largely influence individual disaster behavior, though in Itteren it goes a bit further than in Borgharen. For instance, in Itteren flood awareness and the Meuse seem to affect personal choices such as personal housing and landscaping choices more than it does in Borgharen. In addition, there are local organizations, like the Veiligheidsregio (Safety Region) Limburg Zuid and Waterschap (Water Board) Roer en Maas that have extensive experience with flooding and have subsequently specific knowledge, understanding and preparations embedded within their organization to effectively deal with floods. The disaster subculture thus also influences some local organizations.

With respect to scope, we have to say that the disaster subcultures are narrow in scope since they are prevalent mainly throughout the flood-prone areas and not, for instance, throughout all of the wider area. The disaster subculture is, however, represented by both formal and informal organizations within and outside the directly affected parishes.

5.7 Conclusions

This study showed that the disaster subculture framework, as it was originally formulated, can be used to identify and describe disaster subcultures in a context other than the context in which it was developed. Even though it was developed in the United States, applying it in the Netherlands has proven fruitful, mainly because it enabled us to discern that even a small country like the Netherlands knows distinct disaster subcultures and it allowed us to empirically identify and describe two concrete cases of disaster subcultures. Furthermore, as a conceptual tool, it unveiled

elements of these neighboring parishes' flood reality that otherwise might have gone unnoticed and can shed light on these two parishes' levels of vulnerability and resilience.

Because disaster subcultures evolve, we feel this lens should not be used as a snapshot approach, but should instead try to capture its dynamic dimensions over time. Subsequently, it would be fruitful to carry out these type of studies periodically to monitor the development of specific cases and identify factors or processes of change that affect communities' resilience and vulnerability either positively or negatively. Possible factors and processes of change are numerous and can vary from the occurrence of a specific event to the effects of for instance broader political processes.

In fact, our study uncovered an unsettling reality of change that could increase community vulnerability. The changed flood management paradigm and the subsequent introduction of infrastructural protection works that are common in other parts of the Netherlands, but not throughout the province of Zuid-Limburg, could easily subvert existing community capacities. Due to the *Maaswerken,* the river's behavior has changed and community members are no longer able to read and interpret the river's behavior. The river and the communities of Borgharen and Itteren are becoming estranged, engagement with the environment is left to others, mainly water authorities and professionals, and slowly but surely the foundations on which the current disaster subculture has been engendered are trembling, if not disappearing. It seems that the communities are losing grip of their environment and are subsequently losing their ways to effectively deal with both the opportunities and threats their environment embodies. This does not mean that the disaster subculture will disappear totally, but it will certainly be altered and lead to new vulnerabilities and levels of resilience. For instance, our findings suggest that these changes could transform two self-sufficient, responsible and resilient communities into two dependent, less prepared and therefore more vulnerable communities.

Even though our objective was not to critically engage with the conceptual framework we used, we do think that the findings of our study could provide empirical evidence to feed a more conceptual discussion aimed at improving it. One element that comes to mind is the fairly static nature of the framework. A dynamic use of it could add significant analytical and explanatory power.

Lastly, we would like to mention that this lens enabled a greater understanding of the way the Dutch 'high-lands' deal with the recurrent threat of fluvial flooding. Even though communities in the high-lands are almost on an annual basis confronted with the threat of flooding, there are few studies in the Netherlands that describe how these communities have found ways to live and flourish in an inherently risky environment.

Chapter 6: Disaster Subculture in Greater Concepción, Chile: Resourcefulness in the Face of Earthquake/ Tsunami Events[9]

6.1 Abstract

On February 27, 2010, south-central Chile was hit by a powerful earthquake that triggered a devastating tsunami. Greater Concepción was one of the most affected regions. Such events are recurrent and understanding vulnerability to them is important. We took the 2010 disaster as an opportunity to investigate earthquake/ tsunami vulnerability by applying a disaster subculture lens to people's 2010 disaster experiences. The focus was on relevant (disaster) cultural capital that people have access to and the way this capital affects their vulnerability.

This article presents the findings of this qualitative and highly exploratory study. We located a long-standing, broad and comprehensive disaster subculture that on the one hand makes it possible for people to resist impact and on the other helps them cope with events that surpass their resistance through agility and adaptability. We also uncovered some critical issues that affect vulnerability negatively and will require further attention.

Key words: Disaster, subculture, vulnerability, resilience, Chile

---

[9] This chapter has been submitted and is under review by the International Journal of Mass Emergencies and Disasters. It should be cited as Engel, K., Frerks, G. & Warner, J. (2018) Disaster subculture in Greater Concepción, Chile: resourcefulness in the face of earthquake/ tsunami events. Manuscript submitted for publication.

6.2   Introduction

> "[a] powerful earthquake destroys in an instant our most inveterate associations; the earth, true emblem of solidity, moves under our feet....one second has begotten in one's spirit a strange idea of insecurity, that would not have been produced hours of reflection
>
> (Darwin 2012, p.70)."

Because Chile is atop a highly active subduction zone (Lomnitz 2004, p.368), it is one of the most seismically active countries in the world that is regularly confronted with powerful earthquake/ tsunami events. The most recent one hit south-central Chile on February 27, 2010. It was a powerful M8.8 earthquake that triggered a tsunami that left a trail of destruction along the coast (hereafter these events will be referred to as 27F in line with Chilean usage). One of the most affected regions was Greater Concepción (GC), Chile's second largest conurbation.
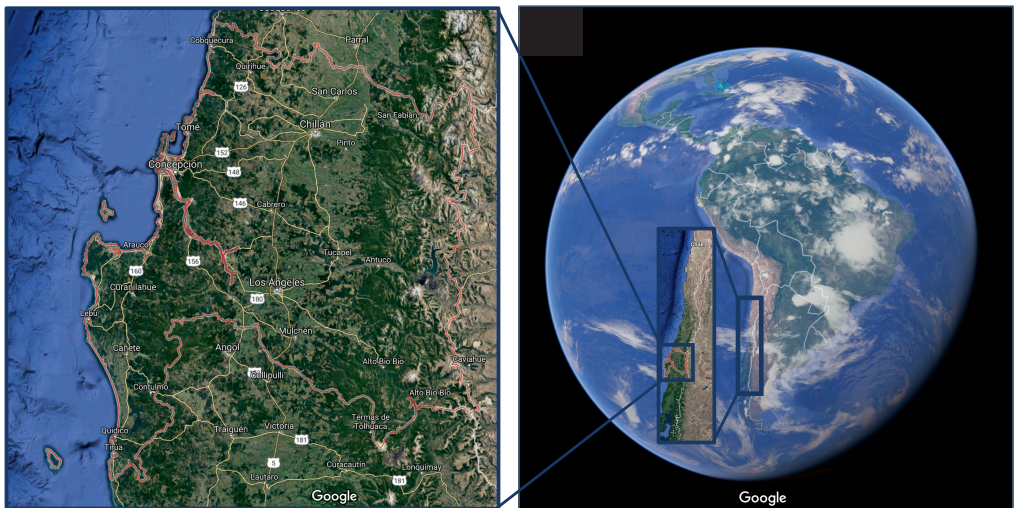
Figure 6-1 Greater Concepción, Chile (elaborated by the authors using Google maps)

Disasters provide a unique window into the way communities adapt or fail to adapt to their environment (Oliver-Smith 1996, p.303). In other words, if we would

take 27F as an opportunity to learn more about the way people in GC have accommodated in their inherently hazardous environ and, in the process, have adapted to recurrent earthquake/ tsunami events, the devastating events of 27F could lead to something positive. It would be possible to generate insights that would shed light on the vulnerability that people in GC face vis-à-vis earthquake/ tsunami events. This article is part of a study that aimed to do this. The empirical material for this article was gathered through an exploratory and qualitative study carried out by the first author in GC in the wake of 27F.

The underlying study looked at people's 27F experiences through a disaster subculture (DsC) lens. This lens was chosen because DsC remains one of the few conceptual frameworks that enables a systematic study of patterns of adaptation that emerge from communities' repeated experience with similar hazardous events. Also, research into flood DsC in the Netherlands (Engel et al. 2014) revealed that this lens remains relevant and provides valuable insights even when applied in a different context than it was developed in. Zooming into DsCs means concentrating on important cultural capital that people have at their disposal to deal with the persistent hazards that make up their environment.

Moore (1964) is credited with first positioning the concept of disaster culture to refer to "those adjustments, actual and potential, social, psychological, and physical, which are used by residents of such areas to cope with disasters which have struck or which tradition indicates may strike in the future (Moore 1964, p.195)." Over time, the concept was adapted to disaster *sub*culture to reflect that disaster subcultures complement wider cultures. Since Moore, different scholars, such as Anderson (1965), Wenger and Weller (1972, 1973), Turner (1982), and more recently Granot (1996), Bankoff (2013) and Engel et al. (2014) have used it in their work. It is also often referred to (see Gaillard et al. 2008; Marín et al. 2010; Bankoff 2015). Still, further conceptual development and more applications of the framework would be desirable (Granot 1996; Bankoff 2003, 2013; Engel et al. 2014; Krüger et al. 2015).

Applying the DsC lens in the aftermath of 27F exposed meaningful earthquake/ tsunami vulnerability realities. The approach we chose to explore vulnerability is inspired by Watts and Bohle (1993) and Gallopín (2006). It distinguishes three coordinates, namely exposure, sensitivity and capacity of response. Unlike Watts and Bohle (1993), though, we chose the more wide-ranging dimension 'capacity of response' as our third dimension. Resilience is related to this dimension. The study revealed that the prevalent GC earthquake/ tsunami DsC has both a positive and a negative effect on people's vulnerability, but ultimately preserves significant levels of adaptive resilience.

The objective of this article is to present our empirical findings, in particular those that shed light on the DsC that we encountered and are considered linked to people's vulnerability. To do this, we first introduce the DsC lens. Then we go on to discuss vulnerability. To increasingly understand the underlying study, we move on to a methodology paragraph. Before concluding, we present and our empirical data and, most importantly, our findings.

6.3   A Disaster Subculture Perspective on Vulnerability

Disaster Subcultures

Because hazards vary by locality and do not strike every day, "wider cultures that cover larger geographical areas…are generally unable to provide all its members with an exhaustive assortment of appropriate hazard-related solutions (Engel et al. 2014, p.863)." When this is the case, subcultures emerge (Cohen and Short 1958; Gelder 2005). When these subcultures have emerged from experience with disasters to provide ways to deal with similar events in the future, they are referred to as *disaster* subcultures. DsCs are *platforms of techniques, tools and artefacts, tangible and intangible, that are (re-)produced over time to provide resources for coping with recurrent (natural) hazard and be able to survive and prosper within one's inherently hazardous environment.* DsCs are therefore the

product of adaptability and its components manifestations of it. By providing resources, they provide stability. They emerge from communities' collective learning processes and allow people to make sense and feel confident when (significant) changes are brought about. Because of a DsC, when an event similar to previous events affects a community, people are not surprised and have resources available to address upcoming challenges and this ensures leeway to cognitively engage with more unexpected or complex ones. Key to DsCs is therefore the perpetuation of successful patterns of adaptation to a recurrent disaster context (Wenger and Weller 1972, 1973). The more successful the DsC the more successful the community can be at reaping the fruits of their environment and progress. In light of this, DsCs are tightly linked communities' vulnerability and resilience.

Like culture, DsCs are arbitrary (Inglis 2005, p.10) and the result of human activity and choice (Fine and Kleinman 1979, p.12). Subsequently, the following should be taken into account:

❖ DsCs are based on culturally conceived necessities rather than 'natural' ones, even when nature is an important factor cultures incorporate in their decision-making;

❖ Even though DsCs provide structure, individuals and groups "always possess agency to change or renegotiate their behavior in the face of these subcultures and thereby redefine the subculture itself" (Engel et al. 2014, p.863);

❖ Even though DsCs resources were successful in the past this does not guarantee success in the future, in fact they can become debilitating factors when circumstances change (Engel et al. 2014).

The disaster subculture lens

Conditions	
1. A community should both face and acknowledge a recurrent hazard;	
2. The hazard should allow for a period of forewarning;	
3. The impact of the focal agent should be salient to different segments of a community.	
Descriptive categories	
Valuative elements	Values define what is important.
Normative elements	Norms define desirable hazard-related behavior and guide people's actions.
Beliefs	Beliefs concerning the hazardous event, ranging from beliefs regarding one's vulnerability to those shaping behavior. Beliefs are intertwined with attitudes.
Knowledge	Do people have and apply relevant (scientific, local, or indigenous) information?
Technology	Are technical artefacts and socio-technical systems used to cope with the recurrent hazard?
Patterns for intra- and interorganizational reponse	How do organizational units (co-)operate?
Socialization	How do people get access to the DsC at hand and how are the DsC elements preserved and (re-)produced?
Comparative dimensions	
Manifest/ Latent	Are DsCs visibly present? Do they shine through the wider culture or do they only become visible as soon as a hazard strikes?
Individual/ Organization	Are hazard-related matters delegated to specific (professional/ administrative) organizations or is the whole community involved?
Instrumental/ Expressive	Are the DsC components aimed at controlling/ resisting hazards or are they directed at providing social meaning?
Narrow/ Broad	Is the DsC limited to the community exposed to the hazard at hand or is it broader in scope and does it also include (formal and informal) social units that are not directly exposed?

Table 6-1 Disaster Subculture Framework by Wenger and Weller (1978, 1979)

Even though there has been increasing interest in the way people adapt to hazardous environments, few efforts have resulted in a clear cut analytical tool appreciating of such efforts. Wenger and Weller's (1972, 1973) DsC framework is a unique tool to focus on identifying and exploring subcultural themes concerning recurrent hazards embedded within a larger culture. As a lens, it sheds light on the pool of cultural resources that people have at their disposal to face the adverse consequences of recurrent events that could lead to a disaster. It makes it possible to really go into the relationship between people's access to and use of cultural assets and their experience of vulnerability.

While it is based on studies in the United States, recent applications (Engel et al. 2014) have shown that it remains a useful lens to explore hazard related cultural resources. The framework includes three conditions that should be met for a DsC to emerge, descriptive categories and comparative dimensions (see table 6-1).

6.4 Vulnerability to disasters

Even though disasters induced by natural hazards are often referred to as natural disasters, disasters are not natural: "hazards are natural, disasters are not (Bankoff et al., 2008, p. 2). Disasters mirror vulnerability. There is no agreed-upon definition of vulnerability. It comes from the Latin word 'vulnerare' which means 'to wound', but over time numerous more definitions, conceptualizations and approaches have been presented. Some define it as "the physical, economic, political or social susceptibility or predisposition of a community to damage in the case of a destabilizing phenomenon of natural or anthropogenic origin" (Bankoff et al., 2008, p. 37), while others define it as "the susceptibility to be harmed…[or] the degree to which a system is susceptible to and is unable to cope with adverse effects (Adger, 2006, p. 269)." What most definitions have in common, though, is that they interpret, vulnerability in negative terms. We, however, consider vulnerability to be a system's potential for change or transformation when confronted with a

perturbation(s) (Gallopín, 2006) which emerges from a system's exposure to disturbance(s), sensitivity to perturbations and capacity of response. Central to this approach is 1) that vulnerability is not merely interpreted as negative, but can instead also be considered in a positive light and 2) resilience is not the opposite of vulnerability, but rather an attribute of it. Regarding the positive side of vulnerability, we ally with authors like Bijker (2006) and Hommels et al. (2014) who argue that vulnerability goes together with openness to change and accept uncertainty and is therefore intimately related to learning and innovation. A certain degree of vulnerability is even necessary to ensure learning and adaptation (Hommels et al., 2014, kindle loc. 370). Similar approaches are those by Watts and Bohle (1993) who consider vulnerability in terms of risk of exposure, inadequate capacities to cope, severe consequences and the attendant risk of slow or limited recovery, and Steffen et al. (2005, p. 205) who define vulnerability in terms of exposure, sensitivity, and resilience. Our approach to vulnerability is closely related to the one presented by Watts and Bohle (1993) and Gallopín (2006) and considers three dimensions: exposure, sensitivity, and capacity of response.

Resilience is related to capacity of response and refers to *the systemic quality that emerges from a community's collective performance in the face of (unexpected or unpredictable) change and represents the system's ability to absorb whatever change(s) encompasses* (Walker, 2004; Engel & Engel, 2012). It involves '[t]he challenge... to conserve the ability to adapt to change, to be able to respond in a flexible way to uncertainty and surprises. And even to create the kind of surprises that open opportunity (Gunderson & Holling, 2002, kindle loc. 756)." It reflects the system's ability to learn, self-organize, take advantage of opportunities, access to resources, potential for change and the degree of internal control over variability. Dovers and Handmer (1992, p. 270) identified three types of resilience or three ways a system can maintain itself: 1) by ensuring resistance and maintenance (form 1), 2)

by change at the margins (form 2), and 3) through openness and adaptability (form 3).

Vulnerability cannot exist without hazard (Bankoff, 2008, p. 38) and hazards and disasters are integral parts of environmental and human systems (Oliver-Smith, 1996, p. 304). To deal with such matters, communities engage with their environment and past experiences to cultivate means to make sense of and respond to them (Warner & Engel, 2014, Binder & Baker, 2017). Taking this into account, culture can be considered a 'toolkit' that community members have at their disposal to adapt to inherently hazardous environment, i.e. address hazard-related challenges by constructing appropriate 'strategies of action' (Swidler, 1986, p. 273). At the same time, cultural frameworks influence people's decisions, for instance choices of occupation, where homes are built, and resources available for social preparedness activities (Companion, 2015, p. 6; Hewitt, 2013). In short, cultures can offer and restrict access to relevant opportunities and resources and thus affect the vulnerability that people experience. This takes us to another important point. It is key to keep in mind that vulnerability is intrinsically 'social' and differential. It emerges from broader patterns of society (Engel, 2016 p. 1062), such as cultural, social, economic, and political patterns, and people are affected differently.

6.5 Methodology

"[S]ometimes we simply have to keep our eyes open and look carefully at individual cases—not in the hope of proving anything, but rather in the hope of learning something! (Hans Eysenck (1976) in Flyvbjerg, 2006, p. 224)."

This article is part of a broader study that aimed to uncover, understand and describe the vulnerability to earthquake/ tsunami events that people in GC experience by applying the DsC lens to the 27F aftermath. The study took place between 2011 and 2016. This period included over a year of immersion in 'the field'

by the first author. Since *experiences* are central to this study and "meanings cannot be measured only understood (Bhaskar, 1989, p. 46)" this study was qualitative. In addition, a qualitative approach was fitting because when this study was designed and largely carried out there were few studies looking into these matters in this region and it would thus be a highly explorative endeavor.

Even though we looked at GC, we chose to select a couple of cases we could zoom into. For this the strategy for inquiry that we chose was 'case-study'. This strategy was considered appropriate because we wanted to go in-depth into people's experiences. Furthermore, even though case-studies are appropriate for all types of research (exploratory, explanatory, and descriptive), it is particularly suitable for exploratory investigations. In time we decided to focus eve more on the area that had experienced both the earthquake and the tsunami. The two coastal cases were located in the town of Talcahuano and the more in-land case in the town of Hualqui. In each town people from an urban community and a rural community participated.

To select the cases purposeful sampling was used, in particular snowball sampling (Biernacki & Waldorf, 1981, p. 141). This method was considered particularly appropriate because of the sensitive nature of the participation in this study. Participants were asked to convey their 'disaster' and 'recovery' stories and to many participating in this study meant recollecting painful experiences and displaying vulnerabilities. So through this form of sampling it was possible to 1) follow the actors and ensure that relevant actors for the community were included, 2) ensure increasing trust and rapport between researcher and participant, and 3) make sure confidentiality was safeguarded throughout the study.

Collecting data encompassed various qualitative sources. However, the primary sources were (in-depth) interviewing and observation, but literature and document review, participation, and the review of audio-visual sources were also part of the study. The interviews were largely unstructured to enable the participants to lead the 'conversation' and take me to the experiences they considered important.

The researcher would, however, ensure the interview would stay 'on-topic'. The main objective was to learn as much as possible about the participants' context and background to enable me to interpret their 27F experiences as accurately as possible. The result is a pool of data from a wide variety of people from different socioeconomic backgrounds, ages and even ethnic backgrounds. Informants included community members, officials and professionals concerned with disaster management. Over a hundred individuals were formally included in the study, but many more respondents provided valuable insights in more informal settings. The data collected made a rich picture and triangulation possible.

The data were recorded through field notes, interview notes, recordings, and video. Because of the sensitive nature of the data it is highly confidential. They are personal accounts that lay bare vulnerabilities, not just societal, but also personal ones. It is therefore of utmost importance that the integrity of this data is properly protected. Because the anonymity of the respondents is so important, we chose to refer to them as 'objectively' as possible. The communities that were involved in this study are small and personifying the quotes by for instance describing the participants in combination with the citation could lead to recognition of the participant involved. We considered pseudonyms, but we felt they would add a dishonest dimension to the work and to the personal account. In light of this, we chose an unorthodox way to cite participants. It is a more impersonal way as we take the data as 'raw data' and cite them as such to convey an argument and disclose as little personal information as possible. We only convey contextual information that will enable the reader to understand the 'raw data'. Lastly, validation of the data were achieved through triangulation, member checking, and prolonged time in 'the field'.

The analysis of the data revealed patterns of adaptation to earthquake/tsunami events that shed light on the experiences of vulnerability people experience in light of these events. These are presented in this article.

6.6 Disaster subculture in Greater Concepción

Conditions

Two of the three conditions are met. In terms of condition one, a community should both face and acknowledge a recurrent hazard, we quickly concluded that GC faces *and* acknowledges the recurrent earthquake/ tsunami hazard they face. Respondents' narratives and the literature we reviewed revealed that the city of Concepción used to be a coastal city, but was relocated to a more inland location after it was devastated by a major earthquake/ tsunami event in 1751 (Lomnitz, 2004, p. 370; Interviews GC 2012/2013). In addition, they stressed they knew every approximately 20 years they would be affected by a major earthquake and that such earthquakes could trigger tsunamis. Scientific literature supported this further: GC is exposed to major earthquakes that can be accompanied by tsunamis because it is situated along a portion of the subduction zone that experiences stronger friction (Aon, 2010, p.4).

Regarding condition two, the hazard should allow for a period of forewarning, we found, like Turner (1982) that this condition is generally not met when it comes to earthquakes, except maybe in preparation for aftershocks. We did, however, detect a comprehensive DsC.

Condition three states that the impact of the focal agent is salient to different segments of a community. In the wake of 27F it was apparent that these events affect everyone and is thus salient to different segments of a community. Impact was differential, but nobody escaped it. Even the tsunami. It hit coastal communities directly, but affected a large part of the country since important services, labor opportunities, and tourists are hosted there. So when they were hit, the affected included members from communities all throughout the country.

Descriptive Categories

Throughout the following paragraphs we will present a number of manifestations of DsC that allowed us to learn more about vulnerability to earthquake/ tsunami events people experience.

Valuative elements.

What do people value? Why do people collectively devise means, i.e. cultivate a DsC, to more effectively cope with natural hazards? Mostly because people want to safeguard that which they value. In the GC case, what participants valued most and would drive them to (re-)produce the DsC was: *life* and *family*. A leading sentiment was that family is *everything*: "if you don't have family, you have nothing" (Interview GC-Hualqui 2016). Respondents underlined that "things can be recovered, but lives cannot" (Interview GC-Hualqui 2014, 2016) and that "you love people, not things" (Interview GC-Hualqui 2014). In line with this, we learned that participants did not care much about material possessions or their physical environment. Participants stressed that in time, with effort, material possessions can be recovered if you put forth effort and apply yourself. In light of this, we identified values like *endurance, sacrifice, effort, and progress* to have had a positive effect on people's capacity of response: 'when you get knocked down, you get back up and move on, there is no other way' (Interviews GC 2012-2016). We have seen these values kindle a remarkable perseverance and stamina that have supported their recovery efforts.

Solidarity

Another value that this study found key to the way people in GC respond to earthquake/ tsunami events is solidarity. In the rural coastal locality, for instance, it was key to evacuating everyone uphill, even the incapacitated:

"All escaped up the hill because their instinct told them to do so. We did have some difficult cases though. One neighbor for instance, could hardly walk and her family and neighbors had to lift her up to escape. To do this they tied a robe around her waist and pulled her up while her daughter pushed. We also had another neighbor with difficulties walking who first did not want to escape but eventually did because his daughter in law told him she would only escape with her daughter; his granddaughter, if he would also do so. Together with the help of neighbors they got him out (Interview GC-Talcahuano 2013)."

We also found that the communities' leading rescue capacity is shaped by solidarity. The *voluntary* fire brigades are the primary rescue capacity. These brigades' financing depends largely on the community members' own contribution. Similarly, we found that most of the recovery-related resources were made possible because of solidarity. The majority stressed that most of the assistance they received had been from private entities. From family, friends, fellow countrymen, companies, etc.:

"Private parties helped a lot, a lot! They gave us many things. We did not lack food, jackets, clothes. Almost everything was private (Interview GC-Talcahuano 2013)."

"We had friends with businesses who would bring us food so that it would not go to waste. People would even call our family the flinstones because we got ribs. My friend next door helped us prepare them and we were like the Flinstones eating those bones…we had a lot of friends who brought us

seafood... we ate so much shrimp I cannot see them anymore. We had to cook everything immediately so that it would not go to waiste…we would share withour neighbors and they would share with us and that's how we were (Interview GC-Talcahuano 2014)."

Beliefs and attitudes.

Regarding the material, what we found different participants shared was the idea that situations and conditions are largely transient; just 'for now' (mientras tanto). Things change. Interestingly, we saw this belief stimulating a positive attitude towards recovery. Participants did not seem to hold on to the past, but were rather figuring out how they could positively influence change. This is related to another belief that we identified throughout GC. Participants did not consider themselves victims of nature. Instead they would take their natural environment, including the hazards, as a given and their responsibility to make sure they strive notwithstanding that environment as a must. In fact, we found that participants showed great confidence and pride in the way their communities had adapted to their environment. They stressed that the means they have developed allow them to resist most quakes between M1 and M7 (Risk mapping exercises Hualqui 2014, Observations GC 2012-2014, Interviews GC 2013-2016).

Even though this confidence and pride could translate into an attitude of defiance (Moore 1964; Engel et al. 2014), we did not observe this in GC. Instead we observed a humble attitude towards nature: "nature rules" (la naturaleza manda). Interviews revealed a respect for nature that verged on fear. Regularly we got the impression that people felt they lived at the mercy of nature. The following passage regarding the sea illustrates this:

"Blessed is the sea for providing us with employment and sustenance, but damn her for taking our people. And the sea really takes! Rarely do you

actually get to bury the deceased... But then when she gives, and she gives a lot(!), you remember that you need her (Interview GC-Talcahuano 2013)."

The interviews clarified that our participants knew their capacity to response had their limits and that for a telluric event equal or beyond M7, for instance, they would have to turn to protective behavior immediately.

Normative elements: behavior and practices.

Characteristic of the participants' response to earthquakes and tsunamis was *the practice of fleeing*. As soon as the most powerful shaking had ended, participants fled their dwellings: "The first reaction was to get out…outside is where you feel safest." Most participants stayed outside for days after the main quake. Also in response to tsunamis, fleeing was a key practice. Respondents knew that a major earthquake along the coast could mean a tsunami was forthcoming:

> "In that specific moment you just think about saving yourself and … you just follow you instinct and ours told us to go up the hill. As we moved up the hill we would shout out at our neighbors to alarm them and when we got to the plateau we saw that all our neighbors had escaped: all! Because of our community's response, we only had two deaths... (Interview GC-Talcahuano 2013)."

For most respondents from inland communities, but also for those from urban localities along the coast, this knowledge was latent. Because of this it did not always translate into practice. Especially respondents from the urban coastal locality revealed that they were aware of this practice, but that in their response to 27F they did not turn to it.

We also found a practice which we dubbed *'rapid event appraisal and protective behavior selection'*. Our respondents revealed knowledge and skill to appraise telluric events rapidly (Interviews GC 2013-2016) and have this appraisal inform their selection of fitting protective behavior. Their lengthy experience with tremors of varying magnitudes makes this possible. The appraisal is prompted as soon as a telluric event is detected and encompasses: 1) a rapid appraisal of the event, particularly *strength* and *duration*, 2) an evaluation of actual impact, 3) an estimation of possible impact, and 4) the selection of a right course of (protective) action. For instance, if the event is barely discernable it is considered negligible:

"It is difficult to understand, especially for foreigners, that we live with [earthquakes] so internalized that we don't even give them notice most of the time (Interview GC-Talcahuano 2013)."

It became apparent throughout this study that most seisms between M1-M5 do not move people. They might be felt, but they do not trigger a response. Only those approaching 'earthquake' status get a response. Regarding this, we found that the 'earthquake' label is reserved for the most powerful telluric events, i.e. M7 or beyond. In other words, only events that really test the region's capacity of response, like 27F (magnitude 8.8), Iquique 2014 (magnitude 8.2) and the most recent northern earthquake (magnitude 8.3) are considered *real* earthquakes. They can afford to do so because they have the capacity to withstand most smaller quakes.

Respondents revealed continuous awareness of the possibility of a 'real' earthquake. This is why on February 27, 2010, they knew, when the shaking got stronger and did not stop, that it was the one they had been waiting for.

Respondents from the rural coastal communities informed us that in case of tsunamis the appraisal practice was complemented with the practice of interpreting the environment for signs that point at the arrival of a tsunami. Respondents indicated that in 2010 they interpreted natural warning signs, such as a retreating

sea, to determine that a tsunami would be forthcoming and this led to most of them taking appropriate measures.

Whereas Chile, and therefore also GC is characterized by advanced building codes to ensure a resistant built environment, participants underlined it is mostly the *practice of earthquake resistant design and construction* that ensures a resistant built environment. A participant building his own home stressed it was not to abide with the laws that he would ensure building seismically, but rather his desire to keep his family safe. Our findings suggest that the awareness that earthquakes can be a real threat to life and family moves people to put codes and laws into practice. As a result, we found that not just professional contractors that practice earthquake resistant design and construction, but also households constructing their own homes (Interviews GC-Hualqui 2013).

What emerged time and again was the importance of *improvisation*. Throughout the time in 'the field' it was repeatedly stressed how people would not focus on preparations, but rather on improvisation. The fire fighters, for instance, call themselves the 'kings of improvisation'. This seems facilitated by the voluntary nature of the fire brigades. Fire fighters also have a day-job. So besides emergency response they have access to different professional capabilities, networks and resources and can swiftly and capably shift between roles and system configurations.

Throughout the time in 'the field' it became apparent that opportunism is widespread. In fact, passing up on opportunities is frowned upon— "hay que aprovechar!" (one has to take advantage) is a phrase that is used repeatedl) (Interviews GC 2012-2016). So, in whatever situation, *opportunities are considered and seized*. Also in times of disaster. One government functionary expressed that 'emergencies are opportunities because previously tight resources are finally released. This is why they try to declare as many emergencies as possible'. Similarly, high officials of two towns disclosed that post-27F resources were used to realize previously defined plans. In Talcahuano, the previously devised plan was to improve

Talcahuano's appearance and in Hualqui a pressing concern was housing. Both local governments saw opportunities to address issues and they did. To what extent this is desirable should be assessed but it does illustrate the underlying norm.

A more negative form of this 'norm' was 'looting'. Even though some people, particularly those from the coastal communities, saw this practice as the only way to address pressing needs, we found that it severely harmed GC's social fabric. For many people the 'social earthquake' as they called it was more frightening than the earthquake itself. People felt equipped to deal with the 'natural' earthquakes, but not with 'social' one: the looting:

> "The anguish of people steeling; the idea that people would go into your house, and not being able to buy anything. That was the worst. In fact, most of the post-earthquake dread was because of the people, not because of the earthquake (interviews GC-Hualqui 2014)".

Knowledge: the confluence of indigenous, local, and scientific knowledge.

The practice of fleeing in case of a tsunami seems rooted in the region's indigenous past and preserved in *indigenous knowledge*. We learned this from historical writings. In 1882 Medina, for instance, shared Olivares' passage on the way Mapuches respond to major quakes:

> "They have a particular and circumstantiated superstition when a great tremor hits: as soon as the major violence of the movement has passed, both men and women get themselves together, gather food and plates on their heads and move with their young and just the poor clothes on their back to the nearest mount they call ten-ten...and they only feel safe when they have reached the top. They explain their behavior by saying that similar earthquakes have caused sea water to overflow onto shore and that they are therefore fearful that the land will flood like tradition says it did in the past.

[Since] this Tenten has the quality of always rising above water, with food it is possible to stay while the flood lasts (Medina, 1882, p. 237)."

Moreover, this practice is central to the Mapuches' story of origin—the *legend* of Tenten and Caicai (Lenz, 1912; Bengoa, 2000; Benedetti, 2011; Kronmüller, Atallah, Gutiérrez, Guerrero, & Gedda, 2017). The moral of this legend is that every province has a Tenten; a hill, on which Mapuches' ancestors survived the great (tsunami) flood and which is there for them to escape to in case of another (Lenz, 1912, p. 764). Today both the practice and the knowledge have become mainstream and are no longer specifically Mapuche. This does however show the preservation of relevant tsunami-related knowledge.

The 'rapid event appraisal and appropriate protective behavior selection' practice that is used for telluric events is, however, founded on a confluence of *scientific* and *local knowledge.* The magnitudes of the Richter magnitude scale are used to label events (scientific knowledge), but the estimation used to label events is done through local knowledge that is attained through experience with similar events (Interviews GC 2013-2015).

Dealing with tsunamis includes both *indigenous* and *local knowledge.* Members of coastal communities proved knowledgeable about their environment and earthquake/ tsunami events and can therefore interpret natural warning signs to determine whether a tsunami is imminent. This knowledge is combined with the response strategies embedded in indigenous knowledge that is preserved through narratives like the legend of Tenten and Caicai. We found that this knowledge is not widespread throughout GC and mostly accessible to coastal communities. The coves Candelaria, Canteras and Porte Ingles, for instance, were severely hit by the tsunami but only two members died because they had access to relevant tsunami-related knowledge and strategies. Coastal communities from more urban localities,

however, stressed their knowledge was very latent and was therefore almost inexistent when 27F hit.

The practice of earthquake resistant design and construction is heavily based on scientific knowledge, but to some extent also on local knowledge. Local knowledge of the environment prompts people to ensure earthquake resistant construction and local knowledge about construction materials and their seismic behavior allows people to independently ensure earthquake resistant construction. People know for instance that wood has reasonably good seismic resistance, as they are quite flexible during shaking. This knowledge, which is based on science, is preserved in local knowledge. One respondent's father for instance had told her that "wooden houses are like match boxes, they might shake but will not collapse" (Interview GC-Concepción 2013). People also know that, as Alexander (1999, p. 327) points out, adobe constructions are extremely aseismic. Participants stressed that in their view constructions that 'fell', which were mostly adobe, "had to fall" so they could be replaced with earthquake resistant constructions.

What supports this knowledge is the availability of natural capital, i.e. great quantities of lumber, so households that might not be able to afford confined masonry constructions or reinforced concrete can opt for wooden constructions. The communities studied had a significant number of wooden dwellings because people know about their good seismic resistance.

Technology.

When it comes to technology, the tsunami warning system requires attention. Chile is a member of the International Pacific Tsunami Warning System (IPTWS). This system is based on observation networks of seismometers and sea level measuring stations that send real time data to national and regional warning centers (TWCs) (IOC). These TWCs then confirm or cancel a tsunami watch or warning. In case of a potentially destructive tsunami it is up to national authorities to decide if a tsunami warning and evacuation should be issued. In 2010 the international component of

the system worked and communicated to the relevant Chilean officials that a tsunami was to be expected. For various reasons, from technological failure to human error, this message was disregarded and national officials discarded the possibility of a tsunami and told people it was safe to return to tsunami-exposed homes. One local official told us how he learned the national authorities had discarded a tsunami:

"We thought a tsunami was imminent, but then I heard the intendant and other authorities say on the radio that there wouldn't be a tsunami. So we were calm. We believed it. It wasn't just some guy giving me this information, it was the intendant; a superior authority with supposedly relevant information. So for me, there was no tsunami…I remember telling different members of my staff to go back home. One of them asked me 'chief, what do I do?' I told her 'take your family home'. She was living in the neighborhood 'Las Salinas' where the tsunami wave entered with great violence. She told me days later that she had been taken by the wave (Interview GC-Talcahuano 2016)."

Similarly a respondent residing along the shore, who lost a family member because of the tsunami, told us the following:

"The authorities informed us through the radio that the tsunami had been discarded. The intendant spoke and the president, the whole world said the tsunami was not coming. The police passed by our house with megaphones to inform us. In fact, there was a policeman on the corner and we asked him and he said we should not (Interview GC-Talcahuano 2012)."

The national component of the IPTWS failed and this resulted in numerous deaths. Interestingly, in coastal communities with significant levels of long-standing local tsunami-related knowledge the official messages were ignored and people evacuated up the hills anyway. This saved lives.

Patterns for intra- and inter-organizational response.

We found that the primary functional social unit of was the extended family. When this unit is intact; together, people feel confident and in a position to deal with whatever comes their way. In line with this, people sought to assemble their families as soon as the most powerful shaking had passed:

> "After the earthquake, my brother immediately went up to see us. He got in his car and managed to get to our house before the tsunami" (Interview GC-Talcahuano 2014).

As institutions collapsed and could not recover quick enough to respond to emerging needs, private parties, in particular (extended) families drove the response and recovery. The (extended) family includes direct and more indirect family members and can include friends whom have proven trustworthy and reliable over time. These family units could be very extensive and reach beyond geographical borders.

Socialization mechanisms.

For both earthquakes and tsunamis, people know what to do and what to expect because of stories their parents or grandparents shared with them:

> "My parents and in-laws lived the [1960] earthquake and they would tell me about it. They told me how people were left homeless as their adobe homes all collapsed. Everyone was left homeless and without food or water. It was terrible (Interview GC-Hualqui 2014)."

The difficulty with this being the primary type of socialization lies in that it is difficult for outsiders, who are not part of family structures with relevant experience, to become socialized and as such get access to relevant disaster subcultural assets. The tsunami knowledge that is, for instance, key to survival in the face of tsunamis is mostly transmitted orally.

> "Our grandparents told us, that in case of a strong earthquake that would make us fall and would not let us get back up we would have to run up the hill

because the sea would start to recede and recede and rise…so we knew since we were young. Now we have to tell our grandchildren (Interview GC-Talcahuano 2014)."

The comparative dimensions of the framework.

Our literature review revealed that a number of DsC elements have been observed decades ago and that the DsC might thus be a long-standing one. For instance, the combination of confidence and humility was observed by Chilean author Augusto d'Halmar (1975, p. 299):

> "We live confidently atop *terra firma*; nevertheless, she will engage with us and makes us lose our equilibrium or its internal equivalent: control, and one stumble is enough to give it to us hard and find ourselves with our noses against a mother turned stepmother; a minimal negligence can put our personal integrity at risk [...] Nature, with a capital 'n', once again imposes herself on our artificial civilization" - Chilean author Augusto d'Halmar (1975, p. 299).

Similarly, in Ortega y Gasset (1965) observed values like endurance, sacrifice, effort, and progress in the wake of a disaster to be characteristic to Chilean society: "This flourishing Chile has something in common with Sisyphus…as it seems condemned to having brought down a hundred times whatever they have raised with their effort a hundred times". In fact, Onetto (2014, p. 191) asserts that Chile was notorious for its environmental risks as early as 1660 and Chilean society has since been praised for their capacity to repeatedly 'redo the undone' and 'grow in the face of adversity' (Gandarillas, 1960, p. 7).

We also found that the practice of fleeing one's dwelling is not a recent one:

"[I]nhabitants avoid bodily harm by escaping from their homes because of any moderately perceptible shaking, since there is no telling what might follow; and the praiseworthy custom has been the more successful, as strong shocks are generally preceded by lighter ones (Gol (1904) cited by Lomnitz (1970, p. 1312))".

In addition, Onetto (2014, p. 196) points out that the practice of labelling only potentially disastrous telluric events as 'earthquakes' dates back to the 1700s (Onetto, 2014, p. 196). Another finding pointing at the long-standing nature of this DsC was the finding by Lomnitz (1970, p. 1312) that historically the practice of fleeing one's dwelling has been successful and thus preserved: 'rapid evacuation of dwellings has been effective in preventing or reducing earthquake casualties (Lomnitz, 1970, p.1312).' He points out that in both 1730 and 1960, this practice prevented deaths because the foreshocks had moved people to spend days outside their dwellings. So when the main shocks hit, people were out of harm's way.

Our findings also suggest the DsC is broad in scope and possibly covers more than GC. The finding by Onetto (2014) provided above illustrates that the values that we found characteristic of the GC DsC have been used to describe the Chilean people as a whole. Also, the study by Marín et al. (2010) that covered different Chilean regions also found the practice of 'fleeing up a hill as soon as an earthquake is detected that is so strong that you cannot stand up and walk' (Marín et al. 2010, p. 1383) and the local knowledge that makes it possible for people to interpret their environment for possible natural warning signs.

Lastly, we found that Sehnbruch et al. (2016) also identified this practice of taking advantage of opportunities that we uncovered: "...different government agencies produced widely differing statistics on the damage caused by the earthquake, in some cases vastly inflated by the pressures exerted by local communities… to declare the most damage possible with the objective of obtaining the largest possible share of reconstruction resources."

The DsC we studied was furthermore *latent* and encompassed both *expressive* and *instrumental* dimensions. Instrumental assets safeguard resistance while more expressive assets stimulate flexibility and adaptation. What is also notable is the DsC's individualized nature. Access to DsC assets is not provided by formal organizations and as a result individuals and thus communities get empowered. Hence they are not dependent on distant experts. Actually, this strategy has been institutionalized as governmental documents like ACCEMAR call for a *'natural' early warning:* a red alert should be imminent as soon as "a seism occurs with such intensity that people cannot stay afoot, walls collapse, towers crumble and manages to displace some wooden dwellings" (ONEMI, 2001, p. 9). All indicators taken from local knowledge-based rapid event appraisal. The idea is that complex technical systems that depend on experts render individuals vulnerable. Firstly, because going through such systems are time-consuming processes and encompass numerous points of potential failure, while an individualized response system is more robust. This strategy proved critical in response to 27F as the 'natural' early warning approach proved more effective than the more complex technical tsunami warning system that was in place. In fact, the latter failed and resulted in numerous deaths (Soulé, 2014).

6.7 Vulnerability in Greater Concepción

There is little that can be done to reduce exposure, but the participants in GC showed that through collective learning and ingenuity they can make sure vulnerability is positively affected by improving their capacity of response. What contributes to this is the DsC that they cultivated. It became apparent that from the value accorded to 'life' and 'family' a will emerged to ensure that future earthquake/ tsunami events are less deadly and disastrous. This resulted in the cultivation and preservation of a DsC; a plethora of cultural resources, ranging from scientific knowledge and complex socio-technical systems to indigenous narratives, that enable people to cope with violent earthquake/ tsunami events. Our investigation

into these resources suggests that these resources enable a capacity of response defined by resistance and agility. Throughout the following section we will discuss the contributions of the DsC to vulnerability to earthquake/ tsunami events in GC.

Sensitivity

Resistance—From the confluence of scientific and local knowledge ensues increasing resistance, i.e. decreasing sensitivity to earthquake/ tsunami events. The built environment and the people can withstand significant telluric events. The environment's resistance is founded mostly on the practice of earthquake proof construction. People's resistance on the other hand comes from ample risk awareness and knowledge, stemming from their considerable experience with telluric events. People are able to interpret events, translate them into possible impact and opt for fitting protective behavior. Experience taught them, however, that most events are negligible. Accordingly, such events do not even 'move' them.

Capacity of response

Resourcefulness, flexibility and openness to change—Resistance allows communities to continue life without excessive interruptions in a continuously quaking locality. Various DsC resources however allow for increasing resourcefulness, flexibility and openness to change and subsequently resilience. These make it possible for communities to safeguard their integrity even in the wake of a major event like 27F. The attitude that situations and conditions are transient is, for instance, beneficial to resilience, since it advances flexibility rather than stability. People acknowledge that things change and as Walker and Salt (2006, kindle loc. 209) stresses, recognizing and accepting change is at the heart of resilience: "to ignore or resist [that things change] is to increase … vulnerability and forego emerging opportunities".

Similarly, values like endurance, sacrifice, effort, and progress as well as an attitude of 'not looking back, but moving forward' makes it more likely that a community will 'bounce forward': will find relevant resources, take advantage and learn to ensure necessary adjustments are made to accommodate to a new situation and find ways forward to progress into a 'new normal'.

The attitudes of 'confidence' and 'pride' reflect the success the communities have had at adapting to their environments. They have been successful and can thus live confidently and proud in an inherently hazardous environment. At the same time, these attitudes do not exceed responsible levels because a sense of 'humility' keeps these sentiments in check.

The availability of the 'rapid event appraisal and protective behavior selection' practice in combination with high risk knowledge and the practice of 'fleeing' for both earthquakes and tsunamis provide people an action-perspective. Independently of risk professionals and authorities, people can interpret their environment and access and select an appropriate alternative strategy that will increase their chance of survival in case of earthquake/ tsunami events. We observed, like other researchers such as Soulé (2014) for other communities along the affected coast, that "self-warning and voluntary evacuation of possible inundation zones limited the extent of the disaster" (Soulé 2014, p.380). People did not wait for official warnings and even ignored them when contradictory to their own estimations. This saved a lot of lives (Marín et al., 2010; Fritz et al., 2011; Interviews GC 2013-2016).

This is related to the observation that the DsC is mostly reliant on bottom-up socio-techncial systems and community assets instead of more complex, science based top-down ones. This is particularly useful in the case of fast-onset events during which you want a quick activation and the least possible dependencies and points of failure. A salient instance of this was the overall ability of members of coastal communities to interpret natural warnings and select the right protective measures in a timely manner. In line with this, New Zealand's tsunami evacuation

tsunami education "stresses the importance of natural warnings and immediate evacuation in the event of a local-source tsunami, because in such events it is possible for tsunami waves to arrive at the coast faster than it is possible to disseminate a warning to the public" (Fraser et al., 2016).

What also contributes to flexibility is having the family as primary functional unit because these are durable even in the wake of material destruction. According to Weick (1993, p. 642) this is not surprising and even useful in emergency situations: "[t]he only [organizational] form that can keep up [with a rapid changing environment] is one based on face-to-face interaction." He argues that the collapse of role systems among people where trust, honesty, and self-respect are more fully developed is more likely to lead to new options, such as mutual adaptation, blind imitation of creative solutions, and trusting compliance and this is key for recovering and accommodating to a new 'normal' (Weick, 1993).

Lastly we would like to stress that the individualized nature of the DsC allows for increasing accessibility and seems very suited for rapid onset events like tsunamis. Members of communities are independent and capable of responding correctly. This is powerful because people affected by a major hazardous event are generally responding on their own for approximately 48 hours.

Critical issues

Some DsC elements contribute negatively to earthquake/ tsunami events by negatively affecting capacity of response. The incorporation of the tsunami warning system has, for example, entailed numerous failures. This needs addressing. Our findings suggest this failure may be related to the system currently not being adequately embedded in the DsC. In terms of tsunamis, DsC components, like ACCEMAR, local knowledge and practices to appraise the situation and determine fitting protective action, and the tsunami 'practice of fleeing' are all directed at swift, bottom-up responses to a fast-onset hazard based on local knowledge and

experience. The level of complexity is such that there are few possible points of mayor failure. The earthquake-tsunami warning system is the opposite. It is top-down, involves a multitude of organizations and is so complex that it is cumbersome, time-consuming and encompasses multiple points of possible failure. It corresponds to the technical expert system that ACCEMAR stresses should *not* trigger evacuation in the case of a local source tsunami because it takes too much time to produce relevant information. In 2010 numerous points of failure came to light and it was empirically proven that evacuation in case of a local source tsunami should not depend on it. To make it fit the DsC, it could *support* the dominant (and successful) bottom-up system and lose any pretension of authority. It could be functional and subservient to the traditional system.

What also negatively affects vulnerability is the nature of the socialization mechanisms. The DsC is preserved mostly through family narratives of past experiences. The importance of face-to-face interaction ensures flexibility but is also fragile and contributes negatively to vulnerability. This is not inclusive and can result in the death of 'outsiders'. The EERI (2010) report illustrates this: in places like Pellehue and Curanipe campers accounted for large numbers of fatalities (EERI 2010) because "there were no education programs targeting tourists or other transient populations" (EERI, 2010, p. 6).

The reliance on solidarity is similarly worrisome. While people are grateful for all the assistance they received, the provided relief did lack design, structure, reliability and adequacy. According to our participants, the allocation of assistance was heavily guided by the mass media. This meant that there were heavily affected areas with little media-coverage that received little outside assistance. On top of this, since there was no formalized approach a lot of the assistance was redundant or not responding to needs. It was largely driven by altruistic motives and was therefore also very temporary. As soon as the novelty of the situation had worn off and people had to return to their daily business, assistance would diminish even

though important needs persisted. In addition, the deeply rooted norm that the response should be primarily guided by solidarity seems to prevent the fire brigades from achieving uniform capabilities throughout the communities. There seems to a lack of political will to secure relevant resources for the brigades to rid of the prevalent disparities. Political will could for instance allow fire brigades to be exempt from paying toll fees. Until recently this has not been the case. Solidarity as the primary source for calamity response seems so entrenched in the DsC that it prevents the government from intervening and rectifying such shortcomings and securing the necessary resources for all brigades to have adequate doctrine, training and resources to provide equally competent services.

The sole focus on improvisation also raises questions. As Harrald (2006) notes, disaster response generally requires both discipline and agility. In other words, one should prepare to improvise (Engel & Engel, 2012) and thus invest also in discipline and doctrine. In this sense, emergency response is very much like jazz (Wachtendorf & Kendra, 2006, p. 6; Engel & Engel, 2012).

Two critical issues concern the fire-brigades. Because of their voluntary nature and solidarity based funding capacities vary across communities. A brigade made up of affluent members is generally better equipped than those composed of lower middle-class members. Affluent fire brigades have substantial facilities such as a proper dormitory for the night shift, a living room, including a bar, a small soccer field, training area, workshop with tools and machinery, gym, and swimming pool. While less well-off brigades have to cope without even the most basic items, such as proper dormitories for night shifts and proper gear and equipment such as a fire truck with brakes that does not require the use of tree branches to stay in place while the crew is responding to a fire (Interview Hualqui 2013).

The idea exists that professionalizing the brigades will solve this. While this might be the case it could also lead to reduced agility. The fire brigades' voluntary character means that they are embedded in the communities they operate in and

that they have access to a significant pool of resources and capabilities. They are part of various networks and have varying skills because the firemen have different day jobs and have the ability to swiftly and capably shift between roles and system configurations. According to Weick (1993) this facilitates improvisation and bricolage, which is useful in times of emergencies. Because like battle, emergencies hold the potential of "destroy[ing] men, equipment, and organization, which need constantly and continually to be brought back into some form of unity through on-the-spot improvisation" (Janowitz, 1959, p. 481). This could be lost. The question is also whether a more highly organized fire department would fit the prevalent community-based DsC and be able to function within it. The events of 27F brought to light that few of the formal emergency organizations was capable of responding aptly and swiftly.

Lastly, we would like to underline the absence of governmental actors. Even though they did contribute to the recovery they were not considered very relevant to our participants' experience. They appreciated whatever the government did do, but expected very little. Similarly governmental actors stress their lack of resources to really contribute effectively to disaster risk reduction. Sometimes it even seems that the prevalent community-based DsC justified such a position. This is troubling. The government has the constitutional responsibility to provide the Chilean people with safety and security (Constitución Politica de la Republica 2003). Also they have important resources. In this sense we observe something similar to what Bankoff (2003, p. 84) observed for the Philippines: "[g]iven the frequency and magnitude of natural hazards…and the cost in terms of human life and property damage, disaster preparedness should play a key role in the national agenda", yet it does not. Right now, the impact of telluric events is largely absorbed by the community itself without much help from the national authorities. The question is, however, whether the community can continue to carry the 'burden' alone? Or will their elasticity turn into inelasticity?

6.8   Conclusion

This endeavor shows that the DsC components in GC contribute to the communities' capacity to response, resilience, but also negatively affect vulnerability to earthquake/ tsunami events. These should be addressed as they enhance undesirable vulnerability. The DsC is clearly a pool of cultural capital that provide people with relevant resources, such as tools, techniques, strategies, etc. to adjust to the changes that earthquake/ tsunami events are accompanied with. Their capacity of response is characterized by flexibility and adaptation, but resistance remains important. Resistance gives an important base from which resilience can emerge. At the same time, there are critical issues that require attention. These negatively affect vulnerability and should be addressed before the next big earthquake/ tsunami event hits.

A 'can-do' attitude was observed and a resilience that would typify 'bouncing forward' (Manyena et al., 2011). Instead of looking back and reminiscing loss and change, respondents revealed significant acceptance of the situation and the willingness to get up and move forward. Respondents are not resigned; they accept such events are part of their reality and find ways to accommodate and still progress within this reality. Their ingenuity has enabled them to resist most the telluric violence and recover from those they cannot resist. It would be valuable to take these insights to enable improved management of their vulnerability.

Lastly we consider the DsC framework useful as a lens to expose the resources communities have cultivated and preserved to deal with recurrent hazards. This lens allowed a systematic picture of relevant cultural capital that enables people to cope with important hazards inherent to their environment. We would however, recommend adjusting it to ensure greater alignment with other cultural frameworks. This could ensure greater, applicability, more precision, and comparative opportunities.

Chapter 7:   Talcahuano, Chile, in the wake of the 2010 disaster: A vulnerable middle?[10]

7.1   Abstract

Because of Chile's geographical position, earthquakes and tsunamis are recurrent phenomena and reducing vulnerability to these events is imperative. To do this, one needs to understand the geophysical features of the hazards involved and the vulnerability that exposed communities live with. This article presents some unexpected findings of a research regarding the latter and devised to investigate the vulnerability realities that the devastating 2010 earthquake/tsunami event in Chile exposed. Interestingly, this study revealed households that are formally considered resilient in the face of natural hazards, but are in fact not. These households are part of a group I call the emergent middle. The 'middle' because they are neither rich nor poor, but do not fit the typical middle-class category, and 'emergent' because their primary concerns are staying out of poverty and climbing the socioeconomic ladder. The findings of this research suggest that they find themselves in a precarious situation and that their vulnerability to natural hazards largely emerges from their economic fragility and their limited access to relevant resources in the wake of a hazardous event. This article is based on data that were collected through extensive field work in the Greater Concepción area and in particular in Talcahuano that was severely hit in 2010.

Keywords: Subculture, flood, community, resilience, The Netherlands

---

7.2   Introduction

Because of Chile's geographical position along the Atacama trench between the Nazca and the South America plates, Chileans are blessed with the beautiful Andes mountain range but are also condemned to face the dangers of recurrent earthquakes and tsunamis. To appraise the extent to which these natural hazards represent a disaster risk, it is important to learn more about both the hazards involved and the vulnerability that exposed communities live with. While numerous studies have examined the geophysical features of earthquakes and tsunamis in Chile (Lomnitz 2004; Kiser and Ishii 2011; Yamazaki and Cheung 2011; Brodsky and Lay 2014; Hayes et al. 2014; Cisternas et al. 2005), only a few have dealt with more societal aspects of vulnerability (Lomnitz 1970; Bitar 2010; Letelier 2010; Mella Polanco 2012; Dussaillant and Guzman 2014). This study aims to contribute to the body of literature dealing with the latter.

On February 27, 2010, the south-central region of Chile was hit by a magnitude-8.8 Mw earthquake that triggered a devastating tsunami (hereafter 27F, in line with Chilean usage). While disasters are devastating events, they also provide a unique window into the complex interaction between two opposing forces: "those processes generating vulnerability on the one side, and the natural hazard event (or sometimes a slowly unfolding natural process) on the other" (Wisner et al. 2004: 46). In other words, 27F could be an opportunity to learn more about vulnerability and in particular the coping capacity and resilience of Chilean households vis-à-vis earthquake and tsunami events. With this in mind, the research described in this article was conceived and fieldwork was undertaken in the Biobio region, one of the most affected areas, two years after 27F when the dust had settled and evidence of vulnerable conditions had become more discernible.

In the field, some unexpected observations were made. Specifically, this research found households that are neither poor nor rich, and thus find themselves in the middle, that face significant vulnerability to natural hazards such as

earthquakes and tsunami. This was rather surprising since middle-class households are typically considered to be "affluent homeowners with access to economic resources, insurance, networks of power and influence in the wider community, and social and cultural capital" (Fordham 1999: 27). Only Romero and Vidal (2010) suggest that middle- and lower-middle-class households were disproportionally negatively affected by the 27F tsunami. In this article, I wish to shed light on the plight of these households. The vulnerability of these households seems to represent a blind spot that cannot be ignored in a country that is continuously beleaguered by a wide variety of natural hazards.

The research from which these findings emerged was not aimed at looking into the socioeconomic aspects of vulnerability. However, as the research advanced it became apparent that some socioeconomic observations could not be ignored, mainly because they were unexpected and in some cases even inconsistent with the literature. Against this background, this article aims to share these findings in order to enhance understanding of some vulnerable realities that exist in Chile so that they can be put on both research and policy agendas and as such can hopefully be adequately addressed in the future.

The data were collected from multiple sources using qualitative methods, i.e. from in-depth, semi-structured and group interviews, observations, participation, formal and informal documents, photographs, films, etc. Data were collected in the field, i.e. "at the site where participants experience the issue or problem under study" (Cresswell 2009: 175), in the Greater Concepción area, particularly in Talcahuano, but also in Concepción and Hualqui, over a period of 6 months in 2012 and 2013 and 5 months in 2014.

Because the aftermath of a disaster is a sensitive topic, especially to those directly affected, for this research I decided to use snowball sampling, which "yields a study sample through referrals made among people who share or know of others who possess some characteristics that are of research interest" (Biernacki and

Waldorf 1981: 141). Using this sampling method, I was able to draw on insiders' knowledge to locate people who would be willing to recount their stories, which are often hard to tell, for this study. This method enabled me to access a wide variety of people from different socioeconomic backgrounds, ages and even ethnic backgrounds. The respondents in the Greater Concepción area 47% were female and 53% male, aged between15 and 82. Most respondents were lower, middle or higher middle class (see Fig. 7-1).

Figure 7-1 Socioeconomic distribution of respondents in the greater Concepción area and Talcahuano
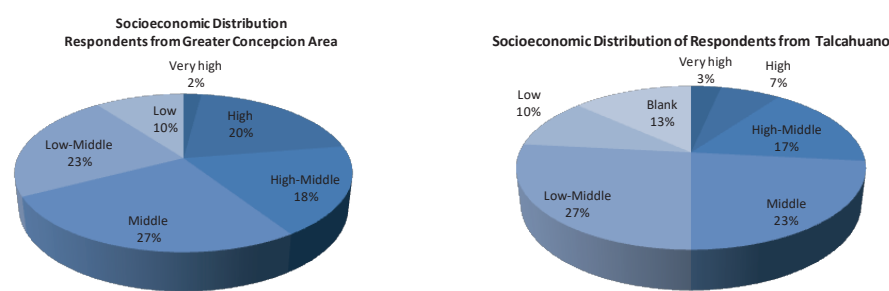
I conducted formal interviews with 62 respondents, 12 group interviews, and engaged in numerous participation/observation opportunities and professionally engaged with various professional institutions dedicated to disaster risk reduction. As I was completely immersed in life in the Greater Concepcion area, almost every interaction in formal and informal events was useful to my study. The software package ATLAS.ti was used to assist the data analysis.

This article is structured as follows. Section 2 briefly describes the theoretical underpinnings of the study, namely how key concepts such as vulnerability, coping capacity and resilience are viewed. Section 3 introduces the 'emerging middle' households in Talcahuano and their exposure to earthquake and tsunami hazards. Section 4 then describes the central findings that support the idea that these households from the 'emerging middle' find themselves in a precarious situation vis-à-vis earthquake/tsunami disasters. Finally, section 5 presents some conclusions.

7.3 Vulnerability

What is Vulnerability?

While the 'hazards' or 'agent-specific' approach remains dominant, it is increasingly agreed that natural hazards only become disasters when they interact with a *vulnerable* community: "there cannot be a disaster if there are hazards but vulnerability is (theoretically) nil, or if there is a vulnerable population but no hazard event" (Wisner et al. 2004: 43; Warner and Engel 2014; Birkmann 2006). As a result, increasing attention is being given to understanding the vulnerable realities people face vis-à-vis (natural) hazards (Cutter 2008). This is easier said than done, however. Although the word 'vulnerability' comes from the Latin verb *vulnerare* ('to wound'), the disaster literature provides a wide array of definitions, conceptualizations and approaches. Cardona (2003), for instance, defines vulnerability as "the physical, economic, political or social susceptibility or predisposition of a community to damage in the case of a destabilizing phenomenon of natural or anthropogenic origin". Cannon et al. (2003: 4-5), on the other hand, emphasizes social vulnerability to highlight that it is about people and their specific characteristics. Vulnerability is not necessarily opposed to coping capacity and resilience but can in fact embrace both. Take, for instance, Watts and Bohle's (1993) approach to vulnerability, in which they distinguish three basic coordinates:

1. The risk of exposure to crises, stress and shocks (*exposure*)

2. The risk of inadequate capacities to cope with stress, crises and shocks (*capacity*)

3. The risk of severe consequences of (*potentiality*), and the attendant risks of slow or limited recovery (*resiliency*) from crises, risk and shocks.

Steffen et al. (2004) adopted a similar approach, in which they define vulnerability as a function of "1) exposure –the degree to which a human group or ecosystem comes into contact with particular stresses, 2) sensitivity – the degree to which an exposure unit is affected by exposure to any set of stresses, and 3) resilience – the ability of the exposure unit to resist or recover from the damage associated

with the convergence of multiple stresses" (Steffen et al. 2004: 205). There are other approaches, however, that view vulnerability, coping capacity and exposure as separate features. Bollin et al. (2003), for instance, clearly put forward disaster risk as emerging from four independent components, namely: hazard, exposure, vulnerability, and capacity/measures. I do not subscribe to this latter view as it seems to neglect the complex interactions from whichvulnerability emerges. I thus take an approach in line with that of Watts and Bohle.

The key elements of vulnerability, then, are exposure, capacity and resilience. Exposure entails more than spatial exposure and includes social and institutional features, i.e. "processes that increase defenselessness and lead to greater danger, such as exclusion from social networks" (Birkmann 2006: 19; Watts and Bohle 1993, Cannon et al. 2003). Coping capacity is more straightforwardly defined as "[t]he means by which people or organizations use available resources and abilities to face adverse consequences that could lead to a disaster" (UN/ISDR 2004:16-17). Resilience likewise has many conceptualizations and definitions (Engel and Engel 2012). For Pelling (2003: loc 1229), resilience is a component of vulnerability and "the ability of an actor to cope with or adapt to hazard stress".

For the purpose of this article, I will use Watts and Bohle's concept of vulnerability. Since respondents expressed an intrinsic relationship between their experience of vulnerability and their access to and use of specific assets, I will borrow from the livelihood assets of the sustainable livelihood framework (DFID 1999) to structure my findings. This pentagon is central to the livelihood framework and allows the important interrelationships between different assets to become more visible (see Fig. 7-2). Because asset endowments change, over time the shape of the pentagon that represents a household's assets also changes.
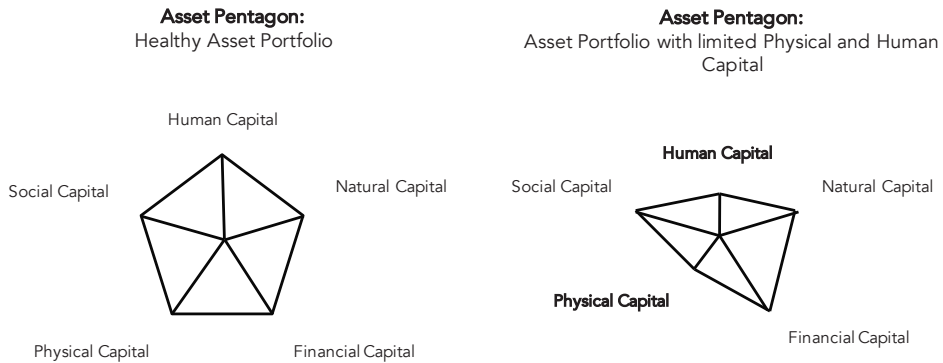
Figure 7-2 Asset pentagons presenting different asset portfolios (DFID 1999: 5)

Rather than capital stocks in the strict economic sense of the term, these assets should be viewed as the building blocks of sustainable livelihoods. The following assets are included in the pentagon:

1. *Human capital* refers to the stock of "skills, knowledge, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives" (DFID 1999: 7). Labor is often used to refer to the flow of human capital or "the flow of effort, skill, and knowledge that humans directly provide as inputs into productive activities" (Goodwin 2003: 5), although for some authors labor resources are subsumed under human capital. Human capital is important because it is key to making use of the other assets.

2. *Social capital* refers to "the social resources upon which people draw in pursuit of their livelihood objectives" (DFID 1999: 9). In other words, these resources are the "stock of trust, mutual understanding, shared values, and socially held knowledge that facilitates the social coordination of [productive] activity" (Goodwin 2003: 6) upon which people can draw (networks, social claims, social relations, affiliations, associations). Throughout this article, the distinction between bridging (or inclusive) and bonding (or exclusive) social capital is important. Bonding social capital "is inward looking and tend[s] to reinforce exclusive identities and homogeneous groups', while bridging social capital is "outward looking and encompass[es] people across diverse social cleavages" (Putnam, 2000, chapter 1).

141

3. *Natural capital* is the "natural resource stock from which resource flows and services (e.g. nutrient cycling, erosion protection) useful for livelihoods are derived" (DFID 1999: 11). Natural capital is made up of a great variety of resources that include intangible public goods such as the atmosphere and biodiversity to divisible assets used directly for production such as trees or land (DFID 1999: 11). Natural capital is important not just for people who derive their livelihoods from resource-based activities, but for everyone. Human capital, particularly health, for instance, is affected by industrial air pollution.

4. *Physical capital* includes "the basic infrastructure and producer goods needed to support livelihoods" (DFID 1999: 13). Infrastructure entails changes to the physical environment that enable people to meet basic livelihood needs such as affordable transportation, secure shelter and buildings, access to information, etc. Producer goods include the tools and equipment necessary to function productively.

5. *Financial capital* refers to the financial resources that people use to achieve their livelihood objectives. As DFID points out, such a definition might not be economically robust since it includes flows as well as stocks and it can contribute to consumption as well as production, although it does capture an important aspect, namely, "the availability of cash or equivalent, that enables people to adopt different livelihood strategies" (DFID 1999: 15); in other words, capital that can be invested in order to produce something, at the very least more money for its owner (e.g. cash, credit/debt, savings).

DFID's definition of social capital includes vertical networks and connectedness (patron/client) that other authors such as Rakodi (1999: 318) term 'political capital'. I would however like to make a distinction between social and political capital and refer to social capital as horizontal relations (vis-à-vis peers) and to political capital to identify vertical power relations (e.g. vis-à-vis the state or landlord). Political capital then is increasingly related to power and to "the extent to which different groups are aware of their rights and willing and able to assert them" (Carney 2003: 42).

The Social and Differential Nature of Vulnerability

Vulnerability is to a significant extent determined by the social, political and economic environment and is thus essentially *social* since it emerges from these broader patterns of society. Social, political and economic environments "operate to generate disasters by making people vulnerable" (Wisner et al. 2004: 8). At the same time, vulnerability is *differential*: some people are more affected (wounded) by specific hazards than others. So the underlying social (human-made) structures that condition the capacity of specific individuals and groups to respond to, cope with, recover from, 'adjust to' or 'adapt to' hazards (Cannon 1994: 14; Hewitt 1995: 319; Cutter et al. 2003: 243; Hufschmidt 2011).

Since vulnerability is social and differential, the location of a person or group in the social hierarchy influences not just their life experiences, relationships, opportunities and overall life chances (Fothergill and Peek 2004: 90), but also their vulnerability. Against this background, various vulnerability studies have shown how the poorest stratum of society is generally hardest hit by natural hazards and "lose[s] relatively more in disasters... and likewise [has] a more challenging time recovering" (Phillips 2010: 86; Beatley 1989; Dash et al. 1997; Fothergill and Peek 2004; Wisner et al. 2004; Cannon 1994). The position of the poor in the social hierarchy seriously limits their ability to withstand losses and this stratum is therefore the most vulnerable in the event of a disaster: "[l]ivelihoods that provide people with little more than basic needs are unlikely to enable the provision of self-protection, and any associated lack of social protection for such people will result in high levels of vulnerability" (Cannon 1994: 24). At the same time, scholars warn that despite the observed high correlation between poverty and vulnerability, "vulnerability cannot be read directly off from poverty" (Wisner et al. 2004: 12).

Most studies, though, seem to be built on a commonly accepted idea that the poor are the most vulnerable to disasters and that higher strata are not, since they

have access to sufficient stocks of capital. These higher strata include households from 'the middle' since they have transcended poverty and are thus considered self-reliant and resilient. As a result, their levels of vulnerability are rarely investigated. While this assumption seems widespread and forms the basis of many studies of vulnerability, the question is whether it is correct. Does 'the middle' in fact have access to sufficient resources, and are they capable of recovering from a disaster in a timely and satisfactory fashion?

7.4 The 'Emerging Middle': Some Observations

Throughout this research I came across households that were neither rich nor poor, but did not fall neatly into the classic middle-class category in terms of education, job security or purchasing power. They seem to have more in common with what the OECD in Latin America has identified as households from *the middle sectors*: "people in the middle –neither the richest nor the poorest in society...[that] are often quite economically vulnerable[11], subject to the risk of falling down the economic ladder" (OECD 2010: 15).

According to the OECD study, the narrow focus on poverty alleviation has led to a growing number of 'emerging' households that are considered to have overcome poverty and are therefore seen as self-sufficient and self-reliant. Arriagada et al. (2012) also observed this development. They discuss a newly emerged group that cannot necessarily call itself middle-class in the traditional sense, but neither is it eligible to benefit from poverty reduction schemes. These households overlap with those that I call households from the 'emerging middle'. Their income levels are comparable with those of households in the lower deciles, but the latter receive a significant portion of their income from the government. According to the OECD (2010) this has created "many vulnerable households in the lower reaches of the middle sector that are just over the disadvantaged income threshold" (2010: 16, 71)

---

[11] I will refer to economic fragility instead of economic vulnerability to prevent confusion regarding vulnerability.

and are very vulnerable to "even short-term shocks, such as temporary lay-off or a period of illness, [since these] can permanently move them back into poverty in the absence of public support" (OECD 2010: 84). To many middle sector households in Chile, the tsunami 27F was such a shock.

Because of the Chilean government's narrow focus on poverty alleviation the disadvantaged enjoy public benefits, while households from the 'emerging middle'– who pay taxes and contribute to the existence of public services – do not. As the OECD (2010: 158) exposes, in addition to the limited eligibility of the majority of middle segment households to receive government assistance, the poor quality of public services compels them to spend significant portions of their income on private education and/or healthcare for their families, "even where the extra cost is a significant additional burden on household budgets" (OECD 2010: 166). To these households these costs are important investments. Education, for instance, is often seen as essential to improve social mobility and thus represents an investment in future generations. In addition, over the past 20 years, the level of over-indebtedness of middle-class households has risen substantially as they have taken advantage of the lax rules on the availability of credit. This "has led to over-indebtedness in these social groups, from the D to the C2, due to consumer loans for mortgages or children's education" (Barozet and Fierro 2011: 31). Indebtedness makes 'the middle' even more vulnerable as the substantial costs or 'investments', largely in education and healthcare, in combination with indebtedness, leads to increasing distress as feelings of financial insecurity rise.

What I also learned about these households from the emerging middle at least the ones from my study is that they seem to share some values. Throughout the interviews it became clear that they find hard work, effort and sacrifice important values, especially in light of their primary objective, which is to improve their socioeconomic situation. For instance, many remarked that, whenever possible, they were willing to pay the extra costs of private healthcare and/or educational

opportunities, even if it meant taking out a loan that would take decades to repay. To them these are investments in opportunities for their children and grandchildren, even if stretching their resources in effect also means increasing their overall vulnerability.

It seems that the precarious position of this group in Chile is also closely related to persistently high levels of economic inequality and social differentiation in terms of access to social services such as schools, hospitals and housing, and to opportunities more generally (Larranaga 2009: 13; Solimano 2011; 2012). Even though Chile has enjoyed significant economic growth and poverty has declined, it faces important challenges that, according to Solimano (2011; 2012), persist as genuine attempts to introduce reforms, improve incomes and wealth distribution, and increase social protection are constrained by "the high concentration of economic power and political influence of the dominant elites that block any serious attempt to shift income distribution to the middle income and the working poor".

In addition, there is some controversy about the accuracy of the actual poverty figures used by the government. In 2008 the economist Felipe Larrain published a study in which he reassessed the official poverty figures by generating a new consumption basket using a household consumption study of 1996-1997. The cost of the new basket was 51% higher than that of the basket used to define the official poverty line for 2006, which was based on consumption patterns in the 1980s and thus did not reflect recent demographic and economic changes. Based on this reassessment, Larrain arrived at a poverty rate of 29%, more than double the official rate of 13.7%.This begs the question of whether some of the households currently considered middle class should in fact be reclassified as poor.

It is important to note that these challenges are accompanied by an overall feeling of discontent that is not helped by a political system that remains "a highly elitist affair with low degrees of social participation in public decision-making" (Solimano 2011: 9). Also, as Cleuren has observed, "Chilean politics are marked by

low levels of citizen participation, and the recently created participatory initiatives are only instrumental without a genuine commitment of the government to open up the decision-making process to its citizens" (Cleuren 2007: 14). This has resulted in low levels of trust in government institutions and political parties. According to a survey by the Centro de Estudios Públicos only 17% of respondents stated that they have significant trust in the government and a mere 3% in political parties. The municipalities scored a little better, with 22%. Such low levels of trust were also reflected in the 2010-2014 World Values Survey, in which 52% of respondents stated that they have little or no faith in the government and 80% have little to no faith in political parties (WVS 2014). As Solimano (2011) observed, these challenges make social cohesion in Chile very elusive.

The households discussed here also share similarities with those that Barozet and Fierro (2011) consider middle class. For instance, they also find a segment of the middle sector to which hardly any public policies are directed and who find it difficult to ask and receive assistance because they consider it beneath their dignity: "while the poor and more popular segments [of society] can receive and look for state assistance, because of their precarious situations, the Chilean middle sectors either do not qualify for assistance because they have certain resources or simply find it difficult to ask for assistance because they feel it implies lowering themselves" (2011: 26). The latter idea that receiving assistance is equivalent to lowering oneself I also found throughout my interviews. I learned that to my respondents state assistance had a negative connotation, and was often associated with handouts for the needy; as one respondent told me, "nobody wants to be 'el pobrecito' (the little needy one)" (interview, 2013). In their eyes, state assistance is not something that citizens might be entitled to in times of unforeseen adverse events, for instance, or an indicator of good governance.

The households that I refer to as the 'emerging middle' also appear to overlap with the *D* and *Cb* segments in the Esomar Nivel Socio Economico (socioeconomic)

marketing scale (Adimark 2000, hereafter NSE Esomar). This letter-based stratification scale classifies households based on two variables, the educational level and occupation of the household's principal provider, which together determine the NSE of a household. There are six categories:

A   very high

B   high

Ca   higher middle

Cb   middle

D   lover middle

7.5   The Impact of 27F in Chile, the Biobio region and Talcahuano

Because of Chile's geographical position, strong earthquakes accompanied by substantial tsunamis are recurrent phenomena (Silbergeit and Prezzi 2012). Consequently, Chile has a significant seismic history, present and future, with "a magnitude 7 every five years, and a magnitude 4 occurring five times a week" (Earthquake Engineering Research Institute 2010: 6). One of the regions that is most often struck by strong earthquakes and tsunamis is the Biobio region. This can be explained by its location along "the younger portion of the 5000km subduction zone, where the Nazca plate dives fast with a stronger coupling (tight sticking that causes strong friction between the two plates) with the overriding plate" (Aon 2010: 4).

The relatively high frequency of earthquakes has moved Chileans to develop a variety of mechanisms to deal with the often adverse effects. For instance, even though internationally it is advised to 'duck, cover, hold' when an earthquake strikes, Chileans tend to escape their homes as quickly as they possibly can. This behavior was observed as long ago as 1904 and my interviews suggest that it remains the primary instinctive course of action: "[Chilean] inhabitants avoid bodily harm by escaping from their homes because of any moderately perceptible shaking, since there is no telling what might follow; and this praiseworthy custom has been the

more successful, as strong shocks are generally preceded by lighter ones" (Goll 1904). According to a study by Lomnitz, this course of action has been successful at saving lives: "the average out-of-doors is safer than the average indoors [and] [r]apid evacuation of dwellings has been effective in preventing or reducing earthquake casualties" (Lomnitz 1970: 1312). In addition to effective behavior, Chile has also seen great advances in the construction of earthquake-resistant buildings that enable survival even if earthquakes are so strong that standing up and leaving are impossible. This was the case with 27F. The magnitude-8.8 Mw earthquake was so strong that many people were thrown to the floor while trying to escape.

Tsunamis occur significantly less frequently than earthquakes, and as a result there seem to be fewer coping mechanisms. The primary coping mechanism used by coastal communities is based on *local knowledge* that when a major earthquake strikes (one above magnitude-7.5 Mw) you should run up the nearest hill. While I was unable to find out where and how this local knowledge developed, I did come across the story of origin of the Mapuches (Bengoa 2000), the indigenous people of south-central Chile. Their story begins with a major flood that Mapuches survived because Ten Ten, a snake that lived in the hills, advised them to run up the hill whenever CaiCai, a great snake that lived in the sea, made the sea waters rise. Those who got up the hill survived, while those who did not were transformed into fish. While I did not find a direct connection, it seems that the local knowledge that moved people to run up the nearest hill in response to 27F could have its roots in this story. Since 27F and the large number of deaths caused by the tsunami, Chile is moving towards more tsunami mitigation and preparedness. The municipality of Talcahuano, for instance, is working on evacuation routes and locations (see Fig. 7-3), increasing tsunami awareness and preparedness, and has built a significant number of supposedly tsunami-resistant dwellings.

The powerful earthquake that struck Chile at 03:34:17on February 27, 2010 triggered a substantial tsunami that severely impacted 700 km of the south-central coastline (Aon 2010: 10) and caused damage as faraway as California (Information Collection Assessment Team 2010). The main shock was so powerful that it shortened a normal day on earth by 1.26 μs and moved the city of Concepción 3 m to the west and the capital Santiago 28 cm to the west-southwest (Information Collection Assessment Team 2010; Aon 2010). For many coastal localities the tsunami caused most of the destruction. The overall impacts of 27F were significant–

Figure 7-3 Talcahuano (Source: Google Maps)

562 lives were lost, 75% of Chileans were affected, 2 million of them directly, over 200,000 homes were destroyed, and the economic losses have been estimated at US$ 30 billion (EM-DAT; Gobierno de Chile 2010: 5). Furthermore, the mainshock was followed by numerous aftershocks, "including over 130 magnitude 6 or higher aftershocks within the following week" (Technical Council on Lifeline Earthquake Engineering 2010, 1). In fact, a magnitude 6.9 aftershock startled guests and journalists just before Sebastian Piñera was to be sworn in as president (Barrionuevo, 2010).

Talcahuano, an important port city in the Biobio region, was severely affected by both the earthquake and the tsunami. In total 37 people lost their lives (21 due to the tsunami), 53,637 people were affected, 1956 dwellings were severely damaged and 6442 suffered minor damage, 1805 people had to find shelter in camps and 380 in other locations (PNUD 2012: 13).

The tsunami that hit Talcahuano consisted of three waves. The first wave, with a runup of 5 m (the vertical height of the wave above sea level at its furthest point inland), occurred half an hour after the mainseismic shock. The second wave was smaller, with a runup of 3 m, and reached Talcahuano at 5:15 am. The third wave was the largest, with a runup of 6 m, and hit Talcahuano at 7:30 am (Quezada et al. 2012; La Tercera 2010: 12). A thick fog covered the city and it was still dark, so few people actually saw the waves. The just heard "a nasty sound of dragging iron", which later turned out to be the noise of containers and shipping vessels being dragged onshore into the city. Only at daybreak, when the fog dissipated, did people realize what had happened. Aside from destruction, the tsunami deposited a thick layer of oily debris: "there was a disgusting blubber...it must have been all the dirt that was on the sea floor...Petrol, fish and other kinds of residue...It was disgusting cleaning it up and it took months to get it all out" (interviews 2013). As one professional diver remarked, "after the tsunami, the ocean was lovely since it had been cleansed" (interview 2013).

7.6 Vulnerability in Talcahuano

This research unveiled a group of households from the emerging middle that were not just economically fragile, but in the wake of 27F proved significantly vulnerable to natural hazards. Their vulnerability to natural hazards seems to have primarily emerged from a disproportionate exposure to tsunamis and a limited access to important resources that inhibit their coping capacity and resiliency. Throughout these paragraphs, I will elaborate on these findings. Since my respondents indicated the particular importance of four forms of capital, namely natural, financial, social and political capital, I will borrow these from the sustainable livelihood approach to guide the discussions.

Exposure

Throughout my research it quickly became apparent that in Talcahuano some households from the 'emerging middle' in particular are experiencing increasing

exposure to tsunamis. This was first brought to my attention by one of my respondents, who remarked that Talcahuano had also been affected by a tsunami in1960 tsunami but that it had been largely contained by the area where the Santa Clara neighborhood now stands. This and various other neighborhoods have been built on wetlands that used to absorb and disperse tidal surges and thus damp down the adverse effects of tsunamis. Today, however, these wetlands have been infilled and the area is occupied by families from the middle who were unaware of the tsunami risk they were exposing themselves to by moving to these neighborhoods. In fact, Santa Clara was one of the neighborhoods most affected by the 27F tsunami (UNDP 2011: 27; 2012: 25). That particularly households from the middle are exposed to tsunamis is confirmed when putting together a tsunami risk map and a socioeconomic map of Talcahuano[12]. Here one sees the predominance of middle- and lower-middle-class households in tsunami-exposed areas (see Fig. 7-4).

[12]http://gestionderiesgotalcahuano.blogspot.com/search/label/mapas,

http://siit2.bcn.cl/mapoteca/mapa_view?t=Poblaci%C3%B3n%20y%20Censo&u=Comuna&s=Talcahuano&h=1 - 2006 map.

■ High tsunami risk (H>2m)	■ High
■ Medium tsunami risk (h approx. .5m)	■ Middle-High
■ Low tsunami risk (h < .5m)	■ Middle
	■ Middle-Low
	■ Low
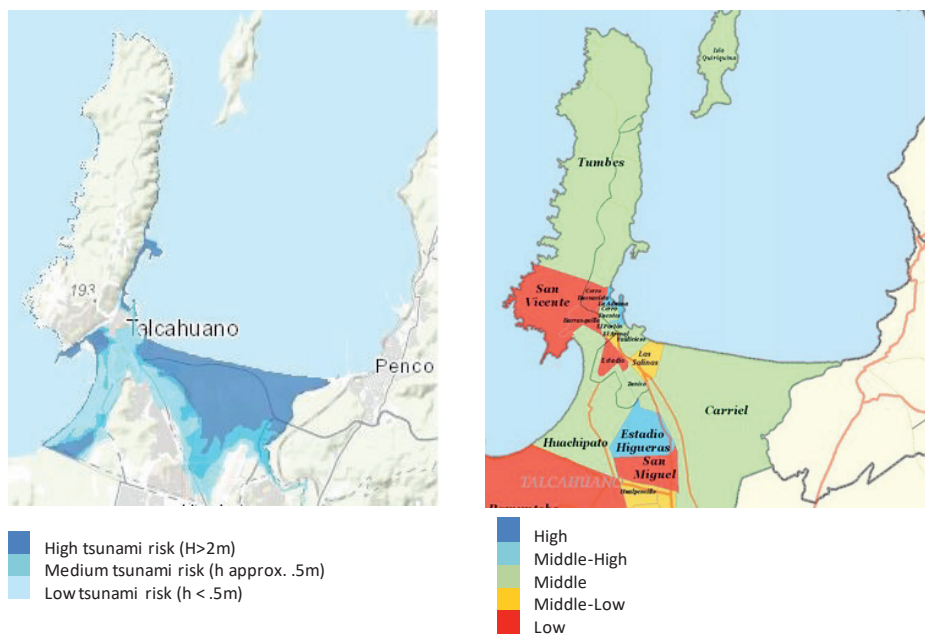
Figure 7-4 A tsunami risk map and socioeconomic map of Talcahuano revealing the exposure of households to tsunamis (Sources: Municipal Disaster Risk Management Department; National Congressional Library)

This helps to explain Romero and Vidal's (2010) finding that middle- and lower-middle-class households were disproportionally negatively affected by the 27F tsunami (see Fig. 7-4 and 7-5).
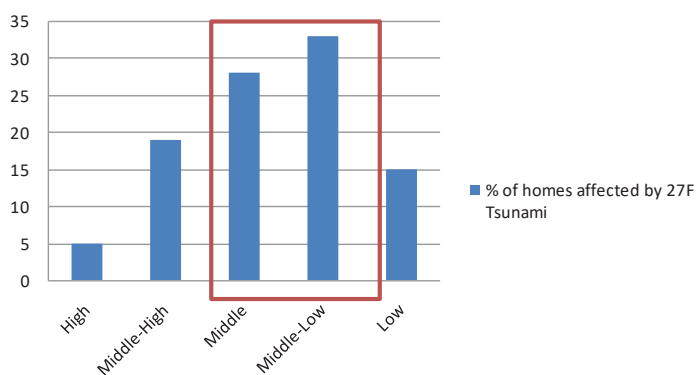
Figure 7-5 Socioeconomic distribution of homes in Talcahuano affected by the 27F tsunami (Source: Romero and Vidal 2010)

Investigating this further, it came to light that Talcahuano has been built on two types of territory: a peninsula and an isthmus. The peninsula is high ground and together with the hills on the isthmus are often referred to as 'the hills'. To the east of the isthmus, also known as the isthmus of the Low Lands, lies the Rocuant wetland, which is colloquially referred to as 'the plain' (see Fig.7-6). The isthmus houses approximately two-thirds of the population of Talcahuano and, together with the bays along the shores of the peninsula, is exposed to tsunamis.

Most neighborhoods on 'the hills' are unplanned settlements that over time have been normalized by local authorities. Because of their unplanned nature, there

Figure 7-6 Talcahuano: 'the hills', the isthmus and the Rocuant wetland (Source: Own elaboration with Google earth)

are few basic services, such as schools, healthcare and police presence, and are located at considerable distances from job opportunities, commercial centers and transportation. These neighborhoods are commonly regarded as marginal and unsafe. For instance, when I asked my respondents from the emerging middle whether they would consider moving there they would tell me that was not an option since people there are different and there are fewer opportunities. In terms of their exposure to tsunamis, however, 'the hills' are safe.

The majority of 'the plain' is wetlands. Historically, these wetlands served to absorb tsunamis and reduce their impact (interviews 2013; Vidal and Romero 2010: 1; Bucci 2013) and were not allowed to be urbanized. Throughout the second half of the twentieth century, however, the city experienced significant growth (since 1970 the urban area of Talcahuano has doubled). The demographic pressure, in combination with the liberalization of the land market, eventually led to the

urbanization of areas exposed to natural threats, like tsunamis and flooding (Vidal and Romero 2010: 11). The development of the wetlands was attractive to real-estate companies since building on (steep) hills is technically more complex and thus more expensive (Pauchard et al. 2005: 274). So when the land market was liberalized and permission was granted to develop previously restricted areas, real-estate companies jumped at the opportunity to buy and develop the wetlands cheaply and sell homes at profitable margins (interviews Talcahuano 2013-2014), even though this meant doing away with Talcahuano's mitigation area and placing more people at risk: "In 1960 we had a tsunami here in Talcahuano, but it was largely absorbed by the area where I now live" (interviews Talcahuano 2013). Real-estate companies endorsed the commonly accepted idea that wetlands were wasteland that could provide a greater public service if drained and filled in (Pauchard et al. 2005: 274). Since then large parts of Talcahuano's wetlands have been used to develop residential areas, and they continue to be urbanized.

These new residential areas were perfect for young families aspiring to a better way of life with access to basic services, commercial centers and transportation. As a result, by 2010, these neighborhoods were occupied by a large number of households I have labeled 'the middle'. These households had no idea that this upward movement would come at the expense of increasing their exposure to natural hazards. They assumed that the (local) authorities would never allow the development of unsafe land and the subsequent sale of 'unsafe' houses, just as they do not permit the sale of unsafe goods in supermarkets. To what extent this assumption was false became apparent in the wake of 27F.

Even though the respondents residing on the wetlands expressed they were unaware of their exposure, coastal communities know that in case of a *real* earthquake, i.e. of more than 7.5 Mw, they should climb the nearest hill. This latent knowledge that is part of a greater disaster subculture (Engel et al. 2014) saved many people so that the number of deaths in Talcahuano due to the tsunami was limited.

Still people died, either because they did not believe a tsunami would affect them or because the authorities assured them there was no threat and they should return to their tsunami-exposed homes.

While some households have been resettled since 27F, most residents do not want to leave. The households that were part of this study revealed they felt strong ties to their neighborhoods. They revealed that these feelings were primarily related to the time and energy they had invested in developing a perfect living situation for their families. From what I have seen, in the Greater Concepción area it is common to buy a home at an early stage of family life which can be expanded in time and in such a way as to provide the family with the right living conditions, including the social and built environment. Over time, these investments result in unique homes that are tailor-made and satisfy all the family's specific needs. Against this background, leaving becomes undesirable. Leaving implies leaving behind the product of years of effort, sacrifice and financial investment. Moreover, interviews revealed that often these families do not have the resources to start all over. For instance, households from this study expressed that moving to 'the hills' is not an option, largely because of the prevalence of poverty and high crime rates and the distance to resources and services. Leaving would thus entail a decreased sense of security on a daily basis, and putting at risk the access to relevant resources they do have. Leaving would for example mean losing a social environment that for many is key to their household's resilience. In other words, the households that are discussed here continue to live in neighborhoods that are substantially exposed to tsunamis.

Natural Capital

The rapid urbanization and industrialization of Talcahuano has had a negative impact on the environment. For instance, for decades waste was dumped indiscriminately, particularly into the sea. However, as a Balinese once told me, the

sea always returns whatever is dumped in its waters. This seems to have been the case in Talcahuano, as the retreating tsunami left a thick black microlayer of oily waste containing high concentrations of bacteria, viruses, toxic metals and organic pollutants on shore. The wetland areas affected by the tsunami were also covered by this layer and the pollutants it contained were to some extent absorbed into the soil. Few studies have been done to determine the extent of the *contamination* so that residents are unaware of the potential risks they face residing on this contaminated land (interviews 2013, Fariña et al. 2012).

In addition to the contamination, the residents of the wetland neighborhoods are exposed to several other risks. Infilled wetlands tend to amplify earthquake waves due to their 'soft' soils and sediments. Such *amplification* can result in greater damage. In addition, wetlands tend to suffer from liquefaction, which "involves the temporary loss of strength of sands and silts which behave as viscous fluids rather than soils … when seismic waves pass through a saturated granular layer of uncohesive sediments, distorting the granular structure and causing some of the void spaces to collapse" (Alexander 2010: chapter 4) and "[w]idespread liquefaction-induced ground deformation and related damage to soils and foundations occur to spectacular and devastating effect in almost every strong earthquake" (Huang and Yu 2013). In other words, liquefaction can have significant consequences, such as "the collapse of foundations or the settling of structures" (Alexander 2010: chapter 4). During the 27F earthquake "several coastal and river vicinities experienced extensive liquefaction…" (Technical Council on Lifeline Earthquake Engineering 2010: 6). Because liquefaction can cause catastrophic failures in building structures (Verdugo 2012: 708), Alexander (1999: chapter 4) has argued that it is best to avoid building on such susceptible terrains.

The wetland neighborhoods of Talcahuano have already experienced liquefaction and will continue to do so in the future. Because of the lack of comprehensive studies of the state of the soil beneath the wetland neighborhoods

it remains unclear to what extent the soil has been negatively affected by the 27F earthquake and tsunami. The consequences include increasing exposure to the dangers associated with liquefaction in the event of future earthquakes. Much remains unknown, but it is clear that residing on infilled wetlands in a region that is repeatedly subjected to strong earthquakes and tsunamis entails exposure to a variety of substantial dangers.

Infilling wetlands for the development of residential areas for the 'emerging middle' households has not just enhanced their exposure, but has also reduced the stock of natural capital available to provide protective services and subsequently decrease the probability of a disaster occurring or reducing the damage in case of an event. That is, the wetlands enabling flood control and mangroves attenuating wave and storm surges (Kousky 2010). Combine this with the contamination and liquefaction of the soil on which most of these households reside since 27F and we can conclude that their natural capital, and that of the community at large, has been severely reduced.

Financial capital

The households from this study expressed that their limited access to financial resources seriously limits their ability to recover in an adequate and timely fashion. Having access to financial capital can for example enable a family to absorb the loss of their belongings or to arrange satisfactory temporary housing. For the respondents of this study the reality was however, that already before 27F their stock of financial capital was minimal as their situation together with others from the middle sectors was economically fragile. So in the wake of 27F, this fragility was exposed and they found themselves with no financial resources to absorb the adverse impacts and recover. The respondents of this study exposed that the state or any other formal organization acknowledged their financially fragile situation and

subsequent limited access to financial capital for recovery. Subsequently, even in the wake of 27F they were still not eligible to receive state assistance.

Despite Chile's extensive experience with major earthquake/tsunami event, the government did not have specific tools to be used in the wake of an earthquake/ tsunami disaster. They therefore used existing mechanisms that worked in 'normal' situations, such as the Ficha de Proteccion Social (Social Protection Card, Chile Atiende 2015), to determine, for instance, a family's level of vulnerability in light of 27F.[13] This instrument was not adapted to ensure that post-disaster needs were satisfied, however, and led to some households from 'the middle' with higher post-27F scores, i.e. more affluent, than before 27F (interviews Talcahuano 2013 and 2014; Chamorro et al. 2011). This seems unfair, to say the least, but it did determine the level and kind of assistance these households were, or were not, eligible to receive.

The 'emerging middle' households in Talcahuano experienced various kinds of damage. Some families with one-story dwellings and exposed to tsunamis lost practically everything, while others with two-story dwellings mainly lost belongings from their living room, dining room and kitchen, such as sofas, chairs, tables, and electrical appliances (fridges, washing machines, dryers, televisions, kitchen appliances, sound equipment, etc.). While some things could be recovered with dedication and patience, most of the losses would have to be recovered over time whenever the households' income would allow it. Since the 'emerging middle' households from this study had little or no financial buffers, they had to hold on to their jobs or find work as quickly as possible. This is what most of them, and in particular the men of these households, did. However, many companies in

---

13 The Social Protection Card (Ficha de Proteccion Social) is an instrument that is used to determine whether persons or households are entitled to state benefits. To access such benefits the person/household should be either (socioeconomically) vulnerable or poor. To determine the socioeconomic status of the person/ household at hand a survey is used. This survey registers various aspects, such as age, education, health and income, which are later used to calculate a score and determine the person's/household's (socioeconomic) status (Chile Atiende 2015).

Talcahuano, like fisheries, had also been affected, so that job opportunities were scarce. Moreover, respondents revealed that some companies applied article 159 No. 6 of the Chilean Labor Code enabling them to fire workers due to a 'fortuitous event or force majeure' without compensation. One respondent reported that "They fired my husband who worked in San Vicente...interestingly enough, the company was hardly affected by the earthquake and even less by the tsunami...[but] after two months they took them [him and other employees] all back. As he was fired and left without any money...he was forced to leave Talcahuano and find work in the south" (interview Talcahuano 2014). Even though some men[14]got their jobs back after a while, many households were left without an income at a time when they needed it most. Men who could not find a job in or near Talcahuano left their families behind to look for work elsewhere, which meant that many women were left in charge of most of the recovery process at home.

Because poorer households were eligible for financial assistance, there are cases where one could state that households from the 'emerging middle' are now worse off than those from poorer segments. I encountered several cases where this could be said. For instance, take one of my respondents from a lower segment of society. She is a Colombian single mother who came to Chilewith nothing. When 27F hit, she was living with a friend in Santa Clara. She did not have a house, possessions, a job, anything. In the wake of 27F she was able to acquire a house, goods and most importantly technical schooling to become a beautician. In other words, 27F made it possible for her to acquire a home and new skills that enabled her to earn a permanent income to ensure a livelihood. When comparing this story with those from the emergent middle households, some of whom still do not have a home four years after the tsunami and are still working hard to even come close to where they were before, one starts to wonder how assistance should be framed and distributed. From

14 My data suggests that in Talcahuano, men are the principal breadwinners.

my study, it seems that these households are largely on their own and this seems to be significantly delaying their recovery. More research is necessary, however.

According to my respondents, the limited public policies directed at the emergent middle households, also in the wake of a disaster, significantly inhibited their access to financial capital and subsequently their ability to recover in a timely fashion. Their recovery often entailed finding employment to ensure an income, and over time, little by little, finding ways to set aside resources to replace what they had lost. For most, any kind of recovery required first and foremost an income to spend on daily necessities and from which to start accumulating financial resources to construct a new home (interviews 2013-2014).

Finally, the few mechanisms that were available to affected 'middle' households were often not responsive to their actual needs. One of my respondents explained for instance how she had only two real options to recover her house. The first option involved government assistance, but this forced the family to move from their relatively decent hill neighborhood[15] to a tsunami-affected and exposed area, and to leave behind the important social capital the family had built up over decades in their old neighborhood. In other words, receiving government assistance required giving up substantial levels of natural and social capital. The other option was to work until they could build a solid house on their land. This however, would take a long time and forced them to continue living in the emergency accommodation until they succeeded. Since the family still owns the land on which their house is located, the ideal solution would be for the government to enable financial assistance to reconstruct a new, more solid house that can resist future earthquakes.

---

15 There is a handful of hill neighborhoods, mostly the older ones, that are decent to live in. In fact, some of these used to host the older and more affluent families of Talcahuano.

Political capital

For the households that I talked to, values like personal effort, sacrifice and self-sufficiency are very important. However, upholding these values seems to inhibit their access to political capital. Such values for instance discourage these households from making their grievances known and mobilizing powerful actors to address them.

These households value effort and pride themselves on achieving the life they have through hard work and sacrifice. This is why they would not become emotional at the loss of their *physical* house, but rather at the loss of their *home*; the loss of the results of years of labor, overcoming obstacles, and the sacrifices and effort involved. It is the realization that this can be lost from one moment to the next: "my mother put in all the effort and sacrifice to have her house...that's what hurts. But then I tell my mother, 'that is not what matters'. We are alive. We can continue to sacrifice to have a house again. It will not be immediate because it is difficult, but at some moment we will have a house again" (interview Talcahuano 2013). What this quotation highlights is the hurt, but also the firm belief in one's capability to attain what one desires. From my sample, households from 'the middle' believe that if they put in the effort again, they will over time replace all they have lost. It might take time, blood, sweat and tears, but that's life. This 'effort' ethos enables them to do what has to be done, with few complaints, but the substantial levels of acceptance also prevent them obtaining support from outside.

In addition to valuing effort, self-sufficiency is very important. My respondents from the 'emerging middle' would not easily ask for any kind of assistance. In particular, government assistance is perceived as 'charity' for 'the needy'. Since these households do not wish to be viewed as 'needy' and generally are not viewed as needy and thus do not receive much assistance, they are not keen and rather hesitant to request government assistance. While it is admirable how these households get up and start rebuilding their lives on their own, this attitude isolates them, makes them rather invisible and inhibits a speedy recovery, perhaps by mobilizing political

capital. From my study, it seems that political capital is very important in Chile and can enable access to a great variety of resources. One does have to play the game, however, which entails first and foremost mobilizing the media to visibly display one's grievances. The households I talked to have worked hard to avoid a 'needy' livelihood and status, so this game seems unacceptable. They would prefer a lengthy but dignified recovery process to a short and unbecoming one. Households from the 'emerging middle' have worked hard to not be needy, and portraying their family's grievances for everyone to see in order to receive what they perceive as charity does not match their normative and valuative schemes. They see themselves as upwardly mobile and so do not wish to be identified with the extremely vulnerable ones that receive assistance after investing everything they have in order not to be needy.

In fact, even though the constitution (Constitución Politica de la Republica de Chile 2003) provides them with a right to safety and security, for instance, 'the middle' view such rights in a negative light, as something that is a luxury, an extra. In addition, demanding one's rights is often considered as being rowdy and disruptive and thus does not fit their image of themselves as decent, participating citizens. Such imagery is however befitting the Mapuches as they struggle to see their human rights respected, for instance (interviews 2013-2014). From my time in the Greater Concepción Region I learned that demanding ones rights to be respected is considered somewhat unruly and the households I engaged with preferred to stay out of trouble, accept what is and expect nothing more. In addition, as their low levels of trust in the political system also demonstrates, they do not believe that political engagement can make a difference for them. So why bother, if one is additionally too busy working to stay afloat.

Because these households largely fend for themselves and do not seek outside assistance they are rather easily ignored and generally very *invisible*, unlike those living in emergency camps occupying a public space, for instance. Poorer segments of society, moreover, seem increasingly to be part of the political system.

Since government policies are generally pro-poor, they are part of the institutional landscape. They have direct contacts with government officials and are familiar with bureaucratic processes. In addition, they are not bothered when it comes to making their grievances known through the media and seem quite capable when it comes to accessing relevant resources. This makes them visible and provides them access. In this sense it appears that their political capital is more substantial than that of 'the middle'.

The lack of visibility of the households that I talked to from the 'emerging middle' has significantly affected their access to both formal and informal relief. Since the provision of relief was not well informed, guided or coordinated, the quality and quantity of the assistance was often insufficient, but the households from 'the middle' would be the last to receive whatever there was because assistance would first go to wherever TV and radio journalists were reporting from. For many the media was the primary source of information. TV and radio reports largely informed the choice of location and type of assistance. This led to some areas, particularly those where people were open about their grievances, overflowing with relief and others, mostly 'the middle' neighborhoods, receiving very little. The neighborhood of Villamar, for instance, had been inundated by the tsunami but received no media attention, since the media was focusing on the fishing community of Tumbes and the coastal neighborhood of Santa Clara.

Social capital: "in life, good friends are more valuable than money"[16]

According to respondents from this study, the lack of access to different forms of capital forced them as households from 'the middle' to heavily rely on their informal social networks, more specifically on what Putnam (2000) labeled bonding social capital.Bonding social capital refers to forms of social capital that are inclusive,

16"En la vida màs vale tener amigos que dinero"is a commonsaying in Chile.

inward looking and "tend to reinforce exclusive identities and homogeneous groups" (Putnam 2000: chapter 1). Bridging social capital, on the other hand, includes forms of social capital that are more "outward looking and encompass people across diverse social cleavages" (Putnam 2000: chapter 1). It seems that households from 'the middle' have limited trust in people outside their direct social networks. As a result, they relied mostly on bonding social capital and turned to their extended family and informal networks to meet their needs and provide emergency accommodation, food and other resources they needed to cope with the effects of 27F. "Networks of reciprocity ...play[ed] an important role...in creating an informal social security system to survive" (Lomnitz 1988: 42), as"[t]he relief; the support, came from family and friends more than from some kind of institution" (interviews Talcahuano 2013). Because of this, neighborhoods largely populated by 'the middle' households did not need to stay in emergency camps or homes (mediagua); "many stayed with friends or family, at least for a while, until after a while such housing situations become more difficult and they are not welcome anymore" (interviews Talcahuano 2013). Today, after five years, some are still living with their family or friends because they have not yet been able to accumulate sufficient resources to pay for adequate accommodation. While it is great that this type of assistance gave many people a roof over their head, an emergency situation of four years in which two families are forced to share one small home is far from ideal.

As Lomnitz and Sheinbaum (2004) indicate, it is not surprising that in times of substantial need people turn to their extended family: significant favors, like rebuilding a home, require a matching level of trust or 'confianza'. To this end, the fact that extended families in Chile include not only biological family members but also close friends, and tend to be extended terms of both numbers and geographical distance is favorable. This became evident as family members and friends from far beyond the affected region organized themselves to provide assistance for those in need. In fact, these networks are global, but are mobilized to first and foremost assist

members of the family. Subsequently, when 27F happened, extensive networks were activated and assistance came to Talcahuano from all over the world.

Already in 1971 did Lomnitz observe the importance of informal social networks that are largely held together by trust, for the Chilean 'middle' (Lomnitz and Sheinbaum 2004: 4). She found that these networks were crucial for the Chilean middle to get access to required resources (Barozet 2006: 23). In fact, she stressed that they were particularly valued by those who cannot seem to escape some form of social vulnerability since they enable them access to protection and security through social rather than economic capital. From this study, it became evident that this remains so. In fact, the findings corroborate that institutions are not residues of some 'pre-modern' society but are important forms of capital in societies "where the state and market have failed to adequately insure the satisfaction of needs of all members of society" (Lomnitz and Scheinbaum 2004: 7). My findings support this idea for 'the middle': "the support of a social group for which [they felt] sufficient trust [and they could] rely on [...] for major emergencies as well as for the satisfaction of [their] most immediate needs" (Lomnitz and Sheinbaum 2004: 7) was key to 'the middle'. Most if not all of the recovery process, whether it involved providing emergency accommodation or cleaning up debris, rested on existing informal social networks of exchange.

The need to rely on these informal social networks was exacerbated by the often unsound and unreliable functioning of the government. For instance, the failure of the tsunami warning system (Wisner et al. 2012: chapter 26) due to prevalent inadequacies and incompetence throughout the government system led to a substantial number of unnecessary deaths and to diminished faith in the competence of state institutions. This faith was further diminished by the major delays and unreliability of government assistance due to numerous instances of fraud and bad practices. This compelled households to respond with the capital they had, i.e. social capital, to satisfy their needs.

7.7 Conclusion

If we go back to our approach of vulnerability, we have to conclude that a subsection of the middle-level households in Talcahuano, which we called the 'emerging middle,'seem more vulnerable than is generally assumed, or described in literature. Just like anyone else in Chile they are exposed to earthquakes, but unlike most other socioeconomic segments they are also disproportionately exposed to tsunamis. And while their capacity to rebound seems high, their resilience seems to be low, and deteriorating. Their exposure is largely the result of the location of newly developed residential areas in highly exposed areas. Besides, these households have limited financial capital, i.e. opportunities to finance the cleanup and reconstruction necessary to rebound, that in light of the devastation caused by 27F has only further decreased. Finally, they command relatively low levels of political capital, which continues to be low. Fortunately for them, social capital was available to enable them to overcome the first blows, but one has to wonder to what extent they would be able to mobilize this social capital if another major adverse event were to occur. If we take this information and present it through the asset pentagons presented in Fig 7-7. Here you clearly see how their asset portfolio was already frail, but since then has deteriorated to unhealthy proportions.

Before 27F:
Limited Financial Capital and Diminished Natural Capital

After 27F:
Diminished Natural , Financial, Social, and Political Capital

Human Capital

Social Capital

Natural Capital

Physical Capital

Financial Capital

Human Capital

Social Capital

Natural Capital

Physical Capital

Financial Capital
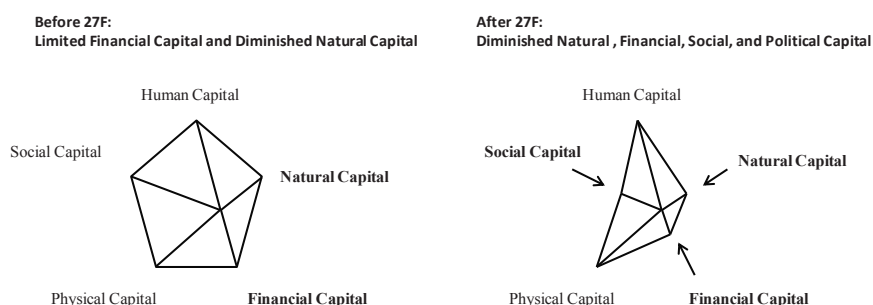
Figure 7-7 The Deteriorated Asset Portfolio of the Emerging Middle since 27F

This study adds to research presented by the OECD, scholars like Solimano (2011; 2012), Barozet and Fierro (2011), and Arriagada et al. (2012), identifying a

vulnerable middle segment that seems to receive little or no consideration in the wake of disasters such as 27F. This 'emerging middle' is a rather new group that does not fit traditional middle-class frameworks. Although capturing the realities faced by this group remains difficult, this should not prevent researchers and policymakers approaching their concerns and finding ways to respond to their grievances. In 'peacetime', when lives have not been disrupted by the effects of an adverse event, this group may be successful when it comes to overcoming poverty and ensuring upward mobility. But the investments necessary to do so leave these households with an extremely limited asset portfolio that does not provide the necessary buffer they need to ensure their resilience. As a result, upwardly mobile households are extremely vulnerable to unforeseen crises, stresses and shocks. In a country like Chile, where hazardous events are frequent, substantial levels of resilience are necessary. Since January 2014, for example, Chilean households have had to respond to a magnitude 8.2 earthquake/tsunami event near Iquique, devastating floods in the Atacama desert, a disastrous fire in Chile's primary port city Valparaiso that left thousands homeless, and three eruptions of the Chalbuco volcano.

Disasters like 27F should therefore be taken to learn more about realities faced by specific groups of vulnerable households and the lessons learned should provide a starting point for change to increase their resilience. As the findings of this research show, increasing the resilience and reducing the vulnerability of these households does not require handouts, but rather enabling people to build up an adequate asset portfolio that will allow them to 1) reduce their exposure to risks, 2) improve their capacities to cope with unforeseen events, and 3) absorb the adverse effects of events and ensure their adequate and timely recovery.

Chapter 8:   Resilience in Talcahuano, Chile: appraising local disaster response[17]

8.1 Abstract

On February 27, 2010, the south-central region of Chile was hit by a powerful earthquake and a devastating tsunami. This article presents the findings of a qualitative study that was done to learn more about local forms of resilience that emerged in response to this disaster in two localities (one urban and one rural) in Talcahuano, Chile: a port that was severely hit by both the earthquake and the tsunami.

This study is part of a larger qualitative and exploratory research into experiences of local earthquake/ tsunami vulnerability, especially capacity of response, in Greater Concepción, Chile. Data was collected by the first author over a period of 13 months in the field through various qualitative methods. For the analysis, a straightforward and practical resilience scheme that categorizes manifested resilience using two dimensions, namely damage and responsiveness, was modified to enable the appraisal of a social system. The findings suggest that damage levels in the two communities were similar between the two localities, but that the responsiveness was not. One locality revealed high levels of resilience, while the other exposed significant susceptibility to future adverse events. The study and the findings are relevant because they expose actual resilience. This provides insights about prevalent vulnerability, in particular the local capacity of response, that can be used for the elaboration of concrete earthquake/ tsunami disaster scenarios and the design of interventions to achieve disaster risk reduction.

---

[17] This chapter has been submitted as an article to the journal Disaster Prevention and Management and is currently under review. It should be cited as Engel, K. & Warner, J. (2018) Resilience in Talcahuano, Chile: appraising local disaster response. Manuscript submitted for publication.

Key words: Chile, community, vulnerability, earthquake, disaster, resilience, resources, capital, middle, class, emergence.

8.2 Introduction

On February 27, 2010, a M8.8 earthquake struck the south-central region of Chile and triggered a ravaging tsunami. Talcahuano was one of the most heavily affected cities (hereafter these 2010 disaster events will be referred to as 27F in line with local usage). To learn more about local responses to 27F and earthquake/ tsunami vulnerability in Talcahuano, a qualitative resilience assessment was devised and applied to two localities in Talcahuano. To do this we used a scheme inspired by Bellingham *et al.'s* (1995). It was adapted to fit the appraisal of communities, i.e. social systems, by modifying the indicators. The scheme uses two dimensions to assess resilience, namely damage and responsiveness, and is therefore straightforward and practical. This article presents the findings.

This study is part of a larger one looking into the earthquake/ tsunami vulnerability that people in Greater Concepción (GC), Chile, experience and which were laid bare by 27F. Because it was mostly exploratory and experiences cannot be measured, only understood, it is *qualitative*. Data was collected mostly in 'the field' by the first author. She spend over a year collecting data, between 2012 and 2016. Various sources, such as (in-depth) interviewing, observation, participation, and document review were used. To safeguard the focus on participants' experiences most interviews were semi-structured: participants would lead the 'conversation'. Through purposeful sampling, specifically snowball sampling, a pool of over 150 participants was achieved. It included a wide variety of people from different socioeconomic backgrounds, ages and even ethnic backgrounds. The majority of the participants were community members, but scholars, governmental officials and (emergency) professionals also participated. Validation of data was achieved through triangulation, member checking, and prolonged time in 'the field'. Because of the confidentiality of our participants, we opted for an unorthodox way of citing

participants. It is highly impersonal as we cite selections as 'raw data' and reference them with merely the year of the interview.

This article is organized as follows. First we briefly go into the conceptual building blocks this article is founded on. Secondly we present the scheme that was used for this 'after-action' resilience analysis. Then we move on to present the findings. Lastly we discuss the findings in a synthesis and shortly conclude the article.

8.3 Resilience: A descriptive approach

Hazardous events remain important tests to communities' limits and ingenuity. In light of this, the concept 'resilience' gained ground and is more and more "framing current thinking about sustainable futures in an environment of growing risk and uncertainty" (Mitchell and Harris, 2012, p.1). Even though there is no agreed upon definition, it is generally associated with a system's capacity to 'bounce back', 'adapt to', 'cope', 'withstand', 'resist', 'recover' from adversity (Bruneau *et al.*, 2003; Aldunce *et al.*, 2014; Manyena, 2006; Warner and Engel, 2014). While some consider it the flipside of vulnerability, we argue that it is related to vulnerability because it affects a system's capacity of response to disturbances and subsequently influences the extent of the change brought about (Gallopín, 2006) (See Fig. 8-1).

The concept 'resilience' has been welcomed because it "is associated with the proactive approach of harnessing the strengths of communities, as distinct from the traditional reactive, top-down approaches to DRR associated with the deficit model of vulnerability, where disaster victims are seen as 'helpless' (Manyena, 2016, p.42)". Also, it is a readily recognizable that allows people from different disciplines and communities of practice to work across silos (Sudmeier-Rieux, 2014; Mitchell and Harris, 2012).

This article considers resilience a systemic quality that emerges from a community's collective performance in the face of (unexpected or unpredictable) change. It reflects the system's ability to self-organize, adapt, resist, take advantage of opportunities and access resources to prevent such structural changes. The main

challenge is "to conserve the ability to adapt to change, to be able to respond in a flexible way to uncertainty and surprises. And even to create the kind of surprises that open opportunity (Gunderson and Holling, 2002, ch. 2)." In this sense, central to resilience is an acceptance that "things change--and to ignore or resist this change is to increase our vulnerability and forego

Figure 8-1 Vulnerability vs. Resilience

emerging opportunities" (Walker and Salt, 2006, ch.1). Resilience should be differentiated from adaptability. Resilience is a systemic quality and adaptability is the human ability to influence resilience: people are not destined to simply react, they can be proactive, adjust their condition and affect resilience.

This application of resilience is descriptive rather than normative. The aim is to learn more about communities' responses to hazard-induced changes. Also, we do not consider resilience a good in and of itself because it can be a major impediment to transformative changes needed to address root causes that make communities sensitive to perturbations. In addition, a descriptive approach seems more conducive to insights about communities' *actual* response capacity that can uniquely inform routes towards disaster risk reduction.

The article builds on Engel *et al.*'s (2014) research on disaster subcultures, which showed that even within a few miles, communities can adapt very differently to the same hazard. The result is that damage incurred may vary, but community responses as well. In short, different forms of resilience emerge.

8.4   Appraising Forms of Resilience: The Model

To categorize forms of resilience that manifest in response to stress, Bellingham *et al.* (1995) devised a practical scheme in which resilience is a function of *damage* and *responsiveness* and which classifies populations into four groups:

resistant (limited damage, limited response), *usurper* (limited damage, significant responsiveness), *resilient* (significant damage, significant responsiveness), and *susceptible* populations (significant damage, limited responsiveness) (see Table 8-1 and Fig. 8-2). While Bellingham *et al.* (1995) and later Batista and Platt (2003) used this model to classify tree populations, it was adapted by Cai *et al.* (2016) to typify communities' levels of resilience in the Lower Mississippi River Basin. They considered this scheme "valuable because it is a straight-forward way of identifying and breaking down a system's response to adverse change; stress, i.e. appraise resilience when it manifests itself (Cai *et al.*, 2016, p.3)." In Cai *et al.*'s Resilience Inference Measurement model (RIM) "…vulnerability refers to the latent relationship between exposure and damage, whereas adaptability indicates the latent relationship between damage and recovery (..). If a community (...) has high exposure to a hazard but sustains low damage, then the community is considered to have low vulnerability. Similarly, if a community sustains high damage but has a favourable recovery (e.g., return of population, infrastructure, or health status), then the community is considered to have high adaptability. Resilience is measured based on the two relationships. A high vulnerability/adaptability ratio is considered low resilience, whereas a low vulnerability/adaptability ratio is considered high resilience." [1]

For our study, we decided to stick to the original model and use both dimensions (damage and responsiveness) as well as the classification of resilience (susceptible, resilient, resistant, and usurper). See table 8-1 for the resilience classification as presented by Bellingham *et al.* (1995).

Table 8-1 Resilience classification as presented by Bellingham and Tanner (1995)

Susceptible	Substantial damage, limited responsiveness. The system finds it difficult to recover and is often worse off after a hazardous event.
Resilient	Significant damage and significant responsiveness. It is highly variable and adaptive.
Resistant	No major damage and responsiveness. The hazardous event is absorbed.
Usurper	No damage, but opportunities are found for growth.

To suit social systems, we adapted the model by operationalizing damage and responsiveness. We were able to formulate specific indicators which we believe give a comprehensive picture of the nature of resilience that emerges in response to change on the basis of relevant literature (Anderson and Woodrow, 1998; ECLAC, 2003; Wisner *et al.*, 2004; IBRD, 2010; CADRI, 2011; De Groeve *et al.*, 2014; EC, 2015; Parsons *et al.*, 2016; Scott and Few, 2016, Scott *et al.*, 2016; Toseroni *et al.*, 2016). The indicators are presented in Table 8-2. Then, based on available data, a score on a three-point
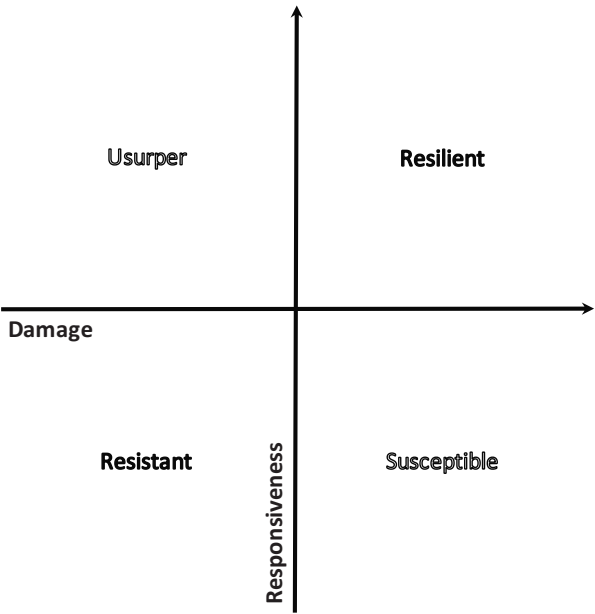
Figure 8-2 Visualization of Bellingham et al.'s resilience

scale was given (Low, Medium, High) for each locality. Since the appraisal includes the communities' evaluation of the indicator, the score given is shaped by the value the community gives to the loss or responsiveness component at hand. Take human loss, for instance. The rural community regularly loses people to 'the sea'. As a result, the losses from the tsunami due to, according to them, stubbornness and vice, is downplayed and not considered disastrous even though percentage wise, it is significant. The impact of this on the scoring is kept limited, but we did chose to let it affect it. The following paragraphs present the findings of our resilience appraisal.

Table 8-2 Overview damage and responsiveness indicators

Damage

Human loss	• Population affected, including death, injury, missing and indirect effects.
Social sector loss	• Social services, such as health and education services • Housing and human settlement.
Social infrastructure loss	• Social infrastructure, such as social cohesion.
Economic loss	• Damage to property, economic activity or infrastructure (anything considered structure that provides a service, such as water supply and sanitation, electricity supply, transport and communications). • Economic activity, i.e. the productive sector (agriculture, industry, commerce, tourism).
Cross-sectoral loss	• Damage on public administration, financial sector and the environment.

Responsiveness

Cross-sectoral response	• Institutional responses.

Mobilization of actors and resources	• Mobilization of a diverse pool of actors and resources, including human, social, economic, and political resources?
Self-organization, cohesion and ability to address needs	• Self-organization (including leadership), social cohesion, and the ability to address specific needs, on a community and household level.
Openness	• Openness to change with the purpose of learning and/or adapting.
Accountability	• Right holders and duty bearers deliver on their obligations.

8.5   Post-event resilience analysis: urban vs rural Talcahuano

Talcahuano is the second largest port in Chile. It serves as *the* hub for the provision of logistic, maritime and port services for GC, the second largest conurbation in Chile, and the south. The fishing industry is one of the principal economic sectors (UNDP and Municipality of Talcahuano, 2011, p.14-15), but it also hosts a Chilean Navy base, 20.5% of the population of GC, and various industrial plants related to steel, oil refinement, petrochemicals, gas and cement. In 2010, Talcahuano was heavily affected by both the earthquake and the tsunami. While the number of fatalities remained relatively low at 37 deaths, of which 21 due to the tsunami, the physical environment was ravaged and lives seriously interrupted (UNDP and Municipality of Talcahuano, 2012). This article takes a closer look into 'the Plain', an urban locality that includes residential areas like Salinas, El Morro, and Talcahuano Centre, and 'the Bays' a rural locality that includes the bays Canteras, Candelaria, and Puerto Ingles. See table 8-3 for a description of the localities.

The Localities

Table 8-3 Description of the localities included in this study

Urban Talcahuano or 'The Plain'	Rural Talcahuano or 'The Bays'
Talcahuano consists of two types of territory: a peninsula and an isthmus. The peninsula is high ground and the isthmus, known as the isthmus of the Low Lands or colloquially as 'The Plain', is mostly low-lying land that includes wetlands. 'The Plain' houses approximately two-thirds of Talcahuano's population (Engel, 2016) as well as the city-center and most governmental, industrial, and commercial entities. Even though historically it was prohibited to use the wetlands for residential purposes (Interviews Talcahuano, 2012-2014; Romero and Vidal, 2010, p.1; Bucci, 2013, Engel, 2016), today it hosts different middle-class neighborhoods.	'The Bays' covers three small bays that, before 27F, hosted roughly 107 families when 27F struck. It is situated on the Tumbes peninsula beyond the larger and more known Tumbes Bay. The peninsula is owned by the Chilean Navy, but colonization was tolerated. Their principal economic activity is artisanal fishery, mostly the extraction of seafood and seaweed. Since these bays were tolerated, but never formalized, they did not have access to public goods such as drinking water, electricity or transportation. Life, particularly in winter, could be tough. High tides would, for instance, cut them off from 'the continent' for vast periods of time. Despite this, interviewees stressed they enjoyed the tranquility, beauty and quaint character of the bays. These bays were theirs and

	jointly, as a community, they were able to overcome even the most demanding challenges and enjoy the *fruits de mer* these bays had to offer. Social cohesion and solidarity were high.

The following paragraphs present our comparative analysis of the localities. We look into both localities' damage and responsiveness to provide more insights into the type of resilience that manifested in response to 27F.

8.6 Damage analysis rural vs. urban Talcahuano

Indicator	Urban Talcahuano: 'the Plain'	Rural Talcahuano: 'the Bays'
Human loss	L	L
Social sector loss	M	H
Social infrastructure loss	L	M
Economic loss	H	H
Cross-sectoral loss	M	M

Table 8-4 Damage analysis: urban vs. rural Talcahuano

Human loss

Table 8-4 presents the outcome of the damage analysis. In terms of human loss, both localities suffered. Everyone in both localities was adversely affected. Also, both localities lost lives. Only 'the Plain' due to the earthquake, but both localities due to the tsunami. There are few, however, reliable and specific statistics. So exact numbers per localities cannot be provided (Senhbruch, 2017). From what is known,

'the Bays' lost two members (approx. 2 percent of the population). Our data suggests that this loss was lamented but not exceptionally: it was not the first time "the sea took from them (interview Talcahuano 2012)". Also, in their view the deaths were related to personal decisions shaped by stubbornness and vice (one refused to evacuate because he wanted to go safeguard his boat and the other refused because he was intoxicated and believed nothing would happen).

Human loss in the urban locality was different. The number of lives was lower, but the impact was greater (UNDP and Municipality of Talcahuano, 2016). Losses were greatly lamented because a number were the result of misinformation from the government; from a trusted source. People who had decided to evacuate but were told to go back home because a tsunami had been discarded:

"[Son:] 'The authorities had said that a tsunami had been discarded. The governor, the president, everyone said the tsunami was not coming. The police came by with a megaphone and I asked them and they told me not to worry…[Mother:] we hear the sound of the tsunami and my husband opens the door to look. I saw the water coming in with great force and my 'old man' disappears…I take a deep breath and I throw myself up to get somewhere I can breathe…I keep myself afloat as I endure the blows from furniture floating in the room[…]my house was a traditional, colonial house, with just one floor, but very high, almost 6 meters, ceilings (Interview Talcahuano, 2013)."

"On the radio they were saying to stay calm and that a tsunami had been discarded. Then you listen to what the news says. This is when people started coming back, repeating what they had heard. Also, the firemen were saying through their megaphones to return home because there was no tsunami warning. I listen to people I consider informed. One always takes notice of what the police or the firemen say, right?[...]Then suddenly a man runs towards

us, yelling 'run, the sea is coming.' That's when the most terrible starts (Interview Talcahuano, 2014)."

Aside from lives lost, people were directly affected by the waves. People who stayed because they did not know a tsunami was imminent and people who were told to go back to their tsunami exposed homes were 'taken' by the waves and this left them injured and emotionally impaired (interviews Talcahuano, 2012-2016).

Social sector loss

Both communities depended on the same social services, so these services were interrupted both were affected. Regarding homes, both localities saw their homes affected, but the rural locality also lost their 'place'. The navy prohibited colonization of 'the Bay's' and disallowed their return. Since their personal, social and cultural identity were heavily intertwined with their environment, impact was significant. Their homes, their social gatherings, their professional lives: everything happened on 'their' beaches. Families would await the return of their men there and, when home, men would jointly fix their netting. More importantly, they had direct access to the sea that provided them with a livelihood: seafood and seaweed.

In addition to losing their 'space', they were relocated to two emergency camps situated in a humid golly in the Tumbes Bay. This brought them a lot of grief. They lived in 'emergency housing' (small wooden prefabricated dwellings) meant to provide temporary shelter for no more than a few weeks, for over five years. The time in these camps was tough. Mostly because the emergency structures were not constructed for long-term accommodation and started to disintegrate. This made life in a humid golly that was cold and prone to flooding distressing. ON top of this, they could not see the sea from this gully. After five years they were offered permanent housing in a newly developed neighborhood on top of a hill in the Tumbes Bay. This resettlement was not easy because it meant giving up their vicinity to 'their' sea; 'their' beaches. At the same time, at least they could see the sea.

Residents from the 'the Plain' did not lose their 'place' but damage to the social sector was important. Some homes were lost and most homes were negatively affected by the tsunami. The extend remains however, unclear. It is for instance unknown to what extent salt-water penetration will have long-term adverse effects on concrete and masonry constructions.

Social Infrastructure loss

In terms of social infrastructure, the urban locality lost little. Social cohesion was already minimal and 27F did not change that. What is noteworthy is the impact that state-led recovery initiatives had on areas that needed to recover their built environment. People were not resettled, but their built environment, that had reflected the residents' cultural and social setting and had organically developed over time, was completely altered. The state imposed a standard layout as well as standard state-designed tsunami-proof dwellings without any consideration of the social and cultural needs of the residents. This left residents feeling estranged from their environs and provoked people to move away. This had a negative impact on the social infrastructure. This was, however, not an overriding effect that was felt throughout 'the Plain'.

The rural locality did experience negative impact on their social integrity. Their relocation meant moving to a place shaped by the state. This was different than their original place that had been developed over time. The distribution of homes, for instance, was done on the basis of objective criteria. Houses were allocated on the basis of households' active participation in the recovery process. This meant that households that had been financially and naturally active in the process were allowed to choose before those that had not. This led to a completely different organization of the neighborhood and people were left with neighbors that they otherwise might

not have had. These types of changes have had a negative impact on social cohesion. Organically grown social units were disrupted.

On the other hand, there was also a 'positive' effect of 27F on social cohesion. Before 27F, in winter the residents could be locked in for weeks. Such periods of isolation would bring the community together. A good example of this is how they would make sure people would in these instances be brought to the hospital:

"[where we lived] ambulances could not come, so whenever anyone needed to get to an ambulance we would use towels and clothes to build a stretcher and take them up to where the ambulance could come (Interview Talcahuano, 2014)."

Today, however, such isolation is no longer an issue. This does mean that the communities no longer experiences challenges that require collective action and this implies fewer instances of collaboration and solidarity.

Economic loss

In terms of economic loss, the tsunami affected Talcahuano's entire productive sector as the port, customs, numerous public and private buildings, the naval base, and ASMAR shipyards, to name a few, were severely damaged. These were the backbone of Talcahuano as a logistical, maritime, and port services hub. In addition, the entire fishery sector, both industrial and artisanal, was devastated and paralyzed for months as boats had crashed onto shore and fish-processing plants were badly damaged (UNDP and Municipality of Talcahuano, 2011, p. 16). All over Talcahuano, this led to job scarcity and unemployment.

For 'the Bays' damage was more significant. They were solely dependent on the fishing sector, especially on artisanal fishery (small-scale, low-capital fishing undertaken by individual households for commercial and/or subsistence reasons). So

when the tsunami hit and devastated their coastline, entire 'businesses' were lost: boats, tools; investments; capital. Plus, because labor opportunities were scarce in the aftermath of 27F it was impossible for them to recover it.

Then economic loss to the 'Bays' was worsened by increasing sensitivity due to cross-scale interactions. Most noteworthy was the on-going declining fish supply due to overfishing and the new fishing law that was put in place in 2013. This fishing law favors the industrial fishing industry over traditional, artisan fishing. For 'the Plain' cross-scale interactions and existing sensitivity also affected damage adversely. The neo-liberal economic system, for instance, had left households on 'the Plain' sensitive to shocks (Solimano, 2012, p.74; Engel, 2016). This negatively affected 'the Plain's' ability to recover (Engel, 2016).

The urban locality suffered more infrastructural damage. Since households were depended on this infrastructure, it disrupted their lives. In fact, participants conveyed that as soon as the infrastructure returned they could return to normalcy. Since the rural locality did not have access to most infrastructure they were not depended on it and impact was minimal.

Lastly, physical damage to housing and personal property translated into substantial financial losses for households. Material possessions were lost and homes with salt-water contamination are weakened. These losses translate into significant financial damage. Economic damage on a household level was nevertheless more extensive in 'the Bays'. Approximately half of the residents lost almost everything and the other half lost key occupational assets vital to most households' livelihoods.

Cross-sectoral loss

Since both localities depend on the same public administration infrastructure, they were both equally affected by its collapse. Not just were employees directly affected by 27F, but most of the physical infrastructure (buildings, archives, ICT, etc.)

was also lost, including relevant documentation. Most offices were, and continue to be, on tsunami exposed land. This impaired public services significantly.

What was different for the two localities was damage to heritage. With the loss of their place, the rural locality lost an important dimension of it. Being away from the sea-side and having to look towards other livelihood options since artisanal fishery is not such an obvious option anymore, is changing the cultural identity of the community. Men and women used to both work in artisan fishing. Today, however, the declining fish stock in combination with access to other job opportunities, has moved women to seek labor elsewhere. This translated in our analysis to greater cross-sectorial losses for the rural locality than for the urban one.

Lastly, we would like to discuss environmental damage. In terms of contamination the urban locality has been affected more extensively. Their land was covered in oily waste containing high concentrations of bacteria, viruses, toxic metals, and organic pollutants that penetrated the soils. Participant believe this contamination of the environment to be extensive but exact levels are uncertain since no comprehensive studies have been conducted. Such contamination can have long-term consequences for the residents.

8.7 Responsiveness analysis Urban vs. Rural Talcahuano

Indicator	Urban Talcahuano: 'the Plain'	Rural Talcahuano: 'the Bays'
Cross-sectoral response	L	M
Mobilization of actors and resources	L	H
Self-organization, cohesion and the households ability to address needs	L	H
Openness	L	H
Accountability	L	M

Table 8-5 Responsiveness analysis: urban vs. rural Talcahuano

Cross-sectoral response

In table 8-5 the results of the responsiveness analysis are presented. In terms of *cross-sectoral responsiveness*, we found that the urban locality's responsiveness was negatively affected by the inadequate governmental response, particularly the poor execution of the warning process. Despite various international tsunami warnings, the Chilean professionals and authorities discarded the possibility of a tsunami and told people to go back to their homes on tsunami-exposed lands. The people that obeyed, were struck by the tsunami waves and a number died in the process.

"My instinct told me to get out and go up to higher ground. Not because of the sea, but because this is what you are always told to do so in case of something major like this. I never thought the sea would reach us. In fact, I just wanted to go to my parents' house, which is like the meeting point of my family. This is where everyone will come together and where we feel safe, together…We were about to go, when neighbors come back saying we should return to our homes because there is no tsunami warning. We also heard the firefighters and the marines say this. We were about to return when a man comes running to us, screaming 'run, run, because the sea is coming'. This is when the terror started….as the water started to reach us, we ran and tried to find anything to hold on to (Interview Talcahuano, 2014)."

The rural locality's response was not affected by this deficiency. This points at households' and individuals' abilities to respond appropriately to impending tsunami-events. Participants expressed reliance on their own judgement. They knew that a major earthquake along the coast could be accompanied by a tsunami and they were capable of interpreting natural warning signs to confirm their reasoning. The participants from the urban locality expressed their tsunami-awareness was too latent and therefore easily overridden by the authorities' messages. Still a significant number did evacuate up the hill. Mostly because they did not run into anyone telling them to do otherwise and thus relied either on their instinct, based on latent knowledge, or other people's behavior or tsunami-related knowledge.

Even though the participants from the urban locality expressed limited tsunami-related knowledge, they did show earthquake-related knowledge. They were able to identify the magnitude of the telluric event and opt for fitting behavior: because of force and duration it was a telluric event greater than M7 that required the exit of the dwelling one is in. This has proven a successful strategy in Chile (Lomnitz, 1970).

Self-organization, cohesion and ability to address needs

Participants from the rural locality conveyed that they started organizing themselves as soon as the earthquake stopped. This is when they mobilized the community to make sure everyone, including those incapacitated, would be evacuated to higher ground. In the morning, when they could see that the tsunami had passed they moved on to organizing themselves for the direct aftermath and short-term well-being. People went down to see what remained and could be useful to the community. Even though families tended to their own families first, respondents stressed that everyone made sure surplus would be shared with the others and especially with those who had lost everything:

> "We would fix everything together. The people that had not lost anything would share with those who did, we would cook and eat together and we would share all the relief we received (Interview, Talcahuano, 2014)".

Respondents from the urban locality shared they preferred a more inward-looking response. They focused on their own families and generally did not prefer to organize on a larger scale. The areas that were severly hit, did to some extent. But mostly households kept to themselves. The response was thus more disparate and household-led. Each family would start at their own pace and in their own way:

> "We immediately started cleaning our house…what was difficult to clean was the furniture which was all black and nasty. [My husband] cleaned it all…even the fridge…he patiently cleaned the engine, washed it, dried it with a hairdryer…and it started working…. There was nothing one could do, but

have patience and try to recover whatever could still function" (Interview, Talcahuano, 2014).

(Lower) middle-class respondents shared that they felt uncomfortable with the way the media led the mobilization and guidance of relief. They did not want to publicly, and often dramatically, broadcast their needs and be seen as 'needy'. In their eyes, they were not 'needy'. It would take time, but they would be able to recover on their own through hard work and sacrifice. These respondents remain far from recovery. This approach does not mobilize enough actors and resources to ensure a speedy recovery. Moreover, their desire to remain silent makes them invisible (Engel, 2016).

Mobilization of actors and resources

Respondents from the rural locality mobilized and engaged a great number and of actors and resources. Actors ranged from international to local and public to private. This was aided by their organization and leadership. They had a single point of contact and a specific organization for managing incoming aid. Respondents regretted, though, that they were not able to align aid to their specific needs. In their view this was because of lack of doctrine and structure. Everyone was just 'winging it'. Relief was for instance mostly spontaneous and supply-, rather than demand-driven. Respondents told us few donors would take communities' actual needs as a starting-point. This led to the arrival of a lot of clothes, but not to increasing economic contributions or assistance towards more qualitative housing options.

The respondents from the urban locality were not able to mobilize similar amounts of actors and resources. Aside from not being able to mobilize enough resources for a fast recovery, they were unable to prevent actors from worsening their situation. For instance, they were unable to get a proper assessment and fixing

of the actual tsunami damage to their homes. Also, on the wetlands residents were unable to prevent the government from using their lands as a garbage deposit and worsening the contamination of their lands. Their limited access to actors and resources led to slow recovery and possibly even worsened sensitivities.

Openness

Respondents from the rural locality showed more openness. They would, for instance, seek out opportunities to reconfigure their lives and fasten their recovery. Women found themselves applying for jobs at the sea-side restaurants as soon as they were back in business. Other women sought out courses that allowed them to roll-out small-scale enterprises selling for instance, sea-food pies (*empanadas de mariscos*). In time, many women, who had previously worked in fishery or had never worked before because work at sea is harsh, found themselves opportunities to work and support their families' recovery efforts. Eventually the men also got back to work and like this they were able to start getting life back on track, even though circumstances had obviously changed drastically.

Another good example of their flexibility and ability to adapt their conditions regards the homes that they received from the state. These were generally too small for the families. They solved this by negotiating that larger families would get larger plots. Then by reusing the materials of emergency dwellings, these families adapted their homes. Respondents share that their adaptability has led them to a better situation. Many of them consider their lives now better than before 27F. They have more opportunities of employment; they are no longer isolated and have easier access to different kinds of services. Some respondents feel their adaptability has grown because of the difficult circumstances they lived in. In 'the Bays' they had to overcome a lot of hardship. This might have helped them to also overcome the changes brought on by 27F.

The respondents from the urban locality did not show similar patterns of openness. They seemed more passive and preferred to stick to what they knew. Even though their needs grew, they did not want to change the way people viewed them. They seemed to prefer longer a longer recovery time than for people to change their view of them.

Accountability

In terms of accountability, the rural locality's organization was characterized by transparency. They aimed for fairness and transparency. The leading organization came up with a specific method to guarantee this. For instance, there were clear rules and everything was done out in the open on one specific location known as 'the mall': "everything was done openly, so that everyone could see (Interview Talcahuano, 2013)". We did not encounter something similar for the urban locality. In fact, some participants relayed dissatisfaction with the way the aftermath and in particular relief was organized.

8.8 Synthesis

The 'after-action' analysis revealed that the localities experienced similar levels of damage, but responded quite differently. Even though the rural locality suffered substantial damage, their responsiveness made it possible to absorb impact and 'bounce forward' (Manyena et al., 2011). We concluded they are '*resilient*'. Their acceptance, endurance, flexibility and ability to seek out and take advantage of opportunities (adaptability) made it possible, at least for our respondents, to consider themselves better off than before. They recognize that they lost a lot, including 'their' place, but they also realize that they gained access to valuable services and resources. They know that even without 27F, in time they would have had to make important changes to their way of life, largely due to the declining fish stock and their increasingly disadvantageous position in a contracting fish sector. These events made them make those changes a little sooner than expected. Today,

their exposure to tsunamis is less. Their access to services and resources makes them less sensitive and exposed to hardship. The question is, though, will this negatively affect their capacity of response? Will less variability diminish the capacity that in light of 27 facilitated their resilience? As our respondents mentioned, the improved situation offers fewer opportunities for cooperation among themselves and according to them this is affecting their cohesion and the prevalent solidarity. Time will tell.

We found the urban locality to be '*susceptible*' to earthquake/ tsunami events. Damage was significant, but their responsiveness was not. Damage included loss of housing stock, job opportunities, personal possessions, damage to health and wellbeing and natural capital, etc. The response was largely organized by each individual household/ family and was adversely affected by limited access to actors and resources.   Many respondents were unable to appraise and respond appropriately to the events they faced during and after the earthquake/ tsunami events. They did not mobilize relevant resources and actors, self-organize, seek and materialize opportunities, and address relevant recovery issues such as increasing soil contamination and the need for tsunami mitigation. Many were not able to 'bounce back' to a similar situation and a few seem even accommodated in a 'new, but worse, normal'. A normal characterized by more tsunami exposure, soil contamination, salt-water contamination of housing stock, and limited resources. In light of this, our urban respondents seem generally worse of today than they were before 27F. In terms of vulnerability, this means that exposure remains the same, but that sensitivity has increased. Housing stock is most likely more sensitive and their resource stock has diminished by the costs they have had to bear to recover. Similarly more people were actually exposed to the tsunami because of a failed institutional tsunami warning and this has left psychological traces that are difficult to shake off. The list goes on. In terms of capacity of response, 27F shows that it was minimal and we believe that it has decreased as a result of 27F. At the same time, tsunami

awareness has increased and institutions are investing in more tsunami preparedness. The information received from our respondents however, suggests that those efforts are minimal and that it does not address matters of exposure and sensitivity nor does it significantly improve capacity of response.

8.9   Conclusion

To learn more about the types of resilience that emerged in response to 27F we applied a resilience model to look into localities' resilience in terms of damage and responsiveness. Resilience in this sense was a descriptive rather than prescriptive tool. Even though most scientific work aims to develop predictive models to ascertain localities' resilience levels before an event occurs, we felt it would be useful to first learn more about resilience and the forms it can take in the wake of disasters. This can be a useful basis for further investigations into predictive models. Against this background, we developed a model to appraise communities' response, i.e. resilience, to a specific event. Since the data generated throughout this study was qualitative they are subject to the researcher's interpretation and estimations and await comparison with a future quantitative endeavor.

We broke down localities' damage and response in order to identify the form of resilience that manifested when the events of 27F transpired. This provided insights into the two localities' capacity of response which can be key to formulating constructive paths towards disaster risk reduction. This article intends to start the ball rolling in developing resilience analyses that enable descriptive analyses 'before' and 'after' events to ensure that both strengths and weaknesses are appraised and proper paths that build on existing capacities and move towards disaster risk reduction are secured. This implies that more similar investigations will be necessary to attain a proper model and increasing evidence.

[1]   We did not adopt Cai *et al.*'s framework because we felt their adaptations were not always consistent with our understanding of resilience. For instance, in our view we take *exposure* as a given and just look at the response and damage. We find it challenging to determine that a locality's resilience that is less exposed

or not exposed at all to an event will be compared to one that is. Also we understand vulnerability as vulnerability to change and stress which we do not necessarily relate to socio-economic aspects. There are various studies that have shown that poorer societies, because of the high levels of variability they live with on a daily basis, are highly resilient. Having a phone does therefore not necessarily relate to limited resilience. In fact, in our study phones proved absolutely useless in terms of response and recovery resilience since networks had collapsed. Resilience seems more equated with the way communities respond to such changes in their environments.

Chapter 9:   Findings and conclusions

With this study, I dove into GC to zoom in on four communities in the wake of 27F to learn more about their earthquake/ tsunami disaster subculture, including a technological culture perspective. As Krüger et al. (2015) argue, linking culture to disasters is valuable because it gives "a framing that can offer explanations for dealings and doings in the disaster context that might, if culture was left out, be considered as 'confused', 'irrational', 'unwise', 'weird' or 'irrelevant'...[and] culture has a (often hidden) power that enables, or hinders, people and populations to deal with hazards appropriately" (p. 2).

To do this I explored people's experiences to uncover and gain a better understanding of manifestations of DsC and of the underlying cultural mechanism at play. Throughout this exploration I was attuned to manifestations of vulnerability that emerged concurrently with those of DsC. See figure 9-1 for a visualization of the research purpose. The wake of 27F was just the right time for this. The events would make people turn to the DsC for means to cope with the events and the impact of these events would simultaneously reflect vulnerability.
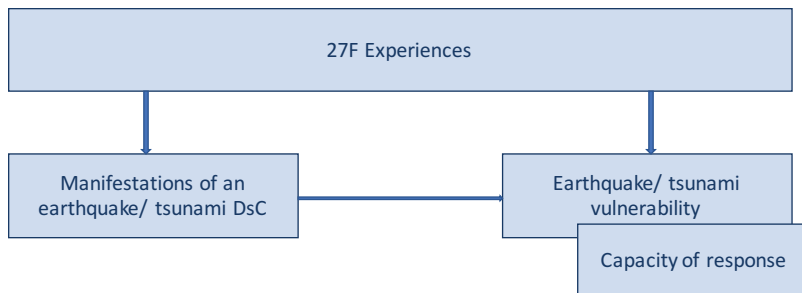
Figure 9-1 Illustration of research purpose

Commonly matters of vulnerability point at issues of sensitivity and susceptibility. I tried, however, to also focus on *what people can accomplish and have accomplished*. I wanted to ensure that the capacity of response that *is* available is not overlooked. Because these existing capacities should eventually be the foundation for furthering disaster risk reduction efforts.

Below I will present my findings and conclusions, seeking to answer the research questions (see Box 9-1). Then, before going on to the discussion and conclusion of the main question, I will identify a number of opportunities for advancing DRR and future research.

Box 9-1 Research questions

Question 1: What can we learn from applying a disaster subculture lens to people's 27F experiences in Greater Concepción about their earthquake/ tsunami vulnerability?

Question 1.1: What do people's 27F experiences reveal about an earthquake/ tsunami disaster subculture when applying the disaster subculture lens?

Question 1.2: What do people's 27F experiences reveal about their earthquake/ tsunami vulnerability?

Question 1.3: How can exploring earthquake/ tsunami disaster subculture enhance our understanding of earthquake/ tsunami vulnerability, and in particular capacity of response?

Question 1.4: How can a technological culture perspective enrich our understanding of the prevalent disaster subculture and associated earthquake/ tsunami vulnerability experiences?

9.1 Questions 1.1 and 1.2: Exploring 27F experiences in search of a disaster subculture and manifestations of vulnerability

Because the DsC is intrinsically related to vulnerability, below I present the answers and findings with regard to research questions 1.1 and 1.2 together. A forced division would not do justice to their interrelatedness.

Question 1.1: *What do people's 27F experiences reveal about an earthquake/ tsunami*

disaster subculture when applying the disaster subculture lens?

Question 1.2: *What do people's 27F experiences reveal about their earthquake/ tsunami vulnerability?*

When applying the DsC lens, my attention was directed at the different means people have developed by collectively learning from disaster experience as well as preserving and building on these lessons to secure perseverance and progress in an inherently hazardous environment. Central to the DsCs was an ability to learn and self-organize, but also to exploit creativity and intelligence. The DsCs were clear manifestations of adaptability.

Through cognizance of vulnerability while applying the DsC lens, it became apparent that DsCs are the product of people managing their vulnerability. In Itteren the disaster subculture contributed to fitting capacity of response to riverine flooding and in GC, the disaster subculture contributed to decreasing sensitivity as well as appropriate capacity of response. Central to the cultivation of the DsCs was an

acceptance of the risks involved and a recognition that vulnerability *can* be managed and *should* be managed. How this is done, however, is distinct to each community.

In GC, the primary area of study, findings suggest a disaster subculture that is long-standing and comprehensive. Through the confluence of the human, social, technical, and natural a disaster subculture has emerged that allows communities to significantly resist telluric events and adjust in agile and resourceful ways when the limits of resistance are surpassed. While the disaster subculture is mostly grounded in communities, it integrates more top-down scientific knowledge and practices. In fact, this choice effectively supports their efforts towards resistance. In addition, I found that intangible tools, such as norms, knowledge, and forms of organization, gives the communities fortitude in the face of destructive forces. The table below gives an overview of the disaster subcultural elements I identified and their contributions to vulnerability.

To enrich the pictures of the disaster subculture and its elements, or assets, and therefore attain a better understanding of the way people have adapted their conditions to ensure adaptation in their environ, the technological culture perspective I complemented the DsC lens with was crucial (see for instance, knowledge and socio-technical systems in table 9-1) .

Table 9-1 Overview of DsC elements in GC

Worldviews: Beliefs, values, and attitudes	
Life	Drive (re-)production of DsC and adaptability.
Family	
Situations and conditions are transient	Manifestation of adaptability and contribution to capacity of response (agility)
Life is about sacrifice, endurance, effort, and moving forward.	
Confidence and pride in the DsC resources they have fostered over time to deal with earthquake/ tsunami events, but in particular with telluric events.	Supports (re-)production of DsC
Accepting attitude towards earthquakes and tsunamis.	Facilitates risk awareness, the (re-)production of DsC and thus adaptability.
Behavior: Norms and Practices	
Practice of fleeing	Capacity of response contributing to capacity of response (agility).
Rapid event appraisal and appropriate protective behavior selection	
The practice of earthquake resistant design and construction	Capacity of response contributing to resistance
Solidarity	Contributes to and contribution to capacity of response (agility).
Bricolage and improvisation	
Opportunism	
Knowledge	
Confluence of local, indigenous and scientific knowledge	Capacity of response enabling both resistance and capacity of response (agility).
Socio-technical systems	
Earthquake resistant physical environment	Capacity of response enabling resistance
Tsunami warning system	Capacity of response negatively affecting vulnerability. The inadequacies of the system led to a great number of deaths.
Social structures incl. patterns for intra- and inter-organizational response	

(Extended) Family	Contributes to capacity of response (agility).
Manifestations	
Decaying 27F memorial monument	Manifestation of critical issue In light of people's attitude towards the material, the government's decision to spend a lot of money on a memorial was not appreciated. It now represents the gap that has been felt between the state and the affected throughout the aftermath.
Socialization mechanism	
Narratives	Reproduction of DsC
Experience	
Comparative dimensions	
Broad in scope	Contributes to widespread adaptability as it is accessible to many communities.
Latent	Has been successful for the (re-)production of the DsC, but at the same time contributes negatively to vulnerability because it limits access to 'outsiders' .
Combination of expressive and instrumental elements	Makes both resistance (limiting sensitivity) and capacity of response (adaptability) possible
Individualized	Makes a timely response for rapid onset hazards, like earthquakes and tsunamis, possible and therefore contributes to capacity of response (agility).

To conclude, applying the DsC lens allowed me to investigate people's 27F experiences and identify and describe their earthquake/ tsunami disaster subculture. In addition, by minding throughout this process vulnerability I learned that central to people's ability to manage their vulnerability to earthquake/ tsunami events is the DsC and the means it encompasses. Throughout the following paragraphs I will briefly discuss the findings related to questions 1.1 and 1.2.

Sensitivity: the susceptibility of urban Talcahuano

The experiences that I brought together revealed a lot about earthquake/ tsunami vulnerability, laid out in Chapters 4 through 7. One particular finding stood out, though, because it was somewhat counterintuitive. This was the fact that I found susceptible middle-class households. Most disaster literature assumes middle-class households are self-sufficient when it comes to natural hazard induced events and they therefore do not receive a lot of attention. Literature tends to focus on the poor; the most vulnerable. In GC, however, I found an increasingly susceptible 'middle'. Chapter 6 shows this locality's middle-class households found themselves exposed and without access to relevant resources that would enable them to firstly respond to the events fittingly and then ensure a timely and appropriate recovery.

In Chapter 8 we furthermore concluded that the resilience that manifested throughout the urban locality in the face of 27F can be typified as 'susceptible' to shock, while the rural locality's response was characterized by high resilience. We found that even though both localities suffered great damage, responsiveness was very different. The rural locality was able to absorb it, adapt and move forward, the urban locality was not. Some participants of the rural locality even consider themselves better off: they 'bounced forward'. This shows how vulnerability can also embody positive changes, even vulnerability for earthquake/ tsunami events.

Significant for this 'bounce forward' (Manyena, 2006) were expressive DsC elements, such as norms, beliefs and attitudes. Participants had accepted earthquake/ tsunami risk and as a result embraced relevant DsC components that would enable them to deal effectively with risk. Then when 27F happened, they knew how to interpret their environment and act fittingly. Damage to the communities was significant. The losses were lamented, but their new situation was also quickly accepted as they realized there was no other way but to do so and move forward. This approach was facilitated by the assortment of techniques, tools, tangible and intangible, and artifacts that their communities had cultivated over time for them to

reach to when in need. One could say that the vulnerability to earthquake/ tsunami events triggered collective learning processes that led to means enabling greater adaptation. Interestingly, the DsC was not populated by technological artefacts (e.g. computers, satellite telephones, databases) or elaborate socio-technical systems (e.g. flood barriers, disaster response system), it comprised rather more intangible tools and techniques that were directly accessible to those exposed. This was valuable, because they persisted even in the midst of severe physical havoc.

Concerning vulnerability, we learned that *DsCs can have both positive and negative effects on vulnerability*. For GC, the positive effects arise mostly from the resistance it enables, i.e. decreasing sensitivity, and the increasing capacity of response it facilitates. The convergence of scientific knowledge and practices with local ones have for instance, allowed for a very resistant physical environment in terms of telluric events. As a result, most quakes (at least up until M6) do not 'move' these communities. People report going on about their business as if nothing has happened. When, however, the limits of their resistance (quakes beyond M7) are reached, people turn to DsC resources to ensure they can adjust to the new more uncertain circumstances.

Capacity of response

In both the Borgharen and Itteren case, the DsCs contribute to *capacity of response*, which in turn have a positive effect on vulnerability. Itteren's public space is filled with symbols alluding to the risk of flooding and keeping people aware, houses exposed to flooding are build higher and have a tiled ground floors so that impact is limited when flooding does occur, and people have means to quickly safeguard their possessions on the ground floor. In Borgharen people exactly know when to start cleaning so that it is made easier by the retreating water, divulge stories of past flood experiences and are organized to respond swiftly. Because of these

different means their sensitivity to flood events is checked. This was also the case for GC.

In terms of exposure there is very little that GC communities can do. Major earthquake/ tsunami events *will* be a part of their future and because of their specific location they will not be mild. They manage their level of sensitivity and capacity of response through the (re-) production of the prevalent DsC which is a cultural reservoir of means with which people engage to ensure resistance, capacity of response and resilience to future events. Essentially, DsCs are stable platforms that allow people to make sense and respond fittingly. Such stability is essential to ensure a resilient response. For example, foreseeable challenges can be dealt with by turning to the DsC. This gives people more capacity to cognitively engage with the novel challenges that hazardous events generally comprise. It is undesirable to have to reinvent the wheel over and over again, especially for matters that can be overcome through preparations (planning, discipline and structure), because this exhausts cognitive capacity which is required to deal with often pressing and complex new predicaments. So ideally, here the planned converges with creativity and practical intelligence to address the unforeseen through improvisation. How successful improvisation can be however depend on the preparations done ahead.

Resistance, flexibility, and agility

Central to the DsC is resistance through the convergence of scientific and local knowledge in practice and flexibility or latitude through mostly intangible tools such as values, norms, beliefs and attitudes. People are able to quickly read the environment and the situation to determine a right course of action, (re-)organize themselves and re-shape their conditions to swiftly get to a new 'normal' to mobilize actors and resources to secure a way forward.

Here it is important to note that communities do not enjoy uniform levels of resilience vis-à-vis tsunamis. Certain households are adversely affected by conditions

and dynamics at other scales. To be precise, there are signs that the neo-liberal system shaped by the constitution established by Pinochet impinges on vulnerability.

No zero-risk logic

Interestingly, characteristic of the DsCs that were explored was the acceptance of the natural hazard involved and a commitment to a collective, but at the same time individualized, capacity of response. Each individual member of the community is engaged and committed to the DsC. There is a *no zero-risk logic*, but rather risk acceptance. They do not aim to control nature, but rather acknowledge the hazards and ensure capacity to respond and adjust fittingly to changes involved. Because of the dimensions involved, i.e. the floods were 'manageable', this led to an agreeable relationship with nature, and especially the river, in Itteren. For GC where earthquake and tsunami events can be of catastrophic dimensions, the relationship is less harmonious. The forces that people from GC have to endure are significant when it comes to earthquake/tsunami events. So their relationship with nature is rather one characterized by 'respect' leaning towards 'fear'.

Critical Issues

The absent state

Throughout participants' experiences, the state was largely non-existent. Moreover, participants shared that they had little expectations from the state. Whatever the state would do would be appreciated, but aside from that, they felt they were in charge of taking care of themselves. Some even frowned upon receiving assistance from the state.

Whenever the state did come into the picture, it was often not in a positive way: the role was either minor or deficient. The state failed to successfully engage the tsunami warning system, failed to respond in a timely and coordinated fashion, failed to lead and give oversight to the reconstruction, and failed to give account for

their overall performance. Scholars (Sehnbruch et al., 2017; Arana Araya, 2017) have argued that this is largely due to skeletal state that accompanies the neo-liberal model that underlies Chilean society. While the neo-liberal model's influence was outside the scope of this research, the studies do reflect my findings. My research, for instance, clearly showed there is a very limited state that does not consider adequate disaster preparedness one of their priorities.

This reality is thought-provoking, because most disaster literature points at the central role of the government in terms of DM. *Introduction to international emergency management* by Coppola (2011) states for instance that the "[r]esponsibility for disaster management ultimately rests with the local and national governments of the affected country or countries. Citizens <u>expect</u> their governments to provide both pre- and post-disaster assistance, regardless of the cause of a disaster (Coppola, 2011, kindle loc. 11453-11456)." My findings suggest however, that in Chile no level of government really takes on this responsibility nor do citizens expect them to do so and be held accountable if they do not. In the wake of 27F the weaknesses of this approach became apparent. The communities were left to deal with the response and their recovery spontaneously with very limited resources. It is valuable to see people and communities as capable of cooperating and acting for themselves like Tocqueville envisioned (Patterson, Weil, & Patel, 2010, p. 129), because people and communities *are* in fact capable and responsive, especially in times of disasters (Scanlon, 2005; Rodriguez et al., 2006): "spontaneous response mechanisms will arise as a result of people's survival instinct and collective community concern (Coppola, 2011, kindle Loc. 11478-11479)." The question though is, whether there are governmental capabilities and resources to support them? In the GC cases, this was not the case and this affected their capacity of response negatively.

So even though three of the four communities that I looked into displayed ingenuity and resourcefulness and an ability to bounce back and even 'bounced

forward' through flexibility and openness, the current reality would be even better if they would have been supported by increasing preparedness, coordination and cooperation at various levels and both top-down and bottom-up. It is understood that when it comes to disasters, the community will always be the first responders (Kirschenbaum, 2004). The state however still has an important role to play because of the various resources they have access to. Resilience cannot be seen as leaving it all to non-state partners and having an ill-functioning state in times of disasters: just like a collection of resilient individuals does not guarantee a resilient community (Norris et al., 2008, p. 130), a collection of resilient communities does not guarantee a resilient country. At the same time, a strong state with an unprepared community is also undesirable. The Borgharen and Itteren cases show how a dependent community can increase susceptibility. The whole is more than the sum and it is therefore crucial that the state also contributes to a resilient whole vis-à-vis (earthquake/ tsunami) disasters. At the end of the day a community is only as resilient as its weakest part. Please see table 9-2 for an overview of state presence and engagement in both Greater Concepción as Borgharen and Itteren.

Table 9-2 Comparative table state and community presence and engagement for the cases

Case	State (presence and engagement)	Community (presence and engagement)
Greater Concepción	Low	High
Borgharen and Itteren	High	Low

Neo-liberalism reinforcing negative vulnerability

There were various instances which pointed at the neo-liberal system in which communities operate seems to negatively affect their vulnerability to earthquake/ tsunami events. First I have shown the way the neo-liberal model inspired the socio-

economic state that left middle-class households in an increasingly precarious state and vulnerable to even the smallest shocks, let alone major ones like earthquake/ tsunami events (see Chapter 6). Then it became apparent that the neo-liberal model facilitated the liberalization of the land-market that allowed for tsunami exposed lands to be converted in middle-class neighborhoods that would put an increasing number of middle-class households exposed to tsunamis. Thirdly, the neo-liberal model had assisted the rise of a skeletal state unable to provide assistance in response to 27F thus leaving people on their own. From this I consider further research into the effects of neoliberalism in Chile on disaster vulnerability a worthwhile area for future research.

Lack of planning? Fantasy documents and winging it

Even though the experiences I gathered from GC were filled with statements like "we were not prepared", "we have no protocols", "we decide what to do on the spot", there exist documents. There is a civil protection organization (see Fig. 9-2) (structure) accompanied by doctrine (e.g. protocols, policies and laws). In fact, like Aguirre (2010) noted, the plan is quite sophisticated on paper integrating different goals of the different phases of DM cycle and even ensuring citizen participation. This study found, though, that in terms of practice, doctrine in particular hardly makes an appearance in daily life and could even be construed as 'fantasy documents' (Clarke, 1999; Birkland, 2009). People do not know the documents, policies and protocols and therefore do whatever they believe is right. People will get together in accordance to the figure below, but aside from that I could detect little in the way of a prepared, structured and organized response. People just seemed to 'wing it' on the spot and rely on what they labeled 'improvisation'.
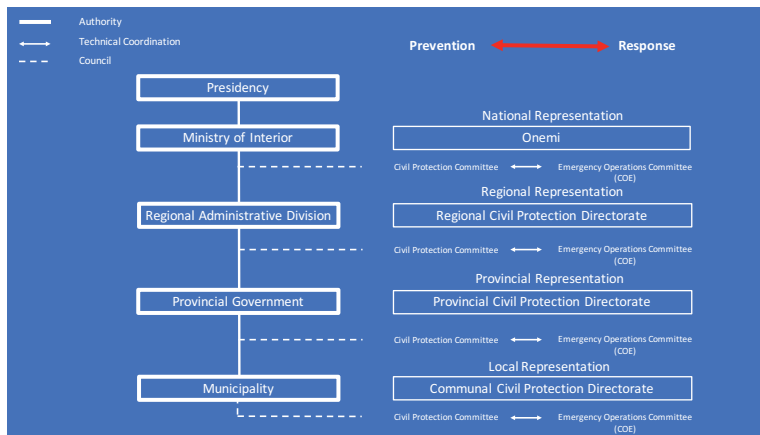
Figure 9-2 Chilean civil protection organization

Harrald (2006) however stresses the importance of *both* discipline (structure, doctrine and process) and agility (creativity, improvisation and adaptability). They are two sides of the same coin and are largely interdependent: "Where discipline ingrains and strengthens, agility releases and invents . . . agility applies memory and history to adjust to new environments to react and adapt, to take advantage of unexpected opportunities" (Boehm & Turner, 2004, p.1). Without any preparation one is exhausting cognitive capacity and energy on reinventing the wheel over and over again and the result is generally unsatisfactory because of the prevalent time constraints, uncertainty and stress that is involved. Participants' experiences revealed this. They self-organized but still there was no coordination, complementarity or structure and this led for instance to redundant relief that was not geared towards actual needs and that was directed largely by the media. Whichever community was able to hold the attention of media outlets, would receive abundant assistance. The response was thus spontaneous and emergent and did show high levels of agility, but it was deficient because of the lack of discipline and essentially learning.

Here I would like to note that the lack of discipline fits well with the overall DsC which is mostly individualized and geared towards flexibility and adaptation. This could be the mechanism underlying the 'failure' of existing doctrine, i.e. underlying the 'fantasy documents'. In this sense the DsC might be hindering DRR.

9.2 Questions 1.3 and 1.4: Applying the disaster subculture lens from a technological perspective to explore disaster subculture and better understand vulnerability

These paragraphs are dedicated to answering Questions 1.3 and 1.4 as well as presenting the conclusion and the findings on which the conclusion is based.

Question 1.3: How can exploring earthquake/ tsunami disaster subculture enhance our understanding of earthquake/ tsunami vulnerability, and in particular capacity of response?

Question 1.4: How can a technological culture perspective enrich our understanding of the prevalent disaster subculture and associated earthquake/ tsunami vulnerability experiences?

Exploring earthquake/ tsunami disaster subculture can enhance our understanding of vulnerability vis-à-vis earthquake/ tsunami events by directing our attention to the means that people cultivate to manage their vulnerability; to *cultural capital*. DsCs are particularly valuable in light of capacity of response and resilience. They represent a stable platform of resources that people can turn to when recurrent hazards befall them. From here people respond and forms of resilience emerge.

Since today's societies cannot be analyzed without appreciating the concomitant nature of technology and culture, a technological culture approach to DsC was key. Applying the DsC lens from a technological culture perspective was important to capture the intricacy that accompanies the fact that reality emerges from the confluence of the human, social, technical, and natural. One should aim for a rich picture and taking this approach makes that possible. It becomes possible to appreciate how DsCs emerge from highly technological learning processes. Even the most intangible tools, like knowledge, emerge from innovative collective technological processes as available resources of knowledge are brought together in new ways to adjust and ensure increasing adaptability. In the GC this encompassed bringing together the scientific, local, and the indigenous knowledge. But it also enables identifying, understanding, and adequately appreciating DsC resources.

In conclusion, exploring earthquake DsCs can enhance our understanding of vulnerability to earthquake/ tsunami events by unearthing the means with which people manage their vulnerability and resilience. By furthermore ensuring technological culture perspective one assures a rich picture that does justice to the role both the social and the technological play and points one's attention to realities that might otherwise be overlooked. The following paragraphs will discuss findings.

The use of the disaster subculture lens to assess vulnerability and capacity of response

In Chapter 5 I presented the article *Flood disaster subculture in The Netherlands: the parishes of Borgharen and Itteren.* This was the first article of four and was intended to assess the conceptual opportunities of the disaster subculture lens, before going into 'the field'. The primary questions were, does this lens still have contemporary relevance, can it be applied in another context than it was developed in, and if applied today does it result in valuable insights? Since this lens remains underemployed, I preferred one more application in another context before applying it in GC. This would give me increasing understanding of the lens and its application and therefore enhance my application of it in the GC area.

Doing this turned out to be useful for the purpose of this study. It became apparent that "the disaster subculture framework, as it was originally formulated, can be used to identify and describe disaster subcultures in a context other than the context in which it was developed" (Engel et al., 2014, p. 879). In addition, it led to novel insights about these parishes' flood vulnerability. An important (theoretical) finding was that a changing flood management paradigm could have an adverse effect on these parishes' flood vulnerability. This will be elaborated upon in section 8.12.

The application of the DsC lens to Borgharen and Itteren confirmed its suitability to exploring vulnerability in GC from a cultural perspective. The articles presented in chapters 6, 7 and 8 present the rich findings of the application of the DsC lens to Greater Concepcion in the wake of 27F. Since the scale of the case was much larger, because of the number of natural hazards involved (2) and their enormous magnitude, I was glad it was not my first application of the concept.

In terms of the lens itself, the most important finding was that its application enabled a focus on the means that communities cultivate over time to accommodate in inherently hazardous environments and cope with recurrent hazardous events. On

the basis of the Dutch case study, we found that only minor adjustments to the framework would be desirable. First we recommended to eliminate the forewarning condition. Two studies, for instance, have now shown that this condition is not necessary for a DsC to emerge (Turner, 1982; Chapter 5). It seems that exposure, sensitivity (impact is salient to different segments of society) and recognition of people's exposure and sensitivity prompt the development of a DsC. So dropping the forewarning condition would make the framework more up to date and more widely applicable. Secondly it was recommended to align the framework with other more conventional cultural frameworks. This would make studies more compatible with one another and allow for more confluence between different types of cultural studies into disaster vulnerability and resilience. Thomalla et al. (2015), use more conventional descriptive categories that could be integrated to do this.

Whereas the dimensions of the hazards that Borgharen and Itteren and GC deal with are different, it is possible to say that as separate units of analysis they have been successful. The DsC that these communities cultivated allow them to absorb significant impact and adjust to changing circumstances when their capacity to resist is surpassed. Hence, DsCs are a clear result of the communities' capacity to learn and innovate over time to improve their adaptness. In this sense, the DsCs in GC and in the parishes of Borgharen and Itteren are clear manifestation of *adaptability*.

Appreciating cultural capital for vulnerability

Chapter 7 presents an analysis using the 'asset pentagon' which is central to the livelihood framework. This pentagon illustrates important interrelationships between assets that should be considered the building blocks of sustainable building blocks. The assets that are included are: human capital, social capital, natural capital, physical capital and financial capital. Chapter 7 shows how vulnerability in Talcahuano is negatively affected by a limited access to resources. This limited access inhibits coping capacity and resiliency.

Chapter 5 and 6 present findings from this study that illustrate how culture can limit susceptibility to natural hazards. It would therefore be my recommendation to broaden the scope of analysis to include cultural capital. The pentagon would become a hexagon and would give a more comprehensive representation of households' access to resources. For Talcahuano, the hexagons depicting accessible resources before and after 27F is presented in Fig. 9-3.

Before 27F   After 27F
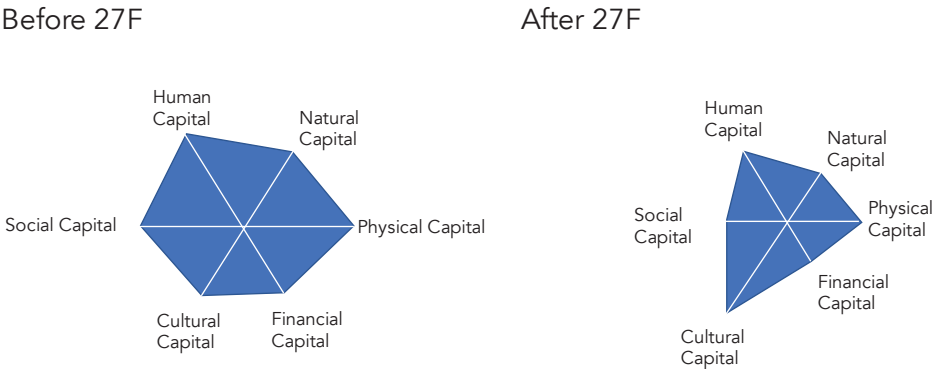
Figure 9-3 Asset hexagon for Talcahuano before and after 27F

Chapter 6 shows how before 27F households in Talcahuano were already feeling strain when it comes to natural and financial capital. These were already being negatively affected, and especially 'the middle' households were exposed to this. What is interesting here is that from what I have seen I would say that cultural capital increased after 27F. Not everyone in Talcahuano knew they were exposed to tsunamis. This limited their access to tsunami-relevant resources. Since 27F, however, everyone knows and more is being done to ensure that households have access to tsunami relevant cultural capital. This increase is depicted in the 'After 27F' hexagon. Central to this research's findings was that access to resources had an important effect the experience of negative vulnerability or rather susceptibility of the respondents included in the study. Time and again this was something inhibiting their response and recovery. This is why I feel it would be key for any study of vulnerability to appraise assets and include one of the most important assets: cultural capital.

The added value of incorporating a Technological Culture Perspective

In the following section I would like to present two examples to illustrate how incorporating a technological culture perspective complemented the DsC lens and contributed to a deeper understanding of DsCs functioning.

Borgharen and Itteren: from acceptance to resistance, from resilience to susceptibility?

When investigating the DsC in Borgharen and Itteren we found that the introduction of the new flood management paradigm and the associated technologies "could transform two self-sufficient, responsible and resilient communities into two dependent, less prepared and therefore more vulnerable communities" (Engel et al., 2014, p. 882). The 1993 and 1995 flooding events incited a nation-wide discussion about the acceptance of flooding. Since the (coastal) storm surge disaster of 1953 the leading idea in the Netherlands was "to reduce the probability of flooding to (negligibly) low levels in areas where impact of coastal or riverine floods was expected to be greatest" (Engel et al., 2014, p. 865). This would be done through complex socio-technical systems driven by science and expertise, such as impressive flood barriers.

Since the province of Limburg is relatively thinly populated and enjoys high grounds, this province was excluded and allowed to design and execute their own flood protection approach. This approach would be characterized by regular, but, according to the inhabitants, manageable flooding. What the DsC lens revealed was that DsC elements made it possible for the inhabitants to effectively deal with flooding. Central to the DsC was an acceptance of flooding: *living with floods.*

Their success was such that flood events used to be considered joyous times. Flood events were a time of solidarity, excitement, and creativity. Together the community would make sure everyone would be taken care of and impact would remain limited. This was facilitated by normative and valuative elements (e.g. solidarity), beliefs (e.g. the river as a relished neighbor that sometimes loses her wits

as opposed to a 'Waterwolf', community self-sufficiency), symbols (e.g. poems, works of public art) knowledge (e.g. reading the river to know when it will be high water), technology (e.g. architecture), patterns for intra- and inter-organizational response (e.g. emergent response), and socialization (e.g. pubic symbols and narratives).

The discussion that the 1993 and 1995 flood events prompted was largely dominated by the flood-prevention paradigm. This is not strange since most of the Netherlands and in particular the wealthier and more powerful parts of the Netherlands (the Randstad) are guided by it. It did mean, however, that suddenly flood events were considered problems that needed fixing or rather, preventing. Since the problem was defined from within the dominant paradigm, the solution was as well. The result was: *the Maaswerken*. This complex socio-technical system would control the river Meuse, and seize the burden of flood events.

The introduction of this 'solution' that was not envisaged in light of the local DsC can have significant impact which might even be adverse to these parishes' vulnerability. Exposure remains even though it is considered negligible. Sensitivity might decrease, because preventive measures will reduce the number of flood events, but this decrease might be neutralized as an increased sense of flood safety can increase risk taking considering the continuing flood exposure. Since floods are no longer considered a part of the future, flood-sensitive developments might be pursued. In addition capacity of response will weaken as communities will no longer see the need to (re-)produce DsC elements that enable communities to cope with flooding. DsC elements are already becoming obsolete due to the introduction of the new paradigm and associated solutions. The changing behavior of the river, for instance, has made prevalent flood-related knowledge inadequate. Before the communities could initiate a flood warning process themselves by 'reading' the river. Today however, they are dependent on a complex socio-technical system dominated by scientific knowledge and technologies such as telecommunications with numerous possible points of failure. Also collective and individual creativity and intelligence will

no longer be directed at living with flooding: no more residents designing drainage systems for their living rooms or poems adorning the public space. The findings suggest that increasing resistance to flooding may well have a negative effect on the communities' vulnerability, as the DsC is undermined or becomes obsolete.

In terms of resilience, this case also shows how a more adaptive kind of resilience is being replaced by a more engineering resilience and how this could make the communities at hand more sensitive to change as their resilience to flood events will decrease. Resilience is built through exposure to perturbations. So when exposure and thus experience with flood events diminishes, collective learning, self-organization and coping with adversity will be limited as well. As Gunderson and Holling note (2002, kindle loc. 1019) increasing resistance can induce increasing sensitivity to even the smallest changes. This will have to be monitored over time to see whether this will be the case.

Through technology people alter the conditions of their environment and ensure a plethora of means that made it possible for them to 'make sense' of flood events and respond fittingly without too many surprises. When surprises would arise, they were able to deal with them because cognitive capacity was not preoccupied with 'making sense' and 'reordering'. There was space to reorder and find novel solutions. At the same time, they were not entirely self-sufficient and did not need to be because different governmental institutions, including foreign ones, were there to assist them. Central to these DsCs were risk-acceptance and agility.

GC: the contributions of a poorly integrated socio-technical system to vulnerability

The response in GC to the tsunami entailed two systems: one sophisticated and complex science-based socio-technical top-down system (institutional tsunami warning system or ITWS) and one bottom-up one grounded in experience, local knowledge and practices (local tsunami warning system or LTWS). In light of 27F, the latter was successful and the former failed. This was particularly interesting from a technological culture perspective. What went wrong? As I explored GCs DsC it

became apparent that the failure could be related to the poor integration of the tsunami warning system into the DsC because the system was inapt for the DsC. It did not fit.

Let me shortly discuss the two sociotechnical systems. The ITWS comprises various organizations, institutions, technical artefacts, scientific knowledge, authorities, experts, professionals, policies, procedures, laws, etc. (see Fig. 9-4) It is formal, multilayered, characterized by rigid hierarchical structures and depends on
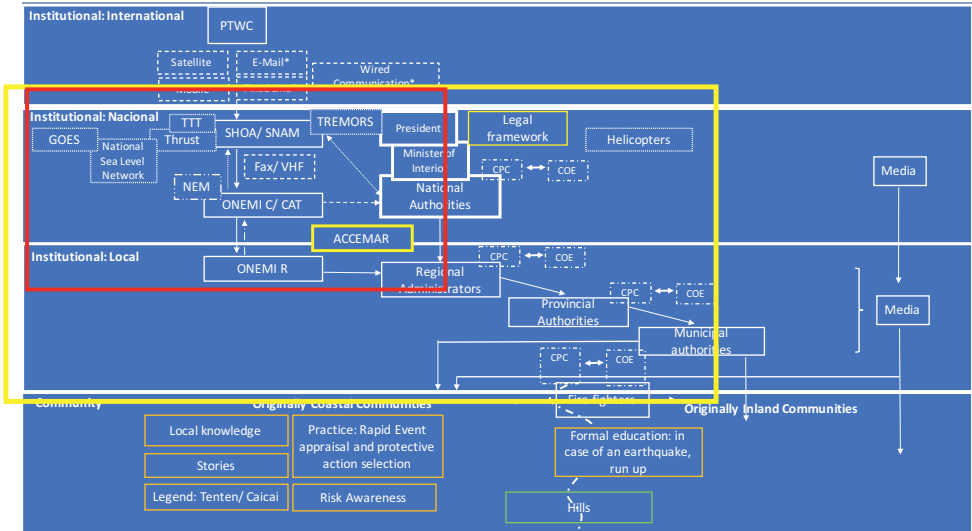
Figure 9-4 Illustration of the sociotechnical institutional warning system.

practices and artefacts. Hence, important features are its inclusion in the Pacific Tsunami Warning System (PTWS), the integration of THRUST (Tsunami Hazard Reduction Utilizing Systems Technology) into the Chilean national emergency system based at Valparaiso (Lorca, 1991; Alexander, 1999, kindle loc. 1161), GOES (Geostationary Operational Environmental Satellite, National Aeronautics and Space Administration (NASA), 2017), microcomputers, water-level sensors, phones, faxes, etc. For instance, THRUST entails that as soon as an M7 earthquake is detected within 100 km off the coast, a signal is transmitted, via a geostationary GOES satellite positioned over the eastern Pacific Basin, to a standard microcomputer, which decodes the signal, starts monitoring water-level sensors and sends a prerecorded

telephone message to officials responsible for evacuation plans (Alexander, 1999, kindle loc. 1158-1160). The key output of this system is whether or not a tsunami is forthcoming. In 2010 the President communicated that a tsunami had been discarded and that people could therefore return to their tsunami-exposed lands. Many people did and they were directly hit by tsunami waves.

The other LTWS rests on the premise outlined by the policy document ACCEMAR, which is strictly speaking also part of the ITWS since it is drafted by one of the primary institutions—the Chilean Navy Hydrographic and Oceanographic Service (SHOA): since the instruments and technical analysis of data to determine whether a tsunami has in fact been triggered by an earthquake takes too much time an evacuation to higher ground should be prompted by the mere detection of a quake so strong one cannot stay afoot (ACCEMAR). Central to this system is that it is individualized (individuals are key actors) and based on experience, and local knowledge and practices. It is mostly operated by the residents of coastal communities, based on narratives that disseminate local knowledge and practices, values like solidarity and safeguard life and family, etc.: its components are thus mostly intangible. This system was able to mobilize a lot of people. It was, however, negatively affected by the ITWS. Participants reported that uncertainty of the situation moved them to either stay (if they had not evacuated yet) or return home to exposed lands when they heard the President's message and officials repeating it (see Chapter 6).

Comparing the two, it becomes apparent that they are completely different. In light of the DsC that I encountered in GC I would conclude that the LTWS is more in line with the nature of the prevalent DsC. The ITWS is not. This might have led to it not being properly accommodated and subsequently not enabled to function properly. Looking at the failures, I even get the idea that the system was not understood and taken seriously. In light of ACCEMAR it seems that the system should have played a supportive role, rather than a decisive one in terms of

evacuation in the 27F event. In addition, with the amount and type of failures, I cannot believe it was ever intended to really succeed. A reconstruction of the events and an analysis of the failures points at key players having no relevant knowledge or capacities, no ability to interpret the situation and realize the urgency and seriousness of the threat at hand, no familiarity with key manuals and practices, etc. This led to crucial event data from various institutional and formal sources being dismissed and ignored and resulted in a wrong interpretation of available data. There seems to have been no real commitment on the part of the authorities and experts to make the system work. But even if the system would have functioned, it still should have had a supporting role rather than a principal role because of the time constraints that accompany local (source) tsunamis (tsunami with a nearby source, ITIC, 2017). From this study I believe answers lie in the DsC. From there one is able to understand its (non)functioning and determine ways forward to ensure the system supports communities rather than impedes them. In addition, however a technological culture approach to culture is key. If the system is not evaluated as a whole, i.e. systemically, then the danger is that the failure might be put down to one individual. For instance, to the one individual who did not speak English or the President who apparently did not listen to the right people. Nobody will look at the system that underlies these individuals. How come a person who did not speak English was posted in a position that required English. Why did the President not act in line with doctrine and disregarded relevant information? These are systemic flaws. Nobody would look at the failures from a system's perspective and consider systemic errors, for instance at the interface of the technological and the socio-cultural systems. Even though this is where various failures seem to lie. Changing the people that supposedly failed will not make the system successful. Understanding why it did not properly work and determining whether it should be part of the prevalent DsC could lead to improvements that can strengthen the communities

capacity to respond to tsunamis. Only of course, if the information derived from such analyses is put into action and become part of the communities' body of knowledge.

Here I would like to shortly focus on one aspect of this case that I found important, namely the power of the local and intangible cultural products (See Box 9-2 for an example). Particularly in Western societies DRR and DRM are ideally consisting of sophisticated science-based parts, deploying different kinds of scientists, experts and authorities, and based on numerous laws, policies and protocols. From these societies' professionals' and experts' perspectives, all this will enhance mitigation and preparedness. In certain cases this will be the case. In contrast, I believe the local and the intangible are equally important. In fact, the GC case leads me to find that well-balanced DsCs emerge from engagement with the diversity of technical resources available, whether intangible, tangible, local, scientific-based, etc. Depending on the situation and objectives, it is key to limit bias towards for instance only science-based artifacts and systems, and consider whatever is available and determine what cultural resources will be best for the job at hand. One might figure out that a poem or a statue is the best for the job.

Box 9-2 An example of a technical artefact that is developed for a specific sociocultural reality

Throughout this study I learned that houses are family homes in that over time they are adjusted to specifically fit the needs of the family living there. As a result, even in the most uniform neighborhoods, homes are different. This is for instance already the case in the new neighborhood where the community from the Bays has been relocated to. With whatever materials they can get their hands on they immediately started adapting their homes. One of the first adaptations was done to the kitchens since these are considered the most important area in the home. In Constitución, another coastal town devastated by the tsunami, the recovery of homes included an entire area of two-story half houses. 'Elemental', led by the architect Alejandro Aravena, evolved the idea of 'half a house' by John F.C (see Fig. 9-5). Turner to provide households with homes that would meet the

Chilean legal requirements for low-income housing and everything that is difficult to build alone, such as concrete foundations, plumbing and electricity, but which they can expand to fit their needs with time.

This is a good example of a technical solution emerging from the convergence of social needs, practices and technology to deliver a solution that will fit the sociocultural system in which it will be placed. It was not, however, utilized in more localities. Most homes provided by the state were uniform and designed in accordance to the resources available without taking into account families' needs. For the rural community 'the Bays' however, some arrangements were made so they would at least have space to adjust their homes to fit their needs.

Figure 9-5 'Elemental' housing project used in response to 27F

9.3 Five opportunities for advancing disaster risk reduction in Greater Concepción

To answer my fifth and last research question, on the basis of my findings I would like to suggest five opportunities that I believe could advance DRR in GC vis-à-vis earthquake/ tsunami events. These recommendations are mostly directed at

community leaders, including authorities, scholars, and emergency professionals. It is important to note that these opportunities involve interventions and that these should therefore done with careful considerations for the possible effects on vulnerability.

Question 1.5: What insights about earthquake/ tsunami vulnerability that people in Greater Concepción experience, derived from applying the disaster subculture lens and the technological culture perspective, can contribute to disaster risk reduction?

Build on existing resources and explore the DsC to determine these

As this study revealed GC has a DsC that comprises numerous resources. I suggest to use these to define and implement strategies for DRR, and to explore how they contribute to vulnerability, i.e. exposure, sensitivity, and capacity of response, and resilience. Part of this should be an analysis of accessible resources. The asset hexagon can be used for this. It is furthermore recommendable to ensure that available capacities are not lost by the introduction of new 'solutions'.

To learn more about underlying mechanisms CR should be used. This can allow studies to move towards richer pictures of experiences. To make sure that interventions are successful it is valuable to include relevant actors from the beginning to the end. This will be key to the success of interventions. In GC this is mostly the community itself, including local government and emergency professionals. They are responsible for most of the response and recovery. Ideally the state will increase their involvement and ensure already functioning local systems are supported.

When transferring a 'technology' make sure it fits the prevalent disaster subculture

To make sure the transfer of a technological solution will work, it should fit the prevalent DsC and relevant actors must be willing to accept them. If not, effects can be disastrous like the ITWS showed. To do this, one should also take account of the 'ology' of the technology at hand. In what context was it developed and what premises have guided its development?

Prepare to improvise

Discipline and competent agility enable successful improvisation. This study revealed that most of the professional and institutional emergency responses were guided by ill-prepared improvisation: no resources, no discipline or structure, no preparation. This is undesirable. Emergency response should be regarded like jazz in which improvisation is made possible by significant preparation and discipline. Like Engel and Engel (2012) argue: prepare to improvise. Improvisation is founded on discipline, doctrine and structure. Improvisation is not just 'winging it', so the capacity to improvise depends on preparation.

Invest in formal preparedness

For this it is also wise to invest in institutional preparedness, more specifically the preparedness of authorities and professional organisations key to the preparedness, response and recovery phases of a disaster. For instance, the local government is part of the formal emergency response. It would be desirable that it would not collapse like it did in 27F and could contribute to a successful response. This is unfortunately an unlikely scenario (see Box 9-3). This will require more community-wide, but also (inter-)organizational discipline and competent agility. If also organizational structures and their institutions can re-organize as swiftly as their communities can, they can be complementary rather than an impediment.

In the case of Talcahuano, which is still exposed to tsunamis, it should be assured that the local government has a place where it can operate from, can access necessary information, and can stay for longer periods of time to manage and operationalize complex disaster operations. At this point in time, they recovered all local government facilities on tsunami exposed lands. The next time a tsunami hits, they will have significant losses again. This is where one should 'bounce forward' and not just 'back'. Similarly, cooperation between the various formal agencies at a local level are based on hierarchical rather than functional structures. What is important is status rather than what needs to be done. For instance, an emergency meeting will include everyone who feels they should be there rather than including everyone that has a role to perform for the response to unfold adequately. This is a cultural matter than hinders preparedness and should be addressed.

In terms of preparedness, the already ingrained responses, such as evacuate up a hill when a major earthquake is detected along the coast, can be supported by 'public' efforts, such as improving evacuation routes and the tsunami warning system to not interfere with successful bottom-up techniques. This however requires public resources and to date this is an issue, since the state and its responsible agency, ONEMI, continue to stress they do not have the resources to effectively do this.

Evaluate for learning

Evaluations are often done for accountability purposes. This is not the case in Chile and this is not something I would suggest to do. I would however propose to evaluate for learning. Take different emergencies as opportunities to explore vulnerability; available capacities and weaknesses. Emergencies are also

manifestations of vulnerability and investigating these regularly will provide the necessary insights that will contribute to furthering DRR.

9.4 Five opportunities for further research

Throughout this study it became evident that this was only the beginning. While I was able to answer my research questions, I was left with many more. Here I would like to present five opportunities for further research that I identified throughout this endeavor.

Apply the disaster subculture lens to other disasters and evolve it conceptually and practically

I have applied the DsC lens now twice and I believe it has great potential, especially concerning matters of vulnerability and resilience. I would therefore recommend for this lens to be applied to more emergency situations so that it can evolve conceptually and practically.

Develop the 'after-action' resilience analysis model further

Chapter 8 showed the potential of a 'post-action' resilience analysis model. I believe it would be worthwhile to develop this model further by applying it to more and different situations. In addition I would recommend to use the DsC lens to explore findings of 'after-action' resilience analyses. DsC findings could allow for more understanding of the 'after-action' resilience analysis.

Take the Critical Realist approach one step further and explore underlying mechanisms

From a CR perspective I believe a next step is to go deeper into the manifestations of DsC and vulnerability to discern the underlying mechanisms at play. In light of this, the neo-liberal model that shapes Chilean society requires more

attention. With CR as my ally I could not be blind to revelations of underlying mechanism and throughout this study I came across different instances that pointed at the neo-liberal model having a negative impact on vulnerability to earthquake/tsunami disasters.

Follow-up research in Borgharen and Itteren and Gran Concepción

DsCs, vulnerability and resilience are not static. It would be worthwhile to follow these findings up and see how these communities develop. Such follow-ups could in addition pay specific attention to the critical issues. Are these indeed inhibiting vulnerability? In light of this, a longitudinal study could provide relevant insights. This would give the findings of this study another dimension: time.

Investigate smaller events as manifestation of vulnerability

Investigate smaller events as manifestations of vulnerability to learn more about vulnerability. The more manifestations we can explore, the more we can also learn about underlying mechanisms.

Chapter 10:   Conclusion

As communities are repeatedly confronted with a specific hazard inherent to their environment, disaster subcultures emerge. Disasters teach communities what it means to live where they do and are important stimuli for communities to learn, innovate and adjust to enable adaptness and/or adaptability. Learning through disasters is a harsh way to learn, though. Lessons are learnt as exposure, sensitivities and insufficient capacity of response converge and loss of lives, injury, and destruction highlight the need for, and hopefully induce, learning. The number of disasters that are experienced yearly confirm that adjustments have been insufficient and natural hazards remain serious threats. The 27F disaster exposed that (major) earthquake/ tsunami events remain serious threats for GC and that learning in order to improve adjustments and reduce these events' disaster potential is imperative. This study aimed to contribute to this learning process by answering the research questions.

Though I was able to answer my questions, I must conclude this endeavor with many more questions than I started with. Throughout the following paragraphs I will briefly answer the main question of this study 'What can we learn from applying a disaster subculture lens to people's 27F experiences in GC about their earthquake/ tsunami vulnerability?'. Then I will go on to reflect briefly on the study and discuss its relevance and innovative aspects. I will end this chapter by providing insights for advancing DRR efforts in GC and recommendations for further research.

First of all, I must conclude that the aftermath of 27F was an opportune period to investigate matters of adaptability and vulnerability. By investigating people's 27F experiences through a DsC lens with a particular focus on matters of vulnerability and resilience, I was able to identify and subsequently study manifestations of both. Impact and the way people responded to it revealed 1) cultural products to which people turn to cope with the changes induced by the event, 2) sensitivities and capacity of response, and 3) underlying mechanisms that color these. The multitude

and diversity of insights that this study led to is reflected in the findings presented in Chapter 9. To appreciate underlying mechanisms the philosophical underpinnings that I borrowed from CR were valuable. Even though I was not able to go much deeper than the empirical world, I got glimpses of underlying mechanisms at work that will allow future research to move beyond the empirical and thus towards more holistic pictures of the vulnerability and resilience that people in GC experience vis-à-vis earthquake/ tsunami events. I would also like to stress that I consider CR especially appropriate for disaster research where dualisms such as mind/ body, structure/ agency, and behavior/ materiality limit proper understanding and sometimes even depreciate experiences. Disasters happen where the material, ideal and behavioral converge and vulnerability and resilience emerge. Any study truly wanting to understand this requires the depth and possibility for bridging dualities that CR enable.

What made this study extra rich was the technological culture approach that helped point the DsC lens to manifestations emerging from the confluence of the technical, natural, and socio-cultural exposing both ingenuity and increasing sensitivities. In too many cultural studies the technical is seen as mere material culture; tangible artefacts that are used for a specific purpose. This study, however, exposed how the technical affects both the natural and the socio-cultural (the introduction of the Maaswerken), but also how the socio-cultural shapes the technical (the introduction of the half houses and the failure of the tsunami warning).

In terms of resilience, the descriptive approach I opted for was valuable to understand better the experiences that I was exploring. Especially in Chapter 8 I was able to apply the concept to learn more about communities' responses and prevalent sensitivities. This effort also showed that resilience should not be considered a good in itself. It is a descriptive property that sheds light on the response of a system and in GC's case we learned that the rural community was very resilient, but that this resilience entailed numerous sensitivities and had emerged from significant

experience with perturbations in their past. It seems however, that their resilience might decrease because of their 'bounce forward' and this might be a good thing. Because of their 'bounce forward' they will experience less perturbations and resilience will therefore be less necessary. Also, their exposure to tsunamis has changed. They will still be affected because they live along the coast and work with the sea, but their homes will no longer be directly affected. These changes will most likely result in less agility, but more resistance which might equate to overall less adaptive resilience. This is however not a bad thing, because a certain level of resistance could provide them more stable conditions to move forward from. As long as it does not impede adaptive capacity.

The main motivation of this study was to learn more about vulnerability. But not vulnerability as the susceptibility for harm, but rather vulnerability as susceptibility for either positive or negative change. Such an approach to vulnerability opens up the opportunity to not just look at what is missing and should be added or altered, but also see what is already there. That was key for this study. Instead of focussing on what is not; on what lacks, I wanted to focus on capabilities that are there and can be built on. In this way, this study would move towards a foundation for further action which, in light of the continuing exposure and increasing sensitivity of communities, I consider essential. Not just for Chile, but also for other countries facing the recurrent threat of these events. Even if the number of violent natural events is not necessarily on the rise, sensitivity or susceptibility to negative change is. More and more people move to exposed lands while insufficient resources are directed at effectively dealing with sensitivities. In terms of earthquake/ tsunami events it is not possible to influence exposure, besides leaving the country. At least not in Chile, a country that is long and thin and for the coastal zones provide a significant part of her population with livelihood opportunities. This makes it paramount that negative vulnerability is turned more positive. This focus on capacity and opportunities is relevant. While there are issues of sensitivity to harm that the

GC case exposed, there were also numerous examples of capabilities that have successfully enabled GC communities to deal with the powerful events that involved 27F. The institutional actors might have failed, but the communities resurfaced as leaders of their own recovery. Ideally in the future, however, they will triumph even more with institutional actors on their side.

Epilogue

Through this epilogue I would like to briefly reflect on this scientific endeavour. Like anyone having completed a PhD trajectory as well as people supporting PhD candidates know, it is an enriching journey satiated with challenges. Only when reaching the end, one can conclude it was successful. But one cannot dismiss the intricacies this success embodies. Here I will briefly discuss a few that accompanied me throughout this undertaking.

This research was increasingly exploratory. When I started, few investigations had been directed at exploring cultural means with which people in GC deal with earthquake/ tsunami events. There was very little literature I could work with. Since then, however, much more has been written and issues regarding the sociocultural realities of disasters are also increasingly introduced in Chilean academic circles.

In addition, 27F had just happened and I did not know what to expect. Would people want to talk to me and share their experiences? People lost loved ones, were caught by tsunami waves, and were now recovering, moving forward. Would they want to look back and share how they recovered, but also what had made them vulnerable in the first place? This made it difficult for me to work with a fixed research design and thus a fixed article strategy. It was for me impossible for me to know beforehand what I would find, how the research design would evolve and more importantly what would be interesting and enrich scientific knowledge. The question whether writing an article-based thesis was the most adequate form to capture a qualitative and explorative research efforts kept haunting me. It might not be. First one goes into the field to gather data. With immersion comes a lot of data that cannot necessarily be processed while in the field. Ideally, like in my case, one goes into the field more than once. This gave me time to process and the opportunity to go back and confirm findings. But only after this second time in the field I felt ready to process the data and determine what findings needed sharing. This left me with little time to produce the articles and this is not ideal since getting them published

are timely ventures. In addition, immersion gives one a lot of data. Much more than can be processed in the limited number of articles. Moreover, one has limited time left to write after all data has been collected. For me it was a difficult process, choosing what to include in the dissertation. I was for instance not able to include most of my Hualqui data. This will have to be done after the PhD is concluded.

Choosing was also problematic in the field. There was so much data. Since there was little written, there were a lot of new findings that I would have loved to learn more about and shared. But one cannot. I would have loved to go more in-depth into the analysis of sociotechnical systems for instance or the effects of neo-liberalism on the vulnerability to disasters that people experience. Also, while I was in Chile there were two earthquake/ tsunami events in the North. If I would have had more time I would have taken the opportunity to collect data there and complement this study. But, choices have to be made. In light of this, I have to admit that from time to time I did wander outside the exact realm of my study. While this took time I did not really have, it also taught me. For instance, I participated in local initiatives aimed at enhancing resilience in light of disasters and climate change. This was not directly related to my research, but indirectly it certainly was. These activities allowed me to meet people, talk to them about disasters and risk and enabled me to get a better picture of the context I was in. Similarly, being in the field I learned that data collection never stops. Every moment of the day is interesting and ideally one would be filming or recording every instance. This brings me to my last reflection and that is an ethical one.

Disasters are dreadful events for people. When going about disaster research this can sometimes be overshadowed by the opportunities one sees to learn. On the one hand one is excited to learn, on the other one collects and explores mostly upsetting experiences. Juggling this can be difficult. Especially when immersed and one is always on the lookout for data; new material to work with. Then six months becomes a longAAb time. One coping mechanism is to focus on the exciting part;

the learning. What new data are we finding today? At the same time, this attitude can translate into an insensitive position towards one's participants. This should be avoided at all times. Because one's participants are your treasure; they hold the key to your questions; and most important of all, they are people. People who suffered and deserve all the respect and kindness one can give. Practically, I tried to address this by, for instance, sharing their experiences as anonymously as possible. These are their experiences and should remain, as much as possible, theirs. But more importantly, I feel they deserve that their experiences can be translated into something positive. This is what I hope I can do. For them.

References

Adger, W.N. (1996). Approaches to vulnerability to climate change. *CSERGE Working Paper GEC* (96-05) Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.662.5892&rep=rep1&type=pdf.

Adger, W.N. (2006). Vulnerability. *Global Environmental Change, 16,* 268-281.

Adger, W.N., & Vincent, K. (2005). Uncertainty in adaptive capacity. *Comptes Rendus Geoscience, 337*(4), 399-410.

Adimark (2000). El Nivel Socio Economico Esomar: Manual de Aplicación. Retrieved from www.microweb.cl/idm/ documentos/ESOMAR.pdf

Aguirre, B.E. (2010). Chile's Civil Defense and Lack of Mitigation. *Comparative Emergency Management Book Project.* Emmitsburg, MD: FEMA Emergency Management Institute.

Aldunce, P., Beilin, R., Handmer, J., & Howden, M. (2014). Framing disaster resilience: The implications of the diverse conceptualisations of "bouncing back". *Disaster Prevention and Management, 23*(3), 252-270.

Alexander, D.E. (1999). *Natural Disasters.* Dordrecht: Kluwer academic publishers. Kindle Edition.

Alexander, D.E. (2013). Resilience and disaster risk reduction: an etymological journey. *Natural hazards and earth system sciences, 13*(11), 2707-2716.

Anderson, J. (1968). Cultural adaptation to threatened disaster. *Human Organization, 27*(4), 298-307.

Anderson, M.B., & Woodrow P. J. (1998). *Rising from the Ashes: Development Strategies in Times of Disaster.* London, United Kingdom: IT Publications.

Anderson, W.A. (1965). Some observations on a disaster subculture: the organizational response of Cincinnati, Ohio, to the 1964 flood, *Disaster Research Center research report* (6). Columbus, OH: Disaster Research Center, the Ohio State University.

AON Benfield (2010). Event recap report: 02/27/2010 Chile Earthquake. Chicago: Impact Forecasting LLC. Retrieved from http://www.aon.com/attachments/reinsurance/201003_ab_if_event_recap_chile_earthquake_impact_forecasting.pdf

Arana Araya, I. (2016). Aftershocks of Pinochet's Constitution: The Chilean Postearthquake Reconstruction. *Latin American Perspectives, 44*(4), 62-80.

Aranguiz, R., Villagran, M., & Eyzaguirre, G. (2011). Use of trees as a tsunami natural barrier for Concepcion, Chile-11th International Coastal Symposium. *Journal of Coastal Research, 164*, 450-454.

Arriagada, I., Campo del, E., Daude, C., Grynspan, R., Lopez-Calva, L.F., Lustig, N., Malagon, J., Moran, M.L., Ocampo, J.A., Oliveira, L., Ortiz-Juares, E., Paramio, L., Sojo, A., Vega, M., & Visacovsky, S. (2012). Clases Medias en Sociedades Desiguales. *Pensamiento Iberoamericano, 10.* Retrieved from https://www.fundacioncarolina.es/wp-content/uploads/2014/07/PensamientoIbero10.pdf

Bahadur, A. V., Ibrahim, M., & Tanner, T. (2010). The resilience renaissance? Unpacking of resilience for tackling climate change and disasters. *SCR Discussion Paper* (1). Retrieved from https://www.gov.uk/dfid-research-outputs/the-resilience-renaissance-unpacking-of-resilience-for-tackling-climate-change-and-disasters-scr-discussion-paper-1

Bankoff, G. (2001). Cultures of disaster: society and natural hazard in the Philippines. *Indonesian Environmental History Newsletter, 15,* 13–15.

Bankoff, G. (2003). *Cultures of disaster: society and natural hazards in the Philippines.* London, United Kingdom: Psychology Press.

Bankoff, G. (2007). Dangers to going it alone: social capital and the origins of community resilience in the Philippines. *Continuity and Change*, *22*(2), 327-355.

Bankoff, G. (2013). The 'English Lowlands' and the North Sea basin system: A history of shared risk. *Environment and History, 19*(1), 3-37.

Bankoff, G. (2015). Design by disasters: seismic architecture and cultural adaptation to earthquakes. In: F. Krüger, G. Bankoff, T. Cannon, B. Orlowski, & E.L.F. Schipper (Eds.). *Cultures and disasters: understanding cultural framings in disaster risk reduction* (chapter 3). London, United Kingdom: Routledge. Kindle edition.

Bankoff, G., Frerks, G., & Hilhorst, D. (Eds.). (2004) *Mapping vulnerability: disasters, development, and people.* London, United Kingdom: Earthscan.

Bankoff, G., Frerks, G., & Hilhorst, D. (Eds.). (2008). *Mapping vulnerability: disasters, development, and people.* London, United Kingdom: Routledge.

Barozet, E. (2006). El valor histórico del pituto: clase media, integración y diferenciación social en Chile. *Revista de Sociología, 20,* 69–96.

Barozet, E., & Fierro, J. (2011). Clase media en Chile, 1990-2011: algunas implicancias sociales y políticas. Santiago de Chile, Chile: Fundación Konrad Adenauer. Retrieved from www.kas.de/wf/doc/kas_29603-1522-4-30.pdf?111202200649.

Barrionuevo, A. (2010, March 11). Aftershocks jolt Chile as new president is sworn in. *New York Times.* Retrieved from www.nytimes.com/2010/03/12/world/americas/12chile.html

Barron, I. (2013). The potential and challenges of critical realist ethnography. *International Journal of Research & Method in Education, 36*(2), 117-130.

Barton, A.H. (1969). *Communities in disasters: A sociological analysis of collective stress situations.* Garden City, NY: Doubleday.

Batista, W. B., & Platt, W. J. (2003). Tree population responses to hurricane disturbance: syndromes in a south-eastern USA old-growth forest. *Journal of Ecology, 91*(2), 197-212.

Beatley, T. (1989). Towards a moral philosophy of natural disaster mitigation. *International journal of mass emergencies and disasters, 7*(1), 5-32.

Bellingham, P. J., Tanner, E. V. J., & Healey, J. R. (1995). Damage and responsiveness of Jamaican montane tree species after disturbance by a hurricane. *Ecology, 76*(8), 2562-2580.

Benedetti, S. (2011). *El Terremoto más grande.* Santiago de Chile, Chile: Origo ediciones.

Bengoa, J. (2000). *Historia del pueblo mapuche (siglo XIX y XX) (Vol. 7).* Santiago de Chile, Chile: Lom Ediciones.

Bennett, A. (1999). Subcultures or neo-tribes? Rethinking the relationship between youth, style and musical taste. *Sociology 33*(3), 599–617.

Bhaskar, R. (1975). *A realist theory of science.* London, United Kingdom: Routledge.

Bhaskar, R. (1978). On the possibility of social scientific knowledge and the limits of naturalism. *Journal for the Theory of Social Behaviour, 8*(1), 1-28.

Bhaskar, R. (2011) *Reclaiming Reality: A Critical Introduction to Contemporary Philosophy* (Classical Texts in Critical Realism (Routledge Critical Realism)). London, United Kingdom: Routledge. Kindle Edition.

Bhaskar, R. (2015). *The possibility of naturalism: a philosophical critique of the contemporary human sciences (classical texts in critical realism).* London, United Kingdom: Routledge. Kindle Edition.

Bhaskar, R. (2017*). The order of natural necessity: a kind of introduction to critical realism.* Createspace. Kindle Edition.

Biernacki, P., & Waldorf, D. (1981). Snowball sampling: Problems and techniques of chain referral sampling. *Sociological methods & research, 10*(2), 141-163.

Bijker, W. E. (1995). *Of Bicycles, bakelites, and bulbs: toward a theory of sociotechnical change.* Cambridge, MA: MIT Press.

Bijker, W. E. (2006). The vulnerability of technological culture. In H. Nowotny (Ed.) *Cultures of technology and the quest for innovation* (pp. 52-69). New York, NY: Berghahn Books.

Bijker, W. E. (2009). Vulnerability in Technological Cultures, Diësrede 2009, delivered on January 8th, 2009 at the occasion of the 33rd Diës Natalis of Maastricht University. Retrieved from https://cris.maastrichtuniversity.nl/portal/files/13821855/PE_277927_1.pdf

Bijker, W., Hommels, A., & Mesman, J. (2014) Studying vulnerability in technological cultures. In: A. Hommels, J. Mesman & W.E. Bijker (Eds.) *Vulnerability in technological cultures: new directions in research and governance (Chapter 1).* Cambridge, MA: MIT Press. Kindle edition.

Binder, S. B., & Baker, C. K. (2017). Culture, local capacity, and outside aid: a community perspective on disaster response after the 2009 tsunami in American Sāmoa. *Disasters, 41*(2), 282-305.

Birkland, T.A. (2009). Disasters, lessons learned, and fantasy documents. *Journal of Contingencies and Crisis Management, 17*(3). 146-156.

Birkmann, J. (Ed.) (2006). *Measuring vulnerability to natural hazards: Towards disaster resilient societies.* Tokyo, Japan: United Nations University Press.

Bitar, S. (2010). Doce lecciones del terremoto chileno. *Estado, Gobierno y Gestión Pública, 15-16*, 7–18.

Boehm, B., & Turner, R. (2003). Balancing agility and discipline: a guide for the perplexed. Boston, MA: Addison-Wesley Professional.

Boin, R.A. (2005). From crisis to disaster: Towards an integrative perspective. In R.W. Perry & E.L. Quarantelli (Eds.). *What is a disaster? New answers to old questions* (pp. 153-172). Philadelphia, PA: Xlibris.

Bollin, C., Cárdenas, C., Hahn, H., & Vatsa, K. S. (2003). Disaster risk management by communities and local governments. Inter-American Development Bank.

Retrieved from http://publications.iadb.org/handle/11319/ 4642?locale-attribute=en

Brand, F., & Jax, K. (2007). Focusing the meaning (s) of resilience: resilience as a descriptive concept and a boundary object. *Ecology and society, 12*(1). Retrieved from https://www.ecologyandsociety.org/vol12/iss1/art23/

Brodsky, E. E., & Lay, T. (2014). Recognizing foreshocks from the 1 April 2014 Chile earthquake. *Science, 344*(6185), 700-702.

Bruneau, M., Chang, S.E., Eguchi, R.T., Lee, G.C., O'Rourke, T.D., Reinhorn, A.M., Shinozuka, M., Tierney, K., Wallace, W.A., & Von Winterfeldt, D. (2003). A framework to quantitatively assess and enhance the seismic resilience of communities. *Earthquake spectra, 19*(4), 733-752.

Bryman, A. (2008). *Social research methods.* Oxford, United Kingdom: Oxford University Press.

Bucci, F. (2013). La complicidad de la planificación urbana en la creación de territorios en riesgo: el caso de las inundaciones urbanas en la ciudad-puerto de Talcahuano. Seminario para optar al Título Profesional de Administrador Público con Mención en Gestión Pública. Concepción, Chile: Universidad de Concepción.

Burby, R.J. (2006). Hurricane Katrina and the paradoxes of government disaster policy: bringing about wise governmental decisions for hazardous areas. *The ANNALS of the American Academy of Political and Social Science, 604*(1), 171–191.

Buurtraad Borgharen (2011). Rapport Dorp aan de Maas: Planvisie Borgharen. Retrieved from http://www.borgharen.nl/welkom/#artikel:361.

Cai, H., Lam, N. S. N., Zou, L., Qiang, Y., & Li, K. (2016). Assessing community resilience to coastal hazards in the Lower Mississippi River Basin. *Water, 8*(2), 46.

Campbell, D.T. (1974). Unjustified variation and selective retention in scientific discovery. In: F. Ayala, & T. Dobzhansky (Eds.) *Studies in the Philosophy of Biology* (pp. 139-161). London, United Kingdom: Macmillan.

Cannon, T. (1994). Vulnerability analysis and the explanation of 'natural' disasters. In A. Varley (Ed.) *Disasters, development and environment* (13-30). Chichester, United Kingdom: John Wiley and Sons.

Cannon, T., Twigg, J., & Rowell, J. (2003). Social vulnerability, sustainable livelihoods and disasters. Retrieved from http://www.radixonline.org/resources/dfid-vuln&live-rep.pdf

Capacity for Disaster Reduction Initiative (CADRI) (2011). Basics of Capacity Development for Disaster Risk Reduction. Retrieved from https://www.cadri.net/sites/default/files/18061_cadribrochureweb2_0.pdf

Cardona, O. D. (2003). The need for rethinking the concepts of vulnerability and risk from a holistic perspective: a necessary review and criticism for effective risk management. In G. Bankoff, G. Frerks, and D. Hilhorst. *Mapping vulnerability: Disasters, development and people* (pp. 37-51). London, United Kingdom: Earthscan.

Carney, D. (2003). Sustainable livelihoods approaches: progress and possibilities for change. London: DFID. Retrieved from www.eldis.org/vfile/upload/1/document/0812/SLA_Progress.pdf

Carreño, M. L., Cardona, O. D., & Barbat, A. H. (2007). A disaster risk management performance index. *Natural Hazards, 41*(1), 1-20.

Centro de Estudios Públicos (2015). Estudio Nacional de Opinión Pública N° 73. Retrieved from http://www.cepchile.cl/dms/archivo_5916_3714/EncuestaCEP_Abril2015.pdf.

Chambers, R. (1989). Editorial introduction: vulnerability, coping and policy. *IDS bulletin, 20*(2), 1-7.

Chamorro, S., Herrera, H., Mathivet, C., Pulgar, C., Valdivieso, E., & Vergara, P. (2011). Informe para la Relatora Especial de Naciones Unidas para el Derecho a la Vivienda Adecuada: el terremoto-tsunami del 27 de febrero 2010 y los procesos de recontrucción en Chile. Informe elaborado por las Organizaciones de Apoyo del Movimiento Nacional por la Reconstrucción Justa. Retrieved from http://www.ucentral.cl/prontus_ucentral2012/site/artic/20120413/asocfile/20120413101745/informe_relatora_onu.pdf

Chile Atiende (2015). Ficha de Protección Social. Retrieved from www.chileatiende.cl/fichas/ver/35332

Chilean Government (2003). Constitución Política de la República de Chile de 1980. Retrieved from https://www.camara.cl/camara/media/docs/constitucion_politica.pdf

Cisternas, M., Atwater, B. F., Torrejón, F., Sawai, Y., Machuca, G., Lagos, M., Eipert, A., Youlton, C., Salgado, I., Kamataki, T., Shishikura, M., Rajendran, C.P., Malik, J., Rizal, Y., & Husni, M. (2005). Predecessors of the giant 1960 Chile earthquake. *Nature 437*(7057), 404–407.

Clark, W.C., Jäger, J., Corell, R., Kasperson, R., McCarthy, J.J., Cash, D., Cohen, S.J., Desanker, P., Dickson, N.M., Epstein, P., Guston, D.H., Hall, J.M., Jaeger, C., Janetos, A., Leary, N., Levy, M.A., Luers, A., MacCracken, M., Melillo, J., Moss, R., Nigg, J.M., Parry, M.L. Parson, E.A., Ribot, J.C., Schellnhuber, H.J., Seielstad, G.A., Shea, E., Vogel, C., & Wilbanks, T.J. (2000). Assessing Vulnerability to Global Environmental Risks. Report of the workshop on vulnerability to global environmental change: challenges for research, assessment and decision making. May 22-25, 2000, Airlie House, Warrenton, Virginia. Cambridge, MA: Belfer Center for Science and International Affairs (BCSIA) Discussion Paper 2000-12, Environment and Natural Resources

Program, Kennedy School of Government, Harvard University, 2000. Retrieved from http://www.ksg.harvard.edu/sust.

Clarke, L. (1999). *Mission improbable: Using fantasy documents to tame disaster.* Chicago, IL: University of Chicago Press.

Cleuren, H. (2007). Local democracy and participation in post-authoritarian Chile. *European Review of Latin American and Caribbean Studies, 83*, 3–18

Cohen, A. K., & Short, J. F. (1958). Research in delinquent subcultures. *Journal of Social Issues, 14*(3), 20-37.

Companion, M. (Ed.). (2015). *Disaster's impact on livelihood and cultural survival: losses, opportunities, and mitigation.* Boca Raton, FL: CRC Press.

Coppola, D. P. (2011). *Introduction to international disaster management.* Burlington, MA: Butterworth-Heinemann. Kindle edition.

Creswell, J. W. (2009). *Research design: qualitative, quantitative, and mixed method approaches.* London, United Kingdom: Sage.

Cutter, S. L. (1996). Vulnerability to environmental hazards. *Progress in human geography, 20*(4), 529-539.

Cutter, S. L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., & Webb, J. (2008). A place-based model for understanding community resilience to natural disasters. *Global Environmental Change, 18*(4), 598-606.

Cutter, S. L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., & Webb, J. (2008). Community and regional resilience: Perspectives from hazards, disasters, and emergency management. *Community and Regional Resilience Initiative (CARRI) Research Report, 1.* Retrieved from http://www.resilientus.org/FINAL_CUTTER

Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social vulnerability to environmental hazards. *Social science quarterly, 84*(2), 242-261.

Cutter, S., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., & Webb, J. (2009) Community and regional resilience: perspectives from hazards, disasters, and

emergency management. Hazards and Vulnerability Research Institute, Columbia, SC. Retrieved from http://www.resilientus.org/wp-content/uploads/2013/03/FINAL_CUTTER_9-25-08_1223482309.pdf.

Cutter, S.L., Burton, C.G., & Emrich, C.T. (2010) Disaster resilience indicators for benchmarking baseline conditions. *Journal of Homeland Security and Emergency Management 7*(1), 1-24.

D'Halmar, A. (1975). Recuerdos olvidados. Madrid, Spain: Editorial Nascimento.

Dake, K. (1992). Myths of nature: Culture and the social construction of risk. *Journal of Social issues, 48*(4), 21-37.

Danermark, B., Ekström, M., Jakobsen, L., & Karlsson, J. Ch. (2002). *Explaining Society: Critical Realism in the Social Sciences.* London, United Kingdom: Routledge.

Darwin, C. R. (2012). *The Voyage of the Beagle* (p.3) (1839). Kindle Edition. Acheron Press.

Dash, N., Peacock, W. G., & Morrow, B. H. (1997). And the poor get poorer: A neglected black community. In W.G. Peacock, H. Gladwin, & B.H. Morrow (Eds.). Hurricane Andrew: ethnicity, gender, and the sociology of disasters (206-25). London, United Kingdom: Routledge.

David, M., & Sutton, C.D. (2004). *Social research: the basics.* London, United Kingdom: Sage.

De Groeve T., Poljansek, K., Ehrlich, D., & Corbane, C. (2014). JRC scientific and policy reports—Current status and best practices for disaster loss data recording in EU member states: a comprehensive overview of current practice in the EU member states. Retrieved from http://www.irdrinternational.org/wp-content/uploads/2015/04/JRC-SOTA-Loss-Report_11182014.pdf

Descartes, R. (2003). *Discourse on method and related writings*, London, United Kingdom: Penguin Group. Kindle Edition.

DFID (1999). Sustainable livelihood guidance sheet. London, United Kingdom: Department for International Development. Retrieved from www.eldis.org/vfile/upload/1/document/0901/section2.pdf. Accessed 29 July 2015

Dombrowsky, W.R. (1981). Another step toward a social theory of disaster. *Disaster Research Center Preliminary Paper, 70.* Retrieved from http://udspace.udel.edu/handle/19716/442

Douglas, M., & Wildavsky, A. (1982). *Risk and culture: an essay on the selection of technical and environmental dangers.* Berkeley. CA: University of California Press.

Dovers, S.R., & Handmer, J.W. (1992). Uncertainty, sustainability and change. *Global Environmental Change, 2*(4), 262-276.

Dussaillant, F., & Guzman, E. (2014). Trust via disasters: the case of Chile's 2010 earthquake. *Disasters 38*(4):808–832.

Dynes, R.R. (1998). Coming to terms with community disaster. In E.L. Quarantelli (Ed.). *What is a disaster? Perspectives on the question* (pp.109-126). London, United Kingdom: Routledge.

Dynes, R.R. (2005). Community social capital as the primary basis for resilience. Disaster Research Center, Preliminary Paper #344. Retrieved from http://udspace.udel.edu/handle/19716/1621.

Earthquake Engineering Research Institute (EERI) (2010). Special earthquake report—Learning from Earthquakes: The Mw8.8 Chile earthquake of February 27, 2010. Retrieved from https://www.eeri.org/site/images/eeri_newsletter/2010_pdf/Chile10_insert.pdf

Ellul, J. (1967). *The technological society.* New York, NY: Vintage books.

Engel, K. (2011). Extreem hoogwater 1993 en 1995. In E. Muller (Ed.) *Crises in Nederland: Rampen, rellen, gijzelingen en andere crises* (121-144). Deventer, The Netherlands: Kluwer.

Engel, K. E. (2016). Talcahuano, Chile, in the wake of the 2010 disaster: a vulnerable middle? *Natural Hazards, 80*(2), 1057-1081

Engel, K. E., & Engel, P. G. H. (2012). Building resilient communities: where disaster management and facilitating innovation meet. In A.E.J. Wals (Ed.) *Learning for sustainability in times of accelerating change* (pp. 133-147). Wageningen, The Netherlands: Wageningen Academic Publishers.

Engel, K., & Trainor, J. E. (2012). Floods and disaster management in the Netherlands: God created the world, but the Dutch created the Netherlands. *Comparative Emergency Management Book Project*. Emmitsburg, MD: FEMA Emergency Management Institute. Retrieved from http://training. https://training.fema.gov/hiedu/downloads/compemmgmtbookproject/comparative%20em%20book%20-%20chapter%20-%20floods%20and%20disaster%20mgmt%20in%20the%20netherlands.doc

Engel, K., Frerks, G., Velotti, L., Warner, J., & Weijs, B. (2014). Flood disaster subcultures in The Netherlands: the parishes of Borgharen and Itteren. *Natural Hazards, 73*(2), 859-882.

Engel, P. G. (1997). *The social organization of innovation: A focus on stakeholder interaction.* Amsterdam, The Netherlands: Royal Tropical Institute.

European Commission (EC) (2015). JRC Science and Policy Reports—Guidance for Recording and Sharing Disaster Damage and Loss Data: towards the development of operational indicators to translate the Sendai Framework into action. Report EUR 27192 EN. Retrieved from http://drr.jrc.ec.europa.eu/Portals/0/Loss/JRC_guidelines_loss_data_recording_v10.pdf.

Fariña, L. M., Opaso, C., & Puz, P. V. (2012). Impactos ambientales del terremoto y tsunami en Chile. Las réplicas ocultas del 27F. Santiago de Chile, Chile: Fundación Terram.

Fine, G. A., & Kleinman, S. (1979). Rethinking subculture: An interactionist analysis. *American Journal of Sociology, 85*(1), 1-20.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative inquiry, 12*(2), 219-245.

Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. *Global environmental change, 16*(3), 253-267.

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C.S., Walker, B., Bengtsson, J., Berkes, F., & Colding, J. (2002), Resilience and sustainable development: building adaptive capacity in a world of transformations, Scientific Background Paper on Resilience presented for the process of The World Summit on Sustainable Development, The Environmental Advisory Council to the Swedish Government, Stockholm. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.629.3759&rep=rep1&type=pdf.

Fordham, M., & Ketteridge, A. M. (1998). "Men must work and women must weep": Examining gender stereotypes in disasters. In E. Enarson (Ed.). *The gendered terrain of disaster: through women's eyes* (pp. 81-94). Westport, CT: Praeger.

Forrest, T.R. (1979). Hurricane Betsy, 1965: a selective analysis of organizational response in the New Orleans Area. Historical and Comparative Disaster Series #5. Newark, DE: Disaster Research Center.

Fothergill, A., & Peek, L. A. (2004). Poverty and disasters in the United States: A review of recent sociological findings. *Natural hazards, 32*(1), 89-110.

Fraser, S. A., Doyle, E. E., Wright, K. C., Potter, S. H., McClure, J., Johnston, D. M., Leonard, G. S., Coomer, M. A., Becker, J. S., & Johal, S. (2016). Tsunami response behaviour during and following two local-source earthquakes in

Wellington, New Zealand. *International Journal of Disaster Risk Reduction, 16*, 123-133.

Frerks, G. E., Hilhorst, D., & Moreyra, A. (1999). *Natural disasters. A framework for analysis and action.* Wageningen, The Netherlands: Disaster Studies.

Frerks, G., Warner, J., & Weijs, B. (2011). The politics of vulnerability and resilience. *Ambiente & Sociedade, 14*(2), 105-122.

Fritz, H. M., Petroff, C. M., Catalán, P. A., Cienfuegos, R., Winckler, P., Kalligeris, N., Weiss, R., Barrientos, S.E., Meneses, G., Valderas-Barmejo, C., Ebeling, C., Papadopoulos, A., Contreras, M., Almar, R. Dominguez, J.C., & Synolakis, C.E. (2011). Field survey of the 27 February 2010 Chile tsunami. *Pure and Applied Geophysics, 168*(11), 1989-2010.

Gaillard, J.C. (2007). Resilience of traditional societies in facing natural hazards. *Disaster Prevention and Management: An International Journal, 16*(4), 522-544.

Gaillard, J.C., Clavé, E., Vibert, O., Denain, J.C., Efendi, Y., Grancher, D., Liamzon, C.C., Sari, D.R., & Setiawan, R. (2008). Ethnic groups' response to the 26 December 2004 earthquake and tsunami in Aceh, Indonesia. *Natural Hazards, 47*(1), 17-38.

Gallopín, G. C. (2006). Linkages between vulnerability, resilience, and adaptive capacity. *Global environmental change, 16*(3), 293-303.

Gandarillas, M. (1960). En 390 años Chile ha sufrido diecisiete fuertes terremotos. *En Viaje, 321*, 6-7.

Gelder, K. (2005). *The subculture reader.* London, United Kingdom: Routledge.

Gemeente Maastricht (2006a). Es de Maos Oetkump (film). Gemeente Maastricht, Maastricht

Gemeente Maastricht (2006b). Es de Maos Oetkump: bewaarboekje. Gemeente Maastricht, Maastricht

Gemeente Maastricht (2011). Hoogwaterinformatie: Sint Pieter 45.80 meter. Maastricht, The Netherlands: Gemeente Maastricht.

Gerritsen, H. (2005). What happened in 1953? The Big Flood in the Netherlands in retrospect. Philosophical Transactions of the Royal Society of London A: Mathematical, *Physical and Engineering Sciences, 363*(1831), 1271-1291.

Gobierno de Chile (2010). Plan de Reconstrucción Terremoto y Maremoto del 27 de Febrero de 2010. Retrieved from http://www.preventionweb.net/files/28726_plandereconstruccinagosto2010.pdf

Goll, F. (1904). Die Erdbeben Chiles. Theodor Ackermann, München. Retrieved from https://ia902609.us.archive.org/17/items/dieerdbebenchil00dessgoog/dieerdbebenchil00dessgoog.pdf

Goodwin, N.R. (2003). Five kinds of capital: useful concepts for sustainable development. G-DEA Working Paper No. 03-07. Retrieved from http://www.ase.tufts.edu/gdae/publications/working_papers/03-07sustainabledevelop ment.pdf

Gordon, M.M. (1947). The concept of the sub-culture and its application. *Social Forces. 26*(1), 40-42.

Granot, H. (1996). Disaster subcultures. *Disaster Prevention and Management: An International Journal, 5*(4), 36-40.

Greve, A.I. (2016). Sustainable development, climate change adaptation and disaster management. In J.I. Uitto & R. Shaw (Eds.). *Sustainable development and disaster risk reduction* (pp. 13-36). Tokyo, Japan: Springer.

Gunderson, L.H., & Holling, C.S. (2002). *Panarchy Understanding Transformations in Human and Natural Systems.* Washington, DC: Island Press. Kindle Edition.

Habets, J. (1872). *De Voormalige Heerlijkheid Borgharen: Eene Bijdrage Tot de Geschiedenis van het Land van Valkenburg.* Roermond, The Netherlands: Snelpersdruk van J. J. Romen.

Hallie, F.P. & Jorissen, R.E. (1997). Protection against flooding: a new Delta Plan in the Netherlands. Destructive Water: water-caused natural disasters, their abatement and control (Proceedings of the Conference held at Anaheim, California). IAHS Publications no. 239. Retrieved from http://hydrologie.org/redbooks/a239/iahs_239_0361.pdf

Harrald, J. R. (2006). Agility and discipline: critical success factors for disaster response. *The annals of the American Academy of Political and Social Science, 604*(1), 256-272.

Hayes, G. P., Herman, M. W., Barnhart, W. D., Furlong, K. P., Riquelme, S., Benz, H. M., Bergman, E., Barrientos, S., Earle, P.S., & Samsonov, S. (2014). Continuing megathrust earthquake potential in Chile after the 2014 Iquique earthquake. *Nature, 512*(7514), 295-298.

Heijnen, H. (1996). De Waterwolf van Itteren. The Netherlands: VPRO. Retrieved from http://www.npo.nl/de-waterwolf-van-itteren/03-09-2010/WO_VPRO_043113

Herberghs, L. (2004). Ode aan Itteren. Retrieved from https://itteren.nl/ode-aan-de-rivier

Hewitt, K. (1995). Excluded perspectives in the social construction of disaster. *International Journal of Mass Emergencies and Disasters 13* (3), 317–339.

Hewitt, K. (2013). Environmental disasters in social context: toward a preventive and precautionary approach. *Natural Hazards, 66*(1), 3-14.

Hickman, L.A. (2001). *Philosophical tools for technological culture: Putting pragmatism to work.* Bloomington, IN: Indiana University Press.

Hoffman, S.M., & Oliver-Smith, A. (2002). *Catastrophe and Culture: The Anthropology of Disaster.* Oxford: The school of American research.

Hommels, A., Mesman, J., & Bijker, W. E. (Eds.). (2014). *Vulnerability in technological cultures: new directions in research and governance.* Cambridge, MA: MIT Press. Kindle edition.

Huang, Y. & Yu, M. (2013). Review of soil liquefaction characteristics during major earthquakes of the twenty-first century. *Natural hazards, 65*(3), 2375-2384.

Hufschmidt, G. (2011). A comparative analysis of several vulnerability concepts. *Natural hazards, 58*(2), 621-643.

Information Collection Assessment Team (ICAT) (2010) After action report Chile earthquake. Retrieved from http://emergency. lacity.org/stellent/groups/departments/@emd_contributor/documents/contri butor_web_content/lacityp_015617.pdf

Inglis, D. (2005). *Culture and everyday life.* London, United Kingdom: Routledge.

Inspectie Verkeer en Waterstaat (2006) Assessment of primary flood defenses in the Netherlands, National Report. The Hague, The Netherlands: Ministerie van Verkeer en Waterstaat.

Interagency Floodplain Management Review Committee (1994). Sharing the challenge: floodplain management into the 21st century. Report. Retrieved from https://fas.org/irp/agency/dhs/fema/sharing.pdf.

Janowitz, M. (1959). Changing patterns of organizational authority: The military establishment. *Administrative Science Quarterly*, 473-493.

Kendra, J., & Wachtendorf, T. (2002) Creativity in emergency response after the world trade center attack. Preliminary papers #324. University of Delaware: Disaster Research Center.

Kirschenbaum, A. (2004). *Chaos, organization and disaster management.* New York, NY: Marcel Dekker. Retrieved from http://www.untag-smd.ac.id/files/Perpustakaan_Digital_1/DISASTER%20MANAGEMENT%20ch aos_organization_and_disaster_management.pdf .

Kiser, E., & Ishii, M. (2011). The 2010 Mw 8.8 Chile earthquake: Triggering on multiple segments and frequency-dependent rupture behavior. *Geophysical Research Letters, 38*(7). Retrieved from https://doi.org/10.1029/2011GL047140

Klein, R. J., Nicholls, R. J., & Thomalla, F. (2003). Resilience to natural hazards: How useful is this concept? *Environmental Hazards, 5*(1), 35-45.

Koestler, A. (1968). Beyond atomism and holism—the concept of the holon. In A. Koestler and J.R. Smythies (Eds.). *Beyond reductionism, new perspectives in the life sciences* (pp. 192-232). New York, NY: The Macmillan Company.

Kousky, C. (2010). Using natural capital to reduce disaster risk. *Journal of Natural Resources Policy Research, 2*(4), 343-356.

Kronmüller, E., Atallah, D. G., Gutiérrez, I., Guerrero, P., & Gedda, M. (2017). Exploring indigenous perspectives of an environmental disaster: Culture and place as interrelated resources for remembrance of the 1960 mega-earthquake in Chile. *International Journal of Disaster Risk Reduction, 23,* 238-247.

Krüger, F., Bankoff, G., Cannon, T., Orlowski, B., & Schipper, E. L. F. (Eds.) (2015). *Cultures and disasters: understanding cultural framings in disaster risk reduction.* London, United Kingdom: Routledge. Kindle edition.

Kuhlicke, C., Scolobig, A., Tapsell, S., Steinführer, A., & De Marchi, B. (2011). Contextualizing social vulnerability: findings from case studies across Europe. *Natural Hazards*, *58*(2), 789-810.

La Tercera (2015, February 28) Olas de 5 metros azotan Talcahuano y arrastran embarcaciones y casas. *La Tercera,* p 12. Retrieved from http://diario.latercera.com/edicionimpresa/olas-de-5-metros-azotan-talcahuano-y-arrastran-embarcaciones-y-casas/

Lambert, R. J. (1994). Monitoring local food security and coping strategies: lessons from information collection and analysis in Mopti, Mali. *Disasters, 18*(4), 332-343.

Larrain, F. (2008). Cuatro millones de pobres en Chile: actualizando la linea de pobreza. *Estudios Publicos, 109,* 1–48.

Larrañaga (2009). Inequality, poverty, and social policy. *OECD Social, Employment, and Migration Working Papers, 85*. Paris, France: OECD Publishing. Retrieved from https://doi.org/10.1787/224516554144

Law, J. (2002). Objects and spaces. Theory, *Culture & Society, 19*(5-6), 91-105.

Law, J. (2009) Actor network theory and material semiotics. In B.S. Turner (Ed.) *The new Blackwell companion to social theory* (pp. 141-158). Oxford, UK: Blackwell.

Lenz, R. (1912). *Tradiciones e Ideas de los Araucanos acerca de los Terremotos.* Santiago de Chile, Chile: Imprenta Cervantes.

Letelier, L. (2010). Descentralización del estado y terremoto: El caso de Chile. *Estado, Gobierno y Gestión Pública, 15-16*, 19-38.

Lewis, J. (1999). *Development in disaster-prone places: studies of vulnerability.* London, United Kingdom: Intermediate Technology Publications.

Lomnitz, L.A. (1971). Reciprocity of favors in the urban middle class of Chile. *Studies in Economic Anthropology, 7,* 93–106.

Lomnitz, L.A., & Sheinbaum D (2004). Trust, social networks, and the informal economy: a comparative analysis. *Review of Sociology 10*(1), 5–26.

Lomnitz, C. (1970). Casualties and behavior of populations during earthquakes. *Bulletin of the Seismological Society of America, 60*(4), 1309-1313.

Lomnitz, C. (2004). Major earthquakes of Chile: a historical survey, 1535-1960. *Seismological Research Letters, 75*(3), 368-378.

Lomnitz, L. A., & Sheinbaum, D. (2004). Trust, social networks and the informal economy: a comparative analysis. *Review of Sociology, 10*(1), 5-26.

Lomnitz, L.A. (1988). Informal exchange networks in formal systems: a theoretical model. *American Anthropologist 90*(1), 42–55

Lorca, E. (1991). Integration of the THRUST project into the Chile Tsunami Warning System. *Natural hazards, 4*(2-3), 293-300.

Maas, R. (2012, March 8). Sinterklaas Kapoentje tegen hoogwater, De Limburger, Retrieved from www.limburger.nl.

Maastricht Rijkswaterstaat (1995). De Maas slaat weer toe…, verslag hoogwater Maas january/february 1995 Maastricht: Rijkswaterstaat. Retrieved from http://www.rijkswaterstaat.nl/water/feiten_en_cijfers/vaarwegenoverzicht/juli anakanaal/

Manyena, S.B. (2006). The concept of resilience revisited. *Disasters, 30*(4), 434-450.

Manyena, S.B. (2012). Disaster and development paradigms: too close for comfort? *Development Policy Review, 30*(3), 327-345.

Manyena, S.B. (2014). Disaster resilience: a question of 'multiple faces' and 'multiple spaces'? *International Journal of Disaster Risk Reduction, 8,* 1-9. Retrieved from https://doi.org/10.1016/j.ijdrr.2013.12.010

Manyena, S.B., O'Brien, G., O'Keefe, P., & Rose, J. (2011). Disaster resilience: a bounce back or bounce forward ability? *Local Environment: The International Journal of Justice and Sustainability, 16*(5), 417-424.

Marín, A., Gelcich, S., Araya, G., Olea, G., Espíndola, M., & Castilla, J. C. (2010). The 2010 tsunami in Chile: Devastation and survival of coastal small-scale fishing communities. *Marine Policy, 34*(6), 1381-1384.

Matthews, B. & Ross, L. (2010). *Research Methods: A Practical Guide for the Social Sciences.* Essex, United Kingdom: Pearson Education Limited.

Mauelshagen, F. (2009). Disaster and political culture in Germany since 1500. In: C. Mauch & C. Pfister (Eds) *Natural disasters, cultural responses: a world history*. Lanham: Rowman & Littlefield.

Mauelshagen, F. (2007). Flood disasters and political culture at the German North Sea coast: a long-term historical perspective. *Historical Social Research/Historische Sozialforschung, 32*(3(21)), 133-144.

Mayunga, J.S. (2007). Understanding and applying the concept of community disaster resilience: a capital-based approach. Retrieved from https://www.u-

cursos.cl/usuario/3b514b53bcb4025aaf9a6781047e4a66/mi_blog/r/11._Joseph_S._Mayunga.pdf.

McEntire, D. A. (2004). Development, disasters and vulnerability: a discussion of divergent theories and the need for their integration. *Disaster Prevention and Management: An International Journal, 13*(3), 193-198.

McLaughlin, P., & Dietz, T. (2008). Structure, agency and environment: Toward an integrated perspective on vulnerability. *Global Environmental Change, 18*(1), 99-111.

Medina, J. T. (1882). *Los aborijenes de Chile*. Santiago de Chile: Imprenta Gutenberg.

Mella Polanco, M. (2012). Efectos sociales del terremoto en chile y gestión política de la reconstrucción durante el gobierno de Sebastián Piñera (2010-2011). *Revista Enfoques: Ciencia Política y Administración Pública, 10*(16), 19-46. Retrieved from http://www.ucentral.cl/prontus_ucentral2012/site/artic/20140101/asocfile/20140101233549/enfoques16_02_marcelomella.pdf

Mileti, D. (1999). *Disasters by design: a reassessment of natural hazards in the United States.* Washington. DC: Joseph Henry Press.

Mitchell, T., & Harris, K. (2012). Resilience: A risk management approach. ODI Background Note. London: Overseas Development Institute. Retrieved from https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/7552.pdf

Moore, H.E. (1964) *And the winds blew.* Austin, TX: Hogg Foundation for Mental Health, University of Texas.

Murphy, R. (2002) Extreme weather and the energy metabolism of the city. *Environment and History, 8*(1): 43-64.

National Research Council (2011). *Building community disaster resilience through private–public collaboration.* Washington, DC: National Academy Press.

Norris, F.H., Stevens, S.P., Pfefferbaum, B., Wyche, K.F., & Pfefferbaum, R.L. (2008). Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. *American Journal of Community Psychology, 41*(1-2), 127-150.

Oliver-Smith, A. (1996). Anthropological research on hazards and disasters. *Annual Review of Anthropology, 25*(1), 303-328.

Oliver-Smith, A., & Hoffman, S. M. (Eds.). (1999). *The angry earth: disaster in anthropological perspective*. London, United Kingdom: Routledge.

ONEMI (2001). ACCEMAR. Retrieved from http://repositoriodigitalonemi.cl/web/handle/2012/116.

Onetto, M. (2014). Terremotos recordados, temblores olvidados: interpretaciones sobre los orígenes de la memoria telúrica en Chile. *Revista de Geografía Norte Grande, 59*. Retrieved from http://dx.doi.org/10.4067/S0718-34022014000300011

Organization for Economic Co-operation and Development (OECD) (2010) Latin American economic outlook 2011: How middle-class is Latin America? Retrieved from www.latameconomy.org/fileadmin/uploads/laeo/Documents/E-book_LEo2011-EN_ entier.pdf

Ortega y Gasset, J. (1965). *Obras Completas, Tomo VIII.* Madrid, Spain: Revista de Occidente, Ediciones Castilla, S.A.

Parsons, M., Glavac, S., Hastings, P., Marshall, G., McGregor, J., McNeill, J., Morley, P., Reeve, I., & Stayner, R. (2016). Top-down assessment of disaster resilience: A conceptual framework using coping and adaptive capacities. *International Journal of Disaster Risk Reduction, 19*, 1-11. Retrieved from https://doi.org/10.1016/j.ijdrr.2016.07.005

Paton, D., & Johnston, D. (2001) Disasters and communities: vulnerability, resilience and preparedness. *Disaster Prevention and Management, 10*(4), 270-277.

Patterson, O., Weil, F., & Patel, K. (2010). The role of community in disaster response: conceptual models. *Population Research and Policy Review, 29*(2), 127-141.

Pauchard, A., Aguayo, M., Peña, E., & Urrutia, R. (2006). Multiple effects of urbanization on the biodiversity of developing countries: the case of a fast-growing metropolitan area (Concepción, Chile). *Biological Conservation, 127*(3), 272-281.

Pelling, M. (2003). *The vulnerability of cities: natural disasters and social resilience.* London, United Kingdom: Earthscan Publications.

Phillips, B.D., Thomas, D.S., Fothergill, A., & Blinn-Pike, L. (2010). *Social vulnerability to disasters.* Boca Raton, FL: CRC Press.

Pierre, J., & Peters, B. (2005). *Governing complex societies: Trajectories and scenarios.* London, United Kingdom: Springer.

Putnam, R. (2000). *Bowling alone: the collapse and revival of American Community.* New York, NY: Simon & Schuster. Kindle edition

Quarantelli, E.L. (2005). A social science research agenda for the disasters of the 21st century. In R.W. Perry & E.L. Quarantelli (Eds.). *What is a disaster? New answers to old questions* (pp. 325-396). Philadelphia, PA: Xlibris.

Quarantelli, E.L., & Perry, R.W. (Eds.). (2005). *What is a disaster? New answers to old questions.* Philadelphia, PA: Xlibris.

Quezada, J., Torrejón, F., Jaque, E., Fernández, A., Belmonte, A., & Martínez, C. (2012). Comparación entre el Terremoto Mw= 8.8 del 27 de Febrero de 2010 y su Predecesor de 1835. *Congreso Geológico Chileno, 13*, 100-102.

Rakodi, C. (1999). A capital assets framework for analysing household livelihood strategies: implications for policy. *Development Policy Review, 17*(3), 315-342.

Reghezza-Zitt, M., Rufat, S., Djament-Tran, G., Le Blanc, A., & Lhomme, S. (2012). What resilience is not: uses and abuses. *Cybergeo: European Journal of Geography*. Retrieved from https://journals.openedition.org/cybergeo/25554

Rhodes, R.A.W. (1996). The new governance: governing without government. *Political Studies, 44*(4), 652-667.

Rijkswaterstaat (1994) De Maas slaat toe .... Verslag hoogwater Maas december 1993.

Rijkswaterstaat (1995) De maas slat weer toe…, verlsag hoogwater Maas January/ February 1995. Maastricht, the Netherlands: Rijkswaterstaat.

Ritchie, L.A. & Gill, D.A. (2011) Considering community capitals in disaster recovery and resilience. *Public Entity Risk Institute (PERI) Scope, 14*(2), Retrieved from http://www.riskinstitute.org/peri/images/file/symposiums/Community_Recov ery_from_Disaster/social,%20day%203.pdf

Rodríguez, H., Quarantelli, E.L. and Dynes, R.R. (eds.) (2007). *Handbook of disaster research (Vol. 643).* New York, NY: Springer.

Rodriguez, H., Trainor, J., & Quarantelli, E. L. (2006). Rising to the challenges of a catastrophe: The emergent and prosocial behavior following Hurricane Katrina. *The Annals of the American Academy of Political and Social Science, 604*(1), 82-101.

Romero, H. & Vidal, C. (2010). Efectos ambientales de la urbanización de las cuencas de los ríos BíoBío y Andalién sobre los riesgos de inundación y anegamiento de la ciudad de Concepción. In: L. Pérez & R. Hidalgo (Eds.). *Concepción metropolitano (AMC). Planes, procesos y proyectos.* Retrieved from http://repositorio.uchile.cl/handle/2250/118084

Rooijendijk, C. (2009). Waterwolven. Amsterdam, The Netherlands: Uitgeverij Atlas.

Rosenthal, U. (1998). Future disasters, future definitions. In: E. L. Quarantelli (Ed.). *What is a disaster: perspectives on the question* (pp.146-159). London, United Kingdom: Routledge.

Rosenthal, U., Bezuyen, M.J., Van Duin, M.J., & De Vreeze Verhoef, M.L.A. (1998). *The 1993 and 1994 floods in Western Europe: a comparative study of disaster response.* New York, NY: Springer.

Scanlon, J. (2005). Strange bed partners: thoughts on the London bombings of July 2005 and the link with the Indian Ocean tsunami of December 26th 2004. *International Journal of Mass Emergencies and Disasters, 23*(2), 149-158.

Schama, S. (1987). *The embarrassment of riches: an interpretation of Dutch culture in the golden age.* London: Collins.

Schein, E.H. (1999). *The corporate culture survival guide: sense and nonsense about culture.* San Francisco: Jossey-Bass.

Schmidt, V. (2001) Oversocialized epistemology: a critical appraisal of constructionism. *Sociology, 35*: 135-157.

Schneider, D. (1957). Typhoons on Yap. *Human Organization, 16*(2), 10-15.

Scott, Z., & Few, R. (2016). Strengthening capacities for disaster risk management: insights from existing research and practice. *International Journal of Disaster Risk Reduction, 20,* 145-153.

Scott, Z., Wooster, K., Few, R., Thomson, A., & Tarazona, M. (2016). Monitoring and evaluating disaster risk management capacity. *Disaster Prevention and Management, 25*(3), 412-422.

Sehnbruch, K. (2017). The Impact of the Chilean Earthquake of 2010: Challenging the capabilities of the neoliberal state. *Latin American Perspectives, 44*(4), 4-9.

Sehnbruch, K., Agloni, N., Imilan, W., & Sanhueza, C. (2016). Social policy responses of the Chilean state to the earthquake and tsunami of 2010. *Latin American Perspectives*, *44*(4), 24-40.

Silbergeit, V., & Prezzi, C. (2012). Statistics of major Chilean earthquakes recurrence. *Natural Hazards, 62*(2), 445–458.

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global environmental change, 16*(3), 282-292.

Solimano, A. (2011). Prosperity without equality: the Chilean Experience after the Pinochet Regime. Retrieved from http://www.andressolimano.com/andressolimano/wp-content/uploads/2012/06/growth-without-equality-chile-solimano-september-24-2011.pdf

Solimano, A. (2012). *Chile and the neoliberal trap.* Cambridge, United Kingdom: Cambridge Books.

Soulé, B. (2014). Post-crisis analysis of an ineffective tsunami alert: the 2010 earthquake in Maule, Chile. *Disasters, 38*(2), 375-397.

Steffen, W., Sanderson, R.A., Tyson, P.D., Jäger, J., Matson, P.A., Moore III, B., Oldfield, F., Richardson, K., Schellnhuber, H.J., Turner, B.L., & Wasson, R.J. (2006). *Global change and the earth system: a planet under pressure.* New York, NY: Springer Verlag.

Sudmeier-Rieux, K. (2014). Resilience–an emerging paradigm of danger or of hope? *Disaster Prevention and Management, 23*(1), 67-80.

Surjan, A., Kudo, S., & Uitto, J.I. (2016) Risk and vulnerability. In J.I. Uitto & R. Shaw (Eds.). *Sustainable development and disaster risk reduction* (pp. 37-56). Tokyo, Japan: Springer.

Swidler, A. (1986). Culture in action: Symbols and strategies. *American Sociological Review, 51*(2), 273-286.

TeBrake, W.H. (2002) Taming the Waterwolf: hydraulic engineering and water management in the Netherlands during the Middle Ages. *Technology and Culture, 43*(3): 475-499.

Technical Council on Lifeline Earthquake Engineering (2010) Preliminary report 27 February 2010 Mw 8.8 Offshore Maule, Chile Earthquake. Retrieved from http://eqclearinghouse.org/co/20100227-chile/wp-content/uploads/2010/04/TCLEE-Web-Report-EERI-v1.pdf.

The International Bank for Reconstruction and Development (IBRD) (2010). Damage, loss and needs assessment: guidance notes. Volume 1. Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/19047/8808 60v10WP0Bo0PUBLIC00TTL0Vol10WEB.pdf;sequence=1

The International disasters database (EM-DAT) (2015) Retrieved from http://emdat.be/country_profile/index.html.

Theordorson G. A., & Theodorson A.G. (1969). A modern dictionary of sociology. New York, NY: Crowell.

Thomalla, F., Smith, R., & Schipper, L.F. (2015) Cultural aspects of risk to environmental changes and hazards: a review of perspectives. In: M. Companion (Ed.) *Disaster's impact on livelihood and cultural survival: losses, opportunities, and mitigation* (pp. 3-18). Boca Raton, FL: CRC Press.

Timmerman, P. (1981). Vulnerability, resilience and the collapse of society. A Review of Models and Possible Climatic Applications. Toronto, Canada: University of Toronto.

Toseroni, F., Romagnoli, F., & Marincioni, F. (2016). Adapting and reacting to measure an extreme event: a methodology to measure disaster community resilience. *Energy Procedia, 95,* 491-498.

Turner, R.H. (1982). Disaster subcultures in earthquake country: between earthquakes in southern California. Retrieved from http://www.eird.org/esp/cdcapra/pdf/eng/doc13409/doc13409-contenido.pdf

Tylor, E.B. (1871) Primitive culture, Vol. 1. In G.A. Theordorson and A.G. Theodorson A.G. (1969) *A modern dictionary of sociology.* New York, NY: Crowell.

Uitto, J. I., & Shaw, R. (2016). *Sustainable development and disaster risk reduction.* Tokyo, Japan: Springer.

United Nations (2015). The 2030 agenda for sustainable development. Retrieved from https://sustainabledevelopment.un.org/post2015/transformingourworld

United Nations Development Program & Municipality of Talcahuano (2011). Plan de Recuperación Post Desastre con Enfoque de Gestión de Riesgo y Participación Ciudadana. Comuna de Talcahuano Región del Biobio Chile. UNDP, Santiago de Chile. Retrieved from http://www.preventionweb.net/applications/hfa/lgsat/en/image/href/1845

United Nations Development Program & Municipality of Talcahuano (2012) Guia Participativa de Orientaciones de Respuesta Frente a Emergencias de Terremoto-Tsunami A partir de la Experiencia de Talcahuano, Chile. Retrieved from http://www.cl.undp.org/content/chile/es/home/library/crisis_prevention_and_recovery/publication_2.html

United Nations Development Program & Municipality of Talcahuano (2016) Estrategias territoriales para la reducción del riesgo de desastre. Retrieved from https://www.slideshare.net/ObservatorioRRD/estrategias-territoriales-para-la-reduccin-del-riesgo-de-desastre-talcahuano-chile.

United Nations Economic Commission for Latin America and the Caribbean (ECLAC) (2003). Handbook for Estimating the Socio-economic and Environmental Effects of Disasters. Retrieved from http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTURBANDEVELOPMENT/EXTDISMGMT/0,,contentMDK:20196047~menuPK:1415429~pagePK:210058~piPK:210062~theSitePK:341015,00.html

United Nations International Strategy for Disaster Reduction (UN/ISDR) (2004). Living with risk: a global review of disaster reduction initiatives. UN Inter-Agency Secretariat of the International Strategy for Disaster Reduction. Retrieved from www.unisdr.org/files/657_lwr1.pdf

Van Dam, P.J.E.M. (2012). Denken over natuurrampen, overstromingen en de amfibische cultuur. *Tijdschrift voor Waterstaatgeschiedenis 12*(1/2), 1–10.

Van der Most, H., & Wehrung, M. (2005). Dealing with uncertainty in flood risk assessment of dike rings in the Netherlands. *Natural Hazards, 36*(1-2),191–206.

Van Heezik, A. (2006). Strijd om de rivieren: 200 jaar rivierenbeleid in Nederland. Den Haag, The Netherlands: Ministerie van Infrastructuur en Milieu.

Van Loon, J. (2002). *Risk and technological culture: Towards a sociology of virulence.* London, United Kingdom: Routledge.

Van Slobbe, E., de Vriend, H. J., Aarninkhof, S., Lulofs, K., de Vries, M., & Dircke, P. (2013). Building with Nature: in search of resilient storm surge protection strategies. *Natural hazards*, *66*(3), 1461-1480.

Velotti, L., Engel, K., Warner, J., & Weijs, B. (2011). Meeting communities where communities meet: Borgharen and Itteren. Maastricht, the Netherlands. Disaster Research Center Miscellaneous report #73. Newark, DE: Disaster Research Center, University of Delaware. Retrieved from http://udspace.udel.edu/handle/19716/10384

Velotti, L., Trainor, J., Engel, K., Torres, M., & Myamoto, T. (2013). Beyond vertical evacuation as an emergency management strategy. *International Journal for Mass Emergencies and Disaster, 1*(3), 60-77.

Verdugo, R. (2012). Comparing liquefaction phenomena observed during the 2010 Maule, Chile earthquake and 2011 Great East Japan earthquake. Retrieved from https://pdfs.semanticscholar.org/eafe/3217f947b8b08e8e31245149cf159e80b193.pdf

Wachtendorf, T. & Kendra, J.M. (2006). Improvising disaster in the city of jazz: organizational response to hurricane Katrina. Understanding Katrina: Perspectives from the Social Sciences. Retrieved from http://understandingkatrina.ssrc.org/Wachtendorf_Kendra/

Walker, B., & Salt, D. (2006). *Resilience thinking: sustaining ecosystems and people in a changing world.* Kindle Edition. Washington, DC: Island Press.

Walker, B., Holling, C. S., Carpenter, S., & Kinzig, A. (2004). Resilience, adaptability and transformability in social–ecological systems. *Ecology and society, 9*(2).

Walsh, D., & Evans, K. (2013) Critical realism: an important theoretical perspective for midwifery research. *Midwifery, 30*, 1-6.

Warner, J., & Engel, K. (2014). Disaster culture matters. Ambiente & Sociedade, 17(4), 1-8.

Watts, M.J., & Bohle, H.G. (1993). The space of vulnerability: the causal structure of hunger and famine. *Progress in Human Geography, 17*(1), 43-67.

Weichselgartner, J., & Kelman, I. (2015). Geographies of resilience: Challenges and opportunities of a descriptive concept. *Progress in Human Geography, 39*(3), 249-267.

Weick, K.E. (1993). The collapse of sensemaking in organizations: the Mann Gulch disaster. *Administrative Science Quarterly, 38*(4), 628-652.

Welsh, M. (2014). Resilience and responsibility: governing uncertainty in a complex world. *The Geographical Journal, 180*(1), 15-26.

Wenger, D.E. (1978). Community response to disaster: functional and structural alterations. In: E.L. Quarantelli (Ed.) *Disasters: theory and research* (pp.17-47). London, United Kingdom: Sage Publications.

Wenger, D.E., & Weller, J.M. (1972). Some observations on the concept of disaster subculture. Disaster Research Center Working Paper #48. Columbus, OH: Ohio State University, Disaster Research Center.

Wenger, D.E., & Weller, J.M. (1973). Disaster subcultures: the cultural residue of community disasters. Disaster Research Center Preliminary Paper #9. Columbus, OH: Ohio State University, Disaster Research Center.

White, G.F. (1945). Human adjustment to floods: a geographical approach to the flood problem in the United States. Research Paper 29. Chicago, IL: University of Chicago, Department of Geography.

Wisner, B., & Luce, H. R. (1993). Disaster vulnerability: scale, power and daily life. *GeoJournal, 30*(2), 127-140.

Wisner, B., Blaikie, P. M., Cannon, T. & Davis, I. (2004). *At risk: natural hazards, people's vulnerability and disasters* (2nd ed.). London, United Kingdom: Routledge.

Wisner, B., Gaillard, J. C., & Kelman, I. (Eds.). (2012). *Handbook of hazards and disaster risk reduction and management.* London, United Kingdom: Routledge. Kindle edition.

World Bank (2004). World development report 2004: making services work for poor people. Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/5986/WDR%202004%20-%20English.pdf?sequence=1

WVS (2014) World values survey wave 6 2010-2014, Official Aggregate v.20150418. Stockholm, Sweden: World Values Survey Association. Retrieved from http://www.worldvaluessurvey.org/WVSDocumentationWV6.jsp.

Yamazaki, Y., & Cheung, K.F. (2011). Shelf resonance and impact of near-field tsunami generated by the 2010 Chile earthquake. *Geophysical Research Letters, 38*(12):1-8.

Yin, R. (2018). Case study research: design and methods (applied social research methods) (6th ed.). Los Angeles, CA: SAGE Publications. Kindle Edition.

Yinger, J.M. (1960). Contraculture and subculture. *American sociological review*, 625-635.

Zhou, H., Wan, J., & Jia, H. (2010). Resilience to natural hazards: a geographic perspective*. Natural Hazards, 53*(1), 21-41.

Websites

BBC. (2010, 28 February). Massive earthquake strikes Chile. Retrieved from http://news.bbc.co.uk/2/hi/8540289.stm.

Digitale Bibliotheek Nederlandse Letteren (DBNL). (2018a) De werken van Vondel. Deel 4. 1640-1645 (1930) – Joos van den Vondel. Retrieved from https://www.dbnl.org/tekst/vond001dewe04_01/vond001dewe04_01_0043.php

Digitale Bibliotheek Nederlandse Letteren (DBNL). (2018b) Joos van den Vondel (1587-1679) Aan de leeuw van Holland. Retrieved from https://www.dbnl.org/tekst/geld008kwil01_01/geld008kwil01_01_0022.php.

Intergovernmental Oceanographic Commission. (2018, August 17). About Us. Retrieved from http://www.ioc-tsunami.org/index.php?option=com_content&view=article&id=1&Itemid=2&lang=en.

International Tsunami Information Center. (2018, August 17) Tsunami classification. Retrieved from http://itic.ioc-unesco.org/index.php?option=com_content&view=article&id=1019:5&catid=1142&Itemid=2433.

National Aeronautics and Space Administration. (2018, August 17). GOES Overview and History. Retrieved from https://www.nasa.gov/content/goes-overview/index.html.

ONEMI. (2002, March 12). Plan nacional: instrumento indicativo para gestión integral decreto n° 156, Retrieved from http://www.onemi.cl/wp-content/themes/onemi-bootstrap-master/library/doc/plan_nacional_0_0.pdf.

Preventionweb (2018) Disaster risk reduction and management. Retrieved from http://www.preventionweb.net/risk/drr-drm.

Seats2mmeet. (2016, May 17). Winner of the 'Architecture Nobel' releases popular
        housing   projects   for   free.   Retrieved   from
        https://magazine.seats2meet.com/popular-housing-projects-free/.

Summary

Chile is one of the most seismic countries in the world. On February 27, 2010, the south-central regions of Chile were hit by a powerful earthquake/ tsunami event (27F) that resulted in significant loss and devastation. Greater Concepción (GC) was one of the most affected regions. Impact showed that the communities of GC remain susceptible to these events. Communities facing recurrent hazards turn to sociocultural systems to accommodate these into their lives. Disasters reveal how successful communities have been at doing this, i.e. how effective they have been at adapting to their environs. They lay bare fundamental features of vulnerability that contributed to the unfolding of the disaster. The study underlying this thesis was designed with this in mind. The aim was to use a sociocultural lens specifically developed to look at disaster-related elements, i.e. the Disaster Subculture (DsC) lens, and investigate people's 27F experiences to learn more about their earthquake/ tsunami vulnerability and resilience in GC. The DsC lens focuses on mechanisms that people cultivate to cope with recurrent hazards. While applying it, it was complemented with a technological culture perspective. This was important because adaptations emerge from the interface of the natural, social, and technical.

The DsC lens has its roots in the 1970s. Since then it's conceptual development has been limited and it was mostly used by academics to refer or label disaster-related mechanisms that communities had developed to deal with recurrent hazards. It remains, however, the one conceptual framework that focusses on disaster-specific cultural assets. It was unclear however whether the lens would be fitting for this study. This is why the main study was preceded by one to ensure its appropriateness. The study had to establish that the lens still had contemporary relevance, could be applied outside the context it was developed in and could produce novel insights. This study investigated DsC in two communities in the Netherlands facing recurrent fluvial flood events: Borgharen and Itteren. On the basis of this study the DsC and technological culture perspective were developed.

Since both objectivist and constructivist approaches are characterized by dualities that cause tension when studying phenomena that emerge from the confluence of the natural, social, and material world, an approach inspired by critical realism was selected. Furthermore the research was qualitative and highly explorative. The former was fitting because central to the study are experiences and these cannot be measured. The latter was the case because at the time when the study was designed there were few studies looking into matters of vulnerability to earthquake/ tsunami events from a cultural perspective. The exploratory nature of this study guided the selection of 'case-study' as the strategy for inquiry. Data collection was done in 'the field' through 'immersion' of a period of over a year. Respondents were selected through purposeful sampling, mostly snowball sampling. The study included over 150 (formal) participants. Most interviews were individual semi-structures interviews. To go more in-depth into experiences interviews were complemented by a number of intensive prolonged interactions and participative processes. Often studies into vulnerability point out issues of sensitivity and susceptibility. Throughout this endeavor the focus was on what people have and can accomplish. What capacity of response for instance prevented them from absolute collapse? This was aided by the cultural approach I opted for.

The main study found that people in GC remain susceptible to earthquake/ tsunami disasters but that susceptibility differs throughout the region. This differentiation is influenced by people's access to resources. For instance, a primary finding was that households typically considered resilient in the face of natural hazards were in fact not because of their limited access to relevant natural, financial, and cultural resources. Cultural resources, and especially disaster subcultural resources, are significant when it comes to disaster. Disaster subcultures encompass lessons learned from past disaster experiences aimed at positively influencing responses to future similar events. This study revealed that GC is characterized by a comprehensive and widespread earthquake disaster subculture which in coastal

communities also includes tsunami-specific resources to limit loss of life. These resources allowed people to effectively deal with the earthquake. The tsunami-resources were however insufficiently accessible to all people exposed to the 2010 tsunami. People originally from inland localities who were now inhabiting tsunami exposed urban localities were for instance insufficiently aware of the tsunami risk they were exposed to. As a result, lives were loss. Also, the DsC did not include resources to prevent or mitigate material loss. Subsequently, material impact was significant and recovery because of this a more lengthy and complex process. Interestingly, an 'after-action' resilience analysis found that two localities from the same town (one rural and one urban one) that had suffered similar damage were very different in terms of resilience. A model inspired by Bellingham and Tanner's (1995) resilience model was developed to assess the type of resilience that emerged in response to 27F stress by looking at the localities' damage and responsiveness. This effort concluded that even though both localities suffered similar damage, their responsiveness was so different that one locality; the rural locality, could be defined as resilient while the other, the urban one, could not and seemed in fact susceptible.

In light of this a central finding is that exploring earthquake/ tsunami disaster subculture can enhance our understanding of vulnerability vis-à-vis earthquake/ tsunami events by directing our attention to the means that people cultivate to manage their vulnerability; to *cultural capital*. At the same time the technological culture approach to DsCs is key. There are important intricacies to be captured as disasters emerge from the confluence of human, social, technical and natural realms. DsCs emerge from highly technological learning processes, bringing together different bodies of knowledge, namely scientific, local and indigenous knowledge, to form one relevant earthquake/ tsunami disaster resource. Including this perspective is thus key to assure a rich picture and do justice to the role the social and the technological play when it comes to the vulnerability that people experience.

The findings are relevant to future disaster risk reduction efforts in GC. They showed existing capacities that should be taken into account when interventions to enhance disaster risk reduction are considered. Such efforts should build on available capacities. Also, the study revealed that GC's DsC is comprehensive but that it contains elements that do not contribute to disaster risk reduction and seem in fact to do the contrary. Take the premise that civilians are the primary responsible for dealing with disaster preparation and response. This has led to poorly prepared governmental institutions that severely limit overall disaster resilience.

All in all, this study showed that (major) earthquake/ tsunami events remain serious threats for GC and that learning in order to improve adjustments and reduce these events' disaster potential remains imperative.

WASS Certificate

Karen E. Engel

Wageningen School of Social Sciences (WASS)

Completed Training and Supervision Plan

Name of the learning activity	Department/Institute	Year	ECTS*
A) Project related competences			
Writing PhD proposal	WUR, Disaster Studies	2012	6
'Resiliencia comunitaria: preparar para improvisar'	Guest speaker for the Talcahuano Fire Department,Talcahuano	2013	1
'Gestión de riesgo'	Risk management workshops with sustenance farmers in Hualqui, Chile	2013	1.3
Council trajectory with local disaster risk reduction authorities in Talcahuano.	Municipality of Talcahuano – Departamento de Gestión Integral del Riesgo de Desastres and Fire Department Talcahuano	2013-2105	2.6
'Adaptación al cambio climatico: perspectivas desde el enfoque de genero'	Adaptation workshops for World Vision, Concepción Santiago de Chile Los Angeles	2013	1.6
B) General research related competences			
Introduction course	WASS	2012	1

CERES Orientation programme	CERES	2012	10
Quantitative methodologies and economics	CERES	2012	2
Qualitative Data analysis for development research	CERES	2012	1.5
CERES Summer School and poster: 'Technological culture: an opportunity to reduce vulnerability to earthquake/tsunami disasters'	CERES	2012	2
NUWCReN symposium (organization, execution, participation) re post-disaster recovery	NUWCRen, Den Haag	2012	0.8
Natural Hazards Workshop and presentation: 'Disaster subcultures in the Netherlands: Theparishes of Borgharen and Itteren'	Natural Hazards Center, University of Colorado, Boulder.	2012	2
EDUCEN – contribution to proposal, webinar Culture & Urban Disaster (https://www.youtube.com/watch?v=8T42jM5dvYs), conference, book	WUR	2014-2016	2.9
C) Career related competences/personal development			
Give guest lectures, co-organize course Analyse van een probleemveld, thema rampen en resilience	WUR	2013-2015	2.9
Module Spatial Policy and Knowledge	University of Twente	2012	5

Total	42.6

*One credit according to ECTS is on average equivalent to 28 hours of study load

About the author

Karen Elisabeth Engel was born January 11, 1982, in Pasto, Colombia. She grew up in Colombia, the Netherlands, and Chile. She completed the International Baccalaureate (IB) at The International School Nido de Aguilas in Santiago, Chile. She continued her academic development at University College, Utrecht, The Netherlands. In 2004 she earned her Bachelor of Arts Degree. Her major was in Social Sciences (Political Science, Law, and Sociology) and her minor was in Humanities (Philosophy). She graduated Cum Laude. She continued her studies and earned her Master of Arts degree, also Cum Laude, in Conflict Studies and Human Rights at Utrecht University in 2005.

After her studies, Engel joined COT Institute for Safety, Security, and Crisis Management. She quickly proved her capabilities and contributed to the institute's efforts as a Disaster and Crisis Management Research-Consultant. With time she complemented her research-consultancy tasks with international product development responsibilities.

In 2011 Engel competed and won The Netherlands Organization for Scientific Research Mozaiek Grant. This grant aimed to give ethnic minorities the opportunity to continue their academic careers and become role models in academia. Since Engel's mother is Chilean and she was herself born in Colombia, she was eligible to apply. This grant made it possible for Engel to investigate the event that unfolded as Chile was struck by a powerful M8.8 earthquake that triggered a devastating tsunami in 2010. It also enabled her to continue her academic career in pursuit of a PhD.

She embarked upon this PhD trajectory together with Prof. G.E. Frerks, former Professor of Disaster Studies at Wageningen Univeristy & Research, as her Promotor and Dr. J.F. Warner, Associate professor, Sociology of Development and Change Group Wageningen University & Research, as her Co-Promotor. The PhD trajectory

included lecturing, writing articles, over a year of field research, supporting proposal writing and on-going projects, and assisting in courses and students.

As she finishes her PhD trajectory, Engel seeks to continue as an academic, but also as trainer, coach, and facilitator. With her work she will continue to look for ways to enable both communities and public and private entities to embrace and engage change. Even sudden, unforeseen, and perceived hazardous change, because this will make it possible for them to secure sustainability and progress in the face of a future that is more and more uncertain, complex and volatile. Since her areas of interest range from DRR, particularly social preparedness, to sustainable development opportunities are diverse. The central themes continue to be though vulnerability (potential for positive/ negative change) and resilience. She will continue to work internationally, as she has done: her experience covers five continents and includes countries like Belgium, Kazakhstan, Kyrgyzstan, Nigeria, USA, and Brazil. Because of her international profile and her fluency in Dutch, English, and Spanish she is able to engage across cultural divides. Engel will look to work mostly with tailor-made and highly participatory processes. She maintains that proper results can only be obtained when work is embedded and stakeholders take the lead to jointly go through relevant processes of change.

Publications

Engel, K. and Warner, J. (2018) Resilience in Talcahuano, Chile: appraising local disaster response. Manuscript submitted for publication.

Engel K, Frerks G, and Warner, J (2018) Disaster subculture in Greater Concepción, Chile: resourcesfulness in the face of earthquake/ tsunami events. Manuscript submitted for publication.

Engel K (2016) Talcahuano, Chile, in the wake of the 2010 disaster: A vulnerable middle? Nat Hazards 80(2): 1057

Engel K, Frerks G, Velotti L, Warner J, and Weijs B (2014) Flood disaster subcultures in the Netherlands: the parishes of Borgharen and Itteren. Nat Hazards 73:859–882

Warner J, Engel K (2014) Disaster Culture Matters. Ambiente & Sociedade, 17 (4):1-8

Frerks, G.E. and Engel, K.E. (2013) Twintig jaar na dato: overstromingscultuur in het maasgebied. Magazine nationaleveiligheid en crisisbeheersing. 11(6): 52 - 53

Velotti L., Trainor J., Engel K., Torres M., Myamoto T. (2013). Beyond Vertical Evacuation: Research Considerations for a Comprehensive "Vertical Protection Strategy"

Engel KE, Engel PGH (2012) Building resilient communities: where disaster management and facilitating innovation meet. In: Wals AEJ (ed) Learning for sustainability in times of accelerating change. Wageningen Academic Publishers, Wageningen, pp 133–147

Engel, K., Kolen, B., Van der Most, H. and Van Ruiten, K. (2012) The Dutch Delta: A Mega-Crisis Waiting to Happen. In [ed] Ira Helsloot, ArjenBoin, Brian Jacobs and Louise K. Comfort. Mega-Crises: Understanding the Prospects, Nature, Characteristics and the Effects of Cataclysmic Events. Springfield: Charles C. Thomas Publisher, Ltd.

Engel, K. 2011. Extreem hoogwater 1993 en 1995. [ed.] E. Muller. Crises in Nederland: Rampen, rellen, gijzelingen en andere crises (translation: Crises in the Netherlands: disasters, riots, hostage situations and other crises). Deventer: Kluwer

Engel, K. &Trainor, J. 2010. Floods and Disaster Management in the Netherlands: "God Created the world, but the Dutch created the Netherlands". In [ed.] D.A. McEntire. Comparative Emergency Management: Understanding Disaster Policies, Organizations, and Initiatives from Around the World. Washington D.C.: FEMA in Higher Education Program, 2010.

Engel, K. et al. (2010) Is verticale evacuatie haalbaar of niet? (translation: Is vertical evacuation feasible?) Magazine NationaleVeiligheid en Crisisbeheersing. 8(5): 34-35.

Engel, K., Ritchie, L.A., Jordan, A. & Gilbert, B. Wat kan Nederland leren van internationale evaluaties? (Translation: What can the Netherlands learn from international evaluations?) Magazine NationaleVeiligheid en Crisisbeheersing. Vol. 8, 5, pp. 32-33.

Engel, K., Torres, M. &Trainor, J. Wat Nederland moet weten over grootschalige buitenlandse bijstand. (Translation: What the Netherlands should know about large scale foreign assistance) Magazine NationaleVeiligheid en Crisisbeheersing. 2010, Vol. 8, 5, pp. 24-25.

Kolen, B., Engel, K., Van der Most, H. & Van Ruiten, K. Leven in de Nederlandse Delta, wachten tot een megacrisis? (Translation: Living in the Dutch Delta: waiting for a mega-crisis?) Magazine NationaleVeiligheid en Crisisbeheersing. 7(7): 43-44.

Zannoni, M., Bos, J., Engel, K. & Rosenthal, U. Brand bij Bouwkunde.(Translation: The large scale fire at the faculty of Architecture in Delft) Den Haag : Boom Juridische Uitgevers.

Velotti, L. Engel, K. Warner, J. And Weiss, B. 2011. Field study report: Meeting communities where communities meet: Borgharen en Itteren. To be published by the Disaster Research Center as a DRC Report.

Acknowledgements

Where to start. Firstly, my promotor, *Georg Frerks*. He believed and supported me from the beginning. This is now almost eight years ago. In 2010 the earthquake and tsunami hit Greater Concepción, Chile. This moved me to write a proposal and apply for a Mozaiek grant at the Netherlands Organization for Scientific Research (NWO). He facilitated this and without his help I would not have been able to win the grant and ensure an independent PhD position at Wageningen University to complete my own research project. Now, eight years later, I'm grateful that he did not lose faith, continued to be there for me, and helped me reach this amazing milestone.

Then of course my daily supervisor and co-promotor, *Jeroen Warner*. He joined the team shortly after I had won the grant. He encouraged me and believed in my capabilities. Talking to him would always give me a boost, especially when I had been sitting alone at my desk in Lagos, Nigeria. He would be enthusiastic and stress the relevance of my work. Never without being critical, though. Lastly, I would like to thank him for the different opportunities. From lecturing to supporting proposals and projects to enabling courses and assisting students. Opportunities were varied, interesting and complementary to my PhD. This was great. I am very grateful he stuck with me for all these years.

To *NWO* for giving me this amazing opportunity. The grant allowed me to develop and execute my *own* project and focus on matters that I considered relevant. This was unique for my own development, but more importantly for my career in academia.

To the Sociology of Development and Change Group. Thank you for supporting my PhD trajectory and more importantly making it possible for me to do my field research in Chile. Here I would like to thank Aicha el Makoui in particular.

Whether I was located in France, Chile, Nigeria or The Netherlands I could always depend on her support, especially when it came to the practical, administrative and logistical matters. This was a welcome constancy throughout the past years that were far from straightforward and steady.

To my family. Their support and dedication has always helped me through. To my father, *Paul Engel*. Intellectually and academically I am indebted to him. From an early age he took me and my questions about the world seriously and stimulated me to ensure that other people would too. I must have been six when I attended my first university class at Wageningen University taught by my father and I remember clearly how he stressed, with funny big clown glasses, that the world people perceive is always colored by their perspectives; 'their glasses'. He would demonstrate with Dalí's art work how different angles can lead to different perceived realities and with a 12 sided dice that our realities are defined by our assumptions. This stuck with me and has defined both my life and academic endeavors, including this work. He still inspires me and he remains one of the few professionals who can help me at the most early stages of my writing. He understands my reasoning and conceptual visions even when they are not fully developed yet and are therefore still a bit incoherent. Additionally he ensures I always translate my work to statements relevant to practitioners and policy makers. This makes discussing my work with him always a very fruitful endeavor.

To my mother, *Maria Rojas*, I have to thank her for taking the time to go back with me to Chile to get my fieldwork off the ground. This was a wonderful but also rewarding experience. She is my beacon when it comes to Chile and has been the primary source of inspiration for this specific project. Without her perspectives throughout my life I would have never looked into the matters of this PhD. She is always showing me that things are not straightforward. Different people have different ideas and practices. This is a given and thus a reality to be dealt with and not to be avoided. At the same time, she always stressed that one's own values, ideas

and practices are just as valid as those of others. So when confronted with cultural complexities, consider your own as bearings, but question them too. But dare to say, if your contemplations lead you to this conclusions, that your reality is acceptable too. This has helped me navigate the world and this PhD trajectory.

To everyone in Chile, without whom I would not have been able to realize this research. They have supported me in different ways, from being gatekeepers, to being part of my investigation and helping me feel at home. Thank you for everything: *Alicia Rojas, Genaro Molina, Ruth Rojas, Mario Orrellana, Bryan Cormack, Antonieta Castro, Alejandra Orrellana, Pedro Orrellana, Mauricio Torres, Boris Saez, Evandro Perez, Gonzalo Arroyo, Lilian Bastides, Oscar Cifuentes, and Irma Villanueva Ojeda.*

Since I wrote this thesis while being expatriated to Paris and then Lagos, Nigeria, this process has from time to time been particularly solitary. To stay motivated and keep on going I am also indebted to a few friends who have helped me in different ways. I want to thank them for staying supportive, providing the right distractions and making sure I had more than just my PhD to stay occupied with. To *Martha Torres*, she was with me in Lagos, Nigeria, and with her support, which ranged from listening to reviewing and discussing my work to ensuring a home away from home, even in Port Harcourt, I was able to stay committed even through the most solitary periods in Nigeria.

Last, but certainly not least, thank you to *Lizzy, Evelyn, and Prosper*. Doing a PhD about Chile at a Dutch university while living in Nigeria was not ideal, but with their help it was possible. I am grateful they understood my situation and were there to assist me so that I could achieve my deadlines. Without their dedication I would not have been able to complete this process.

To *Lizzy* in particular, she understood what I was doing and supported me throughout. She even encouraged me by stressing how inspiring it was to her that I was doing my PhD while also being a (nursing) mother and wife. She stressed that

seeing me work made her realize that women can be more than just a mother and a wife. This was amazing for me to hear and I want to thank her for giving me those words and giving me the encouragement I from time to time needed to continue. Sometimes this meant long hours for both of us. I am very grateful for everything she did for me; for us.