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**Understanding and improving disaster risk governance to
address small-scale recurring disasters: insights from
Aotearoa New Zealand**

A thesis

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of the requirements for the degree

of

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by

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ABSTRACT

As small-scale disasters start to occur more frequently, their impacts accumulate with time and may become intolerable for the communities affected. These impacts tend to be small but frequent, which makes them chronic. Despite this, because of their less significant immediate effects, they receive little attention in both research and practice. Small-scale recurring disasters are often triggered by climate-related events and are characterised by localised floods, landslides, and storms, as well as being linked to the underlying causes of vulnerability.

There aren't specific and clear policies in disaster risk governance that address the emergency response to and recovery from small-scale recurring disasters. Thus, they fall through risk assessment processes because those processes do not sufficiently capture them thereby preventing their evaluation by higher levels in the decision-making process. This leads to the employment of short-term resilience strategies for the recovery from these events, such as insurance mechanisms, which may obscure the underlying issues and exacerbate community vulnerability in the long run. Consequently, they may grow into major problems, increasing the opportunity costs associated with failed interventions. It is therefore imperative to revisit current disaster risk governance frameworks, as they tend to focus mainly on large-scale disasters and neglect small-scale recurring ones. This is so that guidelines and criteria used to inform decisions in disaster risk governance frameworks, especially pertaining to emergency management services activation and resources, address small-scale recurring disasters to ensure timely responses and appropriate community recovery.

This thesis contributes to fill this gap in knowledge by specifically investigating the extent to which small-scale recurring disasters are being accounted for by Aotearoa New Zealand's emergency management system, through a qualitative case study approach. In doing so, this research aims to inform current and future disaster risk governance policies and practices regarding small-scale recurring disasters, to ensure better outcomes for affected communities. To this end, the research is guided by three questions, which were addressed using multi research methods predominately of qualitative nature. The research questions are:

1. To what extent are small-scale recurring disasters incorporated in Aotearoa New Zealand's emergency management frameworks?
2. How can the identification and classification of disaster scales and related impacts be improved to account for a broader spectrum of disasters, and better inform disaster management policies and practice?

3. How can current practices enable a more comprehensive and equitable entry point for local disaster response and recovery, and thus improve the adaptation capacity of affected communities?

With respect to adopted research methods, firstly, a policy document analysis of high order emergency management documents was carried out using the content analysis method. Secondly, secondary data of flood disasters gathered from online sources for a 30-year period were analysed using simple statistical methods in Microsoft Excel. Finally, primary data collected through semi-structured interviews with emergency management specialists were thematically analysed, with support of NVivo qualitative data analysis software.

Based on the findings, this thesis offers a number of insights for improving disaster risk governance related to small-scale recurring disasters in Aotearoa New Zealand, and elsewhere. Firstly, drawing on the policy analysis of high order emergency management documents, it exposes the gaps in policies and corresponding practices in the country's current emergency management framework. The analysis confirms the ambiguity of the policies and their associated processes when dealing with small-scale recurring disasters, as well as the disconnection between top-down policy directives and on-the-ground actions. This leads to a lack of appropriate mechanisms for both policies and practices to understand the characteristics of small-scale recurring disasters, which are important to determine not only the risk these disasters posed to communities, but the impacts they create.

Secondly, the secondary data analysis of flood disaster events over a 30-year period showed that there are many gaps and inconsistencies in both disaster data collection and recording. These gaps tend to create inconsistent and inequitable allocation of emergency management resources to affected communities, especially when multiple disasters occur concurrently. The analysis confirmed the need for more detailed information and data on a range of disasters scales and their impacts, so as to identify potential chronic disaster conditions and inform emergency management policies and decisions. This is important, as climate change is already increasing the frequency and severity of extreme events and stretching resource availability even further.

Lastly, the analysis of empirical data from emergency management specialists confirms the need for improved decision-making criteria to guide emergency management response and recovery related to small-scale recurring disasters, to provide an equitable service delivery to the affected communities. This analysis also highlights the need for streamlining and scaling

up community-driven approaches for the management of small-scale recurring disasters, because it requires a place-based approach with communities at the forefront.

This thesis has encountered several challenges, including the COVID 19 pandemic and the subsequent disasters pertaining to natural hazards that affected Aotearoa New Zealand during the study period. These challenges have limited the number of participants for the interviews and the opportunity to carry out field research at the community level to determine affected communities' perspective on confronting small-scale recurring disasters. There was also a limitation to the publicly available impact data and information related to small-scale disasters, and that limitation has implications on the study results. Further, the research was limited to the analysis of flood disaster data and the concurrent disasters were not considered, to mitigate the complexity of the research. Therefore, future research on small-scale recurring disasters at the community level and interviews with a larger number of on-the-ground specialists could provide further insights for informing disaster risk governance frameworks and corresponding policies and practices.

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A PhD involves more than acquiring academic expertise in a particular field, but it also involves a significant amount of non-academic learning. Its trajectory is full of sacrifices, commitment and hard work. A PhD is undeniably a remarkable milestone achievement, but it was also a personal turning point in my life. This journey would not have been possible without the support and inspiration I have received during these years.

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1 Introduction

Disasters related to natural hazards have been considered one of the major challenges impacting humankind. Over the past few decades, climate change impacts have been underestimated with respect to their intensity and timeline, resulting in a series of simultaneous severe events that are occurring far sooner than expected (IPCC, 2022; United Nations Office for Disaster Risk Reduction, 2019). There is also an alarming trend towards an increase in the economic losses associated with smaller-scale and recurring local disasters (Thomas, 2017).

Small-scale recurring disasters are often triggered by climate-related events that are associated with localised forms of urban flooding, landslides and storms. These are linked to root causes of vulnerability, such as environmental degradation or poor urban planning decisions which impact on people's livelihoods (Shrestha & Gaillard, 2013; Zaidi, 2018). The impact of such disasters tends to be small but frequent, which makes them chronic (Shrestha & Gaillard, 2013). While large-scale disasters result in higher rates of mortality and economic losses, small-scale recurring disasters often result in cumulative losses of economic assets and livelihoods (Browne, 2013). These events are undeniably important for those who are impacted, because they may erode the community's ability to cope, thereby exacerbating their vulnerability in the long run (Shrestha & Gaillard, 2013).

The focus on small-scale recurring disasters, has not received much attention by scholars and authorities alike (Shrestha & Gaillard, 2013), with greater attention being paid to large-scale events that make news headlines (Hallegatte et al., 2016). According to Cadag et al. (2017), one reason for this is because the small-scale disasters do not escalate to the level of an 'emergency' or a 'crisis'. However, when small risks are not captured, or if they are intentionally ignored, they will grow into major problems, increasing the opportunity costs and missed opportunities associated with failed interventions (United Nations Office for Disaster Risk Reduction, 2019). Furthermore, it is important to be attentive to the fact that repetitive disasters are significant in terms of the damages they impose on vulnerable communities (UNESCAP, 2018).

No matter how large or small the disaster is, there is a process of healing that follows when people attempt to repair and rebuild homes and infrastructure, re-establish lost lands, crops, and forests, find alternative resources, work and employment, and re-build their lives. This is commonly

described and understood as disaster recovery (Shrestha, 2016). Importantly, when multiple disasters occur in quick succession, this recovery process becomes complicated. In most cases, recurring disasters do not occur due to any exceptional event, but their recovery can be interrupted by subsequent events (Shrestha, 2016).

A holistic post-disaster recovery involves elements of infrastructural, environmental, institutional, economic, and cultural activities and needs (Tierney & Oliver-Smith, 2012). The periods of response, recovery and readiness for future risks may overlap, or take longer than originally estimated (Finucane et al., 2020). However, post-disaster recovery policies and their practice are largely based on large-scale disasters, with less focus on small-scale recurring disasters (Fraser et al., 2020; Shrestha & Gaillard, 2013). This leaves the people and communities affected by those events on their own when facing them. Their coping strategies are essentially based on their endogenous knowledge, skills, and other resources, which compose their 'capacity' to deal with hazards and disasters (Cadag et al., 2017). Thus, there is a greater need for a better understanding of how disaster governance processes address the needs of communities impacted by these small-scale events, so as to develop appropriate disaster recovery plans and policies (Shrestha & Gaillard, 2013). However, a general consensus on what constitutes a small-scale disaster is absent both in literature and practice. Therefore, for the purpose of this research a working definition was adopted as follows: a small-scale disaster impacts a low number of people, imposes a risk level below the major and extreme thresholds that may not have a threat to life. These disasters could relatively have minor social, environmental and cultural impacts and result in long term cumulative impacts.

While disaster recovery is undeniably important, it is also necessary to pay attention to how emergency response mechanisms function immediately after a disaster. This is because the response interventions during the initial stages after a disaster can help reduce the adverse impacts on affected communities. However, similar to recovery policies, emergency management response policies and frameworks are also largely developed around large-scale disasters, of which the consequences are largely visible. For this reason, a closer look at how they are implemented in the context of small, recurring disasters is imperative to identify their limitations.

1.1 Significance of the study

A study carried out by Marulanda et al. (2010) examining the long-term socio-economic impact of small and moderate disasters in Colombia revealed that the cost of small-scale disasters

superseded the cost of extreme events during a 32-year time period (1971-2002), imposing an additional burden on local resources. Losses from disasters are mostly expressed in economic values. Although these values provide a useful estimation of the damage, Zaidi (2018) argues that this is not sufficient to inform strategies that support the substantial reduction of disaster risk and losses in lives, livelihoods and health. It also does not provide a comprehensive picture of the impacts on affected communities, including economic, physical, social, cultural and environmental impacts, as recommended by the Sendai Framework for Disaster Risk Reduction. Zaidi (2018) suggests that analytical tools should be developed to improve our understanding of disaster impacts, especially the small-scale and slow-onset events that are currently under-represented in the literature. In particular, there is a clear knowledge gap about how small-scale recurring disasters affect communities in developed countries. Additionally, Ferris et al. (2013) argue for more research on the connections between different types of natural hazards, to clarify the conceptual definitions and interactions between recurring, continuous and cascading disasters.

The overarching objective of this research is to identify the extent to which Aotearoa New Zealand's emergency management regime accounts for small-scale recurring disasters and ways to improve their governance to ensure better outcomes for affected communities. In doing so, this research contributes to fill this gap in knowledge also may inform current and future emergency management policies and practices regarding small-scale recurring disasters. To this end, the study seeks to answer the following research questions through the application of a mixed methods research approach:

1. To what extent are small-scale recurring disasters incorporated in Aotearoa New Zealand's emergency management frameworks?
2. How can the identification and classification of disaster scales and related impacts be improved, to account for a broader spectrum of disasters and better inform disaster management policies and practice?
3. How can current practices enable a more comprehensive and equitable entry point for local disaster response and recovery, and thus improve the adaptation capacity of affected communities?

1.2 Thesis structure

This thesis is written in accordance with the University of Waikato's guidelines for 'PhD with Publication'. It includes both published and unpublished research articles that are interlinked and related to the PhD research project. As a result, the chapters are formatted according to the requirements of the outlets they were published or submitted to. These formats may lead to some overlap between the literature cited and the case study descriptions in the chapters 4-6.

The thesis consists of seven chapters in total. The first chapter is the introduction to the thesis (chapter one), the second chapter consists of the literature review (chapter two) and the third chapter discusses about the methodologies used in the research (chapter three). The fourth to sixth chapters contain the published and submitted articles. The final chapter (chapter seven) concludes the thesis with the overall response to research questions guiding the research. To this end:

Chapter two presents the review of the literature.

Chapter three presents an overview of the research methods used in this thesis. However, each publication (chapters four to six) has its own methodology section.

Chapter four refers to the first question of the thesis. It addresses the extent to which the Aotearoa New Zealand's emergency policy framework addresses small-scale recurring disasters.

Chapter five relates to the second question of the thesis. It explores the gaps in the current disaster classification that underrate small-scale recurring disasters, and proposes a mechanism to better capture the impacts of small-scale recurring disasters; thereby also informing disaster management policies and practice more broadly.

Chapter six relates to the third question of the thesis. It examines the current Aotearoa – New Zealand's emergency management practices related to small-scale disasters, and identifies points for improvement.

Chapter seven integrates all the findings of the research and presents the concluding remarks related to each research question.

2 Literature Review

This thesis adopts a two-step narrative literature review methodology (Pautasso, 2019). The first step involves a review of wider literature on disaster risk governance and small-scale disasters. The second step is related to the literature review of specific research questions that are presented in Chapters four to six.

2.1 The consideration of small-scale recurring disasters in disaster risk governance and processes

Disaster risk governance has received attention due to its ability to enhance effectiveness of disaster risk reduction and resilience efforts through participatory decision-making (Hemachandra et al., 2018). According to Tierney (2012, p. 344), disaster governance is ‘the interrelated sets of norms, organizational and institutional actors, and practices . . . designed to reduce the impacts and losses associated with disasters’. Disaster governance is characterised by social inclusion, which involves a broader range of local citizens in disaster response and recovery decisions, and places a high emphasis on collaboration (Finucane et al., 2020). This involves an array of horizontal and vertical linkages spanning local, state, national, regional, and international jurisdictions (Enia, 2020).

Risk governance has become increasingly important as disasters have become more common. Various international frameworks have developed strategies aimed at reducing disaster risks. The Hyogo Framework for Action (HFA 2005-2015) was one of the first international frameworks for disaster risk reduction with the aim of building national and community resilience. The Hyogo Framework for Action laid the foundation for greater recognition of the role of governance in disaster risk reduction (Djalante & Lassa, 2019). As part of its recommendations, it emphasised the key role that local governments play in risk governance and the importance of improving national and local coordination. The Hyogo Framework for Action largely focused on enhancing infrastructure and services, enhancing people's ability to prepare and respond during emergencies, and strengthening land-use planning and other technical measures (UNISDR, 2015a). It also advocated a shift from top-down to bottom-up disaster risk management, from command-and-control to process-oriented leadership, and from reactive to proactive disaster management (Alam & Ray-Bennett, 2021; Ray-Bennett et al., 2015). While the Hyogo Framework for Action

identified addressing the drivers of risk as a priority, there are several flaws with this prioritization, including the lack of operational details (UNISDR, 2007).

Subsequently, the Hyogo Framework for Action was replaced by the Sendai Framework for Disaster Risk Reduction (SFDRR), which placed greater emphasis on disaster risk governance, as its second priority. This integrates governance issues throughout the disaster cycle, from disaster preparedness to recovery (Pearson & Pelling, 2015; UNISDR, 2015a). The Sendai Framework for Disaster Risk Reduction explicitly considers its application to small and large-scale, frequent and infrequent, sudden and slow-onset disasters. Nevertheless, Shrestha (2016) has shown that both frameworks (the Hyogo Framework for Action and the Sendai Framework for Disaster Risk Reduction) continued to practice disaster risk reduction primarily through the protection against tangible external threats. This limits the extent to which small-scale recurrent disasters are considered, because their risks are not as exposed to external threats as large-scale disasters. Additionally, Zaidi (2018) argues that small-scale disasters are underemphasised in the Sendai Framework for Disaster Risk Reduction, due to the absence of systematic reporting indicators for damages and losses associated with these disasters, and in failing to introduce a mechanism to capture the disaster impacts of small-scale disasters. Also, Gaillard et al. (2019) have shown that international governance policies focus primarily on preventing large disasters, while small and frequent hazards belong to neither category and have received little attention.

Another framework of interest is the framework for risk governance put forward by the International Risk Governance Council in 2017 (IRGC). This framework enables risk governance structures and processes to be understood, analysed, and managed by focusing on important risk issues. The principles of the good governance are recognised in the framework. These include transparency, effectiveness and efficiency, accountability, strategic focus, sustainability, equity and fairness, respect for the rule of law, and the need for the chosen solution to be politically and legally feasible as well as ethically and publicly acceptable. Moreover, a key consideration of the International Risk Governance Council framework is the multi-stakeholder participation. The framework was considered to be an important step forward in disaster risk governance because it integrates the notion of cascading risk into resilience-driven strategies (UNISDR, 2017). However, the framework does not provide guidance on the operationalization of cumulative impacts on-the-ground.

Cumulative impacts of small-scale disasters, when aggregated over time, may have similar cumulative social and economic impacts as larger-scale disasters (Marulanda et al., 2010; Moftakhari et al., 2017). In particular, climate change is altering the frequency and severity of weather events such as flooding, storm surge, and drought, exacerbating cumulative impacts (Moftakhari et al., 2017). Nevertheless, as little is known about the cumulative impacts of recurring disasters such as their magnitude, duration, and losses due to the limitation of data (Rentschler, 2013), there is urgent need for disaster risk governance mechanisms to seek solutions.

While disaster risk governance aims to manage and reduce risk by ensuring that capacity and resources are available for preventing, preparing for, responding to, and recovering from disasters, a better understanding of disaster types, from small to large-scale, is important in the development of policy solutions due to climate change projections. This includes policies that consider the cumulative effects of frequent, small disasters, just as they do for other disaster types, locations, and communities.

A number of contemporary studies related to small-scale disasters have shown the importance of improving the disaster risk governance related to them. For example, in their research on recurrent disasters affecting Puerto Rico 2017–2020, Maclis et al. (2022) identified that the complex characteristics of legacy conditions created by one disaster could influence the effects of subsequent disasters. They suggest that the response and recovery actions should include immediate and detailed monitoring of key conditions and the development of legacy scenarios for subsequent disasters. Furthermore, these conditions should be considered in the damage and needs assessment as the legacy conditions have differential impacts on vulnerable communities. Thus, the issues of environmental justice can also be better addressed by sensitive disaster recovery policies.

Fraser et al. (2020) identified the importance of local institutions in mediating the impacts of higher-level economic and political changes on local risks. Their analysis supports a stronger causal epistemology of resilience to disasters but also leads to the re-consideration of the institutional entry points for risk reduction, and the importance of considering context and trade-offs. This includes carrying out causal investigations and interrogating institutional processes that drive the influence of distant conditions on local risks related to small-scale disasters. Additionally,

Liu et al. (2015) explain that small-scale risk assessment requires the principles of regional characteristics, accumulation of cases, and long-term records which could inform the design and implementation of regional temporary migration programs.

Figure 2.1 below confirms the lack of policy space for small-scale disasters, which has been overlooked by policy, along with people's responses to these disasters.

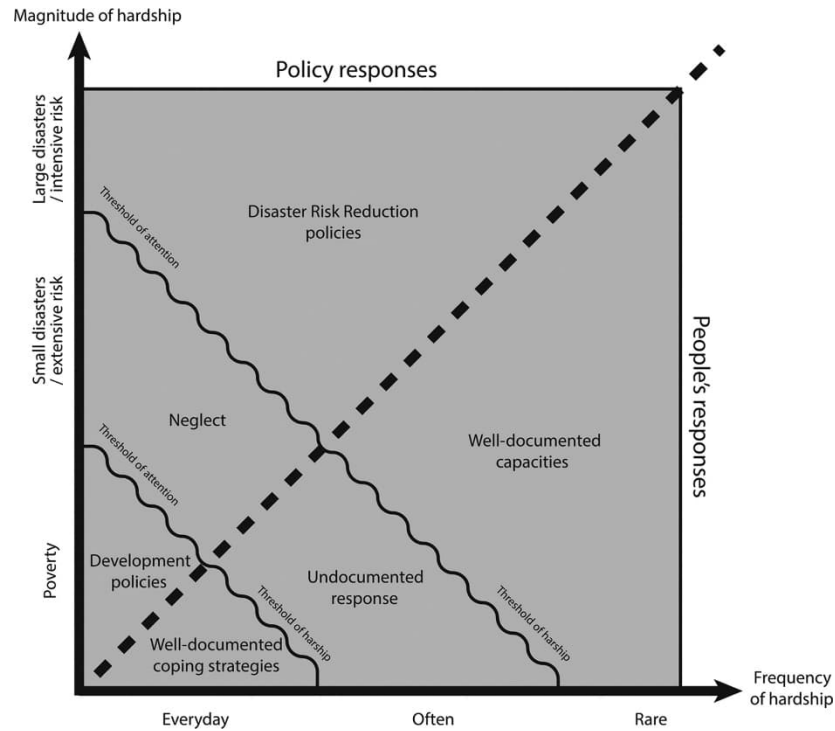


Figure 2. 1 Policy attention towards small-scale disasters

Adapted from “Wildlife hazards and disaster risk reduction” by Gaillard et al.,2019, International Journal for Disaster Risk Reduction 33, p.56 (DOI <https://doi.org/10.1016/j.ijdrr.2018.09.009>). Copyright Status (date Mar 05,2023 licence number 5502850423405)

In a more widely scaled governance system, local governance is the focal point for small-scale disasters (Fraser et al., 2020). However, Gaillard et al. (2019) show that even at present, the technocratic institutional frameworks consider disasters as battlefields that need to be tackled with the military strategies associated with top-down command chains, offering little space for small-scale disasters. Thus, national disaster risk governance frameworks are largely influenced by the international ones, indicating that the lack of certain important elements in the international

frameworks may have trickle-down effects on local frameworks. In this context, it becomes necessary to examine whether adequate provisions have been made for the management of small-scale disasters in disaster risk governance mechanisms at national and local levels.

This thesis emphasises the importance of examining how the top-level national frameworks address the management of small-scale recurrent disasters in a broader perspective. To this end, this research seeks to examine how current emergency management response and recovery mechanisms are tailored to address the specific issues related to small-scale recurrent disasters, and therefore enable the provision of adequate support to affected communities.

2.2 The incorporation of small-scale recurrent disasters in the disaster management cycle

The disaster management cycle comprises two key phases: the pre-disaster (the reduction or readiness phase) and the post-disaster phase (response and recovery) (see Figure 1) (Carter, 2008).

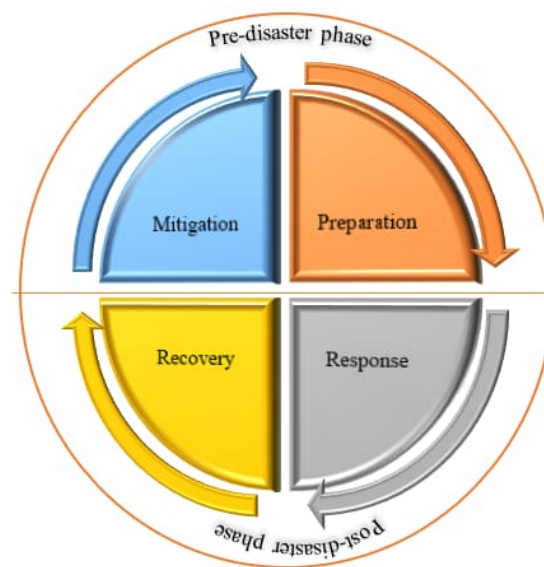


Figure 2. 2 Disaster Management Cycle

(Adapted from Alexander, 2002, p. 6)

There are different names for the phases of the disaster cycle used by different countries and organizations, such as the four R's (reduction, readiness, response and recovery) in Aotearoa New Zealand and PPRR (prevention, preparedness, response and recovery) in Australia (MCDEM, 2019) (Rogers, 2011). In this research, the emphasis is given on the post-disaster phase (response

and recovery phases) that comprise the interventions taken immediately following a disaster that overlap with one another (Lindell, 2013).

The response phase aims to save lives and protect property, such as search, rescue and emergency relief efforts (Carter, 2008), and implement measures to assist disaster-affected communities to return to the pre-disaster stage (Powers & Daily, 2010). Therefore, it is important to allocate necessary resources in a timely manner during the response phase, as failing to do so can exacerbate a disaster situation. Also, to help avoid serious consequences, it is necessary to schedule and sequence time-critical activities, and to assign appropriate personnel in a timely manner during response planning (Rolland et al., 2010).

The disaster recovery phase, on the other hand, is crucial as it shapes the direction of both the long-term and short-term recovery strategies (Finucane et al., 2020). The urgency and ambiguity in the aftermath of disasters often lead to short-term decision-making that does not address, or may even intensify, pre-disaster social, economic and environmental issues; thereby challenging the long-term sustainability of affected communities (Song et al., 2017). Typically, the recovery phase entails restoring things to pre-disaster conditions (Powers & Daily, 2010). Under these circumstances, local communities remain in a grey area between the relief and development offered by policies and strategic decisions (Christoplos et al., 2001). More recent discussions however, call for the post-disaster recovery process to be used as an opportunity for improving pre-disaster conditions, as opposed to simply returning to them; this is also sometimes called the benefit syndrome (Berke et al., 1993; Carter, 2008).

As mentioned in the previous section (2.1), international disaster governance frameworks have a trickle-down effect on national policy, that then feeds into local disaster governance frameworks. In doing so, the intention is to create coherence among disaster policies across countries and offer guidance for developing a comprehensive framework across the disaster management cycle. However, post-disaster recovery policies and their practice are largely based on large-scale disasters, with less focus on small-scale recurring disasters (Shrestha, 2016). This is mainly due to the reason that large-scale intensive disasters result in higher rates of mortality and economic losses; whereas small-scale recurring ones often result in less visible cumulative losses of economic assets and livelihoods (Browne, 2013). Additionally, the recovery from small-scale disasters seems to be extremely challenging and even unachievable, especially for those who lack

sufficient resources. The communities affected by recurrent disasters might end up as exposed or even more exposed to hazards than before (Shrestha & Gaillard, 2013). Thus, there is a greater need for a better understanding of how communities are impacted by and recover from these small-scale disasters, to inform appropriate disaster recovery planning and policies (Shrestha & Gaillard, 2013).

Under this recovery paradigm, there is a focus on improving the resilience of the community at risk so that it can better deal with the next disaster, or build damaged structures and communities back better (Birnbaum et al., 2015). This also creates opportunities to strengthen the local organizational capacity to facilitate economic, social, and physical developments long after the post-disaster phase (Berke et al., 1993). Thus, scholars (Monteil et al., 2020) argue that this period plays a critical role in reducing people's vulnerability and building community resilience. Although the post-disaster recovery phase is important in many ways, it remains the least investigated and most poorly understood phase out of the four phases of the disaster management cycle (Berke et al., 1993; Smith & Wenger, 2007).

The issues around recovery on how and what strategies should be adopted for efficient recovery processes should be considered before a disaster actually occurs (Johnston et al., 2011). Characteristics of each disaster and the affected community may differ from one to another. For that reason, the engagement of affected communities to customize the procedures and strategies to ensure the efficiency and the effectiveness of their recovery is important. Thus, the specific needs of the affected community need to be addressed, be locally coordinated, and be sensitive to their cultural and social characteristics (Powers & Daily, 2010). Therefore, the community must be consulted when developing pre-emptive measures, to determine their level of support for emergency response and recovery regardless of the scale of a disaster.

A broader classification of disaster recovery found in the literature elaborates that this is a process linked with social recovery, and includes many solutions for the issues that stem from the disaster. A holistic post-disaster recovery involves elements of infrastructure, ecosystems, organizations and institutions, economic activities and cultural needs (Tierney & Oliver-Smith, 2012). The diversified characteristics of a community, such as demographics and experience, have a huge influence on how communities face recovery issues, how they use resources to meet their needs, and their ability to use their experience to develop future resilience (Paton, 2006).

Small-scale recurrent disasters sometimes follow an annual cycle, so communities that experience a disaster may experience a further disaster while recovering from the earlier one (Shrestha & Gaillard, 2013). This situation is different to the case of intensive disasters; thereby, an understanding of the recovering processes from small-scale disasters is necessary. There are also distinctive differences between small-scale disaster recovery and intensive disaster recovery, in terms of external support that is much less significant in the case of small-scale disaster recovery, in comparison to intensive disaster recovery. In addition, the support available is also usually focused on the short-term recovery rather than the long-term recovery, which makes the recovery highly reliant on the community's own resources (Shrestha, 2016). Shrestha (2016) suggests that both the disasters and the recovery process in these communities are not a unique isolated event, but they are both deeply embedded in the social system in which they take place.

Typically, disaster cycles are presented as closed loops that move repeatedly from one disaster phase to another, reflecting how disasters can become recurrent 'events' (Bosher et al., 2021). This cycle is a simplistic representation of how disasters are managed, and how they can be avoided, but it does not account for socioeconomic and political factors (Bosher et al., 2021) that are important drivers of small-scale recurring disasters. Thus, small-scale disasters cause communities to fall into a cycle of disaster occurrences and recovery, as disasters strike one after another, sometimes during recovery from the previous disaster. In this background, pre-disaster conditions are not accepted as normal social functioning (Shrestha & Gaillard, 2013). Therefore, if recovery only aims to restore pre-disaster conditions, the population affected by the disaster remains at least as vulnerable as before (Shrestha, 2016). As highlighted by the International Federation of Red Cross (IFRC, 2001), recovery remains a common problem, especially for marginalised communities who lack the resources to rebuild or adapt their houses. The International Federation of Red Cross refers to this process as 'reconstructing the risk', which make them exposed to the future hazards (IFRC, 2001). According to Wisner (2004), such failed recovery can be explained by the ratchet effect. In a disaster, the ratchet effect is understood to occur as part of the process of marginalisation, which links the increasing vulnerability of disaster-affected people with decreasing access to resources. A lack of access to the resources needed for disaster recovery leads to further marginalization and deprivation. Furthermore, there is less or no external intervention for disaster recovery for smaller-scale recurring disasters where the recovery is driven by the

affected communities themselves. Despite their implications for long-term recovery, community-led initiatives are less recognised when it comes to their resilience after small-scale disasters.

2.3 Disaster risk

Disaster risk is an important concept in the discussion of disasters pertaining to natural hazards and has undergone a number of transformations over the last decades (UNISDR, 2017). The current notion of disaster risk is considered as ‘the potential loss of life, injury or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure vulnerability and capacity’ (UNGA, 2016, p.14). In order to understand disaster risks appropriately, it is crucial to consider the social and economic contexts within which they occur, as well as the fact that people perceive risk differently and have different underlying risk factors (UNISDR, 2017). There are a number of sub terms related to risk including extensive disaster risk and intensive disaster risk. According to UNGA (2016) the two concepts are defined as follows:

Extensive Disaster Risk: “the risk associated with low-severity, high-frequency events, mainly but not exclusively associated with highly localized hazards” (UNGA, 2016, p.18).

Intensive Disaster Risk: “the risk associated with high-severity, mid to low-frequency events, mainly associated with major hazards” (UNGA, 2016, p.20).

2.4 Problems with current concepts and definitions

Defining a disaster can be challenging because of the different factors that must be considered, including social, economic, cultural, mathematical, and descriptive concepts. The purpose and content of definitions may vary, and there is no one legitimate purpose or content for defining anything (Perry, 2007). While it may be difficult to have a universally agreed-upon definition of disaster, harm to people and communities is a common element of almost every definition (Etkin, 2016).

In the past, disasters were seen as synonymous with both hazards and larger-scale disasters that were considered as ‘acts of God’ (Wisner & Gaillard, 2009). There has been a shift in the concept more recently, indicating that although hazards can be natural, disasters should not be considered to be unavoidable consequences of hazards. The United Nations Office for Disaster Risk Reduction (UNISDR) defines disasters as a serious disruption of the functioning of a community or society, involving widespread human, material, economic and/or environmental losses, which

exceeds the ability of the affected community or society to cope with the impacts using its own resources (UNISDR, 2009b). By contrast, UNISDR defines a hazard as ‘a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage’ (UNISDR, 2009b, p. 17). The majority of popular representations of disasters depict dramatic moments of chaos such as panicked communities fleeing for safety as earthquakes destroy cities or lava destroys villages, etc. Yet, it is necessary to note that there are numerous temporal scales at which disasters occur (Williamson & Courtney, 2018) that incur different results.

Hazards may have different origins, including natural sources (such as geological, hydro meteorological and biological) or anthropogenic (such as environmental degradation and technological faults) (UNISDR, 2015). Both natural and anthropogenic hazards impact on the economies and societies of countries, irrespective of their level of development, but the magnitude of the damages often depend on the level of exposure and local capacities (Cannon, 1994). In particular, Cannon (1994) argues that technical interventions introduced to mitigate the hazards, or to prepare people to face them, should not be decided in isolation. They should be implemented with a good understanding of their impacts and should not contribute to exacerbate the vulnerability of the social and economic systems.

Most of the literature and practice acknowledge disasters as events that affect a large portion of a human community and are too severe for the community to recover from and absorb within a short period of time (Bates & Peacock, 1987). Bates and Peacock (1987) further state that calamities which affect only a small number of individuals or a single neighbourhood within a large community are referred to as neighbourhood calamities, and not as disasters. In support of this argument, it is stated that despite causing significant damage to those affected, small-scale disasters do not disrupt a social system comprised of numerous institutions, and established systems can typically handle small disasters without routinely causing major disruptions (Cannon, 1994).

It is noteworthy, however, that the frequency of occurrence of large disasters is significantly lower than that of all events in any region. For example, in the Asia-Pacific region during the 2000s, there were more than 28 episodes per country on average, but the frequency of large events was

only 0.5 episodes (Cavallo & Noy, 2009). While small-scale disasters have been acknowledged in disaster literature since the 1980s (Shrestha & Gaillard, 2013), from social, environmental, and geographical perspectives, many professional publications and forums continue to refer to natural hazards as caused by ‘extreme’ occurrences, which are often mistaken as the catastrophe itself (Lavell & Maskrey, 2014).

2.5 The scale of smaller disasters

Small-scale disasters are identified by various terms such as everyday disasters, silent disasters, neglected disasters, invisible disasters (Shrestha, 2016), quotidian and chronic disasters (Zaidi, 2018). Thus, various studies and organizations have attempted to explain their scale. For example, EM-DAT (Emergency Events Database) and DesInventar, two of the most popular international disaster databases that are widely used in academia (Osuteye et al., 2017), use different thresholds to consider an event as a disaster. DesInventar database captures the smaller-scale events exhibiting greater opportunities for research on small-scale disasters, however, it does not offer a clear definition for small-scale disasters (Shrestha, 2016). The UNISDR threshold for a small-scale disaster is 30 people dead and (or) 600 houses destroyed (Serje, 2010), but this may only be a characteristic of developing countries and not be applicable to better resourced communities and nations. Fischer (2003) developed a disaster scale based on a combination of factors such as scale, scope and time, which comprises ten disaster categories. Thus, there are different definitions adopted in the literature and practice around small-scale disasters, such as ‘a type of disaster only affecting local communities which require assistance beyond the affected community’ (UNGA, 2016). Voss and Wagner (2010) describe any event that is damaging to people and their livelihoods to such an extent that disrupts everyday life within the affected community, but with which the community and local stakeholders can cope, possibly with assistance from organizations with a local, state, or regional presence. Brennan and Danielak (2021) operationalise this definition by considering small disasters to be those that killed fewer than ten people and affected fewer than 100 people.

The aim of the scale is to find out the degree, or extent to which, everyday social activity is disrupted, resulting in temporary or permanent changes in the social structure within a community (Fischer, 2003). The Global Network of Civil Society Organizations for Disaster Reduction (GNDR) groups all minor disasters into the small-scale disaster category, regardless of how they impact on people’s everyday lives (The Global Network of Civil Society Organisations for

Disaster Reduction, 2013). Another way of classifying small-scale disasters' risk level is by their exceedance probability or return period (Shi, 2019). The Sendai Framework for Disaster Risk Reduction illustrates that a small-scale disaster is a type of disaster which affects only local communities, who require assistance to deal with impacts, so it only considers the spatial scale of the impact and not their extent (UNISDR, 2015a). Shrestha and Gaillard (2013, p. 46) refer to small-scale disasters as events that cause damage, destruction and suffering at a scale larger than daily hardships (such as poor health, food insecurity, and poverty) but smaller than major disasters.

2.5.1 The issues with recurring disasters

The term 'recurring disasters' is also not an unfamiliar concept. In this context, the term is used to mean repetition. These events are recorded as far as the recorded history is concerned, and over periods of time, human civilizations adapted to these hazards (Ferris et al., 2013). These repeated hazards have become more important than ever before, due to the concentration of population and economic resources in places where disaster risk would be present (Cardona et al., 2012). The Center for Research on the Epidemiology of Disasters (CRED) has reported that there is undoubtedly an increase in natural hazards as a result of global climate change (Wallemacq et al., 2015), suggesting the seriousness of the issue. Factors such as environmental degradation and human intervention in natural ecosystems have been identified as some of the factors that contribute to the reoccurrence of natural hazard events (Cardona et al., 2012). If not remedied or mitigated, increased disruption will impact economies, draining resources for rehabilitation and reconstruction rather than development and social welfare, thus limiting opportunities to improve social outcomes. Therefore, it is important to implement proactive policy measures to reduce these risks. The implementation of sound disaster laws and policies can play an important role in mitigating the negative effects of recurring disasters, and can contribute to the development of more resilient societies (Ferris et al., 2013).

When disasters recur frequently, they destroy material goods and result in inequality and impact on social capital (Ferris et al., 2013). There are a large number of people who are affected by disasters, and these events are not isolated incidents. Experiencing these events are frequent life experiences. The awareness of these events lies just below consciousness and can be triggered at any time by a slight provocation (Bankoff, 2003, p. 179).

Recurring disasters cannot be neglected, as they disclose the underlying local development and planning issues that form the root causes of vulnerability to more extreme events. Recurring disasters tend to remind of the consequences of neglect, and they provide more long-lasting lessons for various disaster phases than the infrequent disasters (Schwab, 2014). The International Federation of Red Cross (IFRC, 2001) discusses ‘what can be done to break the cycle of recurring disasters?’. Their report suggests that, as far as the devastating impacts of disasters are concerned, they will continue to increase unless root causes and symptoms are addressed – relegating the idea of recovery to the slag-heap of pious hopes until root causes as well as symptoms are addressed (IFRC, 2001).

Due to the increasing frequency and severity of weather events caused by climate change, timely and accurate data becomes even more vital. Data collected over time and space are commonly used by analysts to track disaster trends and causal factors. At the subnational level, disaster databases support the development of localised action plans and the investigation of regional trends. They can also be used to monitor progress in reducing the impact of disasters on the economy and population health (Cuthbertson et al., 2021). These data help to shift from a reactive to a proactive approach in disaster risk management, and play an important role in risk management, as well as conventional disaster management (preparation, response, recovery) practices (UN ESCAP, 2021). With the increased frequency of climate-related weather events, the characterization of the full spectrum of disasters – from small to catastrophic – and their associated losses is vital to supporting those at risk (Brennan & Danielak, 2021). Quantitative data on small-scale disasters spanning several decades and geographies are not available for such analysis, as the international databases have designated cut-off limits (explained in 2.7), eliminating data from being recorded at national level, and the national levels do not have granulated data (Brennan & Danielak, 2021). This creates a critical gap in small-scale disaster data, and need to be addressed.

2.5.2 Other definitions in literature

Over time, the understanding of recurring disasters has improved, and different terms are now being used to define them, including consecutive, extensive, recurring and cascading (see Table 2.1). Terms commonly illustrate the continuing nature of disasters, and identify how other factors such as the scale, frequency and types differentiate them from one another. A generally accepted definition for recurring disasters, however, is absent (Ferris et al., 2013).

Table 2. 1 Key disaster terms and definitions

Terminology	Definition
Consecutive disasters	Two or more disasters that occur in succession, whose direct impacts overlap spatially before recovery from a previous event is considered to be completed (De Ruiter et al., 2020)
Extensive disasters	Recurring, localised, low intensity but cumulative, relatively small-scale disasters such as floods, landslides and droughts (Desai et al., 2015)
Recurring disaster	Recurrence of a single natural hazard in the same geographic region within a one-year period (Ferris et al., 2013)
Cascading disasters	Cascading effects are the dynamics present in disasters, in which the impact of a physical event or the development of an initial technological or human failure generates a sequence of events in human subsystems that result in physical, social or economic disruption (Pescaroli & Alexander, 2015)

De Ruiter et al. (2020) state that consecutive disasters can include a broad range of multi hazard types such as compound events and cascading events. The authors highlight that the impacts from these disasters are clearly different from disasters that occur in isolation. Consecutive occurrences of natural hazards are prevalent in many parts of the world. For example, the Osaka earthquake occurred in the summer of 2008, followed by a torrential rain that resulted in floods (De Ruiter et al., 2020).

Another term used in the literature is ‘extensive disasters’, which is associated with extensive risks resulting from smaller-scale disasters. The term extensive risks represent the risks lower than the previously defined thresholds. In UNISDR’s view extensive risk is the accumulation of the eroding effect of many small disasters that affect the vulnerability to the disasters of the affected communities’ who are less capable to cope with them (UNISDR, 2009a). However, this concept is not widely used because: (i) it does not reflect what the small-scale disasters actually bring about, and (ii) they exclude many small disasters that fall below the defined threshold which have displayed severe impacts on people and communities (Shrestha, 2016). The available literature on extensive disasters describes that they result in the loss of economic assets and livelihoods, whereas large scale intensive disasters result in higher rates of mortality and economic loss (Browne, 2013). While the parameters to assess the impacts of extensive risks seem to be absent, Global Assessment Report (2013) indicates that extensive risk mostly affects the agricultural sector, while the damages to educational facilities also rises, and the continuity of education is adversely affected by repeated flood events (Cadag et al., 2017). Global Assessment Report (2013)

reports that 90 percent of damages to roads, power and water supplies are also caused by extensive risks, which have an indirect impact on businesses, especially small ones. Brennan and Danielak (2021) in their study of ‘cumulative impacts and policy implications’ show that the small-scale disasters result in long-term environmental degradation issues. In addition, the researchers have shown that the vulnerability to these events increases with the degree of socioeconomic status of affected communities, and that urban hazards have a higher impact than those that affect similar rural communities. The 2015 Global Assessment Report on Disaster Risk Reduction states that in low and middle income countries, especially developing countries, the extensive risk is accountable for the majority of damages caused to development assets (Desai et al., 2015). The opposite of this situation is the ‘intensive risk’, which is used to describe the risk associated with high-severity, mid to low-frequency events, mainly associated with major hazards (Desai et al., 2015).

Ferris et al. (2013) highlight that hazards that continue over a number of years, such as droughts, are considered as a single disaster, while droughts that occur regularly with shorter or longer breaks in between are called recurring disasters (Ferris et al., 2013). But according to Ferris et al. (2013) the use of the term recurring disasters is confined to only one type of disaster.

Cascading disasters describe a different type of a natural hazard that triggers another and/or where a natural hazard leads to another type of disaster (Ferris et al., 2013, p. 5). An exemplar of this is the 2011 Great East Japan earthquake, which caused a tsunami, damaging a nuclear power plant, that then resulted in enormous damage to human life and aftershocks, leading to the breakdown of a dam (Ferris et al., 2013). Even though ‘cascading disasters’ describes the recurring nature of disasters, its use is limited to secondary disasters that occur as a result of the first one.

Natural hazards such as floods, earthquakes, cyclones and storms may occur in different spatial and temporal ranges, ranging from days to months to years apart, depending on the recovery rate (De Ruiter et al., 2020). The origins of small-scale disasters may have similar features to that of intensive disasters, but are considerably different in many ways, such as the recovery period (Shrestha, 2016). Tarvainen et al. (2006) support the notion that the challenges faced by a community when affected by a subsequent disaster, while in the recovery stage of the former one, are considerably different than the impacts of two static events. Eventually, recovering from and adapting to repeated hazards affect a region’s vulnerability to future hazards (Reilly et al., 2017).

Nevertheless, a universal disaster risk reduction and disaster risk management framework used to address recurring disasters from a modelling and institutional perspective seems to be missing (De Ruiter et al., 2020).

The definition of a disaster determines the type of response and the type of policy decisions made, as well as the type of research required (Etkin, 2016). However, to date, as demonstrated above, disaster definition for small-scale recurrent disasters lack consensus. This has contributed to their under-recognition in both theory and practice. Therefore, this research adopts the following working definition for small-scale recurrent disasters: “A series of disasters that impact a low number of people, have a risk level below the major and extreme threshold limits, or do not pose a threat to life. These disasters could occur at least two to three times during the past decade, or at a greater frequency. Such disasters may often have relatively minor social, environmental, economic and cultural impacts, but long-term cumulative impacts.”

2.6 Summary

The goal of this chapter was to provide an overview of the existing literature, a background on the key research gaps, and of the key concepts emerging from the subject area. The international frameworks for disaster risk reduction and disaster risk governance that provide the context to develop national and local frameworks have not been able to incorporate small-scale recurring disasters sufficiently. This is considered to have a flow-on effect to the national and local frameworks. In addition, the disaster management cycle that is a simple representation of the cyclic process of the four phases of a disaster fails to take important concepts (such as socioeconomic and political factors) into account that play an important role in determining the root causes of small-scale recurring disasters. These factors lead to a need to assess the performance of the national disaster governance frameworks on their inclusion of management of frequent, small-scale disasters.

Furthermore, there is a challenge in defining what a small-scale disaster is. This has created enormous ambiguity around the terminology, limiting the decisions that can be taken in their favour. There is also uncertainty about the scale component of small disasters, and thus consensus on the threshold of small-scale disasters is absent. While there are different schools of thought explaining this, the scale is concluded depending on the context where it is considered. The recurring nature of these disasters trap the affected communities into a cycle of impacts called a

‘ratchet effect’, meaning that communities cannot fully recover from a disaster, making them even more vulnerable to new hazards (Gaillard et al., 2019; Shrestha & Gaillard, 2013).

The absence of operationalizing the management of cumulative impacts in disaster risk governance mechanisms is another gap related to the small-scale recurring disasters. While the international disaster reduction and risk governance frameworks both acknowledge the cumulative effects, they limit it only to an explicit explanation. Consequently, these disasters result in a reactive approach to risk governance, rather than a proactive disaster risk governance approach. The need for a paradigm shift from proactive approach to a reactive approach need disaster impact data and information of small-scale disasters for evidence-based decision making. Therefore, consistent data for longer spans of time need to be collected and recorded, that recognize the characteristics of non-catastrophic disasters.

3 Methods

3.1 Introduction

The purpose of this chapter is to provide a brief overview of the methods used in this thesis. More detailed descriptions of methods used to carry out this research are provided in chapters four, five and six (each comprising a separate publication). Following a case study approach (Yin, 2017) focused on the Aotearoa New Zealand context, this research was carried out in two phases to examine how disaster risk governance and corresponding emergency management policies and practice account for small-scale recurring disasters (see Figure 3.1). The first phase comprised a narrative literature review. Narrative reviews summarize the relevant literature in a qualitative manner by examining what major accomplishments have been made in past research, and identifying key discussions and the most pressing research gaps (Pautasso, 2019). The narrative literature review informed the development of the research questions guiding this thesis, along with the identification of key research challenges. The narrative literature review was carried out in two steps. First, a review of broader literature on community recovery from disasters associated with natural hazards and international disaster risk reduction and governance frameworks was conducted, in order to understand the literature on the topic. In step 2, it was narrowed down to the literature related to the specific research questions, which guided the preparation of the publications presented in chapters four, five and six.

The second phase used a multi-methods approach, predominantly of qualitative nature (Huy, 2012), and involved the collection and analysis of primary and secondary data. The overarching objective of this thesis was to examine the extent to which the emergency management regime of Aotearoa New Zealand accounts for small-scale recurring disasters and ways to improve their governance to ensure better outcomes for affected communities. To this end, the thesis sought to answer three research questions by employing different data collection and analysis methods (see Figure 3.1). First, a policy document analysis was conducted to examine the extent to which the Aotearoa New Zealand's emergency management framework addressed small-scale recurring disasters. This helped to understand any gaps in the existing policies and corresponding emergency management framework that required attention for improved understanding and addressing of small-scale recurring disasters.

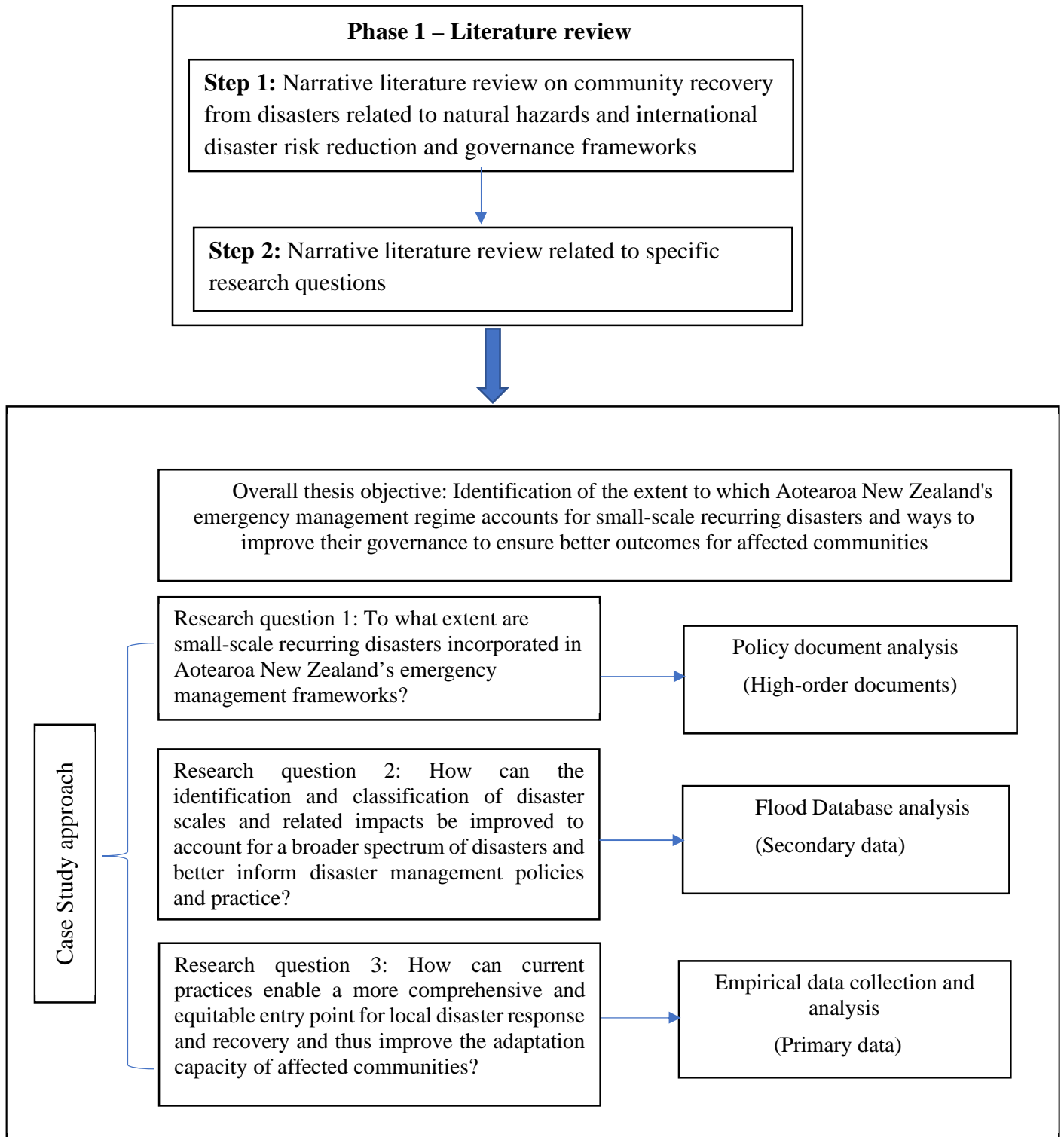


Figure 3. 1 Phases and methods of the thesis

Second, a database analysis using secondary data on flood events (used as a proxy for small-scale disasters) affecting Aotearoa New Zealand in the last three decades was developed. The aim of this analysis was two-fold. First, it helped to determine if the categories used to collect and record disaster data captured flood events that could be considered small-scale recurring disasters. Second, the analysis illustrated that small-scale disasters are dispersed within a broader spectrum of disasters, therefore requiring ongoing monitoring and improved systematic recording to inform policies and practices specifically targeting such disasters.

Finally, the empirical data analysis drew on information collected through semi-structured interviews with emergency management specialists to explore on the ground strategies used to potentially manage small-scale recurring disasters. Importantly, the analysis revealed strategies deployed by emergency management specialists that were not explicitly stated in current emergency management policies. This suggests that some of the best practices adopted in managing recurring small-scale disasters can be potentially scaled up, developed and streamlined for better outcomes for affected communities.

3.2 Case Study Approach and Location

The purpose of a case study is to gain an in-depth, multidimensional understanding of a complex issue within a real-life context (Crowe et al., 2011). A case study helps understand and explain causal links and pathways resulting from a new policy initiative or service provision (Yin, 2009). A case study was appropriate to guide this research because of its suitability to address its primary research questions, and primarily focuses on contemporary phenomena (e.g., how current disaster risk governance systems address small-scale recurring disasters) rather than entirely historical phenomena (Yin, 2017). Following Yin (2003)'s recommendation, the research design identified: (1) which questions to study; (2) which data were relevant for answering the questions; (3) which data should be collected; (4) the relationship between the three previous steps; and, (5) the most appropriate form of data analysis.

Natural hazard risk is increasing in Aotearoa New Zealand due to the impacts of climate change, land intensification and continued development along rivers and coastlines (Ministry for the Environment, 2020). Flooding, coastal inundation and drought events are becoming more frequent, leaving regions with less time to recover from consecutive events (MfE, 2020). Additionally, increased occurrence of flooding has been identified as a main consequence of global climate

change that poses a large threat to the human societies (UNISDR, 2015a). In particular, evidence suggests that flooding is causing an alarming increase in the number of flood victims and economic damages around the world (Genovese, 2006; Kreibich et al., 2022). As a result, there is a great need for research pertaining to flood events to inform disaster risk governance. To this end, this study uses flood disaster data as a proxy to explore the impact of these disasters as a means to both inform emergency response and mitigate flood risks before they turn into disasters, especially regarding smaller flood events that might be overshadowed by larger scale events when occurring simultaneously.

Aotearoa New Zealand is located in the Pacific Ocean along an active geological plate boundary, and therefore is subjected to a variety of geological hazards and to extreme hydro meteorological events (Glavovic, 2010). Additionally, Aotearoa New Zealand is no different to many other countries around the world in experiencing increased frequency and intensity of events such as flooding, coastal inundation and drought. Scholars (Cole et al. 2005) suggest the most common natural hazards in Aotearoa New Zealand are related to storms and floods which are relatively small-scale and short in duration. While the mortality rate from disasters during the past five decades remains low, average annual flood losses amount to NZ\$ 180 million (Dantas & Seville, 2006). Small-scale recurring disasters are also common in Aotearoa New Zealand. For example, in 2007 and 2008, several Northland communities were severely flooded, and towns such as Kaeo experienced repeated flooding within a four month-period (Glavovic et al., 2010). According to the National Climate Change Risk Assessment for New Zealand 2020, approximately 675,500 people are living in areas identified as susceptible to flooding (Ministry for the Environment New Zealand, 2020). Rapid urban development and climate change will likely increase the risks that communities face, especially those who live in flood plains and along the coastline, and these repeated events should not be dealt on an ad-hoc basis in the aftermath of events (Glavovic et al., 2010).

The short- and long-term consequences caused by hazardous events in Aotearoa New Zealand need to be explored and the learning from those events optimised (Johnston et al., 2011). However, to date, only a limited number of reports and papers shedding light on disaster risk governance aspects specific to Aotearoa New Zealand events have been published, and those are primarily related to larger-scale disasters (Johnston et al., 2011), making Aotearoa New Zealand a suitable case study. The details that are available on small-scale disasters are scarce, and confined to the

technical reports of different institutions. Such details are published amongst the analysis of different technical aspects and not purely on small-scale disasters.

3.3 Policy document analysis

In this thesis, policy was considered as text (Ball, 2015) and a document analysis method was adopted. The document analysis procedure is a systematic method by which documents, both printed and electronic, are reviewed or evaluated (Bowen, 2009). Analysis of documents can illuminate insights relevant to particular research problems and reveal meaning, contribution, and understanding, which aligns with this paper's objective (Higgins & Goodall, 2021). The purpose of the document analysis, as with the use of other qualitative research methods, is to assist in the elicitation of meaning, understanding, and the development of empirical knowledge by analysing and interpreting data. Bowen (2009) suggests four uses for document analysis: i) documents can give insight into the background and context within which participants research; ii) documents can contain information that can prompt some additional questions to be asked; iii) documents provide supplementary research data; and, iv) documents provide a means of tracking change and development, and a document can be analysed in order to verify findings or verify evidence.

The research has adopted a policy analysis of high-order documents to examine how they influence or are interpreted on-the-ground. The analysis was used to examine the contents of emergency management documents (such as acts, guidelines, and strategies) at the national level, and of how their policies were accounting for small-scale recurring disasters on-the-ground. Besides the policy document analysis, semi-structured interviews were employed to also explore how policies were interpreted and implementation by important actors (e.g. emergency management specialists) as explained in section 3.5.

The evaluation of the contents of emergency management documents support to determine the extent to which the policies adequately addressed small-scale recurring disasters (see chapter four for more details). The analysis of policy documents is challenging, since it is difficult to determine whether or not the organization actually implemented the principles and strategies outlined in its documents, as policy documents often mention 'coordination' with other actors or 'capacity support' for local authorities (Wach & Ward, 2013). This research adopted a targeted policy analysis of thirteen of Aotearoa New Zealand's higher order documents related to emergency management. Each document was analysed to determine how well it described or addressed the small-scale

recurring disasters and their risks. The key words relevant to the research topic were selected based on ideas, themes and concepts found in literature (e.g., small, small-scale, risk, extensive risk, recurrence, repeat, consecutive, acute, localised and etc.). The documents were uploaded to NVivo qualitative data analysis software, and then searched for the key words using the text search and word frequency analysis. Following Figure 3.2 provides an overview of the textual analysis methodology summary.

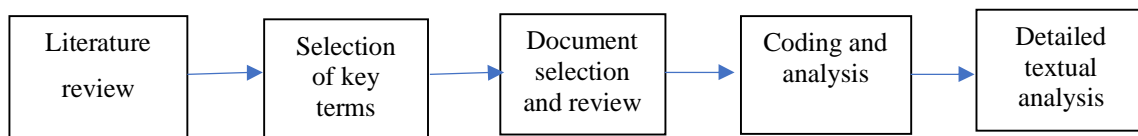


Figure 3. 2 Overview of the textual analysis of high order documents

Although policy document analysis focuses predominantly on the text, it is equally important to consider how policies are developed and implemented. As a result, this review laid the foundation for the third research question of the research, to examine the policy implications in practice.

3.4 Flood Database analysis

Disaster impact databases are indispensable for research, policy development, and decision-making (Cuthbertson et al., 2021). However, disaster databases are highly susceptible to the availability of consistent data (Jones et al., 2022). In this research, the absence of a comprehensive disaster database was mitigated by collecting and compiling secondary data to support disaster impacts analysis, especially to identify how smaller scale, recurring disasters are being captured by such databases. The analysis helped to understand the range of distribution of the scale of disasters, their frequency and impacts over a certain period of time. The database analysis also helped to visualise and analyse the impacts of disasters over affected communities and the relationship between the data categories including: (i) economic damage and number of evacuees; (ii) number of evacuees versus insurance claims; and, (iii) rainfall intensity, rate of evacuation and economic damages per event.

The aims of the database analysis were twofold. It examined whether the conventional categories that were used to record and report disasters were capable of capturing the data of small-scale

recurring disasters, and of distinguishing the characteristics of the impacts related to small-scale disasters.

The study used secondary data available in the online public domain to compile flood event data for a three-decade period (1990-2021) (see chapter five for more details). The term secondary data refers to data that were previously collected by someone other than the researcher for purposes other than those for which the data were collected. In secondary data analysis, data are further analysed or repurposed for purposes other than the one for which they were originally collected (Graves, 2021).

The quantitative data were systematically collected and recorded in Microsoft Excel (see appendix E for details). The details of the events were categorised under sub-categories such as year, month and date, name of the event, scale of the event, amount of rainfall and duration, affected areas, spatial area, population per location, evacuation details, types of flooding, types of damages, recorded economic damage and other available details. The collected data were analysed through a simple statistical (calculating averages, percentages, totals and co-relations) graphical analysis method.

3.5 Empirical data collection and analysis

Researchers can use semi-structured interview questions to ask predetermined questions from an interviewee in a systematic and consistent order, as well as to expand and explore issues beyond those originally posed (Lune & Berg, 2017). In this study, purposely selected interviewees had institutional and practical knowledge of their fields of expertise, and facilitated the gathering of information from different perspectives (Ahlin, 2019). This helped to explore the current on-the-ground practices related to emergency response and recovery, explore novel topics and provide insights to inform disaster risk governance policy related to small-scale recurring disasters.

Ethical approval was obtained from the Human Research Ethics Committee of University of Waikato to carry out the interviews (approval letter FS2020-60, copy of consent form/information sheet sent to participants, interview questions in Appendix B, C and D). The interviewees were mainly recruited using snow-balling technique (Raworth et al., 2012). All interview participants were fully informed about the research project through a participant information sheet that described the purpose, the reasons why they were invited, their rights as participants, as well as how to reach out for more information. It is the responsibility of the researcher to respect the rights

and dignity of the participants, maintain their privacy, and ensure their safety during the research process (Chowdhury, 2015). Participants were asked to provide their consent for their participation in the interview. This was signed by the participants and returned to the researcher before the interview. Furthermore, the participants were informed about the use of collected data and the confidentiality of the information. The semi-structured interview questions were pre-circulated to participants once they were selected and had agreed to participate. Due to the limitation in carrying out in person interviews due to the COVID-19 pandemic, the interviews were conducted through Zoom technology and lasted between 30 to 60 minutes. The interview questionnaire was developed based on the interview protocols and ethical considerations of carrying out interviews (Ferreira et al., 2015; Jacob & Furgerson, 2012). The interviews were recorded and transcribed and uploaded to NVivo 10 software. Transcriptions were read multiple times to identify the key codes generated in the interviews. With the support of NVivo, the codes (vulnerability, consequences, community risk acceptance and etc) were applied to interview transcripts and re-arranged them for detailed analysis (see appendix A for more details).

4 Examining the incorporation of small-scale recurring disasters in emergency management frameworks: Insights from Aotearoa New Zealand

4.1 Statement of contribution to co-authored published paper

PUBLICATION 1:

My contribution to the paper involved the planning of the research, data collection, analysis of the data, and preparation of the manuscript. The co-authors, Silvia Serrao-Neumann and Christina Hanna contributed by providing recommendations, reviewing draft versions of the manuscript, and editing to improve the quality of the piece of work.

This chapter answers the first thesis question: “To what extent are small-scale recurring disasters incorporated in Aotearoa –New Zealand’s emergency management frameworks?”

The bibliographic details for this publication are as follows:

Tennakoon, K., Serrao-Neumann, S., & Hanna, C. (2021). Examining the incorporation of small-scale recurring disasters in emergency management frameworks: Insights from Aotearoa–New Zealand. *International Journal of Disaster Risk Reduction*, 66, 102595. <https://doi.org/10.1016/j.ijdrr.2021.102595>

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This paper drew on to the high-level emergency management policies and its associated processors, in general not confining to a particular type of disaster, to examine the extent to which they were in line with addressing the small-scale recurring disasters and their risks.

4.2 Abstract

Risks pertaining to small-scale recurring disasters are generally not considered by emergency management policies. While their impacts are not immediately recognisable, their recurrent manifestation may result in cumulative as well as indirect impacts. Yet, small-scale recurring disasters both remain under-studied in disaster studies and are often not incorporated in disaster planning and policy. This paper contributes to filling this gap in knowledge by investigating the

extent to which the emergency management framework of Aotearoa New Zealand addresses small-scale recurring disasters through a targeted analysis of high-order policy documents. The findings confirm the incomplete reflection of risk identification related to small-scale recurring disasters in the documents analysed. The paper reaffirms that small-scale recurring disasters should be more explicitly integrated in disaster management policy regimes to eliminate the differences at the lower administrative levels of risk treatment. It also argues for the re-evaluation of short-term solutions (such as insurance coverage) that only improve recovery outcomes temporarily, and the consideration of long-term risk reduction policies for achieving more sustainable recovery outcomes.

Keywords: risk assessment, cumulative impacts, natural hazards, disaster scale, disaster risk reduction

4.3 Introduction

The world is being challenged by an unprecedented increase in the intensity and frequency of natural hazards due to global climate change. While we are seeing a lot of attention paid to large-scale extreme events (e.g., more intense bushfires and floods), small-scale disasters may also become more frequent as a result of climate change (Fraser et al., 2020). The importance of small-scale disasters has long been recognised in disaster literature dating back to the 1980s (Shrestha & Gaillard, 2013) in sociological, human-ecological and geographical perspectives. These include the works of Watts and Bohle (1993), Bohle et al. (1994), Cannon (1994), and Wisner and Luce (1993) which called for consideration of underlying factors of vulnerability to disasters. Such factors are important because they can potentially exacerbate the impact of small-scale recurring disasters in the local context (Delfin Jr & Gaillard, 2008). The focus on small-scale disasters, however, lost traction in the decades that followed before regaining momentum around 2010 both by research (e.g., Marulanda et al., 2010; Voss & Wagner, 2010; Wisner & Gaillard, 2009) and practice (The Global Network of Civil Society Organisations for Disaster Reduction, 2013). Yet, some (Fraser et al., 2020; Shrestha & Gaillard, 2013) argue that small-scale recurring disasters remain under-studied in disaster literature and, more importantly, failed to be effectively captured by emergency management policy and planning (IFRC, 2018; Wisner & Gaillard, 2009).

Despite limited empirical research in this area, there is evidence of the difference between the impacts resulted from intensive and extensive¹ disaster risk (Zaidi, 2018). This calls for risks pertaining to different types of disasters to be separately analysed. However, in practice, small-scale recurring disasters tend to be treated through the emergency management regime as static disaster events. Additionally, emphasis is often given to tackle the immediately visible consequences through the application of short-term solutions rather than dealing with the root causes of disaster vulnerability and exposure (Fraser et al., 2020; Shrestha, 2016).

Disaster literature has argued that recurrent and chronic disasters should be managed in new ways (such as assessment of vulnerabilities), and their associated risks should not be neglected during the pre-disaster stage (Christoplos et al., 2001). Subsequent studies (Fraser et al., 2020; Lavell & Maskrey, 2014) described the importance of disaster risk reduction concerning small-scale recurring disasters as a means to reduce the cumulative impact attributed to the repetitive nature of these disasters. In particular, Marulanda et al. (2010) suggest that small-scale recurring disasters may obstruct the long-term sustainability of local communities because of their associated implications for economic, environmental and social processes. This calls for disaster management initiatives to pay greater attention to potential long-term recovery challenges posed by small-scale recurring disasters, by addressing the underlying risks communities may be exposed to in the first place (Ferris et al., 2013). However, literature reveals that small-scale recurring disaster policies remain ambiguous (Shrestha & Gaillard, 2013) despite the decades of research done in this area. Hence, it is important to investigate the extent to which small-scale recurring disasters are being incorporated into existing disaster management frameworks. This paper contributes to fill this gap in knowledge by investigating how risks related to small-scale recurring disasters are being appraised in Aotearoa New Zealand's emergency management regime. Following this introduction, relevant literature on small-scale recurring disasters is reviewed. Next, the research methods and key themes guiding this study are explained. Based on findings, we discuss the implications for research and practice if small-scale recurring disasters are not fully considered in disaster management frameworks.

¹ Intensive risk refers to high-severity major hazard events that result in catastrophic disaster impacts involving high mortality and asset loss; whereas extensive risk is associated with the high frequency low-severity hazard events that are often localised in nature leading to cumulative disaster impacts (UNISDR, 2009b).

4.4 Small-scale recurring disasters and emergency management frameworks

There is a tendency for policies and corresponding disaster funding to focus on large-scale disasters with limited attention paid to small-scale ones (Shrestha & Gaillard, 2013). A number of reasons are identified in the literature to explain this. First, such limited attention is probably influenced by the lack of a universally accepted definition in terms of both the scale and frequency of small-scale disasters, especially when those are recurrent (Shrestha, 2016; Shrestha & Gaillard, 2013). Various terms such as everyday disasters, silent disasters, neglected disasters, invisible disasters (Shrestha, 2016), quotidian and chronic disasters (Zaidi, 2018) have been interchangeably used to describe small-scale recurring disasters.

Second, a number of studies (Marulanda et al., 2008; Shi, 2019; Voss & Wagner, 2010) and organisations (The Global Network of Civil Society Organisations for Disaster Reduction, 2013; UNISDR, 2009a) have attempted to explain the scale component of small-scale disasters. Despite such attempts, in general, it is the magnitude of events - often associated with the number of deaths and larger financial impact, that receives most public attention and visibility (Wisner & Gaillard, 2009). Accordingly, two of the most popular international disaster loss databases consider different thresholds for a disaster event to be entered into their database, but without capturing the nuanced differences of small-scale recurring disasters. EM-DAT, an international database of natural and technological disasters maintained by the Centre for Research on the Epidemiology of Disasters (CRED), requires one of the following criteria to be fulfilled: 10 or more deaths, 100 or more people affected, or declaration by the country of a state of emergency and/or an appeal for international assistance (CRED, n.d.). On the other hand, 'DesInventar' entries are not required to be enlisted based on thresholds (UNDRR, 2019). If there are social losses, then an event is eligible for inclusion. It considers a broader spectrum of variables than EM-DAT, so that it can take into account a variety of spatial scales and break down 'small scale invisible disasters' into multiple, distinct types (Velasquez et al., 2002). This terminology ambivalence and threshold inconsistency has implications for both scholarly research and practice.

Third, on the global scale, small-scale recurring hazard events are less likely to be considered as disasters (Kim, 2015; Marulanda et al., 2010). This limits the global understanding about these events and curtails the prospects to further investigate them (Zaidi, 2018). For example, there is limited understanding about at what point the level of exposure and vulnerability of places may determine the translation of small-scale hazard events into disasters (IPCC, 2012; Lavell et al.,

2012). Further, the lack of understanding on the social and economic costs that disrupt the lives of poor and marginalised communities also contributes towards the underestimation of small-scale recurring events (Wisner & Gaillard, 2009). Or, how weak local governance and poor planning issues may exacerbate the root causes of vulnerability, leaving communities and places more exposed to the effects of small-scale recurring disasters (Zaidi, 2018).

Last, the duration of small-scale events, and corresponding length of disruption they cause to communities, has been identified as a potential temporal factor that leads towards their neglect in emergency management policy and planning (Wisner & Gaillard, 2009). It is not uncommon for some communities to be still experiencing the consequences of a previous small-scale disaster when a subsequent disaster occurs (Shrestha & Gaillard, 2013). This makes it difficult to determine how much disruption, and for how long, a community experiences disruption from each event.

In parallel, questions remain as to whether the risk component of small-scale recurring disasters are being adequately addressed by disaster management regimes (Marulanda et al., 2008). In particular, the characteristics of the risks associated with small-scale recurring disasters are distinct (Cardona et al., 2012), therefore requiring careful consideration by disaster risk assessments. For example, the United Nations International Strategy for Disaster Reduction (UNISDR) describes the risks embedded in small-scale recurring disasters as ‘extensive risks’, including risks associated with highly localised, repetitive, low or moderate hazard conditions leading to cumulative disaster impacts (UNISDR, 2009b). However, the threshold that determines the scale of extensive risks is left arbitrary (Maskrey, 2008; Shrestha, 2016), limiting the consistent use of the term.

The Global Assessment Report on Disaster Risk Reduction (2015) explains that extensive risks are a result of development related factors, which are both manageable and avoidable through the application of suitable disaster risk reduction measures (UNISDR, 2015b). A distinctive feature of risk pertaining to small-scale recurring disasters is its cumulative nature due to the continuous exposure of the affected communities (IPCC, 2012). Therefore, risk assessment methodologies should be customised to deal with small-scale recurring disasters in terms of its cumulative, complex impacts. Risk assessments use both quantitative and qualitative methods to obtain a

comprehensive description of what risks are and their causes (Lavell et al., 2012). The ISO 31000² encourages scrutiny of cascading and cumulative effects in risk assessment and to recognise risk as an input for decision making (Tonkin & Taylor, 2016). This will help to curtail decisions being made based on common risk characteristics. In the disaster and emergency management literature, however, there is no single accepted definition of risk, with risk being generally described as a combination of hazard, exposure and vulnerability (Mamuji & Etkin, 2019; Serje, 2010). Additionally, as a general rule, risks associated with small-scale disasters are considered irrelevant (Marulanda et al., 2010).

Over the last few decades, global disaster risk reduction frameworks have recognised the application of disaster risk reduction (DRR) to addressing small-scale recurring disasters. For example, the Hyogo Framework for Action (2005) provided the wider dissemination of the DRR concept (Basu et al., 2013). This was followed by the Sendai Framework for Disaster Risk Reduction (SFDRR) and marked a paradigm shift from reaction to disaster prevention. This means a shift from managing the disaster impact to managing and reducing the risks that create a disaster (Mizutori, 2020). The SFDRR annotates that a better understanding of disaster risk and improvement of risk governance is necessary to reduce existing disaster risks. It advocates the promotion of DRR measures at the local level by decentralising, delegating, deconcentrating and empowering local authorities and communities (UNISDR, 2015c).

At its onset, the SFDRR extends its application to small- and large-scale, frequent and infrequent, sudden and slow-onset disasters, caused by natural or human-induced hazards as well as environmental, technological and biological hazards (UNISDR, 2015c). This suggests that the scale of the disaster would not determine the significance of that event for those affected (Shrestha, 2016). While paragraph four of the SFDRR specifically states the term, small-scale recurring disasters and their impacts, it does not define the context in which the term ‘small-scale’ should be used. This ambiguity creates issues for its application, including challenges to reporting progress on the SFDRR’s outcomes and goals (Green et al., 2019). In addition, Zaidi (2018) reports that indicators proposed by the SFDRR do not seem to sufficiently capture the indirect

² ISO 31000 is a set of standards that relate to risk management codified by the International Organization for Standardization. Aotearoa New Zealand has adopted ISO 31000 as its standard for risk assessment in the emergency management system (MCDEM, 2021).

disaster impacts pronounced by extensive disaster risks. Importantly, without being systematically analysed, secondary and tertiary impacts resulting from potentially extensive risks of small-scale recurring disasters cannot be immediately captured and addressed by DRR policies (Zaidi, 2018). Finally, the DRR concept is broadly applied to the development of policies and strategies (e.g., land use planning and urban development planning) aimed at reducing risks and vulnerabilities through the analysis of causal factors leading to disasters (Basu et al., 2013; Twigg, 2015; UNISDR, 2009b). By considering small-scale recurring disasters, DRR approaches can have multiple benefits in the long-term. For example, the total cumulative impact of small-scale recurring disasters may be greater than large-scale events. Additionally, as their frequency and territorial spread increases, they may gradually develop into larger events. Hence, by reducing risks associated with small-scale recurring disasters, local disaster management strategies may be better prepared to deal with larger-scale disasters in the long run (Bull-Kamanga et al., 2003).

4.5 Methods

This paper adopts a targeted policy analysis of high-order documents to investigate the extent to which small-scale recurring disasters are being addressed by Aotearoa New Zealand's emergency management regime. As a starting point, we searched the literature for a definition of small-scale recurring disasters that we could adopt in our research to define the spectrum of small-scale disasters. Although a commonly accepted definition is absent, we based our definition on Voss and Wagner (2010) work which considers small disasters as incidents that disrupt everyday routines and require adaptation and adjustment to social, cognitive, and material culture. They usually occur in the affected community and can be handled by the collaboration of local groups and stakeholders. For this study, we thus adopt a working definition for small-scale recurring disasters as 'events that impact a low number of people, have a risk level below the major and extreme threshold limits, or do not pose a threat to life. In this context, recurring events are those that occur at least two to three times during the past decade or at a greater frequency. Such events will often have relatively minor social, environmental, economic and cultural impacts as well as long-term cumulative impacts.

To illustrate our analysis, we use Aotearoa New Zealand as our case study. While the country is subject to frequent hydrological events such as droughts and floods, and associated extensive financial losses (Frame et al., 2018; Frame et al., 2020; Mason et al., 2021; Ministry for the

Environment New Zealand, 2020), small floods occur more frequently than large floods (NIWA, n.d.). These events, however, are underrepresented in cost estimates and studies which focus mainly on the direct insured flood losses (Frame et al., 2020), creating a knowledge gap. Additionally, Aotearoa New Zealand has committed to the SFDRR, the Paris Agreement on Climate Change, and the Sustainable Development Goals which demonstrates its commitment to reducing and managing risks (Saunders et al., 2020) thereby, making it a suitable case for analysis.

Aotearoa New Zealand has been revising its policies and improving governance mechanisms to create a conducive environment for risk reduction and climate change adaptation to meet its international commitments (Saunders et al., 2020). The local legal mechanism which gives effect to the SFDRR in Aotearoa New Zealand is mainly coordinated by the National Emergency Management Agency (NEMA) (formerly known as the Ministry of Civil Defence Emergency Management (MCDEM)). The primary statutory instrument giving effect to advocate the implementation of disaster recovery is the *Civil Defence Emergency Management (CDEM) Act* (2002), which is framed around the 4R's: reduction, readiness, response and recovery (Rotimi, 2010).

The *CDEM Act* (2002) primarily aims to manage hazards, risks, and emergency response and recovery through the coordinated and integrated policy, planning and decision-making processes at the national and local level. It lays out the duties, functions and powers of central government emergency services, lifeline utilities and the general public (CDEM Act, 2002). The *CDEM Act* has statutory character and mandates both pre- and post-disaster event management (Willis, 2014), and is the primary element of the CDEM framework. The other constituents of the CDEM framework include plans and strategies, guidelines and technical standards and information and tools related to capability development. Under the *CDEM Act* (2002), locally formed CDEM groups are tasked with the identification and understanding of hazards and risks affecting their local administrative areas. The CDEM groups formulate their respective group plans in accordance with the CDEM framework to fulfil its requirements.

4.6 Data collection and analysis

Better understanding of disaster risks provides the basis for the entire DRR process (French et al., 2020). This includes a clear understanding of how risks are being classified or scaled, and what kind of risk is being considered, or neglected, by risk reduction measures. Under the SFDRR, the

DRR process aims to prevent new risks, reduce existing ones and strengthen overall disaster resilience. For this, it outlines four priorities for action: (i) Understanding disaster risk; (ii) Strengthening disaster risk governance to manage disaster risk; (iii) Investing in disaster reduction for resilience; and, (iv) Enhancing disaster preparedness for effective response, and to Build Back Better in recovery, rehabilitation and reconstruction. This paper aims to investigate how risks related to small-scale recurring disasters are being appraised in Aotearoa New Zealand's emergency management regime. Therefore, our document analysis primarily focuses on the first priority of the SFDRR - understanding disaster risk. It is important to stress that our analysis only focuses on the national level policies and does not extend to specific procedures implemented at the local level by differing CDEM groups. To this end, three main themes guided the document analysis:

1. How is risk defined in Aotearoa New Zealand's emergency management framework?
2. To what extent are risks associated with small-scale disasters considered?
3. To what extent is the recurrent aspect of disasters considered?

We selected thirteen key documents (see Table 4.1) to examine the above themes. Qualitative analysis software package NVivo was used for this. Based on ideas, themes and concepts found in the literature (Khirfan et al., 2020), documents were searched for the following terms: 'small', 'small-scale', 'risk', 'extensive risk', 'recurrence', 'repeat', 'consecutive', 'acute', 'disaster', 'natural hazard', 'localised', 'continuous', 'cumulative', 'aggregate', 'disruption', 'threshold', and 'cascading'.

Table 4. 1 Documents Analysed

Title	Year
Civil Defence Management Act (CDEM Act)	2002
Focus on Recovery: A Holistic Framework for Recovery in New Zealand	2005
NCDEM Plan Order	2015
CDEM National Capability Assessment Report	2015
The Guide to the National Civil Defence Emergency Management Plan	2015
Response Planning in CDEM: Director’s Guideline for Civil Defence Emergency Management Groups	2015
Strategic Planning for Recovery - Director’s Guideline for CDEM Groups	2017
CDEM Group Planning Director’s Guidelines for Civil Defence Emergency Management Groups	2018
Recovery Preparedness and Management – Director’s Guideline for Civil Defence Emergency Management Groups (A, B and C)	2019
National Disaster Resilience Strategy	2019
Draft Director’s Guideline: Risk assessment guidance for Civil Defence Emergency Management (CDEM) Group planning	2021

4.7 Results

This section first reports on the findings related to definitions of risk observed in the documents analysed. This is followed by findings related to how documents incorporate risks associated with small-scale disasters and the recurrent aspect of disasters.

4.8 Risk definition in Aotearoa New Zealand’s emergency management framework

In Aotearoa New Zealand, the overarching consideration of risk is established based on an all hazards and all risks approach. The CDEM framework led by the *CDEM Act* (2002) implies that any hazard that could create a risk is being acknowledged and considered under the CDEM framework. In comparison with the academic literature that uses the term disaster, Aotearoa New Zealand’s legislation and policy use the term emergency when describing situations that threaten

life or health, and require an immediate coordinated response (Crawshaw & Blanch, 2016). Therefore, it appears that the CDEM context does not use the term disaster extensively, with the definition of disasters appearing in two of the documents reviewed as follows (please see Table 4.2).

Table 4. 2 Definitions of disaster in the CDEM framework

Document	Definition of disaster
Focus on Recovery: A Holistic Framework for Recovery in New Zealand (2005)	<i>An event that causes significant loss or damage and that overwhelms the capability of the community to manage it. Such an event could require significant additional resources (p.24)</i>
National Disaster Resilience Strategy (2019)	<i>A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, social, cultural, economic and environmental losses and impacts (p.6)</i>

The importance of risk management is emphasised in the CDEM National Capability Assessment Report (MCDEM, 2015a, p. 5), which recommends managing risk rather than managing the disasters, and brings to attention to the need to build resilience: ‘There is a need for CDEM to shift its attention away from managing disasters to managing risk, and building resilience within organisations and communities...’.

All documents reviewed touched upon the importance of addressing disaster risks. Notably, for the last two decades, the definition of risk, interpreted as the likelihood and consequences of a hazard, has remained the same (see Table 4.3). More recent documents, however, have started to expand on this definition by including aspects related to exposure, vulnerability and capacity of affected systems.

Table 4. 3 Definitions of risk in the CDEM framework

Document	Definition of risk
<i>CDEM Act (2002)</i>	<i>The likelihood and consequences of a hazard (s 4)</i>
National Disaster Resilience Strategy (2019)	<i>The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined as a function of hazard, exposure, vulnerability and capacity (p.6)</i>
Draft for Risk Assessment: Guidance for CDEM Group Planning (2021)	<i>The likelihood and consequences of a hazard (p.7)</i> <i>To determine the likelihood and consequences for particular hazards, the basic components of risk must be understood, namely: Hazard component, Exposure component and Vulnerability component (p.7)</i>

As the CDEM framework follows a comprehensive risk management approach, risk is also considered in each of the four phases of the disaster management cycle (i.e., the 4Rs). For example, the Response Planning in CDEM: Director’s Guideline for Civil Defence Emergency Management Groups (MCDEM, 2015b, p. 3) calls for the inclusion of risk identification into the response phase planning: ‘Response planning does not have any direct responsibilities relating to reduction. However, planning activities can identify and quantify hazard risks.’. This suggests that hazard scenarios that are being identified in the readiness and reduction phases are expected to be evaluated further during the response planning exercises. In particular, the Strategic Planning for Recovery Director’s Guideline for CDEM Groups (2017) states that the recovery process should give adequate consideration to the reduction of risks (e.g., ‘Reduce future exposure to hazards and their associate risks’) (MCDEM, 2017, p. 2). This notion is also followed by the Recovery Preparedness and Management: Director’s Guideline for Civil Defence Emergency Management Groups - Part A (2019) which further notes that ‘understanding hazards, risks and consequences’ are required in strategic planning for recovery (NEMA, 2019a, p. 4).

Though it is evident that the CDEM framework incorporates the notion of risk into the emergency management framework, it is vital to understand how risk is translated into risk treatment under this process. The Guide to National Civil Defence Emergency Management Plan (2015) (Department of the Prime Minister and Cabinet, 2015) recommends AS/NZS ISO 31000.2009 risk management standard to be used as the basis for risk assessment and management in Aotearoa

New Zealand. This means that in the risk assessment process, once risks are identified, they are then quantified based on risk attributes or risk analysis. According to the CDEM Group Planning: Director's Guidelines for Civil Defence Emergency Management Groups (MCDEM, 2018, p. 19), risk analysis is the process where the 'components of risk – likelihood and consequence – are broken down, and different scenarios are explored'. The CDEM groups are mandated to analyse the hazard risks in their local area based on the likelihood and consequences of the events. They may further analyse these risks based on a detailed methodology weighting the seriousness, manageability and growth factors described in the guideline.

Interestingly, in Aotearoa New Zealand, risk analysis is also carried out under different methodologies including RiskScape and other methods developed by some of the CDEM groups (MCDEM, 2018). Therefore, it is difficult to determine the common gaps pertaining to the risk analysis methods under the CDEM framework. The existing methodology given in the CDEM Group Planning: Director's Guidelines for Civil Defence Emergency Management Groups (2018) recommends the consideration of different scenarios of the risks, risk interdependencies, and cumulative and cascading effects during the risk analysis stage (MCDEM, 2018). Although such explanation is provided, it does not translate into implementation as the risk template given in the guideline only proposes the conventional likelihood and consequences risk analysis to assign a risk rating. This is unlikely to capture aspects related to cumulative and cascading relationships.

While there is no consistent risk assessment methodology in the CDEM framework, the (proposed) Draft for Risk Assessment: Guidance for CDEM Group Planning (2021) aims at introducing a more comprehensive, uniform risk assessment methodology. The guidance recommends the use of a wider stakeholder group for consultation of risks and provides a detailed risk assessment process. We examine that, although the proposed guidance applies the 'all hazards' notion of the *CDEM Act* (2002), it does not provide further assessment of risks that are being managed under business-as-usual scenarios and creates a boundary to risk assessment. The section for group risk assessment thresholds in the Draft for Risk Assessment: Guidance for CDEM Group Planning (2021) states that hazards with lower risks may be excluded from detailed assessments (MCDEM, 2021).

4.9 Risks associated with small-scale disasters

Risks associated with small-scale recurring disasters are referred to as extensive risks in most of the disaster literature (e.g., Maskrey, 2008; Zaidi, 2018). However, our word search query didn't find any matches in the documents analysed. Since the application of the term extensive risk may be implicit rather than explicit, we used alternative terms in place of extensive risk such as 'small', 'small-scale', and 'localised' in our search. The term 'small' did not appear in any of the documents, including the *CDEM Act* (2002) which does not specifically prescribe nor exclude its scope and applicability to disasters of a certain scale (see Table 4). The Act stipulates that it can be activated in emergency situations, including: (i) natural hazards events that may impact the safety of the public or property that cannot be managed with by emergency services; (ii) or otherwise requires a significant and coordinated response under the *CDEM Act* (part 1 s 4 CDEM Act, 2002, p. 9). The term 'disruption' has been cited in twelve out of the thirteen documents we reviewed. The term has been used primarily in the definition of emergency, and implies interruption. Nonetheless, the National Disaster Resilience Strategy (2019) provides a more direct interpretation of its meaning as outlined in the Table 4.4. This draws an impending question as to whether small-scale recurring disasters are considered as emergencies or not in the *CDEM Act* (2002) as they may not meet the necessary criteria to be considered an emergency.

Table 4. 4 Summary of results on terms related to small-scale

Search term	Document	Extract example
Extensive risks	No results were found.	
Small-scale	Strategic Planning for Recovery Director's Guideline for CDEM Groups (2017)	<p><i>Support needed for a large-scale emergency is well beyond what would be needed for a small-scale locally managed recovery (p.28)</i></p> <p><i>Grouping hazards and risks according to their type, scale and likely consequences. This involves understanding all risks from those that cause small scale, frequent events through to the maximum credible event and possible multiple or cascading events if relevant. (p.21)</i></p>

Search term	Document	Extract example
Small-scale recurring disasters	Draft for Risk Assessment: Guidance for CDEM Group Planning (2021)	<p><i>e.g., Localised but disruptive rainstorm which results in flooding of an urban area to be categorised under Most likely/ mid-range events (p.38)</i></p> <p><i>Frequently occurring events that are managed as a 'business as usual' or routine activity to be categorised under Day-to-day events (p.38)</i></p>
Localised	Draft for Risk Assessment: Guidance for CDEM Group Planning (2021)	<i>Community with a localised flood risk (p.18)</i>
Small	<p>NCDEM Plan Order (2015)</p> <p>Strategic Planning for Recovery Director's Guideline for CDEM Groups (2017)</p>	<p><i>Smaller-scale recoveries that require co-ordination at the CDEM Group level will be co-ordinated through the person responsible for recovery management for the CDEM Group (the CDEM Group Recovery Manager) and, where necessary, the establishment of a CDEM Group Recovery Office (p.97)</i></p> <p><i>The Civil Defence Emergency Management Amendment Act 2016 (Amendment Act 2016) amends the CDEM Act 2002 to strengthen this requirement, to help communities recover more efficiently and effectively from small to moderate scale emergencies (p.5)</i></p>
Disruption	<i>CDEM Act (2002)</i>	<i>Emergency is a situation that is the result of any happening, whether natural or otherwise, including, without limitation, any explosion, earthquake, eruption, tsunami, land movement, flood, storm, tornado, cyclone, serious fire, leakage or spillage of any dangerous gas or substance, technological failure, infestation, plague,</i>

Search term	Document	Extract example
	National Disaster Resilience Strategy (2019)	<p><i>epidemic, failure of or disruption to an emergency service or a lifeline utility, or actual or imminent attack or warlike act (Part 1 s 4)</i></p> <p><i>An event that considerably interrupts normal life, business, functions, operations, or processes, whether anticipated or unanticipated (p.6)</i></p>

The only relevant citation pertaining to risks related to small-scale recurring disasters in the CDEM framework was found under the scenario types and their description in the Draft for Risk Assessment: Guidance for CDEM Group Planning (2021) (MCDEM, 2021). It provides an example of a localised flood event requiring a co-ordinated response by the CDEM Group to be categorised under most likely/ mid-range event. In addition, it establishes that frequently occurring events with ‘highly negligible consequences’ are to be managed ‘business-as-usual’ and are considered ‘day-to-day’ events. Appendix D of the Guideline, illustrates a range of different disaster consequence scenarios, including localised impacts. This helps the users to obtain a better understanding of disaster consequences and more appropriately rank disaster events with potential to capture small-scale recurring events. According to the National Disaster Resilience Strategy (2019), disruption refers to events that would disrupt normal life, business, functions, processes, or operations, whether they are planned or unexpected, which can range from being nuisance events to small-scale events (MCDEM, 2019).

4.10 Recurrence aspects of small-scale disasters

The term recurrence was highlighted in three of the documents analysed. None, however, linked recurrence to small-scale disasters or associated risks. On the other hand, cumulative and cascading impacts were addressed in several documents (see Table 4.5). Overall, documents captured how cumulative and cascading consequences are to be considered in DRR in a broad manner, without specifically relating them to small-scale recurring disasters. Additionally, the term ‘aggregate’ was primarily used to discuss the aggregation of risks of different hazards in risk assessment methodologies, again without linking it to small-scale recurrent disasters.

Table 4. 5 Summary of results for cumulative and cascading terms

Search term	Document	Extract example
Cumulative /Cascading	NCDEM Plan Order 2015)	<i>Take a precautionary approach to managing hazards and risks where there is scientific or technical uncertainty about a hazard or risk; or potential for cumulative or cascading risks to arise (p. 69).</i>
	CDEM National Capability Assessment Report (2015)	<i>Over time, this data has attempted to provide evidence for nimble adaptation of interventions to help people recover from the ongoing and cumulative effects of recovery (p.33). Rarely does the Coordinating Executive Group have a collective oversight of this cumulative risk reduction (p.33).</i>
	The Guide to National Civil Defence Emergency Management Plan (2015)	<i>Take a precautionary approach to managing hazards and risks where there is scientific or technical uncertainty about a hazard or risk; or potential for cumulative or cascading risks to arise (17 Reduction p.2). Hazardscape means the net result of natural and man-made hazards and the risks they pose cumulatively across a given area (appendix 2 p.5).</i>
	Strategic Planning for Recovery Director’s Guideline for CDEM Groups (2017)	<i>Cumulative and Cascading Consequences The speed at which recovery progresses in one environment will influence recovery in other environments. Therefore, to understand all the consequences on the community, consequences in one environment should not be considered in isolation (p.24).</i>
	CDEM Group Planning: Director’s Guidelines for Civil Defence Emergency Management Groups (2018)	<i>Risk analysis Interdependencies of risks, and how risks may become cumulative and cascading, should also be considered (p.19).</i>

	<p>Recovery Preparedness and Management: Director’s Guideline for Civil Defence Emergency Management Groups - Part A (2019)</p>	<p><i>Cumulative consequences occur when individual impacts to a single component of an environment combine to form a significantly larger consequence than the individual impacts on their own. This may occur over time.</i></p> <p><i>Cascading consequences occur when consequences in one environment have a flow-on effect or consequence in another environment or location. Cascading consequences can be positive or negative (p.59).</i></p>
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4.11 Discussion

Marulanda et al. (2010) noted that risks pertaining to small-scale recurring disasters are not considered as relevant, although their implications are significant. Extensive disaster risks characterise early signs of disaster risk accumulation (Gordy, 2016). Their aggregation could possibly result in large scale disasters (Voss & Wagner, 2010). However, emergency management policies do not seem to address small-scale recurring disasters adequately. The results of our analysis provided evidence of this gap in the national emergency management policy of Aotearoa New Zealand. The main legislative instruments (CDEM Act, 2002; National Disaster Resilience Strategy 2019; NCDEM Plan Order, 2015) do not provide specific attention to the risks pertaining to small-scale recurring disasters.

According to the SFDRR, disaster risk management policies and practices should be developed based on all disaster dimensions such as vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment (UNISDR, 2015c, p. 14). Risk assessment is a process that supports the understanding of the risks (Simmons et al., 2017). Although the SFDRR states its applicability to small-scale disasters, it remains silent about the extensive disaster risk in its guidance for risk assessment. This may have had a flow-on effect in influencing the emergency management framework in Aotearoa New Zealand and elsewhere.

In the emergency management system, risk assessment methodologies are created to rank the risks in order to develop risk reduction strategies and policies and to allocate resources needed (Mamuji & Etkin, 2019). Risk assessment systems comprise quantitative and qualitative methods and different emergency management authorities adopt different methodologies. Risk assessment is an

extremely complex process as it requires detailed understanding of many factors (Mamuji & Etkin, 2019). In general, emergency management systems use the two dimensional risk matrix (combining hazard frequency and disaster consequences), which assumes that the probabilities and consequences are well understood and measurable (Mamuji & Etkin, 2019, p. 4). However, Gordy (2016) notes that extensive risks are not sufficiently included in the disaster risk assessments. We observe that the critical elements of extensive risks (cumulative and indirect) are not commonly integrated to be evaluated in the risk assessment methodologies under the emergency management regime although there are some exceptions at the local level depending on their capacities.

The impacts of small-scale recurring disasters do not tend to appear in the short run. This creates a need for new methods to be used so as to capture the cumulative effects existing methodologies are leaving out. Current risk assessment methodologies mostly interpret the present vulnerabilities and capacities rather than interpreting their root causes, promoting the development of short-term policy solutions rather than sustainable disaster reduction measures (Fraser et al., 2020). Further, the risk assessment methods quite often do not account for the indirect losses that small-scale recurring disasters are associated with (Gordy, 2016). Liu et al. (2015) pointed out that the accuracy of risk assessment methodologies in capturing small-scale disasters might decrease when compared with the large and medium spatial scale events. Subsequently, small-scale recurring disasters are not being captured and may go unnoticed by the authorities concerned. As a result, these hazard events are not addressed by DRR approaches. In the long run, this may allow these risks to aggregate and potentially lead to more severe impacts (Gordy, 2016).

The manifestations of risk, exposure and vulnerability factors are highly contextual (Bohle, 2001; Cutter & Derakhshan, 2020). The threshold for small-scale recurring disasters may vary from community to community depending on their level of risk acceptance, risk perception as well as their adaptability. Participatory DRR, which is an integral part of decentralised DRR governance system (Scott & Tarazona, 2011) could be used for decision-making in the risk assessment exercise to minimise this adverse impact. For example, where communities help set the risk thresholds, informed by local knowledge and their experiences in confronting the adverse events.

We identified that the existing two-dimensional CDEM risk assessment system in Aotearoa New Zealand does not capture the risks of small-scale recurring disasters. Whilst the CDEM framework acknowledges the importance of cumulative and cascading risks, it does not suggest a

methodology for how this can be achieved. This gap can be minimised to a certain extent if the proposed Draft for Risk Assessment: Guidance for CDEM Group Planning (2021) is fully implemented, because of its multiple implications such as the introduction of a consistent risk analysis tool, inclusion of broader examination of different disaster consequences and wider community participation. However, even the proposed guideline does not provide a methodology to capture cumulative and cascading impacts sufficiently. In addition, the limitation imposed on lower-level risks and some hazards (that do not need coordination or multi-agency response) by eliminating the requirement for full assessments may leave small-scale recurring disasters out altogether. Small-scale recurring disasters may be considered under the ‘business-as-usual’ threshold in the proposed risk assessment guidelines, thus perpetuating the status quo. Importantly, disaster risk assessments and declaration of threshold limits are linked to funding arrangements (Scott & Tarazona, 2011). As providers of disaster risk reduction goods and services (Wilkinson, 2012), governments find it challenging to choose (a) which events to focus on, (b) what severity and frequency to plan for, and (c) what investments to make (Gluckman & Bardsley, 2021). These decisions are related to the distribution of resources that some (Islam et al., 2021) see as underlying issues of a political economy nature, and potentially exacerbate the root causes of vulnerability of underprivileged communities. Declaring threshold limits in disaster policies requires the allocation of human, technical, and financial resources for activities such as emergency response and recovery as DRM policy frameworks and national policy instruments facilitate the necessary resources for implementation (Weekes & Bello, 2019). Consequently, in many contexts, these events exceed the funding capacities of both households and local authorities to respond to a larger number of repeated disaster events (IFRC, 2018). This may prevent them from including all small-scale disasters frequently affecting their communities into policies.

The Disaster Risk Reduction in New Zealand: Status Report (2020) (UNDRR, 2020) links the implementation of relevant disaster management strategies to local risk assessments. Hence, if small-scale recurring disasters are not identified in the threshold limits used for funding, they may be neglected from DRR measures and become a burden to affected communities. However, in the wake of predictable and recurring events, there is a clear case for a paradigm shift to occur – that is, an effort needs to be made to put more resources in place before an event occur so as to deal with the risk effectively, prepare for it and better handle the immediate impacts (IFRC, 2018). In their study, Moftakhari et al. (2017) show that responding too early to a disaster can waste

important resources and undermine public trust, whereas responding too late might also result in financial losses that could have been avoided as well as loss of public confidence in government. Their research suggests that it is crucial to develop tools which can assist policy-makers in determining whether low-cost incidents can aggregate into high-cost impacts, even though it can be difficult to decide at which point to invest heavily in prevention or response.

Small-scale recurring disasters are deeply embedded in the social system of the affected communities (Shrestha, 2016). These communities opt to adopt different coping mechanisms through their repeated experiences. However, literature explains that with the reappearance of the small-scale disasters, the coping mechanisms that were traditionally practiced by the communities may start to erode (Tesso et al., 2012). Social networks may start to disappear, consequently pushing the affected communities to adopt adverse coping mechanisms. Therefore, the perception of community adaptation to recurring events through long-term practices may need further validation and examination through future studies.

Communities experiencing recurrent disasters may have greater knowledge about the hazard events than decision-makers and experts. Therefore, they tend to adopt a variety of distinctive mitigation measures (Khan, 2012), however these not be supportive towards DRR (Shaw et al., 2008). In the short run, when communities face small-scale recurring disasters, they often opt for short-term resilience strategies such as insurance and rebuilding. Nevertheless, in the long run, as these small-scale recurring disasters recur, short-term adaptive strategies become insufficient and eventually, long-term sustainable practices are required (Saunders & Becker, 2015).

We identified that in Aotearoa New Zealand the insurance system is being used as a popular mechanism to address small-scale recurring disasters. The *Earthquake Commission Act* (1993) introduced a publicly funded insurance mechanism operated through the Earthquake Commission (EQC) to provide funds for disaster recovery. EQC provides insurance coverage to property owners who own a current private insurance policy. Some recovery managers acknowledge that sufficient level of insurance support for effective recovery is available, which is rather difficult to achieve by the risk reduction and resilience strategies (MCDEM, 2015a). This shows the extent to which insurance mechanisms are well absorbed as a short-term resilience strategy to tackle small-scale disasters.

In contrast, scholars (Saunders & Becker, 2015) suggest that sustainable recovery from a natural hazard event must ensure the reduction of existing risks, and manage new risks. In this context, it is vital to evaluate how these insurance related mechanisms help reduce risks and losses in the longer run, especially for communities that may be affected by recurring events. Saunders and Becker (2015) explain that the insurance scheme in Aotearoa New Zealand does not correspond to a risk-based pricing system, which otherwise encourages disaster risk reduction investments. In addition, the indemnity principle allows insurance to replace what is only lost, impeding property betterment/improvements which could help dealing with the next disaster (O'Hare et al., 2016). Glavovic et al. (2010) show that a flooded house which requires elevating to reduce future flooding, will only receive an insurance pay-out to reinstate the building presenting a lost opportunity for risk reduction. Such risk reduction activities need to be borne by the affected policyholder who might be vulnerable from facing cumulative events. There is an ongoing debate that insurance practices may discourage application of risk reduction measures (O'Hare & White, 2013). According to Saunders and Becker (2015), insurance covers typically provide short-term resilience; they promote 'bounce-back' resilience, rather than building back better in the recovery stage. Further, the risk of subsequent disasters is usually factored in to rise insurance premiums, potentially making it unaffordable for some over time. Therefore, the differences between the short-term resilience measures adopted by the communities and long-term sustainability principles need to be considered carefully (Saunders & Becker, 2015).

In our study, it was evident that in Aotearoa New Zealand the top-down policy link for small-scale recurring disasters was missing. This absence may lead to creating impromptu and obscure practices in the local disaster governance system, which is the focal point for small-scale disasters. Inconsistency in approaches across New Zealand makes it harder to ensure that people are receiving the same level of care across the country, and for the national agency and other groups to support responses (Sowry, 2017). Lassa (2011) explains that the recurring nature of disasters and the lack of DRR capacity make it even more difficult for local governments to develop and implement DRR policies. The lack of high-order policy directives creates new challenges as well as exacerbating existing challenges for local governments. Financial scarcity at the local level is a particular challenge (Amaratunga et al., 2018; Scott & Tarazona, 2011). The Disaster Risk Reduction in New Zealand: Status Report (2020) already notes the struggle local governments are facing to acquire funds to implement risk reduction measures at the local level. The local financing

system which follows a property-based rating system constantly has budget constraints in sparsely populated areas due to the low rating base. For example, Le Masurier et al. (2006) explain that the recovery at Matatā (small-medium scale township flooding) was heavily dependent on the Central Government funding although it was a localised event impacting only a small geographical area. This was due to the fact that the local government had insufficient funds for recovery as the council had only a small number of ratepayers. Local governments are under pressure to rationalise their investments against their recurrent expenditure and other functions such as safe land development which may constitute a tension between the revenue and DRR (IFRC, 2014). Hence, allowing local governments to tackle these issues without sufficient top level policy directives may exacerbate vulnerability to small-scale recurring disasters.

DRR implementation varies across lower administrative levels due to resource and technical capacity (Scott & Tarazona, 2011). This creates constraints to carry out risk assessments (Scott & Tarazona, 2011). In Aotearoa New Zealand even though standards on risk assessments are made available, many local authorities carry out different methodologies depending on their capacities, resources and perceptions of risk (UNDRR, 2020). This allows most capacitated local authorities to develop comprehensive assessments, while low capacitated ones develop somewhat insubstantial assessments. Finally, this leads to different risk assessment results and DRR implementation across the country. Clear top-down policy directives would ensure greater national consistency.

4.12 Conclusion

The paper examined the extent to which small-scale recurring disasters are recognised in the emergency management framework in Aotearoa New Zealand. We analysed 13 documents in the CDEM framework including legislation, plans, strategies and guidelines. Our overall results provided evidence that the current emergency management framework does not have clear provision for small-scale recurring disasters. We identified that: i) the two-dimensional risk assessment methodologies did not integrate the characteristics (cumulative and indirect) of small-scale recurring disasters sufficiently; ii) adaptation of short-term solutions for recovery may be prioritised as opposed to long-term solutions; and, iii) several on-the-ground implications for local level authorities in the absence of higher-level policy directives.

Risk assessment is the main tool used in emergency management frameworks to identify risks that need to be treated (Cottrell & King, 2010). If these tools do not incorporate elements to capture different types of risks, such risks will remain neglected. Small-scale recurring disasters are highly localised events that possess different characteristics such as cumulative and indirect impacts. Although the risk assessment methodologies endorse the importance of these effects, in reality the conventional two-dimensional risk analysis methodologies do not seem to capture risks with these events sufficiently. As a result, small-scale recurring disasters remain unnoticed and their risks are tackled as a normal circumstance under a business-as-usual scenario.

Currently, small-scale recurring disasters may be discounted by risk assessments, but they remain important to those who are directly affected (Shrestha, 2016). Affected communities can become exhausted by the repetitive confrontations and have misconceptions that the impacts of these events are unavoidable (Gordy, 2016). These lead them to adopt short-term recovery solutions. Through our study, we identified that insurance pay-out is a prominent short-term recovery response from these events. Although short-term recovery is important to return to functional levels quickly, the repetition of events may deplete the community's resilience. Therefore, it is necessary to move beyond the traditional risk management exercises (which rely on structural mitigation, disaster relief, warning and evacuation) and emphasise the importance of utilising land-use planning mechanisms to reduce the adverse impacts of natural hazard events (Glavovic et al., 2010). Furthermore, the insurance mechanism should be re-visited to consider the development of tailored made solutions for small-scale recurring disaster events.

International disaster management frameworks do not pay explicit attention to the risks of small-scale recurring disasters (Hamdan, 2015). Our study confirmed that this could have a flow-on effect on the national level DRR frameworks, which pursue more or less the same approaches promoted by such international bodies. As a result, the high order level (national) policy guidelines and strategies tend to remain ambiguous leaving it to local level authorities to adapt to their own situations. This results in different levels of DRR applications across a country.

Underestimation by the risk assessments and lack of policy recognition are coupled with other short-comings such as political and economic considerations (Hamdan, 2015) at the local level, meaning that small-scale recurring events are not being identified for risk treatment. Here we

concur with Wisner, Kent, et al. (2011) that the combination of top-down and bottom-up actions are necessary to support the effectiveness of DRR.

Small-scale recurring disasters should be considered as a representation of initial risk accumulation and treated as a matter of primary importance (Gordy, 2016, p. 40). As this requires the development of new methods to capture the long-term cumulative impacts of these risks, they should be integrated into disaster risk assessment methodologies as a starting point. National level policy guidance should inform and provide guidance to the local authorities on how to address these events. Further, local authorities should be cognisant that small-scale recurring disasters are events that are not unavoidable and re-consider their resilience strategies.

In agreement with Moftakhari et al.'s (2017) argument, we suggest that the thresholds for responding to small-scale recurring disaster events need to be pre-determined, based on numerous factors to the best extent possible, including known community vulnerability issues such as limited adaptive capacity, levels of risk acceptance as well as institutional capacity to deal with such events. Such arrangements will support the promotion of community resilience (Maguire & Cartwright, 2008) to repeated small-scale events and help reduce aggravating them into larger losses.

4.13 References

- Amaratunga, D., Malalgoda, C., Haigh, R., Panda, A., & Rahayu, H. (2018). Sound practices of disaster risk reduction at local level. *Procedia engineering*, 212, 1163-1170.
- Basu, M., Srivastava, N., Mulyasari, F., & Shaw, R. (2013). Making cities and local governments ready for disasters: A critical overview of a recent approaches. *Risk, Hazards & Crisis in Public Policy*, 4(4), 250-273.
- Bohle, H.-G. (2001). Vulnerability and criticality: Perspectives from social geography. *IHDP update*, 2(01), 3-5.
- Bohle, H. G., Downing, T. E., & Watts, M. J. (1994). Climate change and social vulnerability: toward a sociology and geography of food insecurity. *Global environmental change*, 4(1), 37-48.

- Bull-Kamanga, L., Diagne, K., Lavell, A., Leon, E., Lerise, F., MacGregor, H., Maskrey, A., Meshack, M., Pelling, M., & Reid, H. (2003). From everyday hazards to disasters: the accumulation of risk in urban areas. *Environment and Urbanization*, 15(1), 193-204.
- Cannon, T. (1994). Vulnerability analysis and the explanation of 'natural' disasters. In A. Varley (Ed.), *Disasters, development and environment*, 13-30 Chichester: John Wiley & Sons.
- Cardona, O. D., Van Aalst, M. K., Birkmann, J., Fordham, M., Mc Gregor, G., Rosa, P., Pulwarty, R. S., Schipper, E. L. F., Sinh, B. T., & Décamps, H. (2012). Determinants of risk: exposure and vulnerability. In *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change* (pp. 65-108). Cambridge University Press.
- Civil Defence Emergency Management Act, Ministry of Civil Defence. Public Act (2002).
- Christoplos, I., Mitchell, J., & Liljelund, A. (2001). Re-framing risk: The changing context of disaster mitigation and preparedness. *Disasters*, 25(3), 185-198.
- Cottrell, A., & King, D. (2010). Social assessment as a complementary tool to hazard risk assessment and disaster planning. *Australasian Journal of Disaster and Trauma Studies*, 2010(1), 1–15.
- Crawshaw, J., & Blanch, C. (2016). Framework for psychosocial support in emergencies. Ministry of Health, New Zealand.
- CRED. (n.d.). EM-DAT. Retrieved 26.8.2021 from <https://www.emdat.be/frequently-asked-questions>
- Cutter, S. L., & Derakhshan, S. (2020). Temporal and spatial change in disaster resilience in US counties, 2010–2015. *Environmental Hazards*, 19(1), 10-29. DOI: 10.1080/17477891.2018.1511405
- Delfin Jr, F. G., & Gaillard, J. C. (2008). Extreme versus quotidian: addressing temporal dichotomies in Philippine disaster management. *Public Administration and Development: The International Journal of Management Research and Practice*, 28(3), 190-199.
- Department of the Prime Minister and Cabinet. (2015). The Guide to National Civil Defence Emergency Management Plan. <https://www.civildefence.govt.nz/assets/guide-to-the-national-cdem-plan/Guide-to-the-National-CDEM-Plan-2015.pdf>
- Ferris, E., Petz, D., & Stark, C. (2013). The year of recurring disasters: A review of natural disasters in 2012. Brookings Institution.

- Frame, D., Rosier, S., Carey-Smith, T., Harrington, L., Dean, S., & Noy, I. (2018). Estimating financial costs of climate change in New Zealand [New Zealand Treasury Commissioned Report]. <https://www.treasury.govt.nz/publications/commissioned-report/estimating-financial-costs-climate-change-nz>
- Frame, D. J., Rosier, S. M., Noy, I., Harrington, L. J., Carey-Smith, T., Sparrow, S. N., Stone, D. A., & Dean, S. M. (2020). Climate change attribution and the economic costs of extreme weather events: a study on damages from extreme rainfall and drought. *Climatic Change*, 162(2), 781-797.
- Fraser, A., Pelling, M., Scolobig, A., & Mavrogenis, S. (2020). Relating root causes to local risk conditions: A comparative study of the institutional pathways to small-scale disasters in three urban flood contexts. *Global environmental change*, 63, Article 102102.
- French, A., Mechler, R., Arestegui, M., MacClune, K., & Cisneros, A. (2020). Root causes of recurrent catastrophe: The political ecology of El Niño-related disasters in Peru. *International Journal of Disaster Risk Reduction*, 47, Article 101539.
- Glavovic, B., Saunders, W., & Becker, J. (2010). Land-use planning for natural hazards in New Zealand: the setting, barriers, 'burning issues' and priority actions. *Natural Hazards*, 54(3), 679-706.
- Gluckman, P., & Bardsley, A. (2021). Uncertain but inevitable: The expert-policy-political nexus and high-impact risks.
- Gordy, M. (2016). The Importance of Extensive Risk. In *Disaster Risk Reduction and the Global System: Ruminations on a Way Forward* (pp. 39-41). Springer International Publishing. https://doi.org/10.1007/978-3-319-41667-0_8
- Green, H. K., Lysaght, O., Saulnier, D. D., Blanchard, K., Humphrey, A., Fakhruddin, B., & Murray, V. (2019). Challenges with disaster mortality data and measuring progress towards the implementation of the Sendai Framework. *International Journal of Disaster Risk Science*, 10(4), 449-461.
- Hamdan, F. (2015). Intensive and extensive disaster risk drivers and interactions with recent trends in the global political economy, with special emphasis on rentier states. *International Journal of Disaster Risk Reduction*, 14, 273-289. <http://dx.doi.org/10.1016/j.ijdr.2014.09.004>

- IFRC. (2014). How law and regulation support disaster risk reduction New Zealand: Country case study report. International Federation of Red Cross and Red Crescent Societies.
- IFRC. (2018). Leaving no one behind (ISBN: 978-2-9701289-0-8).
<https://reliefweb.int/sites/reliefweb.int/files/resources/B-WDR-2018-EN-LR-compressed.pdf>
- IPCC. (2012). Managing the risks of extreme events and disasters to advance climate change adaptation: A special report of working groups I and II of the intergovernmental panel on climate change. Cambridge University Press. <https://www.ipcc.ch/report/managing-the-risks-of-extreme-events-and-disasters-to-advance-climate-change-adaptation/>
- Islam, S., Zobair, K. M., Chu, C., Smart, J. C., & Alam, M. S. (2021). Do political economy factors influence funding allocations for disaster risk reduction? *Journal of Risk and Financial Management*, 14(2), 85.
- Khan, S. (2012). Disasters: contributions of hazardscape and gaps in response practices. *Natural Hazards and Earth System Sciences*, 12(12), 3775.
- Khirfan, L., Peck, M., & Mohtat, N. (2020). Systematic content analysis: A combined method to analyze the literature on the daylighting (de-culverting) of urban streams. *MethodsX*, 7, Article 100984.
- Kim, K. (2015). Planning for post-disaster recovery: Next generation (Planning Advisory Service Report 576). <https://www.planning.org/research/postdisaster/>
- Lassa, J. (2011). Institutional vulnerability and governance of disaster risk reduction: Macro, meso and micro scale assessment [Doctoral Dissertation, University of Bonn].
<https://bonndoc.ulb.uni-bonn.de/xmlui/handle/20.500.11811/4714>
- Lavell, A., & Maskrey, A. (2014). The future of disaster risk management. *Environmental Hazards*, 13(4), 267-280.
- Lavell, A., Oppenheimer, M., Diop, C., Hess, J., Lempert, R., Li, J., Muir-Wood, R., Myeong, S., Moser, S., & Takeuchi, K. (2012). Climate change: new dimensions in disaster risk, exposure, vulnerability, and resilience. In *Managing the risks of extreme events and disasters to advance climate change adaptation: Special report of the Intergovernmental Panel on Climate Change* (pp. 25-64). Cambridge University Press.
- Le Masurier, J., Rotimi, J. O., & Wilkinson, S. (2006, 4-6 September). Comparison between routine construction and post-disaster reconstruction with case studies from New Zealand

- Proceedings 22nd Annual ARCOM Conference, Birmingham, United Kingdom.
<http://openrepository.aut.ac.nz/handle/10292/5809>
- Liu, Y., Feng, G., Xue, Y., Zhang, H., & Wang, R. (2015). Small-scale natural disaster risk scenario analysis: a case study from the town of Shuitou, Pingyang County, Wenzhou, China. *Natural Hazards*, 75(3), 2167-2183.
- Maguire, B., & Cartwright, S. (2008). Assessing a community's capacity to manage change: a resilience approach to social assessment. Bureau of Rural Sciences Canberra.
- Mamuji, A. A., & Etkin, D. (2019). Disaster risk analysis part 2: the systemic underestimation of risk. *Journal of Homeland Security and Emergency Management*, 16(1). 10.1515/jhsem-2017-0006
- Marulanda, M., Cardona, O., & Barbat, A. (2008). The economic and social effects of small disasters: revision of the local disaster index and the case study of Colombia. In H.-G. B. a. K. Warner (Ed.), *In Megacities: Resilience and Social Vulnerability* (pp. 110-120). UNU Institute for Environment and Human Security.
- Marulanda, M. C., Cardona, O. D., & Barbat, A. H. (2010). Revealing the socioeconomic impact of small disasters in Colombia using the DesInventar database. *Disasters*, 34(2), 552-570.
- Maskrey, A. (2008). *Global Assessment Report on Disaster Risk Reduction: GAR extensive disaster risk analysis*.
<http://www.preventionweb.net/english/professional/networks/private/gar-ext>
- Mason, K., Lindberg, K., Haenfling, C., Schori, A., Marsters, H., Read, D., & Borman, B. (2021). Social Vulnerability Indicators for Flooding in Aotearoa New Zealand. *International Journal of Environmental Research and Public Health*, 18(8), 3952.
- MCDEM. (2015a). *CDEM National Capability Assessment Report*. Ministry of Civil Defence & Emergency Management.
- MCDEM. (2015b). *Response Planning in CDEM: Director's Guideline for Civil Defence Emergency Management Groups [DGL 19/15]*.
<https://www.civildefence.govt.nz/assets/response-planning-cdem/Response-Planning-in-CDEM-Directors-Guideline.pdf>
- MCDEM. (2017). *Strategic Planning for Recovery Director's Guideline [DGL 20/17]*.
<https://www.civildefence.govt.nz/cdem-sector/guidelines/strategic-planning-for-recovery/>

- MCDEM. (2018). CDEM Group Planning: Director's Guidelines for Civil Defence Emergency Management Groups [DGL 09/18].
<https://www.civildefence.govt.nz/assets/Uploads/logistics-dgl/DGL-09-18-CDEM-Group-Planning-PDF.pdf>
- MCDEM. (2019). National Disaster Resilience Strategy. <https://www.civildefence.govt.nz/cdem-sector/plans-and-strategies/national-disaster-resilience-strategy/>
- MCDEM. (2021). Draft for Risk assessment: guidance for CDEM Group planning.
<https://www.lgnz.co.nz/assets/905150ada1/DRAFT-for-Consultation-Risk-Assessment-Guidence-for-CDEM-Group-Planning-V2.0-compressed.pdf>
- Ministry for the Environment New Zealand. (2020). National Climate Change Risk Assessment for Aotearoa New Zealand: Main report – Arotakenga Tūraru mō te Huringa Āhuarangi o Āotearoa: Pūrongo whakatōpū. <https://environment.govt.nz/publications/national-climate-change-risk-assessment-for-new-zealand-main-report/>
- Mizutori, M. (2020). Reflections on the Sendai framework for disaster risk reduction: Five years since its adoption. *International Journal of Disaster Risk Science*, 1-5.
- NEMA. (2019a). Recovery Preparedness and Management: Director's Guideline for Civil Defence Emergency Management Groups [DGL 24/20] Part A.
<https://www.civildefence.govt.nz/cdem-sector/guidelines/recovery-preparedness-and-management/>
- NEMA. (2019b). Recovery Preparedness and Management: Director's Guideline for Civil Defence Emergency Management Groups [DGL 24/20] Part C.
<https://www.civildefence.govt.nz/cdem-sector/guidelines/recovery-preparedness-and-management/>
- NIWA. (n.d.). Retrieved Sep 8th from <https://niwa.co.nz/natural-hazards/hazards/floods>
- O'Hare, P., & White, I. (2013). Deconstructing resilience: Lessons from planning practice: Special edition of planning practice and research. *Planning Practice & Research*, 28:3, 275-279. <https://doi.org/10.1080/02697459.2013.787721>
- O'Hare, P., White, I., & Connelly, A. (2016). Insurance as maladaptation: Resilience and the 'business as usual' paradox. *Environment and Planning C: Government and Policy*, 34(6), 1175-1193.

- Rotimi, J. O. B. (2010). An Examination of improvements required to legislative provisions for post disaster reconstruction in New Zealand [Doctoral Thesis, University of Canterbury]. UC Research Repository. <https://ir.canterbury.ac.nz/handle/10092/4145>
- Saunders, W. S., & Becker, J. (2015). A discussion of resilience and sustainability: Land use planning recovery from the Canterbury earthquake sequence, New Zealand. *International Journal of Disaster Risk Reduction*, 14, 73-81.
- Saunders, W. S., Kelly, S., Paisley, S., & Clarke, L. B. (2020). Progress toward implementing the Sendai framework, the Paris agreement, and the sustainable development goals: Policy from Aotearoa New Zealand. *International Journal of Disaster Risk Science*, 11(2), 190-205.
- Scott, Z., & Tarazona, M. (2011). Study on disaster risk reduction, decentralization and political economy: Background Paper to the Global Assessment report on disaster risk reduction. UNISDR.
- Serje, J. (2010). Preliminary extensive risk analysis for the global assessment report on disaster risk reduction: Case study prepared for the 2011 Global assessment report on disaster risk reduction. Geneva, Switzerland: UNISDR.
- Shaw, R., Uy, N., & Baumwoll, J. (2008). Indigenous knowledge for disaster risk reduction: Good practices and lessons learned from experiences in the Asia-Pacific Region. United Nations, International Strategy for Disaster Reduction.
- Shi, P. (2019). Hazards, disasters, and risks. In *Disaster Risk Science* (pp. 1-48). Springer.
- Shrestha, S. (2016). Adrista Sangharsaharu, Sthaniya Sabalta: Exploring recovery from small-scale disasters: examples from remote Nepal [Doctoral Thesis, The University of Auckland]. Auckland, New Zealand. <https://researchspace.auckland.ac.nz/handle/2292/31699>
- Shrestha, S., & Gaillard, J. (2013, 26-30 May). Small-scale disasters and the recovery process [Conference paper]. 6th International i-Rec conference: Sustainable Post-Disaster Reconstruction: From Recovery to Risk Reduction, Ascona, Switzerland.
- Simmons, D., Corbane, C., Menoni, S., Schneiderbauer, S., & Zschau, L. (2017). Understanding disaster risk: risk assessment methodologies and examples. In K. Poljansek, M. Marin Ferrer, & T. a. C. De Groeve, I (Eds.), *Science for Disaster Risk Management 2017: Knowing better and losing less*. Publications Office of the European Union.

- Sowry, R. (2017). Better responses to natural disasters and other emergencies: Ministerial review. <https://apo.org.au/node/134066>
- Tesso, G., Emanu, B., & Ketema, M. (2012). Analysis of vulnerability and resilience to climate change induced shocks in North Shewa, Ethiopia. *Agricultural Sciences*, 3(06), 871-888.
- The Global Network of Civil Society Organisations for Disaster Reduction. (2013). Views from the frontline—Beyond 2015: Recommendations for a post-2015 disaster risk reduction framework to strengthen the resilience of communities to all hazards. www.globalnetwork-dr.org
- Tonkin, & Taylor. (2016). Risk based approach to natural hazards under the RMA (CR 234). <https://www.mfe.govt.nz/publications/natural-hazards-management/risk-based-approach-natural-hazards-under-rma>
- Twigg, J. (2015). Disaster risk reduction. Overseas Development Institute, Humanitarian Policy Group London. https://inec.org/system/files/resources/Twigg_Disaster_Risk_Reduction_2015_ENG.pdf
- UNDRR. (2019). Desinventar Sendai 10.1.2 User Manual. https://www.desinventar.net/documentation/DISendai_DataManagement_2019-2.pdf
- UNDRR. (2020). Disaster risk reduction in New Zealand: Status report. United Nations Office for Disaster Risk Reduction (UNDRR), Regional Office for Asia and the Pacific,. [https://www.undrr.org/publication/disaster-risk-reduction-new-zealand-status-report-2020#:~:text=The%20disaster%20risk%20reduction%20\(DRR,Disaster%20Risk%20Reduction%202015%2D2030.](https://www.undrr.org/publication/disaster-risk-reduction-new-zealand-status-report-2020#:~:text=The%20disaster%20risk%20reduction%20(DRR,Disaster%20Risk%20Reduction%202015%2D2030.)
- UNISDR. (2009a). Global assessment report on disaster risk reduction: Risk and poverty in a changing climate. <https://www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2009>
- UNISDR. (2009b). UNISDR terminology on disaster risk reduction. UNISDR. <https://www.undrr.org/publication/2009-unisdr-terminology-disaster-risk-reduction>
- UNISDR. (2015a). The Pocket GAR 2015. Making Development Sustainable: The Future of Disaster Risk Management. United Nations.
- UNISDR. (2015b). Sendai framework for disaster risk reduction 2015–2030. UNISDR. <https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030>

- Velasquez, A., Rosales, C., & Ramirez, F. (2002). Comparative analysis of disaster databases: Final report submitted to working group 3: risk, vulnerability and impact assessment.
- Voss, M., & Wagner, K. (2010). Learning from (small) disasters. *Natural Hazards*, 55(3), 657-669.
- 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.
- Weekes, C., & Bello, O. (2019). Mainstreaming disaster risk management strategies in development instruments (II): policy briefs for Barbados, Guyana, Saint Lucia, Suriname, and Trinidad and Tobago.
- Wilkinson, E. (2012). Transforming disaster risk management: a political economy approach. ODI Background Notes.
- Willis, G. (2014). Managing natural hazard risk in New Zealand: Towards more resilient communities. LGNZ.
- Wisner, B., & Gaillard, J.-C. (2009). An introduction to neglected disasters. *Jàmbá: Journal of Disaster Risk Studies*, 2(3), 151-158.
- Wisner, B., Kent, G., Gaillard, J., Willison, Z. D., van Niekerk, D., Bhatt, M., Cook, B., Lassa, J., Cardona, O.-D., & Oxley, M. (2011). A Contribution to the Review of the draft GAR 2011, Chapters 5, 6 & 7 Political Will for Disaster Reduction: What Incentives Build It, And Why Is It So Hard To Achieve? [Concept paper]. <http://www.radixonline.org/>
- Wisner, B., & Luce, H. R. (1993). Disaster vulnerability: scale, power and daily life. *GeoJournal*, 30(2), 127-140.
- Zaidi, R. Z. (2018). Beyond the Sendai indicators: application of a cascading risk lens for the improvement of loss data indicators for slow-onset hazards and small-scale disasters. *International Journal of Disaster Risk Reduction*, 30, 306-314. <https://doi.org/https://doi.org/10.1016/j.ijdr.2018.03.022>

5 Identifying and classifying broader scale of disaster impacts to better inform disaster management policies and practice

5.1 Statement of contribution to co-authored published paper

PUBLICATION 2:

My contribution to the paper involved the planning of the research, data collection, analysis of the data, and preparation of the manuscript. The co-authors, Silvia Serrao-Neumann and Raven Cretney contributed by providing recommendations, reviewing draft versions of the manuscript, and editing to improve the quality of the piece of work.

This chapter answers the second question: “How can the identification and classification of disaster scales and related impacts be improved to account for a broader spectrum of disasters and better inform disaster management policies and practice?”

The bibliographic details for this publication are as follows:

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In this paper, the broader international and national disaster classifications were examined to understand the extent to which they incorporate small-scale recurring disasters. In addition, using three-decade flood disaster data collected from publicly available online sources in Aotearoa New Zealand, this study examined if the conventional data collection and recording methods captured less significant impacts of disasters. It identified that the existing categories of disaster impact data collection and recording contribute to a lack of consistency in small-scale recurring disasters data. An improved database would provide better evidence to aid on-the-ground decisions and policies related to small-scale recurring disasters.

5.2 Abstract

Disasters are often assessed by factors such as their magnitude, severity and impact on affected communities. Typically, disaster management policies are largely informed by learnings from large-scale disasters. Many studies, however, have shown that cumulative smaller scale disaster impacts have similar outcomes comparable to larger scale disasters. This indirectly contributes to a lack of consistency in and paucity of data related to both smaller-scale disasters and their associated cumulative impacts. This paper argues that greater attention needs to be paid to collecting disaster impact data on a range of disaster-scale events along with their cumulative impacts to better inform disaster management policies and practice. The paper aims to test the hypothesis that a better understanding of a wide range of disaster scale types and their impacts on communities, including small-scale disasters, enables the development of more just, consistent and equitable disaster management policies and practice. Analysing economic costs, evacuation and rainfall data from past flood events that affected Aotearoa-New Zealand over the last three decades, the paper found discrepancies and lack of coherence in disaster data collection and reporting, along with a predominant reliance on rainfall intensity data for disaster risk reduction and planning. The findings also confirmed the importance of identifying economic damages for a range of disaster scales, including those from small-scale disasters. This highlights the need for developing a spectrum to better classify and identify disaster impacts based on various spatial and temporal contexts. The paper concludes by affirming that such database would provide much needed evidence for developing a methodology that enables the identification of the level of disaster impacts; thereby guiding the implementation of more just, consistent and equitable disaster management policies and practice.

Key words: disaster risk reduction, disaster database, emergency management, disaster response, disaster recovery, flooding

5.3 Introduction

Evaluating and learning from past disasters³, including the intensity and spatial dispersion of their impacts, is critical to mitigate future disruptions more effectively (Aryal, 2012; Johansson, 2015).

³ Disasters are ‘A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.’ *UNISDR. (2009). UNISDR terminology on disaster risk reduction. UNISDR. page 9.*

In disaster literature, many classifications are used to categorise disasters based on their impact and scale, including small, moderate, large or extreme (Johansson, 2015). The development of such classifications provides opportunities for institutional capacity development and policy changes so as to best deal with various disaster types and scales (Baker & Refsgaard, 2007). Nevertheless, disaster management is primarily informed by learnings from large-scale disasters (also called focusing events) that cause severe impacts (Birkland, 2006; Voss & Wagner, 2010). Consequently, research pertaining to small-scale disasters and their cumulative impacts are under-represented, although these disasters are potentially increasing as a result of global climate change (Fraser et al., 2020).

Undoubtedly, large-scale disasters result in more visible consequences in their immediate aftermath due to the number of casualties and financial damage they often cause. However, international studies (e.g., Brennan & Danielak, 2021; Cadag et al., 2017; Wisner & Gaillard, 2009) show that small-scale disasters often have a greater cumulative impact than large-scale disasters. In particular, Cadag et al. (2017) explain that media tend to pay less attention to small-scale disasters that do not reach the level of an 'emergency' or a 'crisis', making them less known to the general public. This leads to a scarcity of loss and damage data on small-scale disasters, including in international disaster databases (Browne, 2013). The absence of such data hinders the understanding of risk patterns pertaining to small-scale disasters and their inclusion in risk assessments supporting disaster risk reduction (Serje, 2012), leading to *ad hoc*, place-based or localised responses (Brennan & Danielak, 2021). Additionally, historical impact data (such as economic impact data) are becoming increasingly important to guide climate change policies (Ignjacevic et al., 2021), especially to ensure more robust information about a range of disaster impacts (from both large and small scale disasters) are available to enable better preparation and response to a wide range of climate related disasters in the future.

In this context, the principal hypothesis guiding this paper is that a better understanding of a wide range of disaster scale types and their impacts on communities, including small-scale disasters, enables the development of more just, consistent and equitable disaster management policies and practice. The rationale behind this is that more detailed information about a wider range of disaster scale types and impacts can facilitate the identification of chronic disaster conditions that may otherwise be neglected by disaster mitigation and recovery efforts, or exacerbated by climate change. To test this hypothesis, the paper focuses on Aotearoa-New Zealand's disaster

management system and analyses flood disaster data spanning three as a proxy to understand how small-scale disasters and their impacts might be reported on and recorded. The paper starts with a review of how disaster impacts are reported in the literature and current classification systems. It then outlines the data collection and analysis methods, followed by key findings. The paper concludes by discussing the application of a disaster scale and impact spectrum for disaster management policy and practice by using the example of high-frequency-low-impact disasters.

5.4 Current trends used to identify and classify disasters and their impacts

Currently, there are several systems used to describe disaster scales and their impacts (Blong, 2003). For example, Ravago et al. (2020) propose the classification of disaster indices into three types, namely: i) disaster event indicators that describe the hazard magnitude and intensity; ii) consolidated indices that generate information from multiple variables to determine disaster impacts at the local scale or disaster resilience; and, iii) national level indicators covering disaster damage, vulnerability and risk.

In parallel, disaster magnitude scales are widely used to facilitate communication about disasters and the corresponding decision-making processes (Ripley et al., 2020). Scales can help in determining when a situation needs to escalate to a higher level of the emergency management hierarchy prior to disasters requiring assistance or intervention (Rohn & Blackmore, 2015). They also enable the comparison between similar or different events, which can be used as an important tool to rationally allocate limited resources to concurrent disasters (Rohn & Blackmore, 2015). However, there is no universally accepted scale for assessing the magnitude of a disaster and their associated impacts together. Disasters, such as earthquakes, are commonly indicated by the strength/degree of the hazard, yet this is not the only factor that drives impacts (Wang & Sebastian, 2021).

Despite the fact that a disaster may have a high value on a hazard strength scale, it can also have a lower impact value if the exposed value and/or vulnerability levels are low (Wang & Sebastian, 2021). The use of hazard scales that solely link physical hazard parameters with expected damage does not always account for the wide range of impacts experienced by different communities in response to disasters of similar hazard intensities (Chang & Tanner, 2022). Disaster impacts are either positive or negative, including economic, social and/or environmental effects. In disaster literature and practice, examples of metrics to quantify social and economic impacts include the

following: number of human casualties and injuries, number of permanently or temporarily displaced people, impacts on properties measured in terms of numbers of buildings damaged or destroyed, impacts on infrastructure and lifelines, impacts on crops and agricultural systems, and financial or economic loss (including insurance loss) (Below et al., 2009; Lavell et al., 2012). These are also assessed based on the disaster magnitude, duration, rate and the irreversibility of impacts.

While there are a number of well-established and widely used disaster scales in the preparation, response, and recovery of disasters (Chang & Tanner, 2022), there isn't a single tool available to evaluate the severity of disasters (Yew et al., 2019). Nevertheless, social scientists such as Henry W. Fischer attempted to propose a system to classify catastrophes similar to the Richter scale. His classification, however, is confined only to the severity of a disaster and its impact on a locality or region, and does not take complex features such as social resilience or economic strength into consideration (Rohn & Blackmore, 2015). Further, various attempts have been made to identify the scale of disasters based on their impacts or strength. These include the Bradford disaster scale (Keller et al., 1997), classification of disaster severity Gad-el-Hak (2009), disaster impact index (Gardoni & Murphy, 2010), unified localisable crisis scale (Rohn & Blackmore, 2015), and emergency events database (EMDAT) (see Table 1 in the Supplementary Material for details).

Notably, the classification systems use different variables to classify disaster scales and their impacts. They also appear to overlook the features of speed and secondary and cumulative impacts, instead placing an emphasis on one-time disasters and their direct impacts (Staupe-Delgado & Rubin, 2022; Twigg, 2004). Further, the terminology used implies that small scale disasters have no consequences or are only marginally disruptive, such as 'insignificant' and 'minor', and therefore are not worth considering. However, despite their non-destructive nature, small-scale disasters can cause serious detrimental socioeconomic consequences, including compromising transportation and sewage systems, and public health (Pando & Lavell, 2012). Furthermore, the vulnerability⁴ factor is also absent from the current disaster classification systems. The damage and loss resulting from a disaster are ultimately determined by the level of vulnerability of the

⁴ Vulnerability is understood as the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. *UNISDR. (2009). UNISDR terminology on disaster risk reduction. UNISDR. page 30.*

community, its infrastructure and its production that varies between different spatial and social units (Lavell, 2002). Repeated disasters increase communities' vulnerability by increasing their constant exposure⁵ to disasters and eroding their ability to cope with future catastrophes (Boubacar et al., 2017). Thus, the impact of a disaster depends on where it occurs (Caldera & Wirasinghe, 2021). Unlike larger scale disasters, small-scale disasters do not cause mortalities or destruction of economic assets, but they do expose certain vulnerable groups more than others (Browne, 2013). In summary, the way the current disaster indices and classification systems are developed can mainly capture the larger scale disaster impacts that are visible immediately after a disaster. Consequently, this is likely to exclude the impacts of smaller to moderate scale disasters that are frequent and chronic (Shrestha & Gaillard, 2013). Failure to capture these impacts, and to respond to them, can make the affected communities more vulnerable to new disasters trapping them into a ratchet effect (Shrestha & Gaillard, 2013); hence the focus of this paper on the importance of capturing data on a broader spectrum of disasters scales and impacts so as to enable the development of more just, consistent and equitable disaster management policies and practice.

5.5 Methods

This paper aims to test the hypothesis that a better understanding of a wide range of disaster scale types and their impacts on communities, including small-scale disasters, enables the development of more just, consistent and equitable disaster management policies and practice. To this end, we apply a case study approach (Yin & Campbell, 2018) focused on Aotearoa-New Zealand's disaster management system. Aotearoa-New Zealand is an island country located in the Pacific Ocean subjected to a variety of disasters, including earthquakes, volcanoes, erosion and landslides (UNDRR, 2020). We chose to focus on flood data as a proxy to understand how small-scale disasters and their impacts might be reported on and recorded because flooding is the country's most common and costly natural hazard (Mason et al., 2021). Additionally, flood impacts are expected to be amplified as a result of land subsidence, climate change, and socioeconomic developments creating a suitable case for our study (IPCC, 2022).

Aotearoa-New Zealand has a three-tiered governance structure comprised of the central government, regional councils and the territorial authorities (Lawrence et al., 2015). The

⁵ Exposure refers to people, property, systems, or other elements present in hazard zones that are thereby subject to potential losses. *UNISDR terminology on disaster risk reduction. UNISDR, page 15.*

institutional-statutory framework for emergency management is led by the National Emergency Management agency (NEMA, former Ministry of Civil Defence and Emergency Management) and the Civil Defence Emergency (CDEM) Act 2002. The CDEM Act (2002) emphasises a coordinated and integrated approach to policy, planning and decision-making at the national and local levels in order to manage hazards, risks, and emergency responses and recovery (CDEM Act, 2002) by empowering regional and territorial authorities. The level of emergency response in Aotearoa-New Zealand is based on the CIMS (Coordinated Incident Management System) through national, CDEM Group or regional, local and incident site level (MCDEM, 2015). Small to medium scale disasters are managed by the territorial authorities or the Civil Defence Management groups at the regional levels. Following the international trend, the system used to classify disaster scales and impacts varies across government agencies (see Table 2 in the Supplementary Material for further details). For example, while the Ministry for the Environment and the National Emergency Management Agency (NEMA) have similar level of detailed classification of impacts, the Ministry for Primary Industries has relatively fewer levels of impact categories. In spite of this, all three disaster classifications deem to acknowledge small to medium-scale disasters, but neither use specific variables to capture the cumulative impacts of disasters such as the past disaster occurrences in the recent years. In fact, Harrison et al. (2022) explain that disaster impact data collected by emergency management organizations are not being stored nor collected systematically. Additionally, at present, Aotearoa New Zealand only has a centralised disaster database for earthquakes and there has been slow progress in expanding this to collate loss and impact data for other hazards (Harrison et al, 2021). Nevertheless, a more comprehensive database covering multiple hazard types and inherent impacts is indispensable for research, policy development, and decision-making (Cuthbertson et al., 2021).

5.6 Data collection and analysis

We collated flood disaster data from the last 32 years (1991-2021) irrespective of their scale, intensity or impacts to identify what and how impacts were reported. The 3-decade period was selected because it is a known timeframe used in climate research that enables the observation of climatic trends (WMO, 2017). This is helpful to illustrate what disaster scales comprise the most common ones affecting the country, and any potential changes in flood trends overtime.

The available disaster data did not cover all the required categories for the examination of the impacts, nor provided detailed information because they are often captured from incident

reporting. Therefore, to address this issue we collected flood disaster data from a range of publicly available online data sources, including websites collating information on historical flood events, media articles and technical reports (see Table 5.1). Additionally, data from international databases were not available because small-scale disasters do not meet the criteria to be included in the EM-DAT database and DesInventar lacks data on Aotearoa New Zealand. Nevertheless, the collated locally available data helped to understand the disaster scale media attention is often focused on, and potentially the type of disasters authorities may deem as important for information to be communicated with the wider public.

To overcome issues related to data paucity and quality, we used several different sources to fill information gaps and, therefore, triangulate information for verification. Data triangulation was an important step because it helped to enhance reliability of the data collected and analysed (Noble & Heale, 2019). However, we were unable to capture specific information on the cause and progression of events, operational tactical decision-making, response measures, and intervention results. This information would be helpful to understand the emergency response against different impact levels of disasters. Care was also taken to extract information from media sources by contrasting them with other data sources so as to avoid inaccurate reports resulting from first-hand accounts gathered under time constraint.

Table 5.1: List of sources used for the data collection

Type of source	Details
Websites	New Zealand Historic Weather Events Catalogue Insurance Council of New Zealand New Zealand Official Year books Meteorological Society of New Zealand National Emergency Management Agency Flood List funded by the European Centre for Medium Range Weather Forecasts New Zealand Flood Pics WeatherWatch New Zealand Insurance Business New Zealand Water New Zealand Science Media Centre

Type of source	Details
	GNS Science Hut Bagger New Zealand Regional Council websites District Council websites City council websites
News outlets	New Zealand News Herald Radio New Zealand Otago Daily Times Stuff New Zealand Newshub New Zealand
Reports	Order paper for the meeting- District Plan review subcommittee 15/12/2020 West Coast Hydrometric and Climatological State of Environment Report Responding to a 100-year storm- An actual example in Auckland Wharekawa Coast 2120 –Wider River Flood Assessment Vulnerability and Interdependency Assessment Reports South Island storm and floods December 2010 Natural hazards background report –Greater Wellington Regional Council 2005 Climate change effects on the Land Transport Network Volume two

We searched for flood events that occurred each year from 1990 to 2021 and compiled them in Microsoft Excel. The events were recorded chronologically. The details of each of the events were categorised into the following, and data triangulation was used to complement missing information:

- year
- month and date
- name of the event
- scale of the event
- amount of rainfall and duration
- affected areas

- spatial area
- population per location
- evacuation details
- type of flooding
- type of damages
- recorded economic damage
- other available details

During our initial search, we selected 350 out of 370 flood events dating up to August 2021 that contained information on their impacts. Given the abovementioned lack of consistency in data reporting, collection and storage (Harrison et al., 2021), we followed an inductive data analysis approach (Azungah, 2018) to identify potential categories suitable for analysis. Following an initial screening of the data collected, we identified four categories for which there was sufficient information related to event reporting and response. These included economic damages, number of evacuees in each event, rainfall data and other direct impact information. Our analysis, therefore, focuses only on these elements.

5.7 Results

Figure 5.1 provides an overview of the distribution of the 350 flood events between 1990 and 2021. The highest number of events recorded in any given year occurred in 2008 (21 events), while the lowest number of events occurred in 1993 (2 events). The average number of events recorded per year is 10.94. Excluding the last two years (2021 and 2020), the highest number of events occurred during the 2000-2009 period. Figure 5.1 also shows that there is no clear trend regarding the frequency and intensity of events over the past 32 years.

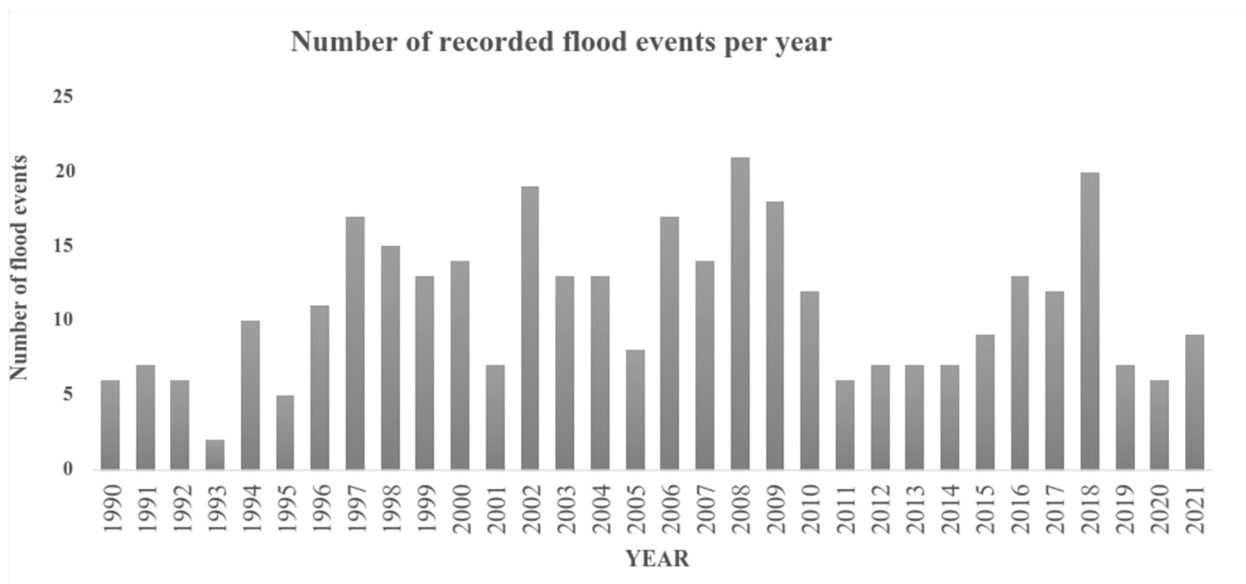


Figure 5.1: Summary of the recorded flood events for the 1990-2021 period by year

Table 5.2 depicts the types of flooding reported. Out of the 350 records approximately 50 percent of the events have recorded the type of the flood event. Even among those recorded events where more than one location is affected, only a few of them cover the type of flooding that may not be representative for the entire event. Localised surface flooding is the most mentioned type of flood, while flash floods are the second most noted.

Table 5.2: Types of flooding reported

Type of flooding	Number of events (n=178)
Flash floods	34
Surface floods	81
Coastal floods/Sea floods	9
River floods/Fluvial floods	5
Localised floods	3
Inland floods	1
Combination of types	11
Localised surface flooding	33
Other	1

5.7.1 Economic damages

Of the 350 flood events analysed, 144 had recorded information on economic damages or losses. We distributed the 144 flood events across time-periods of 10 years and the last two years to identify any decadal pattern (see Table 5.3). The data show a steady increase in economic damages over time. Notably, the eleven rainfall events that occurred over the last two years (January 2020 to August 2021) represent 22 percent of all economic damages registered for the whole 1990-2021 period. It is important to note, however, that this could also be a result of a gradual increase in the insurance payouts to cover for damages due to inflation and not solely based on exacerbated flood events.

Table 5.3: Distribution of economic damages and losses across times

Period	Reported economic damages Amount (NZD Million)	Percentage of the total economic damages (%)*	Number of events per period (n=144)
1990-1999	181	9	34
2000-2009	460	22	49
2010-2019	969	47	50
2020-2021	462	22	11

* Based on the total economic damages of the 144 events taken into the analysis

We further aggregated the economic data into 11 categories based on the value of the insurance claims (see Table 4). This showed that the large majority of events (94 out of 144) resulted in up to less than NZD10 million worth of damages. These events are mostly comprised of surface flooding, flash flooding and localised and minor floods (see Table 5.4).

Table 5.4: Value and number of insurance claims

Value of insurance claims (NZD Million)	Aggregated sum of economic damages (NZD Million)	Percentage from the total events considered (%)	Number of events (n=144)
≤10	260.42	65.3	94
10-20	247.87	11.8	17
20-30	228.94	6.3	9
30-40	170.50	3.5	5
40-50	316.03	4.9	7
50-60	201.48	2.8	4
60-70	183.99	2.1	3
70-80	74.50	0.7	1
80-90	87.72	0.7	1
90-100	188.66	1.4	2
>100	112	0.7	1

5.7.2 Evacuation information

Out of the 350 flood events analysed, 146 event records mentioned evacuations. However, only 117 events had information on evacuation. Many records reported the number of individuals evacuated, while others reported the number of households or families evacuated. To enable comparison, we converted the household numbers to persons, by multiplying the number of households by 2.7, which is the average number of people living in a household according to Aotearoa-New Zealand government statistics (Stats NZ, 2019). Table 5.5 shows the breakdown of the number of evacuees in groups of 50 people. Just over a third of the events resulted in up to 50 evacuees. The next most frequent number of evacuees per event was between 50 and 100 persons (20.5 percent). Notably, only 10.3 percent of the events resulted in the evacuation of more than 500 people.

Table 5.5 : Percentage of flood events based on the number of evacuees per event

Number of evacuees	Percentage of the total number of events considered (%)	Number of events (n=117)
0-50	35.9	42
50-100	20.5	24
100-150	11.1	13
150-200	9.4	11
200-250	6.0	7
250-300	2.6	3
300-350	0	0
350-400	1.7	2
400-450	0.9	1
450-500	1.7	2
>500	10.3	12

5.7.3 Cross-comparison between economic damage and number of evacuees

Only 73 out of the 350 events had both evacuation and economic damages information. There is weak positive correlation of the economic damages and the evacuation data (0.3967) (see Figure 2). Although the statistics suggest the positive correlation between the two categories, high economic damages may not always be associated with high evacuation numbers. Some events that resulted in low economic damages had comparatively higher evacuation numbers. For example, the Northland and Hawke's Bay flooding in June 1997 resulted in the evacuation of 166 people but only NZD 0.5 million in insurance claims have been reported (ICNZ, 2022; NEMA, 2022, January 24). Similarly, approximately 100 people were evacuated from flooding at Tararu in January 2002 but insurance payouts were only NZD 0.25 million (January 2002 South Island and Waikato flooding, the total event recorded more than 220 evacuees and more than NZD 0.5 million damages). By contrast, the November 2020 Napier flooding event led to the evacuation of more than 173 people and estimated damages valued over NZD 87.72 million.

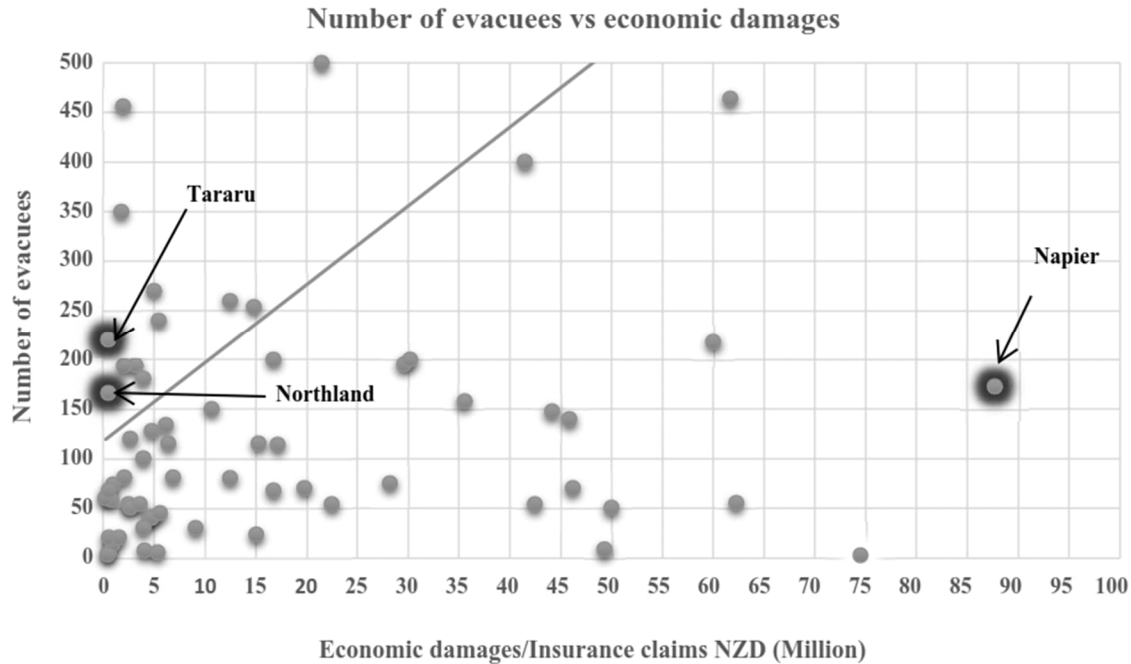


Figure 5.2: Number of evacuees versus insurance claims

5.7.4 Rainfall data

Rainfall data were available for 75 percent of the events that were recorded (n=262). However, rainfall data were reported in many different temporal and spatial scales making it difficult to construct comparisons between events. Additionally, rainfall data were not often reported along with the disaster impact information such as evacuation and economic damages and vice versa. For example, when flooding occurred at a wider spatial scale, reporting on the rainfall data did not cover the entire spatial scale extent and mostly informed the highest rainfall amounts. Therefore, only the above mentioned 262 events had reported rainfall data on both rainfall depth and duration. Only 43 out of the 262 events however, had consistent data for a 24-hour rainfall period, economic damages and evacuation information. We cross examined the data to identify any correlation between rainfall intensity, economic damages and rate of evacuation (see Figure 5.3). The analysis shows a weak positive relationship among the three. For example, the South Island flooding event in November 1999 reported the highest amount of rainfall (i.e., 600mm/24hr) resulting in more than 1,000 evacuations and total insurance payouts valued at NZD 46.1 million. The 2004 February North Island storm and flooding event had a lower amount of rainfall (i.e., 158mm/24h) but led to more than 2,300 evacuations and over a NZD 112 million in insurance payouts.

Rainfall intensity, rate of evacuation and economic damages per event

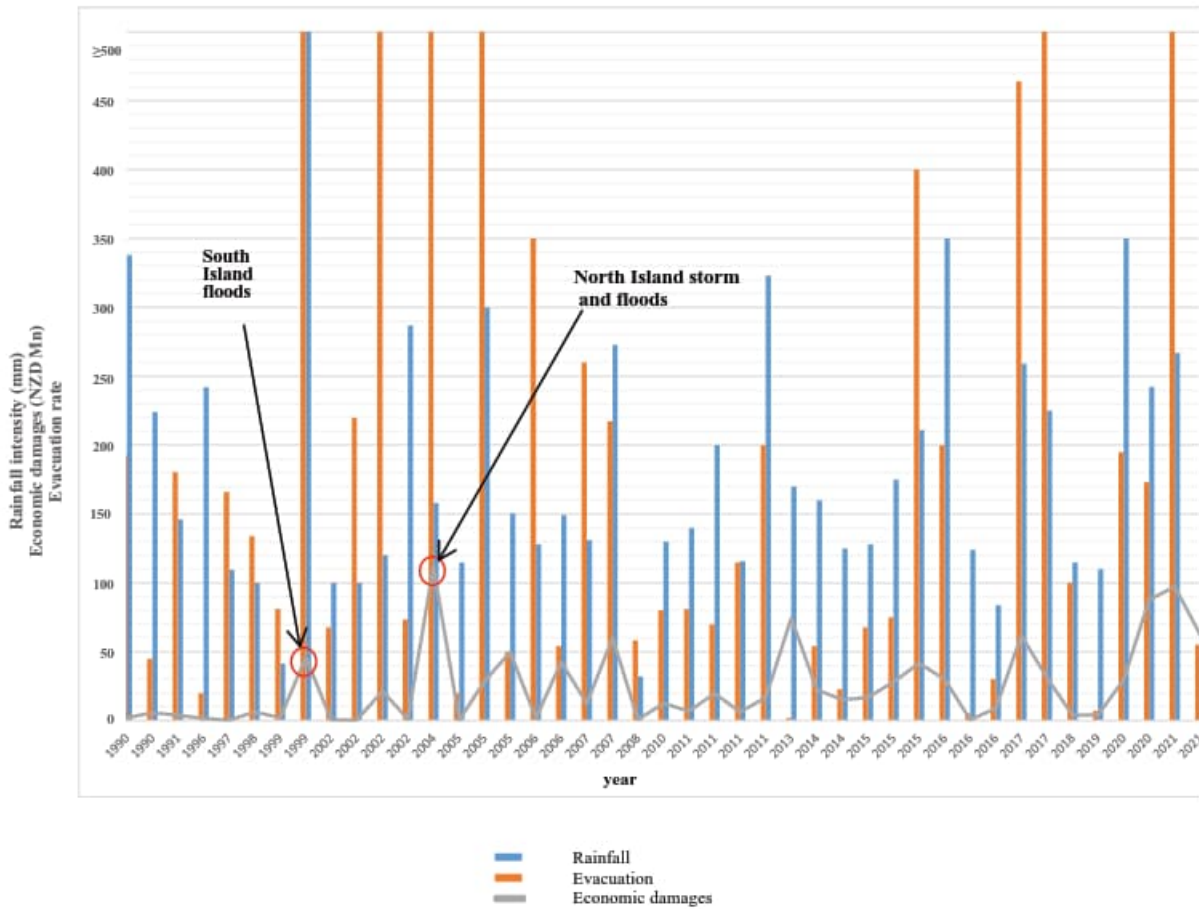


Figure 5.3: Rainfall intensity, rate of evacuation and economic damages per event

5.7.5 Other event attributes

Detailed information for at least one of the three major categories (rainfall intensity, evacuation rates, and economic damages) was available for 289 events out of the 350 recorded events, demonstrating the importance of these triggers for event reporting. While the remaining 61 events did not provide any information related to those categories, we reviewed them to identify other factors that led to those events being covered by the media or technical reports. We found that most of the 61 events had reported impacts on infrastructure damages, especially transport infrastructure. These included road closures, damages to bridges, impassable roads, isolation of communities, disruption to lifeline utilities and infrastructure. Others covered impacts on affected communities such as damages to livelihoods, casualties/fatalities, damage to property, rescue operations, economic damages to livelihoods such as crop and livestock losses. This suggests that

qualitative descriptions of impacts may comprise another attribute that prompts coverage by the media or technical reports.

Out of the 61 events, there were some flood events that were captured only in technical reports and not reported in the main media. These events were considered as ‘minor flood events’. The information on these events were the most limited of all events (see Table 5.6).

Table 5.6: Details recorded on minor flood events

Description	Details recorded
Spatial scale	Mostly limited to 1 or 2 localities
Types of flooding	Localized surface floods, flash floods
Type of impacts	<u>Infrastructure</u> Road closure, inundation of property and damage to infrastructure
	<u>Communities</u> Rescues, accidents
Type of assistance provided to the affected	Business as usual
Duration of the event	1 to 2 days
Fatalities or casualties	No information
Frequency	Repeated occurrences

5.8 Discussion

Findings from our study point to several gaps that prevent a broader range of disaster scales and their impacts from being captured in Aotearoa-New Zealand’s current disaster classifications, event reporting and data recording. This includes, but is not limited to: (i) the lack of coherence in data collection and reporting about disasters; (ii) the limitations of primarily relying on rainfall intensity data for disaster risk reduction and planning; and, (iii) the importance of identifying the economic damages of a range of disaster scales, including small-scale disasters. These gaps make

it difficult to develop more just, consistent and equitable disaster management policies and practice that address the wider range of disaster scales and impacts and how they affect communities.

5.8.1 Discrepancies and lack of coherence in disaster data collection and reporting

As the emphasis in the first priority action of the Sendai Framework for Disaster Risk Reduction (SFDRR) suggests, it is important to have systematic and comparable disaster data so as to ensure more resilient and sustainable societies (SFDRR, 2015-2030). Moreover, the availability of disaggregated data may enhance analysis power and add value to the data (United Nations Office for Disaster Risk Reduction, 2019) as well as disaster risk analysis and forecasting (Mizutori, 2020). The absence of such information, including the duration and intensity of smaller floods can hinder the identification of the spatial and temporal distribution of disasters and their impacts on communities. Our findings show that flooding events tend to not be recorded individually, but rather as aggregates or as a combination of several events. In light of the accumulation of a few events, these combined data can be interpreted as intensive risks. As such, they exceed the threshold for extensive risks⁶ (United Nations Office for Disaster Risk Reduction, 2019) preventing the identification of dangers, challenges and characteristics related to them.

Brennan and Danielak (2021) state that it is essential for decision-makers to understand the full scope of climate-related weather phenomena - from small to large scale events and their associated losses to provide supportive services to populations at risk. However, they also show that there are not enough quantitative and granular data for such analysis - a problem that we have also encountered in our own study. The absence of both local and international historic disaster databases entailing a range of disaster scales, along with the scarcity of information related to their duration and intensity, may hinder the identification of the real impacts of flood hazards. This compromises the development of more just, consistent and equitable disaster management policies and practice because systematic and standardised data on the disaster occurrences and their impacts are crucial for adequate disaster response and recovery activities (Mazhin et al., 2021).

⁶ 'Extensive risk' refers to the risks associated with dispersed populations being exposed to repeated or persistent hazards of low or moderate intensity, often locally specific, which can cause debilitating cumulative effects from disasters UNISDR. (2009). *UNISDR terminology on disaster risk reduction*. UNISDR.

To address this issue, it is fundamental to bridge such a data gap by establishing a national disaster repository that includes data and their impacts on all climate related disasters. Such disaster loss data could record all disasters and their impacts regardless of their spatial or temporal scale. This will help avoid the 'threshold bias' fallacies of the existing threshold criteria, which filter the inclusion of small-scale disasters, resulting in the underrepresentation of small and repeated events (Gall et al., 2009). Importantly, disaster-related information is relatively short-lived and difficult to compare across time and regions, making it less helpful for disaster-related projections (Pascal et al., 2006; UN ESCAP, 2021). In these circumstances, it is critical for disaster loss data to be collated in a disaggregated manner - as recommended by the SFDRR Priority 1, paragraph 24 (e). The Sendai framework also suggests a methodology through the 'Data Collection Protocol' to standardise the collection of disaster data. This protocol lays a comprehensive system that consists of six phases starting with damage and loss data recording and ends with cost-benefit analysis. The protocol also defines actors who should record and analyse the data that corresponds to each phase of disaster loss and damage data collection (Rajasekharan et al., 2021) and formalise the process. Such systematic and methodical collation of data would produce comparable data, enable researchers and practitioners to examine the fuller scope of disasters, and support the development of more just, consistent and equitable disaster management policies and practice.

5.8.2 Limits to using rainfall intensity as a primary trigger for disaster risk reduction planning for flood events

Our study showed that high rainfall was the most common factor for triggering disaster reporting on flood events. This is probably due to how particularly challenging it is to respond effectively during rapid onset events such as flash floods, which are usually triggered by intense rainfall (Khajehei et al., 2020). Although the amount of rainfall contributes towards the scale or the severity of a flood event, our analysis showed that extreme rainfall does not always result in severe impacts. Therefore, rainfall data alone cannot be considered as the main variable for flooding reporting as it has different impacts based on the location's physical and social attributes. Similarly, studies (Pascal et al., 2006; Potter et al., 2021) have shown how the antecedent conditions (e.g., cumulative rainfall) may aggravate to disastrous conditions along with other characteristics such as the vulnerability of the population and the characteristics of the previous season. The damages caused by rainfall are a result of both the precipitation itself and the socio-

economic aspects of the population (Moreira et al., 2017). Therefore, as noted by Khajehei et al. (2020), it is important to examine not only the characteristics of the hazard such as frequency, duration, severity and magnitude, but also the socio-economic vulnerability of the affected community. Data on vulnerability, however, are difficult to collect due to its change over time and space, and it is more challenging to assess social vulnerability or human vulnerability due to their complexity (Harrison et al., 2021). The majority of studies on social vulnerability have focused on physical impacts like loss of life and physical injuries, rather than nuanced social impacts. These vulnerability factors are easier to quantify but may not capture the diversity of the community. For example, other impacts such as poor biophysical, social, and/or financial capital of communities are rather less quantifiable. However, for a better understanding of the dynamics of social vulnerability it is important to identify factors that result from human behaviour such as risk governance aspects, land use decisions, and individuals' status, all of which change over time (Harrison et al., 2021). Our findings showed that relatively small-scale flooding events have generally affected one to three communities at any given event, whereas the temporal scale was mostly limited to a shorter duration of two days. The available information however, does not allow for the identification of the extent of their impacts on these locations. For this to be determined, further examination of potential risk factors such as population density and characteristics of the (built) environment is required. Therefore, our study suggests that the disaster records that are heavily dependent on the spatial and temporal distribution of rainfall may not appropriately inform decisions as their impacts are not adequately considered.

All these aspects suggest that common rainfall thresholds alone are inefficient for determining the scale of a disaster or its corresponding disaster response. In an attempt to bridge this gap, the World Meteorological Organization (WMO) has proposed using impact-based warnings. Impact-based forecasts and warnings aim to anticipate impacts to minimize adverse effects through pre-emptive and preparatory mitigation measures (Jenkins et al., 2022). It is a structured method of combining hazard information with exposure data and vulnerability information to identify risks and guide decision-making (UN ESCAP & World Meteorological Organization, 2021). Therefore, extensive improvements are needed in collecting and storing impact information about events to better facilitate forecasting and decision-making in the future (Kaltenberger et al., 2020). In particular, better frequency and the impact data could help identify communities that are mostly affected by multiple disasters and whether appropriate mechanisms are in place to address their needs.

5.8.3 Economic damages and intangible impacts

Our findings showed that less severe flood events such as frequent, localised flooding were under-reported, including their economic and non-economic impacts. The majority of the events with recorded detailed information were those that were considered larger disasters such as the ones affecting comparatively larger spatial scales, communities and other severe economic impacts. Smaller scale floods were mainly reflected in institutional reports primarily intended for technical analysis, which are not targeted at a general audience. In some cases, small-scale disasters occur concurrently with large-scale disasters which draw all attention (Cadag et al., 2017). Potter et al. (2021) report that in Aotearoa-New Zealand there is no national agency that coordinates smaller scale hydrological events. Also, Aotearoa-New Zealand has a somewhat unique insurance system where the government-owned Earthquake Commission (EQC) provides natural hazard insurance together with the private insurers for affected residential properties (Saunders et al., 2015). As this mechanism is well established to provide funds for recovery, it may suggest that the country may not have had the need to showcase the importance of addressing the small-scale disaster impact separately. Despite its potential as a strategy to reduce disaster risk in theory, insurance serves as a short-term adaptive measure providing financial support for disaster recovery (Saunders & Becker, 2015). In fact, insurance has demonstrated little effectiveness in disaster risk reduction practice, and has been criticised for failing to address the actual vulnerabilities of places as well as encouraging maladaptive tendencies (O'Hare et al., 2016; Saunders & Becker, 2015).

From a community perspective it is necessary to increase awareness of affected communities about future projections of repeated disasters and their adverse physical impacts such as cumulative impacts and chronic conditions. This requires an in-depth examination of whether or not these disasters may impact the coping capacities of households and local authorities. Although insurance plays a role as a short-term recovery methodology, it needs to be underscored that it provides a false sense of security to the insured (O'Hare et al., 2016) and that the risk is always priced. Consequently, it is necessary to thoroughly analyse how effectively insurance mechanisms behave as a short-term resilience⁷ strategy for socio-economically vulnerable communities prone to small-scale recurring disasters (Tennakoon et al., 2023).

Due to the availability of insurance mechanisms as a tool for recovery, countries such as Aotearoa-New Zealand use insurance data to access the losses pertaining to disasters. However, these data largely represent only direct economic losses. More importantly, they reflect insured losses and, as such, only reflect a fraction of the total cost of a disaster (Ladds et al., 2017). Further, our findings also showed that data on economic damages have captured only the larger scale impacts and tangible economic impacts. Generally, the indirect costs of smaller events are considered insignificant (Walton et al., 2004), but communities that confront small-scale disasters concurrently may encounter various different socio-economic impacts which accrue over a longer period and therefore could be considerably larger. Therefore, disaster loss data should be collected and analysed systematically to illustrate the real extent to which disasters impact the economy (Marulanda et al., 2008) despite the argument that economic losses alone do not represent the full cost of disasters.

5.9 Conclusion

In this paper, we aimed to test the hypothesis that a better understanding of a wide range of disaster scale types and their impacts on communities, including small-scale disasters, enables the development of more just, consistent and equitable disaster management policies and practice. For this, we examined records of 350 flood events that affected Aotearoa-New Zealand during a 32-year period through publicly available online data. Firstly, our results have shown that the data pertaining to event reporting and recording evolved mainly around conventional categories related to hazard strength and direct impacts. These include economic damages, evacuation information and rainfall data (hazard strength). Our study also identified inherent challenges to using hazard intensity parameters such as rainfall data to determine the scale of a disaster because they can misrepresent hazards and their risk, especially indirect impacts that are not easily quantifiable.

Secondly, our study also confirmed that disaster classifications and practices do not seem to adequately capture the cumulative impacts of recurring disasters. This gap leads to under-reporting and underrepresentation of disasters that may not show severe direct impacts. Importantly, our

⁷ *Ability to anticipate and resist disruptive events, minimise adverse impacts, respond effectively, maintain or recover functionality, and adapt in a way that allows for learning and thriving. In essence, it's about developing a wide zone of tolerance – the ability to remain effective across a range of future conditions* MCDEM. (2019). *National Disaster Resilience Strategy*. <https://www.civildefence.govt.nz/cdem-sector/plans-and-strategies/national-disaster-resilience-strategy/>.

study showed that most reported disasters did not constitute major catastrophes. Despite this, disaster classification systems are not tailored to capture a wider range of disaster scales resulting in emergency management policies that predominantly focused on fewer in number large scale disasters. This prevents the identification of communities that repeatedly experience small-scale recurring disasters whose disaster resilience may be already at risk and further compounded by not receiving equitable policy consideration.

Thirdly, our results did not identify that emergency response or recovery exercises pertaining to small-scale disasters. It appears that the majority of events (big and small in scale) are predominantly managed under business-as-usual operations and supported by short-term disaster recovery strategies. Hence, more attention needs to be given to examine how different disasters impact communities and whether the current response and recovery strategies are sufficient for achieving improved societal benefits. For this, we need to better understand cumulative and indirect impacts, including by creating mechanisms that are fit for purpose for recording and reporting a range of disasters. This includes small-scale disaster impact data which can shed light upon response and recovery in addition to large-scale disasters.

There were a number of limitations to this study, including the availability of consistent data. While using publicly available data have helped to overcome this gap to a certain extent, it has its own limitations. This study relied on disaster data gathered across a variety of societal sectors, which was not designed nor intended for the purposes of the study. Additionally, data from different sources of information may be inconsistent or conflicting for the same occurrence, with limited verification capabilities and thus being less detailed (Aryal, 2012; Serje, 2012). Another limitation of our study is its focus only on flood events. To simplify the analysis, we excluded other types of disasters that occurred in the same geographical area during the study period.

Findings from this study have important practical and theoretical implications. From a practice perspective, the availability of a more comprehensive database, including improved disaster recording and reporting could provide the means for a detailed understanding of the spectrum of disasters (and associated impacts) affecting a specific area based on various spatial and temporal scales. This could be used to develop a standardised methodology to identify the level of disaster impacts guiding the disaster preparedness and response phase so that small-scale disasters were

not continuously overlooked. To accomplish this, a national disaster repository could be established with the disaggregated data on disaster impacts (as recommended by the SFDRR 2015-2030), alongside with community's vulnerability data. Such a system would avoid the provision of scattered, inconsistent and incomparable data. A comprehensive regional and local impact database would also help determine the different but appropriate levels of disaster response and recovery interventions needed by the different localities against different disaster scales. Hence, helping to reduce the inconsistencies in disaster management policies and practices so as to deliver more just, consistent and equitable outcomes to affected communities.

From a theoretical perspective, the paper identifies several areas for future research. Identifying the disaster trends and hotspots alongside with the changing community vulnerability towards recurring disasters warrants the need to monitor the effectiveness of emergency preparedness and response policies. Additionally, a holistic policy approach, which integrates emergency management policies with socioeconomic policies and development policies, should also be examined simultaneously to inform long term resilient policies.

5.10 References

- Aryal, K. R. (2012). The history of disaster incidents and impacts in Nepal 1900–2005. *International Journal of Disaster Risk Science*, 3(3), 147-154. <https://doi.org/10.1007/s13753-012-0015-1>
- Azungah, T. (2018). Qualitative research: deductive and inductive approaches to data analysis. *Qualitative research journal*, 18(4), 383-400. <https://doi.org/10.1108/QRJ-D-18-00035>
- Baker, D., & Refsgaard, K. (2007). Institutional development and scale matching in disaster response management. *Ecological Economics*, 63(2-3), 331-343. <https://doi.org/https://doi.org/10.1016/j.ecolecon.2007.01.007>
- Below, R., Wirtz, A., & Guha-Sapir, D. (2009). *Disaster category classification and peril terminology for operational purposes*. <http://hdl.handle.net/2078.1/178845>
- Birkland, T. A. (2006). *Lessons of disaster: Policy change after catastrophic events*. Georgetown University Press.
- Blong, R. (2003). A review of damage intensity scales. *Natural hazards*, 29(1), 57-76. <https://doi.org/https://doi.org/10.1023/A:1022960414329>
- Boubacar, S., Pelling, M., Barcena, A., & Montandon, R. (2017). The erosive effects of small disasters on household absorptive capacity in Niamey: A nested HEA approach. *Environment and Urbanization*, 29(1), 33-50. <https://doi.org/10.1177/0956247816685515>
- Brennan, M. E., & Danielak, S. (2021). Too small to count? The cumulative impacts and policy implications of small disasters in the Sahel. *International Journal of Disaster Risk Reduction*, 102687. <https://doi.org/https://doi.org/10.1016/j.ijdr.2021.102687>
- Browne, E. (2013). *Impact of extensive disasters* (GSDRC Helpdesk Research Report, Issue 1016). U. G. Birmingham, University of Birmingham.
- Cadag, J. R. D., Petal, M., Luna, E., Gaillard, J., Pambid, L., & Santos, G. V. (2017). Hidden disasters: Recurrent flooding impacts on educational continuity in the Philippines. *International Journal of Disaster Risk Reduction*, 25, 72-81. <https://doi.org/https://doi.org/10.1016/j.ijdr.2017.07.016>
- Caldera, H. J., & Wirasinghe, S. (2021). A universal severity classification for natural disasters. *Natural hazards*, 1-41. <https://doi.org/https://doi.org/10.1007/s11069-021-05106-9>
- Civil Defence Emergency Management (CDEM) Act, Ministry of Civil Defence. Public Act (2002).

- Chang, S. E., & Tanner, A. (2022). A Community Impact Scale for Regional Disaster Planning with Transportation Disruption. *Natural Hazards Review*, 23(3), 04022019. [https://doi.org/10.1061/\(ASCE\)NH.1527-6996.0000563](https://doi.org/10.1061/(ASCE)NH.1527-6996.0000563)
- Fraser, A., Pelling, M., Scolobig, A., & Mavrogenis, S. (2020). Relating root causes to local risk conditions: A comparative study of the institutional pathways to small-scale disasters in three urban flood contexts. *Global environmental change*, 63, Article 102102. <https://doi.org/https://doi.org/10.1016/j.gloenvcha.2020.102102>
- Gad-el-Hak, M. (2009). The art and science of large-scale disasters. *Bulletin of the Polish Academy of Sciences: Technical Sciences*, 57(1), 3-34.
- Gall, M., Borden, K. A., & Cutter, S. L. (2009). When do losses count? Six fallacies of natural hazards loss data. *Bulletin of the American Meteorological Society*, 90(6), 799-810. <https://doi.org/https://doi.org/10.1175/2008BAMS2721.1>
- Gardoni, P., & Murphy, C. (2010). Gauging the societal impacts of natural disasters using a capability approach. *Disasters*, 34(3), 619-636. <https://doi.org/https://doi.org/10.1111/j.1467-7717.2010.01160.x>
- Harrison, S. E., Potter, S. H., Prasanna, R., Doyle, E. E. H., & Johnston, D. (2022). “Sharing is caring”: A socio-technical analysis of the sharing and governing of hydrometeorological hazard, impact, vulnerability, and exposure data in Aotearoa New Zealand. *Progress in Disaster Science*, 13, 100213–. <https://doi.org/10.1016/j.pdisas.2021.100213>
- Harrison, S. E., Potter, S. H., Prasanna, R., Doyle, E. E. H., & Johnston, D. (2021). Where oh where is the data?: Identifying data sources for hydrometeorological impact forecasts and warnings in Aotearoa New Zealand. *International Journal of Disaster Risk Reduction*, 66, 102619–. <https://doi.org/10.1016/j.ijdrr.2021.102619>
- ICNZ. (2022). *Cost of natural disasters*. <https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters>
- Ignjacevic, P., Estrada, F., & Botzen, W. W. (2021). Time of emergence of economic impacts of climate change. *Environmental Research Letters*, 16(7), 074039. [10.1088/1748-9326/ac0d7a](https://doi.org/10.1088/1748-9326/ac0d7a)
- IPCC. (2022). *Climate change 2022: impacts, adaptation and vulnerability* (Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Issue. C. U. Press. <https://www.ipcc.ch/assessment-report/ar6/>

- Jenkins, S. C., Putra, A. W., Ayuliana, S., Novikarany, R., Khalid, N. M., Mamat, C. S. N. C., Moron, L. A., Monteverde, M. C. A., Cayan, E. O., & Beckett, R. (2022). Investigating the decision thresholds for impact-based warnings in South East Asia. *International Journal of Disaster Risk Reduction*, 76, 103021. <https://doi.org/10.1016/j.ijdrr.2022.103021>
- Johansson, M. (2015). Data sources on small-scale disaster losses and response: A Swedish case study of extreme rainfalls 2000–2012. *International Journal of Disaster Risk Reduction*, 12, 93-101. <https://doi.org/10.1016/j.ijdrr.2014.12.004>
- Kaltenberger, R., Schaffhauser, A., & Staudinger, M. (2020). “What the weather will do”: Results of a survey on impact-oriented and impact-based warnings in European NMHSs. *Advances in Science and Research*, 17, 29-38. <https://doi.org/10.5194/asr-17-29-2020>
- Keller, A., Meniconi, M., Al-Shammari, I., & Cassidy, K. (1997). Analysis of fatality, injury, evacuation and cost data using the Bradford Disaster Scale. *Disaster Prevention and Management: An International Journal*, 6(1), 33-42. <https://doi.org/10.1108/09653569710162433>
- Khajehei, S., Ahmadalipour, A., Shao, W., & Moradkhani, H. (2020). A place-based assessment of flash flood hazard and vulnerability in the contiguous United States. *Scientific Reports*, 10(1), 1-12. <https://doi.org/10.1038/s41598-019-57349-z>
- Ladds, M., Keating, A., Handmer, J., & Magee, L. (2017). How much do disasters cost? A comparison of disaster cost estimates in Australia. *International Journal of Disaster Risk Reduction*, 21, 419-429. <https://doi.org/10.1016/j.ijdrr.2017.01.004>
- Lavell, A. (2002). Local Level Risk Management. Concepts and Experience in Central America. Disaster Preparedness Summit, 21-23 November 2002. New Delhi India.
- Lavell, A., Oppenheimer, M., Diop, C., Hess, J., Lempert, R., Li, J., Muir-Wood, R., Myeong, S., Moser, S., & Takeuchi, K. (2012). Climate change: new dimensions in disaster risk, exposure, vulnerability, and resilience. In *Managing the risks of extreme events and disasters to advance climate change adaptation: Special report of the Intergovernmental Panel on Climate Change* (pp. 25-64). Cambridge University Press. <https://doi.org/10.1017/CBO9781139177245.004>
- Lawrence, J., Sullivan, F., Lash, A., Ide, G., Cameron, C., & McGlinchey, L. (2015). Adapting to changing climate risk by local government in New Zealand: institutional practice barriers

- and enablers. *Local Environment*, 20(3), 298-320.
<https://doi.org/10.1080/13549839.2013.839643>
- Marulanda, M., Cardona, O., & Barbat, A. (2008). The economic and social effects of small disasters: revision of the local disaster index and the case study of Colombia. In H.-G. Bohle & K. Warner (Eds.), *In Megacities: Resilience and Social Vulnerability* (pp. 110-120). UNU Institute for Environment and Human Security.
- Mason, K., Lindberg, K., Haenfling, C., Schori, A., Marsters, H., Read, D., & Borman, B. (2021). Social vulnerability indicators for flooding in aotearoa New Zealand. *International Journal of Environmental Research and Public Health*, 18(8), 3952.
<https://doi.org/10.3390/ijerph18083952>
- Mazhin, S., Farrokhi, M., Noroozi, M., Roudini, J., Hosseini, S., Motlagh, M., Kolivand, P., & Khankeh, H. (2021). Worldwide disaster loss and damage databases: A systematic review. *Journal of education and health promotion*, 10(1).
https://doi.org/10.4103/jehp.jehp_1525_20
- MCDEM. (2015). *Response Planning in CDEM: Director's Guideline for Civil Defence Emergency Management Groups [DGL 19/15]*.
<https://www.civildefence.govt.nz/assets/response-planning-cdem/Response-Planning-in-CDEM-Directors-Guideline.pdf>
- MCDEM. (2019). *National Disaster Resilience Strategy*. <https://www.civildefence.govt.nz/cdem-sector/plans-and-strategies/national-disaster-resilience-strategy/>
- Mizutori, M. (2020). Reflections on the Sendai framework for disaster risk reduction: Five years since its adoption. *International Journal of Disaster Risk Science*, 1-5.
<https://doi.org/https://doi.org/10.1007/s13753-020-00261-2>
- Moreira, F. d. A., Rampazo, N. A. M., & Castellano, M. S. (2017). Impacts of rainfall and vulnerabilities in the metropolitan region of Baixada Santista, Brazil. *International Journal of Safety and Security Engineering*, 7(2), 169-179. <https://doi.org/10.2495/SAFE-V7-N2-169-179>
- Noble, H., & Heale, R. (2019). Triangulation in research, with examples. *Evidence-Based Nursing*, 22(3), 67-68. <https://doi.org/10.1136/ebnurs-2019-103145>
- NEMA (2022). *Previous Emergencies*. Retrieved 10.04.2022 from <https://www.civildefence.govt.nz/resources/previous-emergencies/>

- O'Hare, P., White, I., & Connelly, A. (2016). Insurance as maladaptation: Resilience and the 'business as usual' paradox. *Environment and Planning C: Government and Policy*, 34(6), 1175-1193. <https://doi.org/10.1177/0263774X15602022>
- Pando, L. R. R., & Lavell, A. (2012). Extensive and every day risk in the Bolivian Chaco: Sources of crisis and disaster. *Journal of Alpine Research/ Revue de géographie alpine*(100-1). <https://doi.org/https://doi.org/10.4000/rga.1719>
- Pascal, M., Laaidi, K., Ledrans, M., Baffert, E., Caserio-Schönemann, C., Le Tertre, A., Manach, J., Medina, S., Rudant, J., & Empereur-Bissonnet, P. (2006). France's heat health watch warning system. *International journal of biometeorology*, 50(3), 144-153. <https://doi.org/https://doi.org/10.1007/s00484-005-0003-x>
- Potter, S., Harrison, S., & Kreft, P. (2021). The benefits and challenges of implementing impact-based severe weather warning systems: Perspectives of weather, flood, and emergency management personnel. *Weather, climate, and society*, 13(2), 303-314. <https://doi.org/https://doi.org/10.1175/WCAS-D-20-0110.1>
- Rajasekharan, R. S., Bestak, R., & Dusserre, G. (2021, June 8-11). *A Study on Disaster Management Databases* [Conference paper]. 2021 International Conference on Military Technologies (ICMT), Brno, Czech Republic.
- Ravago, M.-L. V., Mapa, C. D. S., Aycardo, A. G., & Abrigo, M. R. (2020). Localized disaster risk management index for the Philippines: Is your municipality ready for the next disaster? *International Journal of Disaster Risk Reduction*, 51, 101913. <https://doi.org/10.1016/j.ijdrr.2020.101913>
- Ripley, S., Kaiser, L. H., Campbell, E., Shadwell, J., Johnson, D., & Neely, D. (2020). Engaging stakeholders in pre-event recovery planning: Using a recovery capitals framework. *Australian Journal of Emergency Management*, 35(3), 25.
- Rohn, E., & Blackmore, D. (2015). The augmented unified localizable crisis scale. *Technological Forecasting & Social Change*, 100, 186-197. <https://doi.org/10.1016/j.techfore.2015.06.017>
- Saunders, W., Grace, E., Beban, J., & Johnston, D. (2015). Evaluating land use and emergency management plans for natural hazards as a function of good governance: A case study from New Zealand. *International Journal of Disaster Risk Science*, 6(1), 62-74. <https://doi.org/10.1007/s13753-015-0039-4>

- Saunders, W. S., & Becker, J. (2015). A discussion of resilience and sustainability: Land use planning recovery from the Canterbury earthquake sequence, New Zealand. *International Journal of Disaster Risk Reduction*, 14, 73-81. <https://doi.org/10.1016/j.ijdr.2015.01.013>
- Serje, J. (2012). Data sources on hazards. In B. Wisner, J.-C. Gaillard, & I. Kelman (Eds.), *Handbook of hazards and disaster risk reduction* (pp. 179-190). Routledge.
- Shrestha, S., & Gaillard, J. (2013, 26-30 May). *Small-scale disasters and the recovery process* [Conference paper]. 6th International i-Rec conference: Sustainable Post-Disaster Reconstruction: From Recovery to Risk Reduction, Ascona, Switzerland.
- Stats NZ. (2019). *Household size varying across the country*. Retrieved 08.01.2022 from <https://www.stats.govt.nz/>
- Staupe-Delgado, R., & Rubin, O. (2022). Challenges associated with creeping disasters in disaster risk science and practice: Considering disaster onset dynamics. *International Journal of Disaster Risk Science*, 1-11. <https://doi.org/https://doi.org/10.1007/s13753-022-00391-9>
- Tennakoon, K., Serrao-Neumann, S., Hanna, C., & Cretney, R. (2023). Enhancing disaster risk governance for small-scale recurring disasters through pre-determining emergency response and recovery entry points for improved social outcomes. *International Journal of Disaster Risk Reduction*, 104022. DOI:10.1016/j.ijdr.2023.104022
- Twigg, J. (2004). *Disaster risk reduction: mitigation and preparedness in development and emergency programming*. Overseas Development Institute.
- UN ESCAP. (2021). Regional situation analysis: the state of production, dissemination, and use of disaster-related statistics in selected countries in Asia and the Pacific. <https://www.unescap.org/kp/2021/regional-situation-analysis-state-production-dissemination-and-use-disaster-related>
- UN ESCAP, & World Meteorological Organization. (2021). *Manual for operationalizing impact-based forecasting and warning services (IBFWS)*. ESCAP. <https://www.unescap.org/kp/2021/manual-operationalizing-impact-based-forecasting-and-warning-services-ibfws>
- UNISDR. (2009). *UNISDR terminology on disaster risk reduction*. UNISDR.
- United Nations Office for Disaster Risk Reduction. (2019). *Global assessment report on disaster risk reduction (GAR)*. <https://gar.unisdr.org/report-2019>.

- Van Houtte, C., Bannister, S., Holden, C., Bourguignon, S., & McVerry, G. (2017). The New Zealand strong motion database. *Bulletin of the New Zealand society for earthquake engineering*, 50(1), 1-20. <https://doi.org/https://doi.org/10.5459/bnzsee.50.1.1-20>
- Voss, M., & Wagner, K. (2010). Learning from (small) disasters. *Natural hazards*, 55(3), 657-669. <https://doi.org/https://doi.org/10.1007/s11069-010-9498-5>
- Walton, M., Kelman, I., Johnston, D., & Leonard, G. (2004). economic impacts on New Zealand of climate change related extreme events: Focus on freshwater floods. *NZIER report to the New Zealand Climate Change Office (MfE)*.
- Wang, Y. V., & Sebastian, A. (2021). Equivalent hazard magnitude scale. *Natural Hazards and Earth System Sciences Discussions*, 1-33. <https://doi.org/https://doi.org/10.5194/nhess-2021-87>
- Wisner, B., & Gaillard, J.-C. (2009). An introduction to neglected disasters. *Jàmbá: Journal of Disaster Risk Studies*, 2(3), 151-158. <https://doi.org/https://hdl.handle.net/10520/EJC51175>
- WMO. (2017). *WMO guidelines on the calculation of climate normals*. https://library.wmo.int/index.php?lvl=notice_display&id=20130#.YqadyXZByUk
- Yew, Y. Y., Castro Delgado, R., Heslop, D. J., & Arcos González, P. (2019). The Yew disaster severity index: A new tool in disaster metrics. *Prehospital and Disaster Medicine*, 34(1), 8-19. <https://doi.org/10.1017/S1049023X18001115>
- Yin, R. K., & Campbell, D. T. (2018). *Case study research and applications: design and methods* (Sixth edition. ed.). SAGE Publications, Inc.

6 Enhancing disaster risk governance for small-scale recurring disasters through pre-determining emergency response and recovery entry points for improved social outcomes

6.1 Statement of contribution to co-authored published paper

PUBLICATION 3:

My contribution to the paper involves the planning of the research, data collection, analysis of the data, and preparation of the manuscript. The co-authors, Silvia Serrao-Neumann and Raven Cretney contributed by providing recommendations, reviewing draft versions of the manuscript, and editing to improve the quality of the piece of work.

This chapter answers the third thesis question: “How can current practices enable a more comprehensive and equitable entry point for local disaster response and recovery, and thus improve the adaptation capacity of affected communities?”

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This paper discusses the institutional arrangements and the operational decisions related to emergency response and recovery from the small-scale recurring disasters to understand the on-the-ground practices related to them. The empirical data for this piece of research were collected from semi-structured interviews with the emergency management specialists in Aotearoa New Zealand. This paper also inquires about what community-driven best practices are being implemented on the ground which could be expanded and streamlined for effective emergency response and recovery outcomes.

6.2 Abstract

There is growing recognition that climate change is increasing the frequency of disasters globally. Historical disaster data show that the majority of disasters are non-catastrophic. However, these less severe disasters can occur in quick succession and affect the resilience of the communities, and their long-term impacts can be just as severe. Nevertheless, emergency management policies are largely developed around larger-scale disasters, along with related institutional arrangements and operational decisions that establish resource availability for affected communities. This often results in *ad hoc* emergency response and recovery mechanisms, leading to inconsistent approaches to assist affected communities. Drawing on empirical data from emergency management specialists operating across Aotearoa New Zealand, this paper investigates how current emergency response and recovery approaches account for small-scale recurring disasters, and how these could become more comprehensive and equitable for improving local adaptation capacity. Findings indicate the absence of an agreed definition of what comprises a small-scale disaster; the lack of a clear methodology to capture cumulative impacts of disasters; unavailability of resources to establish a formal recovery phase for small-scale disasters; and, ambiguity around the methodology used to activate emergency response operations for small-scale disasters. Our paper concludes by suggesting the establishment of tailored community-based interventions for small-scale disasters, for more effective and equitable service delivery.

Key words: emergency management, disaster risk reduction, risk acceptance, community-based intervention

6.3 Introduction

In the present trajectory of global climate change impacts, disasters are becoming more frequent, exerting pressure on existing disaster governance systems (Raikes et al., 2019; IPCC, 2022; United Nations Office for Disaster Risk Reduction, 2019). Climate variability and climate change can cause small disasters (Marulanda et al., 2010) and it is particularly concerning to see a rise in small and medium-scale disasters (Magrath, 2007) and the economic losses pertaining to them (Thomas, 2017). This calls for more comprehensive disaster data to enable decision-makers to identify changing disaster risk patterns and their impacts, and plan for effective use of resources to minimise disaster risks (Osuteye et al., 2017). However, due to the absence of systematically collected, long-term disaster data covering broad areas and impacts, it has been difficult to make

informed emergency management decisions that are context-specific. In particular, data are mostly available on the larger, more catastrophic disasters that have immediate impacts. Additionally, research and policy focus on small-scale recurring disasters is limited (Gaillard et al., 2019). This lack of scholarly research and practice has disproportionately influenced how, and if, disaster risk governance accounts for less severe, smaller-scale disasters.

Disaster risk governance refers to the coordination of public authorities, public sector employees, media, private sector, and civil society to manage and reduce disasters and climate related risks at local, regional, and national levels (UNDP, 2012). It emphasises the horizontal connections between government ministries and departments, as well as vertical connections between local, regional, and departmental governments, and specific roles assigned to related institutions (Hemachandra et al., 2018). Disaster risk governance is also defined as an emerging version of integrated risk management focused on improving coping capacity under complex and uncertain environments, and the manner in which various actors respond to uncertainties, complexity, and ambiguity (Ikeda & Nagasaka, 2011; IRGC, 2017). A key consideration underpinning disaster risk governance is multi-stakeholder participation to support informed decision-making under high risks and uncertainties. This is vital to minimise the negative effects of trade-offs and encourage decisions that reflect the needs of communities and vulnerable groups (Hemachandra et al., 2018).

Nevertheless, the focus on small-scale recurring disasters is limited in current international disaster governance frameworks, making proactive planning in disaster risk governance revolve heavily around large-scale disasters (Shi, 2019). Despite the lack of research on small-scale recurring disaster governance mechanisms across different countries, available examples suggest the need to improve disaster risk governance mechanisms related to these events (Brennan & Danielak, 2021; Cadag et al., 2017; Fraser et al., 2020; Pando & Lavell, 2012). For example, despite dedicating its second priority action to better managing disaster risk and integrating governance issues throughout the disaster cycle (Pearson & Pelling, 2015), and explicitly considering its application to small and large-scale, frequent and infrequent, sudden and slow-onset disasters, the Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR) does not provide sufficient guidance to help address small-scale disasters, such as systematic reporting indicators (Zaidi, 2018). Another example of this shortcoming is the International Risk Governance Centre (IRGC) Risk Governance Framework. This framework is set to guide the management of multi hazards and risks through the early identification and handling of risks, and with the involvement of a

variety of stakeholders (IRGC, 2017). It consists of a set of interconnected elements and three cross-cutting themes, ranging from risk pre-assessment to risk management and communication (Hemachandra et al., 2018; IRGC, 2017). While this helps with understanding, analysing, and managing critical risks, the framework lacks detail on the application processes and is silent on the risks relating to small-scale disasters.

Additionally, the consideration of small-scale disasters in disaster risk governance is hindered by the lack of consensus on disaster definitions used to guide allocation and activation of resources. This is problematic, because the way in which disasters⁸ are defined influences the actions taken in response to any events, policy decisions, and research (Etkin, 2016). The absence of a definition hinders the decisions made regarding the distribution of capacity and resources allocated to the prevention, preparation, response, and recovery measures for small-scale disasters.

It is also important to highlight that some studies (e.g., Brennan & Danielak, 2021; Zaidi, 2018) show that cumulative and indirect recurring impacts of small-scale disasters (such as loss of access to essential services and educational continuity) can significantly affect communities' resilience (Cadag et al., 2017; Logan & Guikema, 2020). For example, communities that encounter small-scale disasters may face a subsequent disaster before recovering from the former. As a result, peoples' ability to cope with small disasters can be continually eroded and, in the end, leave them at greater risk of increased vulnerability. Over time, small and frequent disasters can create a vicious cycle that further marginalises those affected (Gaillard et al., 2019). In the absence of proactive approaches for managing small-scale recurring disasters, these are managed in a reactive manner.

Furthermore, in recent years, there has been an increasing trend toward privatising risk management, where the individual assumes the responsibility to protect themselves (Raikes et al., 2019). However, studies (Cadag et al., 2017; Shrestha & Gaillard, 2013) have shown that most of the communities affected by small-scale disasters belong to the vulnerable and marginalised segments of society, who are often not able to rally resources in a timely manner. Thus,

⁸ The United Nations define disasters as “a serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts” (UNISDR, 2009, page 9).

communities affected by small-scale disasters, particularly small, isolated communities, frequently deal with disasters on their own without outside support or attention, which can cause unnecessary and severe suffering (Wisner et al., 2012).

On the operational side, current emergency response systems revolve around scale-based perspectives, threshold-based responses and the All-Hazards-Approach (AHA). For example, scaled responses to disasters have gained recognition in both academia and practice and the term 'scale' has been used to refer to both the level of governance (national, regional and local) and the services delivered during the response (Pokarier, 2012). However, there is ambiguity regarding the application of these ideas in relation to small-scale recurring disasters. While it is known that the cumulative impacts of small-scale disasters on people's lives and livelihoods can be similar or greater than those from large-scale ones (Gaillard, 2016), less is known about how the cumulative and indirect impacts from small-scale disasters are considered in emergency response activities. Additionally, Gaillard (2007) demonstrated that institutional frameworks for emergency management are tailored to tackling disasters through top-down command chains that often restrict the ability to deal with small-scale recurring disasters. This pattern reflects the disaster risk governance system which, although it should be holistic and developed across all scales, the key elements guiding the system are concentrated in certain disaster impact levels (Melo Zurita et al., 2015), such as those related to catastrophic disasters. This further contributes to the oversight of small-scale recurring disasters.

Hence, it is necessary to revisit approaches to disaster risk governance at the local level to mitigate gaps pertaining to small-scale recurring disasters and achieve better outcomes in the future, especially in light of a changing climate which is already testing our adaptation capacity (Djalante & Garschagen, 2017). This paper aims to contribute to this by investigating the approaches used to guide emergency response and intervention to small-scale recurring disasters in Aotearoa New Zealand. For this purpose, we define a small-scale disaster as one that impacts a low number of people and imposes a risk level below the major and extreme thresholds, meaning there may not be a direct threat to human life. While these disasters can have relatively minor to moderate social, environmental and cultural impacts, these can result in long term cumulative impacts.

To this end, the paper draws on empirical data from emergency management specialists operating across Aotearoa New Zealand to examine the following research questions:

- i) To what extent do current emergency response and recovery approaches account for small-scale recurring disasters?
- ii) How can current practices enable a more comprehensive and equitable entry point for local emergency response and recovery, and thus improve our adaptation capacity?

The paper is structured as follows. First, we present our data collection methods and the results. We then discuss how current emergency response pertaining to small-scale recurring disasters is practiced in Aotearoa New Zealand to extract insights into how disaster risk governance can better account for small-scale recurring disasters.

6.4 Methods

This paper adopts a case study approach (Yin & Campbell, 2018) focused on Aotearoa New Zealand. The country is prone to a number of disasters including earthquakes, volcanoes, landslides and floods due to its geography and location (UNDRR, 2020). Flooding is the most common disaster which severely impacts infrastructures and communities, and is expected to be amplified by climate change, land subsidence, and socioeconomic developments (Mason et al., 2021; Ministry for the Environment New Zealand, 2020).

Broadly, the governance structure of Aotearoa New Zealand consists of national, regional and territorial governments (district and city councils). The National Emergency Management Agency (NEMA) is the lead agency for emergency management. The Civil Defence Emergency (CDEM) Act 2002 governs emergency management and is instrumental in managing risks as part of the statutory framework for managing the system. It delegates responsibility to local territorial authorities to establish CDEM groups to carry out CDEM activities at the local level, such as initial reduction, readiness, response and recovery initiatives. Among its key aims, the CDEM Act provides a foundation for integrating national and local planning through a national strategy and plan; it also encourages coordination across a wide range of agencies, realizing emergencies are multi-agency events that impact every aspect of society (MCDEM, 2019). Aotearoa New Zealand emergency management framework procedures are based on the Coordinated Incident Management System (CIMS) which outlines the key functions (control, intelligence, planning, operations, logistics, PIM and welfare) and the response levels (national, CDEM group or regional level, local and incident site level). Nevertheless, there is ambiguity regarding how the CDEM framework applies to the emergency response and the management of smaller scale disasters,

which warrants examination of how its functioning is determined at the local level (Tennakoon et al., 2021).

Data collection for this study was primarily undertaken through a qualitative approach using semi-structured interviews. The semi-structured interviews were carried out in 2021 with nine emergency management specialists in Aotearoa New Zealand, including eight practitioners representing national, regional and local level from different geographical locations who were involved in emergency response on different scales of disasters and an experienced researcher. Interview participants were mainly recruited using snow-balling techniques (Raworth et al., 2019). Interviews lasted between 30 to 60 minutes and were recorded using the Zoom technology that supported transcribing. Interview questions aimed to extract insights related to the extent to which current emergency response and recovery approaches in Aotearoa New Zealand account for small-scale recurring disasters, and how current practices could enable a more comprehensive and equitable entry point for local emergency response and recovery, to improve adaptation capacity of communities.

Interview transcripts were analysed in NVivo 10 software to gain an understanding of the practical application of emergency response and recovery operations related to small-scale recurring disasters in Aotearoa New Zealand, and the approaches adopted to potentially improve local adaptation capacity. Applying a content analysis approach (Bazeley & Jackson, 2013), the interview transcripts were read several times to identify themes that contributed to answering the main research questions. This included the development of a coding system using an inductive coding approach to identify themes from emergent data related to the research questions. These themes included: adaptability and adaptive planning; business as usual; build back better; climate change; community risk acceptance; consequences; contextual; cumulative impacts; emergency declarations; evacuation; frequency; impacts (local, insignificant); incident management; insurance; land use planning; legislation; likelihood and recurrence; recovery; resilience; response; community response and planning; welfare response; risk assessment; scale-based thresholds; universal support and vulnerability.

6.5 Findings

Our findings identified a number of issues that affect how small-scale recurring disasters are being considered by current emergency response and recovery approaches in Aotearoa New Zealand.

These include: (i) the absence of an agreed definition and understanding of what comprises small-scale disasters; (ii) the lack of a clear methodology to capture the cumulative impacts of disasters; (iii) unavailability of resources to establish a formal recovery phase for small-scale disasters; and, (iv) ambiguity around the methodology used to activate emergency response operations for small-scale disasters.

6.5.1 The absence of an agreed definition and understanding of what comprises small-scale disasters

When asked to describe their understanding of a practical definition for small-scale recurring disasters, participants described events that would be dealt with ‘at a local level’ (Participant 5) or those that ‘only impact one or two small communities’ (Participant 1). Additionally, they confirmed that these disasters may be responded to through the ‘incident management systems’ (CIMS) which do not necessarily identify them as requiring a recovery phase because the CIMS is ‘more concerned with the response phase’ (Participant 2). Part of these discussions involved framing small-scale disasters as having less impact on communities than other disasters. As one participant described, an example of a small-scale recurring disaster would include:

“...one stream and a town that frequently floods, you know, three houses, and as a nuisance for them, you know, so that means you might be taking into account those kind of events”
(Participant 4)

Part of the context for this approach is that there is no clear definition provided in the CDEM framework for small-scale disasters, as the framework adopts an AHA approach. This scenario is similar to the global level, where there is no universal consensus on the scale and frequency of small-scale disasters, especially when they occur repeatedly (Shrestha, 2016; Shrestha & Gaillard, 2013). Additionally, in the Aotearoa New Zealand context, the terms emergency and hazard are commonly used, as opposed to disaster. The term disaster was replaced with emergency in the 1960s (MCDEM, 1990) providing local authorities with the opportunity to declare a state of emergency in contrast to a disaster. The current CDEM Act (2002, p. 9) defines emergency as a situation:

“that is the result of any happening, whether natural or otherwise, including, without limitation, any explosion, earthquake, eruption, tsunami, land movement, flood, storm, tornado, cyclone, serious fire, leakage or spillage of any dangerous gas or substance, technological failure, infestation, plague, epidemic, failure of or disruption to an

emergency service or a lifeline utility, or actual or imminent attack or warlike act; and causes or may cause loss of life or injury or illness or distress or in any way endangers the safety of the public or property in New Zealand or any part of New Zealand; and cannot be dealt with by emergency services, or otherwise requires a significant and co-ordinated response.”

On the other hand, hazard is defined as a “process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation” (MCDEM, 2019, p. 6). Because the term disaster is rarely used in the context of emergency management in Aotearoa New Zealand, one participant explained that using the term disaster for a small-scale event presents challenges:

“In New Zealand, you don't use the term disasters much, whereas we use the term hazards. So, it's different to match with the literature. It is partly because we try and mitigate the hazard before the disaster occurs, so a lot of our focus is on the hazards, the impacts of planning...and we only talk about that being a disaster if it was so huge, it was unmanageable.” (Participant 4).

This change in terminology is a result of the global paradigm shift under which disasters became considered more of a social phenomenon, moving away from the idea they are triggered only by natural factors (Oliver-Smith, 1996). However, in the absence of consistent parameters for classifying and evaluating the impacts of disasters, practitioners working on-the-ground interpret and plan for disasters, including small-scale ones, based their own experiences and local context. Another issue within the discussion of small-scale disasters is that from a participant's experience, the term ‘small-scale’ had not been widely discussed in the disaster governance space in Aotearoa New Zealand. For example, ‘scale’ could refer to a wide range of factors such as ‘the scale of severity/magnitude (e.g., flood depth; cyclone wind speed), geographical extent, duration of the hazardous event or the resulting impacts (severity – number of fatalities; extent – area or number of communities/people actually impacted; duration – length of time that the impacts are disrupting people's lives)’ (Participant 4). The same participant further suggested that the scale could also be defined in terms of the ‘emergency response taking place (e.g., whether a declaration is made) or the level of response required by the community’. This means that there isn't a clear and concise interpretation of what comprises the scale of a disaster.

The criterion for a declaration of a state of emergency is one parameter used to distinguish the scale of a disaster. For example, the Centre for Research on the Epidemiology of Disasters (CRED) use this as one of the criteria to qualify which disasters are entered into their database (CRED, n.d.). However, the participants were divided on their opinion as to whether a declared state of emergency should be used as a criterion to distinguish the scale of disasters, with one supporting it and others disagreeing or doubting it. One opinion was that an ‘emergency declaration is not based on how significant the event is’ and that it is based on whether the emergency managers have the power they require for their actions (Participant 3). Another participant added that ‘I’ve never felt the declaration of an emergency is a good yardstick for anything. Because some councils will never declare an emergency’ (Participant 8). Based on these experiences, using an emergency declaration to demarcate the scale of disasters does not seem to be effective.

A previous study (Authors, under peer-review) confirmed that in Aotearoa New Zealand, the majority of disaster events are non-catastrophic. However, as our participants pointed out, disaster scales are not clearly laid out, and therefore the emergency response levels required for varied disaster scales are difficult to determine. This also suggests that there isn’t a strong connection between the identification of small-scale disasters in the disaster risk governance regime in Aotearoa New Zealand – an issue also observed by other studies (e.g., Brennan & Danielak, 2021). Small-scale disasters also have distinct characteristics compared to other disasters, such as those with cumulative and indirect impacts that cannot be identified immediately. One participant described: ‘in recent years, cumulative impacts have been a key consideration for response planning’ (Participant 1). While some participants acknowledged cumulative impacts in response planning, another said they are likely to be considered in future emergency responses, due to climate change:

“Climate change is happening, and we’re going to be involved in more and more events at a macro level, and that’s what we’re really starting to look at.” (Participant 2)

Despite the fact that participants acknowledged the importance of the role of cumulative impacts, many were unaware of how they should be captured and incorporated in response planning. For example, one participant said that they didn’t ‘know if you could directly align them’ in emergency response or recovery (Participant 5). Nevertheless, another participant confirmed that progress was being made on this issue and that they are ‘using the dynamic adaptive planning and pathways

tool, in terms of having the conversations with the communities’ (Participant 8). Community engagement at the centre of the decision-making process is seen as an important tool to identify cumulative impacts. While the risk pertaining to small-scale recurring disasters is often considered small, participants also confirmed that frequent flooding events could be considered an early indicator of what regions might experience in terms of more severe impacts in the near future, including the escalation of related cumulative impacts.

6.5.2 Unavailability of resources to establish a formal recovery phase for small-scale disasters

Participants acknowledged the fact that the CDEM approach is ‘about consequence management’ and that ‘there’s a significant amount of budget and time being spent on major and unlikely events, because they have more consequences’ (Participant 5). They also noted that when the consequences are insignificant ‘BAU [business-as-usual] agencies like FENZ [Fire and Emergency New Zealand] or Police would handle them’ (Participant 5). Additionally, it was noted that ‘CDEM recovery is not pre-emptively activated in itself’ (Participant 7).

Nevertheless, some local councils have mechanisms for recovery in place, such as Mayoral relief funds⁹, but this is not the case for all local authorities. Additionally, a number of government and non-government organisations (e.g., the Ministry for Business Innovation and Employment, Lottery Grants Board, Rural Support Trust) also assist with recovery support and funding after disasters occur; hence, it is difficult to determine how much funding is available upfront, as it is often reactive. Importantly, for small-scale disasters, ‘Insurance would be first port of call for recovery’ (Participant 1) – although this may not be a sustainable choice in the long run, as challenges arise in maintaining insurance for higher risk communities (O’Hare et al., 2016). As one participant discussed:

“Insurance companies become increasingly weary of the impacts of frequent flooding and sea level rise and climate change.... a few years later insurance companies may withdraw from certain areas, leaving whole communities without the ability to insure.” (Participant 8)

⁹ Mayoral relief funds are a type of a disaster relief fund that is administered by a local authority formulated to support the disaster impacted communities in Aotearoa New Zealand (NEMA,2019).

In addition to the lack of sufficient funds, community vulnerability in the aftermath of a disaster also affects how communities can improve their resilience (*cf.* Shrestha, 2016) as opposed to ‘just build[ing] back the same’ (Participant 4) and experiencing recurring impacts. When it comes to small-scale recurring disasters, this is what some scholars (Gaillard et al., 2019; Shrestha & Gaillard, 2013) have called the ratcheting effect – that is, the process of generating a vicious spiral of impacts, vulnerabilities, and risks through a series of events (Wisner, 2004).

As one participant suggested, ‘perhaps when communities adapt or ‘build back better’ the impacts decrease over time’ (Participant 4). When considering the recovery from small-scale recurring disasters, participants suggested that better land-use planning may be more effective than using funds to build back better, because it can reduce the amount of people placed at risk of disasters in the first place.

6.5.3 Unavailability of an agreed methodology to trigger emergency response for small-scale disasters

As discussed above, agencies are often activated by the emergency management system to deal with small-scale disasters in a BAU fashion. There are, however, differences in how those agencies are activated across the country. One participant confirmed that those agencies are often a part of the emergency response but ‘not always the lead for it’ (Participant 3). They also noted that the ‘CDEM isn't an organisation, it's a system of management. So, it's really about coordination between the agencies who have responsibilities for providing services’ (Participant 8). Additionally, the CDEM does not set a minimum threshold for the BAU service activation. It only provides ‘universal support’ – that is, it activates support for anyone in need at any time, especially as the threshold levels for activation of services are ambiguous and considered on a case-by-case basis:

“The threshold for us getting involved in the flooding in Westport was much lower than us getting involved in similar flooding, say in Canterbury, and it's simply because the West Coast has far fewer resources than in Canterbury.” (Participant 3)

This shows that current disaster governance mechanisms don't have any nation-wide consistent thresholds available to clearly account for small-scale recurring disasters, hence how, and if, those

disasters are considered depends on the capacity and capability of local authorities.¹⁰ From the interviews, it appears that emergency response mechanisms have a more community-based approach seeking to establish what are their risk tolerance levels. In particular, Participant 1 described how, in their work, they are ‘canvassing the community to give the level of information, what the community ... think, are the minimum thresholds’ and that they are ‘working through this on a couple of projects’. Another participant said that they involve the community and come up with a plan that also looks at community vulnerabilities and involves discussions about the community response planning process. In this case, the local community has also established response groups to activate and look after themselves until help can arrive. This approach relies on their local knowledge to inform authorities of disasters or risks they are unaware of. Additionally, local authorities are enhancing awareness of the communities about their own ability to ‘respond and look after themselves’ (Participant 5).

Importantly, it was noted that the ‘CDEM legislation is best described as a bit of a gap filler, effectively when a situation can't be dealt with via normal BAU mechanisms’ (Participant 3). While there aren't any minimum threshold limits for the activation of emergency services, there are key triggers for such activation, which is dependent on the situation. For example, one participant explained that the key trigger for the activation of emergency services was ‘no accessibility (community isolation)’ (Participant 5). Another said that the ‘scale of our responses is hugely dependent on the vulnerability of the community’ (Participant 3). While most participants agreed that community vulnerability is a key consideration in the emergency services decisions, this is sometimes considered a one-off situation and may not include communities that encounter repeated small events. However, one participant contradicted this perspective by suggesting that it is not the vulnerability that really matters in the activation of emergency services but the impact of the disaster.

¹⁰ It is important to note that since data collection and analysis was completed, Aotearoa-New Zealand has introduced a risk tolerance methodology in order to enable a consistent robust decision-making approach for risk tolerance in the country (<https://www.eqc.govt.nz/resilience-and-research/research/search-all-research-reports/risk-tolerance-methodology/>). It is still unknown, however, how such methodology will help small-scale recurring disasters to be better accounted for.

Another central theme that we identified in the interview data encompassed community choices to accept living in areas with recurring risks such as flooding. As one participant explained, some communities could expect:

“...to have water left in their doorstep or in the house. But the consequences were such that they were willing to take that risk in live there. So that was the kind of personal choice from an organisational perspective.” (Participant 8)

Another participant reported that they are starting to discuss with the affected communities whether they should remain in the location where they are currently living at risk or whether they should move elsewhere. This suggests that some affected communities living in recurring disaster areas are either aware or made aware about the associated risks, and then make decisions around the extent to which they are prepared to accept this risk. It also confirms a known trend of shifting responsibilities to communities (Garrido & Saunders, 2018), as opposed to strengthening how disaster governance systems can and should account for small-scale recurring disasters which may become more frequent due to climate change.

6.6 Discussion

Much of the scholarship on small-scale recurring disasters has shown the importance of understanding the risks, impacts and recovery processes related to these disasters (e.g., Boubacar et al., 2017; Brennan & Danielak, 2021; Cadag et al., 2017; Fraser et al., 2020; Liu et al., 2015; Marulanda et al., 2010; Shrestha & Gaillard, 2013). This study sought to investigate the extent to which current emergency response and recovery approaches in Aotearoa New Zealand accounted for small-scale recurring disasters, and how current practices could enable a more comprehensive and equitable entry point for local emergency response and recovery, and thus improve communities' adaptation capacity. These considerations are important, both in light of the increasing frequency of small-scale recurring disasters as a result of climate change, and because disaster risk governance aims to build coping capacity under complex and uncertain conditions (Ikeda & Nagasaka, 2011; IRGC, 2017). Our findings confirmed that small-scale recurring disasters are not fully considered in current emergency response and recovery approaches due to a lack of recognition of what small-scale disasters are and a failure to capture factors such as their cumulative impacts. In addition, our findings also point to the absence of effective recovery mechanisms and standardised methodology to trigger emergency services for small-scale disasters

at the time of data collection. Hence, to overcome these shortcomings and enable a more comprehensive and equitable entry point for local emergency response and recovery to account for small-scale recurring disasters, and thus improve communities' adaptation capacity, we need to: i) have a clear understanding of what elements characterises small-scale recurring disasters, and how to incorporate their cumulative impacts into decision-making; ii) review existing recovery mechanisms to also account for small-scale disasters; and, iii) establish more consistent decision-making methodology for emergency response and recovery.

6.6.1 Understanding small-scale recurring disasters and their cumulative impact

Our research confirms the findings from other studies (e.g., Cadag et al., 2017; Shrestha & Gaillard, 2013) regarding the lack of consensus on what constitutes a small-scale disaster, and whether they should be considered as disasters. This uncertainty is likely borne from past deliberations regarding the level at which a natural hazard event and its impacts qualify as a 'disaster' (Tierney et al., 2001). This is further compounded when there are conceptual differences about what being impactful means in different contexts (for example, an infrastructure service disruption or broad community resilience impacts). This results in diverse and contextual interpretations, which affect the activation of emergency services from response to recovery. As our findings indicate that the activation of emergency services for disasters are made on a case-by-case basis, and are locally specific, their recognition may also depend on the local adaptive capacity and/ or resource availability. Additionally, when faced with significant limitations of resources and time, emergency managers have the difficult task of prioritising which disasters promptly receive assistance, and how much assistance is provided (Handmer, 2008). Our findings concur with those from Brennan and Danielak (2021) who found that disaster risk governance is largely based on short-term consequences and impacts, and smaller-scale disasters are often left out when their impacts are not directly identifiable, cumulative, or they occur at the same time as large-scale ones.

This could perpetuate inconsistencies in how emergency services are activated, leaving some affected communities out of the equation. Hence, a better understanding of the characteristics of small-scale disasters and their impacts is needed. Consequently, when these events are assessed, it is possible to determine whether their cumulative effects may be equivalent to other large-scale

disasters, or the increasing impacts are a result from climate change. In either case, such understanding could help trigger support for response and recovery to affected communities in a more efficient manner.

Such understanding may require a participatory approach, where the community is supported to identify the problems and potential interventions they need if affected by those disasters. In particular, a participatory approach would enable greater identification of the community's ability to withstand or recover from further and recurring exposures to small-scale disasters. A more comprehensive assessment of cumulative impacts that incorporates social indicators, such as community adaptive capacity, resilience, and deeper understanding of community and regional well-being, may result in more plausible outcomes (Weber et al., 2012).

Our findings concur with Brennan and Danielak's (2021) study which found that the cumulative impacts of small-scale disasters have not been well understood. In particular, while our study observed that the importance of cumulative impacts is acknowledged by participants and guidelines alike (e.g., Recovery Preparedness and Management guidelines, section 7.2. NEMA's, 2019), the operationalisation of what comprises the response to cumulative impacts is missing from both practice and policy. Participants were unsure how to capture cumulative impacts in practice, and were not aware of any guidelines to address them. Hence, as highlighted by Brennan and Danielak (2021), disaster risk governance needs to better account for cumulative impacts, especially as those could become more frequent and coupled with small-scale disasters.

On a positive note, there are a number of efforts that are being implemented in Aotearoa New Zealand concerning cumulative impacts. These include 'The Aotearoa Cumulative Effects Framework' (National Science Challenges, 2023), making cumulative effects assessment a key element of impact (Planning, 2008) and risk-based planning assessments (Saunders & Kilvington, 2016). Further efforts, however, are needed to include the consideration of cumulative effects into policy frameworks, especially for small-scale recurring disasters so as to ensure more equitable distribution of emergency management resources. This may start with improved management of small-scale recurring disasters through a stronger approximation between disaster risk governance frameworks and land-use planning. As suggested by Brennan and Danielak (2021), greater focus and investment in disaster preparedness and mitigation targeting small-scale disasters needs to be

embedded in land-use planning to minimise disaster risks, because poor land-use planning can undermine local capacity and community resilience by increasing their vulnerability to those risks.

6.6.2 Review existing recovery mechanisms to account for small-scale disasters

Although existing international disaster governance frameworks (e.g., Sendai Framework for Disaster Risk Reduction; International Risk Governance Centre Framework) emphasise the post disaster recovery phase, our findings suggest that small-scale recurring disasters often don't undergo a complete recovery phase in contrast to larger-scale ones. This is due to a number of reasons, including lack of institutional frameworks and recognition of the impacts of small-scale events. Our findings showed some consensus among the participants that this may be due to the fact that the CIMS framework guiding emergency response focuses more on response rather than recovery. Nevertheless, the recovery preparedness and management guideline under the CDEM specifies that 'recovery should be flexible and scalable', be applied to disasters of any scale and provide individuals and households with opportunities to access recovery services (NEMA, 2019a, p. 8). In practice, however, this recovery mechanism does not seem to be fully functioning, because access to insurance is a well-established recovery strategy for smaller-scale disasters.

The availability, and affordability, of insurance for some localities may be short-lived however, as climate change may increase the number and frequency of disasters (Storey et al., 2017). This will result in higher insurance premiums and the withdrawal of insurance coverage from certain areas in the future (Owen et al., 2019). Additionally, our findings concurred with those of Marsh et al. (2022) who also found that not only are insurance premiums and excess payments increasing, but this will also be an issue for recurring disasters. Furthermore, insurance may not necessarily support long-term community resilience strategies that seek to 'build back better', as insurance indemnity principles prohibit significant property improvements (O'Hare et al., 2016). This leads to a ratchet effect, as affected communities encounter the impacts repeatedly multiple times (Gaillard et al., 2019; Shrestha & Gaillard, 2013). In failing to recover, affected communities become more vulnerable to new risks (Shrestha & Gaillard, 2013).

6.6.3 Establish more consistent decision-making methodology for emergency response and recovery

Our results showed the absence of consistent methodology to activate emergency services for small-scale disasters. While this enables some degree of creativity and flexibility on-the-ground, it creates inconsistency in operating procedures and systems across the country (Sowry, 2017). Adding to this is the adoption of the AHA, which doesn't require decisions to be guided by pre-determined threshold or scale-based criteria. As large-scale disasters attract more attention when they occur simultaneously with small-scale disasters (Cadag et al., 2017), a lack of methodology for acknowledging the latter not only further compounds such inconsistencies, but also may contribute to the exacerbation of the above-mentioned ratchet effect. Hence, disaster risk governance needs to consider planning for, and developing, service-delivery solutions that are specific to small-scale recurring disasters.

A key solution to this might be greater involvement of affected communities in emergency response and recovery planning. In particular, both the International Risk Governance Council framework and the disaster literature have shown the important role of local authorities and communities as first responders to disasters (IRGC, 2017; Lavell, 2002), especially in the case of small-scale disasters (Pando & Lavell, 2012). In addition, the recovery process of small-scale disasters can also be framed from the perspective and experience of those affected, as opposed to external actors as in large-scale disasters (Shrestha & Gaillard, 2013). This notion emphasises that community engagement can improve the relevance of the decision-making and performance of disaster risk governance outcomes (IRGC, 2017). Importantly, Aotearoa New Zealand's disaster governance approach follows this concept, with emergency management specialists becoming increasingly encouraged to involve the community in disaster risk governance, by obtaining information on their risk acceptance levels and developing community response plans. This ensures that perspectives from a range of stakeholders are incorporated, and helps to better understand and manage disaster risk, resulting in more effective, fair, and acceptable decisions (IRGC, 2017).

Furthermore, the IRGC (2017) emphasises that risk evaluation and management need to go beyond a scientific risk assessment to also include affected communities' understanding of risks and their

consequences. Notably, the 'Wharekawa Coast Project -2120' in the Waikato region of Aotearoa New Zealand is one important example of this practice (Wharekawa coast 2120, n.d.). The project aims to examine a broader range of issues affecting the area by studying historical river flooding events and related community impacts, to inform a long-term resilience strategy for the sustainable management of the coast. This is done through the involvement of local communities, who assist authorities to assess the risks associated with natural hazards and determine the thresholds at which coastal and stream flooding become intolerable to local residents.

Insights gained from the communities are set to be useful to evaluate mitigation options and to determine community's appetite for risk (NEMA, 2022). However, this is a challenging exercise, as risks cannot simply be accepted because a community does not wish, or does not have the means, to mitigate them (Ministry for the Environment, 2010). Community decisions related to risk appetite and risk thresholds¹¹ are determined by the community characteristics, such as their vulnerability, which can affect when they reach intolerable levels. In addition, choosing the level of risk acceptance can be difficult when there are benefits and trade-offs involved (e.g., restrictions on land-use zoning regulations or development constraints). It is therefore important to strike a balance between the benefits and the costs involved in mitigation. Such exercises would shed light on the extent to which communities are willing to accept risk and conceptualise the entry point for disaster risk reduction measures.

Finally, there is a need for disaster risk governance approaches to move beyond a technical emphasis and provide a more on-the-ground community-based approach, to account for small-scale recurring disasters. In the absence of consistent and tailored emergency management policies for small-scale recurring disasters, strengthening the adaptation capacity of communities is paramount, especially because those disasters are likely to increase in frequency due to climate change. The creation of participatory community risk acceptance thresholds would not only provide insights for a more comprehensive and equitable community emergency response and recovery process. These thresholds could also inform disaster risk reduction decisions based on

¹¹ "The community risk threshold is the point at which a community can no longer tolerate the impacts of the risk, which is defined by the frequency of how often can a given set of impacts occur before they no longer are tolerable." Marsh, S., Mills, W., Mourot, P., Hume, T., Liefting, R., & Hunt, S. (2022). *Wharekawa coast 2120: Natural hazard risk assessment* (2020/08). <https://www.waikatoregion.govt.nz/assets/WRC/TR202008.pdf> p.29

the risk tolerance of communities with, or without, risk reduction interventions. As a result, small-scale disasters can be identified as early warning signals which need to be mitigated and monitored before the risk accelerates (Gordy, 2016). It is important to stress, however, that such community engagement does not mean shifting all responsibility to communities to deal with those disasters on their own, but to provide the necessary support and resources to assist them to improve their disaster resilience.

6.7 Conclusion

In this study, Aotearoa New Zealand's current emergency response and recovery practices were examined to understand the extent to which they accommodate small-scale recurring disasters, and to suggest ways forward to enable a more comprehensive and equitable entry point for local emergency response and recovery, and thus improve adaptation capacity of communities and localities experiencing similar circumstances. Drawing on empirical data from emergency management specialists, our results offered a number of insights for scholarship and practice that are useful to improve disaster governance mechanisms for small-scale recurring disasters beyond Aotearoa New Zealand. As a starting point, we found that disaster risk governance mechanisms in Aotearoa New Zealand do not sufficiently address small-scale recurring disasters, although the AHA is expected to be applied to a full spectrum of disasters. As such, there is a need to identify what constitutes a non-catastrophic disaster to develop policies and practices that are consistent across countries and jurisdictions following the AHA. Further, we have identified a gap in the emergency response mechanisms regarding the identification of cumulative impacts from small-scale disasters. This contributes to some types of disaster impacts going under the radar, and being ineligible to obtain emergency response and recovery assistance. Thus, it is necessary to operationalize the concept of cumulative impacts in emergency management frameworks to enable small-scale disasters to effectively portray the need for response and recovery assistance and resources.

Second, we recognised that the trajectory for the recovery from small-scale recurring disasters need to be re-examined. Short-term recovery strategies that are currently available for small-scale disasters appear to work well, since repetitions of these events can be well predicted, thus allowing risk transfer to be practical. We identified that for some individuals and communities, there has been a choice to live with small-scale recurring disasters. However, the projections of a growing number of disasters due to climate change suggest that communities encountering small-scale

recurring disasters may become increasingly vulnerable to future disasters. When small-scale disaster cycles keep repeating, there is an impact on the recovery process; therefore, a long-term sustainable mechanism needs to be introduced to break the cycle of events interfering with the recovery process. In particular, this consideration is important for communities that have ad hoc or informal recovery strategies.

Third, we identified that a consistent policy for responding to small-scale recurring disasters is unavailable due to a number of factors. This includes the application of different response mechanisms under the BAU operations of various organisations, and the absence of a top-down policy direction. Another reason we identified was the flexibility provided to emergency services through governance mechanisms that create room for inconsistencies and prevent the delivery of standardised minimum levels of support to affected communities. This needs to be re-addressed to ensure the availability of consistent and coherent emergency management resources for the affected communities.

To conclude, this study suggests that a best practice disaster risk governance approach for managing small-scale recurring disasters entails a community-led approach to determine the level of risk accepted by communities. This would give emergency management practitioners a practical way of initiating their response and recovery services, as well as decisions regarding disaster risk reduction. Using this bottom-up approach to scale up disaster risk governance mechanisms will enable small-scale recurring disasters to be managed more pro-actively, instead of reactively in, and by, any community.

This study was conducted in 2021 during the COVID 19 pandemic and other subsequent disasters pertaining to natural hazards. It is therefore important to stress that the emergency management specialists who participated in the study were dealing with multiple stressors at that time. Due to this, there was a limited number of participants willing to participate in the interviews, leading to limitations to the study's results in terms of exploring different community interventions in different localities. In the future, more broad scale studies related to small-scale disaster response and recovery will help overcome these gaps and identify potential improvements for shortcomings in policy and practice, as well as potential innovative practices.

6.8 References

- Alam, E., & Ray-Bennett, N. S. (2021). Disaster risk governance for district-level landslide risk management in Bangladesh. *International Journal of Disaster Risk Reduction*, 59, 1-13. <https://doi.org/10.1016/j.ijdr.2021.102220>
- Alexander, D. E. (2015). Disaster and emergency planning for preparedness, response, and recovery. In. Oxford University Press.
- Ardaya, A. B., Evers, M., & Ribbe, L. (2019). Participatory approaches for disaster risk governance? Exploring participatory mechanisms and mapping to close the communication gap between population living in flood risk areas and authorities in Nova Friburgo Municipality, RJ, Brazil. *Land Use Policy*, 88, 104103. <https://doi.org/10.1016/j.landusepol.2019.104103>
- Baker, D., & Refsgaard, K. (2007). Institutional development and scale matching in disaster response management. *Ecological Economics*, 63(2-3), 331-343. <https://doi.org/https://doi.org/10.1016/j.ecolecon.2007.01.007>
- Bazeley, P., & Jackson, K. (2013). Qualitative data analysis with NVivo (second edition ed.). SAGE Publications Ltd. https://us.sagepub.com/sites/default/files/upm-assets/114916_book_item_114916.pdf
- Becker, J., & Saunders, W. (2007). Enhancing sustainability through pre-event recovery planning. *Planning Quarterly*, 164, 14-18. <https://www.qualityplanning.org.nz/sites/default/files/Enhancing%20Sustainability%20through%20PreEvent%20Recovery%20Planning.pdf>
- Bodas, M., Kirsch, T. D., & Peleg, K. (2020). Top hazards approach—Rethinking the appropriateness of the All-Hazards approach in disaster risk management. *International Journal of Disaster Risk Reduction*, 47, 101559. <https://doi.org/https://doi.org/10.1016/j.ijdr.2020.101559>
- Boubacar, S., Pelling, M., Barcena, A., & Montandon, R. (2017). The erosive effects of small disasters on household absorptive capacity in Niamey: A nested HEA approach. *Environment and Urbanization*, 29(1), 33-50. <https://doi.org/10.1177/0956247816685515>
- Brennan, M. E., & Danielak, S. (2021). Too small to count? The cumulative impacts and policy implications of small disasters in the Sahel. *International Journal of Disaster Risk Reduction*, 102687. <https://doi.org/https://doi.org/10.1016/j.ijdr.2021.102687>
- Burton, C. (2010). The Death of All Hazards Planning. *Disaster Recovery Journal*, 23(3).
- Cadag, J. R. D., Petal, M., Luna, E., Gaillard, J., Pambid, L., & Santos, G. V. (2017). Hidden disasters: Recurrent flooding impacts on educational continuity in the Philippines. *International Journal of Disaster Risk Reduction*, 25, 72-81. <https://doi.org/https://doi.org/10.1016/j.ijdr.2017.07.016>
- Civil Defence Emergency Management Act, Ministry of Civil Defence. Public Act (2002).
- Coppola Damon, P. (2015). Chapter 6 - Response. In *Introduction to International Disaster Management (Third Edition)*, pp. 321–404. Elsevier Inc. <https://doi.org/10.1016/B978-0-12-801477-6.00006-X>
- Coughlan de Perez, E., van den Hurk, B., Van Aalst, M., Jongman, B., Klose, T., & Suarez, P. (2015). Forecast-based financing: An approach for catalyzing humanitarian action based on extreme weather and climate forecasts. *Natural Hazards and Earth System Sciences*, 15(4), 895-904. <https://doi.org/10.5194/nhess-15-895-2015>, 2015.

- Damon, P. C. (2015). Chapter 5 - Preparedness. In *Introduction to International Disaster Management* (Third Edition ed., pp. 275-320). Elsevier Inc. <https://doi.org/10.1016/B978-0-12-801477-6.00005-8>
- Djalante, R., & Garschagen, M. (2017). A Review of Disaster Trend and Disaster Risk Governance in Indonesia:1900–2015. In *Disaster Risk Reduction in Indonesia* (pp. 21–56). Springer International Publishing. https://doi.org/10.1007/978-3-319-54466-3_2
- Etkin, D. (2016). *Disaster theory:An interdisciplinary approach to concepts and causes*. Butterworth-Heinemann.
- Fraser, A., Pelling, M., Scolobig, A., & Mavrogenis, S. (2020). Relating root causes to local risk conditions: A comparative study of the institutional pathways to small-scale disasters in three urban flood contexts. *Global environmental change*, 63, Article 102102. <https://doi.org/https://doi.org/10.1016/j.gloenvcha.2020.102102>
- Gaillard, J. (2016). Natural hazards and disasters. *International Encyclopedia of Geography: People, the Earth, Environment and Technology:People, the Earth, Environment and Technology*, 1-15.
- Gaillard, J., van Niekerk, D., Shoroma, L. B., Coetzee, C., & Amirapu, T. (2019). Wildlife hazards and disaster risk reduction. *International Journal of Disaster Risk Reduction*, 33, 55-63. <https://doi.org/10.1016/j.ijdr.2018.09.009>
- Gaillard, J. C. (2007). Resilience of traditional societies in facing natural hazards. *Disaster Prevention and Management:An International Journal* 16(4):522-544 2007. <https://doi.org/10.1108/09653560710817011>
- Garrido, J., & Saunders, W. S. A. (2018). Disaster Risk Reduction and Land Use Planning: Opportunities to Improve Practice. In: Shakoor, A., Cato, K. (eds) IAEG/AEG Annual Meeting Proceedings, San Francisco, California, 2018 - Volume 5. Springer, Cham. https://doi-org.ezproxy.waikato.ac.nz/10.1007/978-3-319-93136-4_20
- Gordy, M. (2016). The Importance of Extensive Risk. In *Disaster Risk Reduction and the Global System: Ruminations on a Way Forward* (pp. 39-41). Springer International Publishing. https://doi.org/10.1007/978-3-319-41667-0_8
- Gregory, P. A. (2015). Reassessing the Effectiveness of All-Hazards Planning in Emergency Management. *Inquiries Journal/Student Pulse*, 7(06). <http://www.inquiriesjournal.com/a?id=1050>
- Hemachandra, K., Amaratunga, D., & Haigh, R. (2018). Role of women in disaster risk governance. *Procedia engineering*, 212, 1187-1194. <https://doi.org/10.1016/j.proeng.2018.01.153>
- IFRC. (2001). *World Disasters Report: Focus on recovery*. <https://www.alnap.org/help-library/world-disasters-report-2001-%E2%80%93-focus-on-recovery>
- Ikeda, S., & Nagasaka, T. (2011). An emergent framework of disaster risk governance towards innovating coping capability for reducing disaster risks in local communities. *International Journal of Disaster Risk Science*, 2(2), 1-9. <https://doi.org/10.1007/s13753-011-0006-7>
- IPCC. (2022). *Climate change 2022:Impacts, adaptation and vulnerability* (Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Issue. C. U. Press. <https://www.ipcc.ch/assessment-report/ar6/>
- IRGC. (2017). *Introduction to the IRGC risk governance framework*. <https://irgc.org/risk-governance/irgc-risk-governance-framework/>

- Lavell, A. (2002). Local Level Risk Management. Concepts and Experience in Central America. Disaster Preparedness Summit, 21-23 November 2002. New Delhi India.
- Lianxiao, Morimoto, T., Siqin, T., An, C., Yuhai, B., & Fei, G. (2022). Evaluating Regional Flood Disaster Resilience Based on the DROP Model and TOPSIS Method: A Case Study of the Katsushika Ward, Tokyo. *Natural Hazards Review*, 23(3), [https://doi.org/10.1061/\(ASCE\)NH.1527-6996.0000551](https://doi.org/10.1061/(ASCE)NH.1527-6996.0000551)
- Liu, Y., Feng, G., Xue, Y., Zhang, H., & Wang, R. (2015). Small-scale natural disaster risk scenario analysis: a case study from the town of Shuitou, Pingyang County, Wenzhou, China. *Natural Hazards*, 75(3), 2167-2183. DOI: 10.1007/s11069-014-1420-0
- Logan, T. M., & Guikema, S. D. (2020). Reframing resilience: Equitable access to essential services. *Risk analysis*, 40(8), 1538-1553
- Magrath, J. (2007). Climate alarm: Disasters increase as climate change bites. *Oxfam Policy and Practice: Climate Change and Resilience*, 3(2), 1-28. https://oxfamlibrary.openrepository.com/bitstream/handle/10546/114103/bp108-climate-alarm-250108_en.pdf;jsessionid=D2704DC3939E8B774C6366F42EC5AC4A?sequence=1
- Marsh, S., Mills, W., Mourot, P., Hume, T., Liefting, R., & Hunt, S. (2022). *Wharekawa coast 2120: Natural hard risk assessment* (2020/08). <https://www.waikatoregion.govt.nz/assets/WRC/TR202008.pdf>
- Marulanda, M. C., Cardona, O. D., & Barbat, A. H. (2010). Revealing the socioeconomic impact of small disasters in Colombia using the DesInventar database. *Disasters*, 34(2), 552-570. <https://doi.org/https://doi.org/10.1111/j.1467-7717.2009.01143.x>
- Mason, K., Lindberg, K., Haenfling, C., Schori, A., Marsters, H., Read, D., & Borman, B. (2021). Social vulnerability indicators for flooding in aotearoa New Zealand. *International Journal of Environmental Research and Public Health*, 18(8), 3952. <https://doi.org/https://doi.org/10.3390/ijerph18083952>
- MCDEM. (1990). *Civil defence in New Zealand: A short history*. Ministry of Civil Defence with the assistance of the Historical Branch, Dept. of Internal Affairs.
- MCDEM. (2019). *National Disaster Resilience Strategy*. <https://www.civildefence.govt.nz/cdem-sector/plans-and-strategies/national-disaster-resilience-strategy/>
- Melo Zurita, M. d. L., Cook, B., Harms, L., & March, A. (2015). Towards new disaster governance: Subsidiarity as a critical tool. *Environmental Policy and Governance*, 25(6), 386-398. <https://doi.org/10.1002/eet.1681>
- Ministry for the Environment New Zealand. (2020). *National Climate Change Risk Assessment for Aotearoa New Zealand: Main report – Arotakenga Tūraru mō te Huringa Āhuarangi o Āotearoa: Pūrongo whakatōpū*. <https://environment.govt.nz/publications/national-climate-change-risk-assessment-for-new-zealand-main-report/>
- National Science Challenges. (2023, 2023). *Aotearoa Cumulative Effects (ACE) framework*. <https://www.sustainableseaschallenge.co.nz/tools-and-resources/ace-framework/>
- NEMA. (2019). *Recovery Preparedness and Management: Director's Guideline for Civil Defence Emergency Management Groups [DGL 24/20]*. <https://www.civildefence.govt.nz/assets/Uploads/recovery/DGL24-20/Recovery-DGL24-20-Full-Version.pdf>

- NEMA. (2022). *Risk assessment: guidance for CDEM Group planning* National Emergency Management Agency. <https://www.civildefence.govt.nz/assets/Uploads/Risk-Assessment-Guidance-for-CDEM-Group-Planning-Directors/Risk-Assessment-Guidance-for-CDEM-Group-Planning-Directors-Guideline-DGL-2322-PDF-3.03MB.pdf>
- O'Hare, P., White, I., & Connelly, A. (2016). Insurance as maladaptation: Resilience and the 'business as usual' paradox. *Environment and Planning C: Government and Policy*, 34(6), 1175-1193. <https://doi.org/10.1177/0263774X15602022>
- Oliver-Smith, A. (1996). Anthropological Research on Hazards and Disasters. *Annual Review of Anthropology*, 25, 303-328. <http://www.jstor.org/stable/2155829>
- Osuteye, E., Johnson, C., & Brown, D. (2017). The data gap: An analysis of data availability on disaster losses in sub-Saharan African cities. *International Journal of Disaster Risk Reduction*, 26, 24-33. <https://doi.org/http://dx.doi.org/10.1016/j.ijdr.2017.09.026>
- Owen, S., Noy, I., Pástor-Paz, J., & Fleming, D. (2019). EQC and extreme weather events (part 2): Measuring the impact of insurance on New Zealand landslip, storm and flood recovery using nightlights. *Storm and Flood Recovery Using Nightlights (November 20, 2019)*.
- Pando, L. R. R., & Lavell, A. (2012). Extensive and every day risk in the Bolivian Chaco: Sources of crisis and disaster. *Journal of Alpine Research/ Revue de géographie alpine*(100-1). <https://doi.org/https://doi.org/10.4000/rga.1719>
- Pearson, L., & Pelling, M. (2015). The UN Sendai framework for disaster risk reduction 2015–2030: Negotiation process and prospects for science and practice. *Journal of Extreme Events*, 2(01), 1571001.
- Planning, Q. (2008). *When is enough, enough?: Dealing with cumulative effects under the resource management act*. https://www.qualityplanning.org.nz/sites/default/files/When_is_Enough_Enough_Dealing_with_Cumulative_Effects_Under_the_RMA.pdf
- Pokarier, C. (2012). Scales of Disaster: conceptual reflections on 11.3. 11 11th Annual Conference of Asian Studies, Tel Aviv, Israel.
- Raikes, J., Smith, T. F., Jacobson, C., & Baldwin, C. (2019). Pre-disaster planning and preparedness for floods and droughts: A systematic review. *International Journal of Disaster Risk Reduction*, 38, 101207. <https://doi.org/https://doi.org/10.1016/j.ijdr.2019.101207>
- Raworth, K., Sweetman, C., Narayan, S., Rowlands, J., & Hopkins, A. (2012). *Conducting semi-structured Interviews*. Oxfam.
- Ray-Bennett, N. S., Masys, A., Shiroshita, H., & Jackson, P. (2015). Reactive to proactive to reflective disaster responses: Introducing critical reflective practices in disaster risk reduction. In *Hazards, Risks, and Disasters in Society* (pp. 99-117). Elsevier.
- Rotimi, J. O. B. (2010). *An Examination of improvements required to legislative provisions for post disaster reconstruction in New Zealand* [Doctoral Thesis, University of Canterbury]. UC Research Repository. <https://ir.canterbury.ac.nz/handle/10092/4145>
- Sai, F., Cumiskey, L., Weerts, A., Bhattacharya, B., & Haque Khan, R. (2018). Towards impact-based flood forecasting and warning in Bangladesh: A case study at the local level in Sirajganj district. *Natural Hazards and Earth System Sciences Discussions*, 1-20. <https://doi.org/https://doi.org/10.5194/nhess-2018-26>
- Saunders, W. S., & Kilvington, M. (2016). Innovative land use planning for natural hazard risk reduction: A consequence-driven approach from New Zealand. *International Journal*

- of Disaster Risk Reduction, 18, 244-255.
<https://doi.org/http://dx.doi.org/10.1016/j.ijdr.2016.07.002>
- Shah, A. A., Gong, Z., Pal, I., Sun, R., Ullah, W., & Wani, G. F. (2020). Disaster risk management insight on school emergency preparedness—a case study of Khyber Pakhtunkhwa, Pakistan. *International Journal of Disaster Risk Reduction*, 51, 101805.
<https://doi.org/https://doi.org/10.1016/j.ijdr.2020.101805>
- Shi, P. (2019). Hazards, disasters, and risks. In *Disaster Risk Science* (pp. 1-48). Springer.
- Shrestha, S. (2016). *Adrista Sangharsaharu, Sthaniya Sabalta: Exploring recovery from small-scale disasters: Examples from remote Nepal* [Doctoral Thesis, The University of Auckland]. Auckland, New Zealand.
<https://researchspace.auckland.ac.nz/handle/2292/31699>
- Shrestha, S., & Gaillard, J. (2013, 26-30 May). *Small-scale disasters and the recovery process* [Conference paper]. 6th International i-Rec conference: Sustainable Post-Disaster Reconstruction: From Recovery to Risk Reduction, Ascona, Switzerland.
- Sowry, R. (2017). *Better responses to natural disasters and other emergencies: Ministerial review*. <https://apo.org.au/node/134066>
- Storey, B., Noy, I., Owen, S., Townsend, W., Kerr, S., Salmon, R., Middleton, D., Filippova, O., & James, V. (2017). Insurance, Housing and Climate Adaptation: Current knowledge and future research.
- Tennakoon, K., Serrao-Neumann, S., & Hanna, C. (2021). Examining the incorporation of small-scale recurring disasters in emergency management frameworks: Insights from Aotearoa–New Zealand. *International Journal of Disaster Risk Reduction*, 66, 102595.
<https://doi.org/https://doi.org/10.1016/j.ijdr.2021.102595>
- Thomas, V. (2017). *Climate change and natural disasters: Transforming economies and policies for a sustainable future*. Taylor & Francis.
- Tierney, K. (2008). Hurricane Katrina: Catastrophic impacts and alarming lessons. In J. Quigley and L. A. Rosenthal (Eds.), *Risking house and home: Disasters, cities, public policy*, (pp.119-136). Berkeley: Berkeley Public Policy Press.
- Tierney, K. J., Lindell, M. K., & Perry, R. W. (2001). *Facing the Unexpected: Disaster Preparedness and Response in the United States*. The National Academies Press.
<https://doi.org/doi:10.17226/9834>
- UNDP. (2012). *Issue brief: Disaster risk governance*
https://www.preventionweb.net/files/29974_20121311issuebriefdisasterriskreduc.pdf, Issue.
- United Nations Office for Disaster Risk Reduction. (2019). *Global assessment report on disaster risk reduction (GAR)*. <https://gar.unisdr.org/report-2019>.
- Weber, M., Krogman, N., & Antoniuk, T. (2012). Cumulative effects assessment: Linking Social, Ecological, and Governance Dimensions. *Ecology and Society*, 17(2).
<http://www.jstor.org/stable/26269026>
- Wharekawa coast 2120. (n.d.). Community risk thresholds. Retrieved 15.01.2023 from <https://wharekawacoast2120.hauraki-dc.govt.nz/>
- Wisner, B. (2004). *At risk: Natural hazards, people's vulnerability, and disasters* (2nd ed.). Routledge.
- Wisner, B., & Gaillard, J.C. (2009). An introduction to neglected disasters. *Jàmbá: Journal of Disaster Risk Studies*, 2(3), 151-158.
<https://doi.org/https://hdl.handle.net/10520/EJC51175>

- Wisner, B., Gaillard, J., & Kelman, I. (2012). Framing disaster: theories and stories seeking to understand hazards, vulnerability and risk. In *Handbook of Hazards and Disaster Risk Reduction* (pp. 47–62). Routledge. <https://doi.org/10.4324/9780203844236-13>
- Yin, R. K., & Campbell, D. T. (2018). *Case study research and applications: design and methods* (Sixth edition. ed.). SAGE Publications, Inc.
- Zaidi, R. Z. (2018). Beyond the Sendai indicators: Application of a cascading risk lens for the improvement of loss data indicators for slow-onset hazards and small-scale disasters. *International Journal of Disaster Risk Reduction*, 30, 306-314. <https://doi.org/https://doi.org/10.1016/j.ijdrr.2018.03.022>

7 Conclusions

7.1 Introduction

The literature related to disaster risk governance has largely evolved around large scale disasters, and previous research on small-scale disasters are scarce. Additionally, small-scale recurring disasters have not been addressed well in international disaster risk reduction and disaster risk governance frameworks. This has a trickle-down effect to national level disaster governance frameworks, including the ones guiding emergency management practices and policies. Additionally, the importance of small-scale recurring disasters does not seem to be apprehended, both in policy and practice, mainly because their risk and impacts cannot be directly captured. Therefore, this thesis aims to highlight the importance of improving the disaster risk governance frameworks and the related emergency management systems to ensure better outcomes for the affected communities.

This chapter outlines the research findings and provides overall conclusions of the research. It revisits the research aims and questions, assesses the main findings and contributions, identifies the limitations of the research, and provides recommendations for future research. This thesis used Aotearoa New Zealand as the case study to explore and examine the research questions. Based on the findings, the main argument that this thesis puts forward is the need for disaster risk governance frameworks to be revisited so as to address small-scale recurring disasters and ensure consistent and equitable allocation of emergency management resources to the affected communities.

7.2 Revisiting the research aims and questions

The main research theme that guided this thesis was “Understanding and improving disaster risk governance to address small-scale recurring disasters: insights from Aotearoa New Zealand”. The overarching objective of this research was to identify the extent to which Aotearoa New Zealand's emergency management regime accounts for small-scale recurring disasters and ways to improve their governance to ensure better outcomes for affected communities. Three research questions were developed in order to achieve the overall objective of the research.

Research question 1: To what extent are small-scale recurring disasters incorporated in Aotearoa – New Zealand’s emergency management frameworks?

Research question 2: How can the identification and classification of disaster scales and related impacts be improved to account for a broader spectrum of disasters and better inform disaster management policies and practice?

Research question 3: How can current practices enable a more comprehensive and equitable entry point for local disaster response and recovery, and thus improve the adaptation capacity of affected communities?

Each of these research questions have been answered through published and submitted articles presented in chapters 4, 5 and 6. Figure 7.1 below outlines the key findings of this thesis, that are elaborated in the following sections.

Overall Research Question

Identify the extent to which Aotearoa New Zealand's emergency management regime accounts for small-scale recurring disasters and ways to improve their governance

Research Question	Chapter	Findings	Contributions
To what extent are small-scale recurring disasters incorporated in Aotearoa New Zealand's emergency management frameworks?	Chapter 4 - Examining the incorporation of small-scale recurring disasters in emergency management frameworks: Insights from Aotearoa New Zealand	<ul style="list-style-type: none"> i) The two-dimensional risk assessment methodologies do not integrate the characteristics (cumulative and indirect) of small-scale recurring disasters sufficiently; ii) Adaptation of short-term solutions for recovery may be prioritised as opposed to long-term solutions; iii) Several on-the-ground implications for local level authorities in the absence of higher-level policy directives. 	Identification of the gaps in the disaster risk assessment methodology that need to be improved to capture the small-scale recurring disasters and the importance of having top-down policy directives on how these disasters could be managed at the ground level.
How can the identification and classification of disaster scales and related impacts be improved to account for a broader spectrum of disasters and better inform disaster management policies and practice?	Chapter 5- Identifying and classifying broader scale of disaster impacts to better inform disaster management policies and practice	<ul style="list-style-type: none"> i) The lack of coherence in data collection and reporting about disasters; ii) The limitations of primarily relying on rainfall intensity data for disaster risk reduction and planning; iii) The importance of identifying the economic damages of a range of disaster scales, including small-scale disasters. 	<ul style="list-style-type: none"> i) Improved understanding on the data collection and reporting gaps on small-scale disasters. ii) Importance of having a national level disaster data repository.
How can current practices enable a more comprehensive and equitable entry point for local disaster response and recovery, and thus improve the adaptation capacity of affected communities?	Chapter 6 - Pre-determining emergency response and recovery entry points for small-scale recurring disasters through a community-based approach.	<ul style="list-style-type: none"> i) Need for a clear understanding of what elements characterise small-scale recurring disasters ii) Need to review existing recovery mechanisms to also account for small-scale disasters; iii) Need to establish more consistent decision-making criteria for emergency response and recovery 	<ul style="list-style-type: none"> i) Identification of a community-based intervention as a best practice for the management of small-scale recurring disasters ii) The need for a consistent decision-making criteria for emergency response and recovery. iii) Identifying what constitutes a small-scale disaster at the local level.

Figure 7. 1 Research questions, findings and contributions

To answer the research questions, the thesis adopted a multi-methods approach. The first research question used a policy document analysis that adopted a documents analysis method to examine higher-level policy documents and other related documents under Aotearoa New Zealand's emergency management framework. A database analysis method was used for the second research question to analyse data on more 350 flood events over a 3-decade period in Aotearoa New Zealand. For the final research question, empirical data were collected through semi-structured interviews with emergency management experts to examine the institutional and operational practices related to the small-scale recurring disasters pertaining to emergency management.

Chapter four examined the emergency management framework in Aotearoa New Zealand and its processors, to understand the extent to which small-scale disasters were incorporated in the existing emergency management mechanism. To this end, the chapter analysed how risk is defined in Aotearoa New Zealand's emergency management framework and the extent to which it applied to risks pertaining to small-scale recurring disasters. The chapter contributes to the literature by discussing why and how emergency management frameworks in Aotearoa New Zealand have failed to include small-scale recurring disasters in legislation, strategies, and other processors, even though they cite their importance without practical application directives. It further illustrates the need for improving risk assessment mechanisms to capture the risks pertaining to small-scale recurring disasters, which can then be escalated to the higher levels of risk assessments that are geared for risk reduction considerations.

Chapter five analysed historical flood data for the past three decades in Aotearoa New Zealand to determine the dispersion of smaller-scale disasters within a broader spectrum of disasters. The purpose of this chapter was to analyse the key categories under which disaster data are collected and recorded, to determine if they captured information on small-scale disasters. Findings confirmed that the majority of flood-related disasters were non-catastrophic, exposing the inconsistencies in data reporting and recording related to small-scale disasters. This comprises a main barrier for identifying both their impacts and frequency of occurrence, which are important to inform policies and decisions on-the-ground.

Chapter six analysed empirical data gathered through semi-structured interviews with emergency management specialists operating across Aotearoa New Zealand. The chapter specifically examined the on-the-ground emergency response and recovery practices for small-scale disasters.

It also examined the availability of methodologies in the emergency management system for capturing the impacts of small-scale recurring disasters, and the consistency of the criteria applied to activate emergency management services to the affected communities, in relation to non-catastrophic disaster events. Findings showed that there were inconsistent approaches across the emergency management framework, and highlighted the gaps that need to be filled. The chapter also suggested best practices that could help improve the management of small-scale recurring disasters.

7.3 Research Findings

The research questions presented in Chapters four, five and six were designed to achieve the overall objective of this thesis: the need to understand and improve disaster risk governance to address small-scale recurring disasters. Below is a summary of the research findings for each research question.

Chapter four addressed the first research question: To what extent are small-scale recurring disasters incorporated in Aotearoa New Zealand's emergency management frameworks? Emergency management literature and policies are predominantly focused on large-scale disasters. This is largely due to their significant impacts and consequences that become evident directly after a disaster. However, the impacts of small-scale disasters are different from that of large-scale, in that they are often not immediately apparent. Although they may seem insignificant, they are cumulatively significant, and capturing them requires a further step in disaster risk assessments. This research identified that the conventional two-dimensional risk assessment methodology is not geared to capture the characteristics of small-scale recurring disasters (such as indirect and cumulative impacts). As a result, these disasters are frequently under-considered, without further evaluation and consideration for risk mitigation. While the existing methods of risk assessment acknowledge their cumulative impacts and importance, none of them provide a simple method for translating this into practice. Consequently, small-scale disasters are discounted from disaster risk reduction. This leaves small-scale recurring disasters to be managed under short-term recovery strategies (e.g., insurance mechanisms), especially in advanced economies such as Aotearoa New Zealand. The analysis of high-level policy documents revealed high insurance penetration of residential property across Aotearoa New Zealand. Although these short-term recovery strategies help communities return to functional levels quickly, in the longer run, they affect community's resilience capacity due to repeated occurrences. Consequently, short-term resilience solutions

neglect to consider the possibilities of repetition of these disasters and the chronic conditions that this could lead to. They also fail to support improvements in existing conditions and in building back better efforts. Furthermore, the emergency management framework lacks a community recovery mechanism for those who cannot afford insurance. Therefore, short-term resilience methods need to be revisited and developed to tailor the solutions for these small-scale recurring disasters. In addition to the above shortcomings, small-scale recurring disasters are not explicitly addressed by international disaster risk management frameworks. The findings have shown that these frameworks have not discussed the risks pertaining to small-scale recurring disasters, nor have they shown the importance of recording the data of such events. This results in a flow-on effect to national and local level frameworks, which leaves those on-the-ground to choose strategies that suit their particular situation. For example, due to the absence of a top-down policy directive for the management of small-scale disasters, local governments tend to adapt practices that are corresponding to their capacities and resource availability. This would create a resource allocation inequality. These findings provided a strong foundation to build on for the two subsequent research questions.

Chapter five addressed research question two: How can the identification and classification of disaster scales and related impacts be improved to account for a broader spectrum of disasters and better inform disaster management policies and practice? In Chapter five, flood disaster data spanning over three decades were analysed to identify how small-scale disasters are dispersed over the broad spectrum of disasters. The findings suggested that the majority of the disasters over the period were non-catastrophic. Nevertheless, current policies and strategies are not dealing with those events, but with those which are the minority – that is, the large-scale disasters. Since policies are often evidence-driven, when there is insufficient evidence to statistically prove the significance of the cumulative impacts of small-scale disasters, their importance becomes underrated. One of the main reasons contributing to the data gap is the fact that disaster data are mainly reported and recorded based on the conventional categories such as economic damages, evacuation information and rainfall data (hazard strength). There is an inherited gap in the way that data are collected which does not capture the indirect and cumulative impacts, therefore limiting the availability of small-scale disaster data for analysis and research. In addition, international disaster classifications are not detailed to the point that they capture non-catastrophic disasters. This has influenced the national level disaster classifications that do not detail well what the smaller-scales are. These

imprecise factors contribute to limiting the collection and recording of different spatial and temporal data for small-scale disasters. Such exclusion would interpret that the data on the impacts of small-scale disaster are unimportant. Therefore, emergency management practitioners are not provided with adequate evidence to inform their decisions. Climate change-driven disaster events show that small-scale disasters are an early indication of larger-scale risks that accumulate over time. Therefore, sufficient amounts of consistent disaster data are necessary for understanding the disaster trends and patterns to inform risk modelling and long-term land use planning related decisions.

Chapter six addressed research question three: How can current practices enable a more comprehensive and equitable entry point for local disaster response and recovery, and thus improve the adaptation capacity of affected communities? This chapter used primary data gathered from semi-structured interviews with emergency management specialists related to on-the-ground emergency management practices concerning small-scale recurring disasters. Small-scale disaster response is primarily handled by ‘business as usual’ operations of multiple organizations. Response strategies vary, are ambiguous and do not trigger activation under a common country wide threshold. This practice does not warrant equitable support under the emergency management services to the affected communities. Additionally, the legislation that governs the emergency management framework provides flexibility to emergency management services, which then has merits and demerits. The advantage of this approach is that emergency responders who have close ties to the affected communities can provide services when they are deemed to be necessary, because they know the community’s vulnerabilities and their expectations of emergency management services. Among its disadvantages is that business-as-usual operations can activate services at their discretion, without any commonly agreed upon criteria or thresholds, and this can negatively affect the response of emergency management to small-scale disasters occurring at the same time as large disasters. The communities, despite being affected by multiple recurring disasters reducing their disaster resilience, may therefore not receive the attention they deserve. Since these communities have been affected by small-scale disasters multiple times, they have a greater understanding of these disasters, as well as the experience to voice their opinions about risk. Thus, risk acceptance practice has been implemented in certain communities to explain the level of risk these communities are willing to accept. This approach advocates a shift from a technical emphasis towards a ‘community driven, bottom-up approach’ to manage small-scale

disasters, that would provide a practical entry point for emergency management services to be triggered. Community could also play an important role in identifying problems and potential intervention decision points in the cumulative impact assessment process. Community-driven approaches however, require empowering communities in the decision-making process by focusing on their needs and help developing links with formal institutions. The best practices applied in managing recurring small-scale disasters can potentially be scaled up, improved and streamlined to benefit affected communities. Importantly, community-driven approaches are primarily place-based and contextual dependent, hence not suitable to be directly replicated from one place to another. Instead, it is a process that requires an in-depth examination of each community's characteristics and an investment in both time and resources in order to be successful. In addition, a clear path for the recovery from small-scale recurring disasters is missing, as their recovery is managed by short-term resilience mechanisms. For example, the insurance system provides a false sense of security and traps the affected communities into a cycle of impacts, especially when the indemnity principle of insurance does not support further improvement of the insured. It is thus necessary to develop and support effective emergency services, preparedness, response, and recovery capabilities, along with socioeconomic policies like safety nets, not just through the insurance system as a risk transfer mechanism. This suggests the need for long-term resilience strategies to address the issue of small-scale recurring disasters.

7.4 Thesis contributions and barriers

The findings of this thesis have important implications for the existing knowledge on disaster risk governance related to small-scale recurring disasters. This, in turn, can inform the incorporation of small-scale recurring disasters to improve the emergency management framework for resilient outcomes. This section summarizes and discusses major contributions of this research, namely:

- i. The need to improve emergency management policies and frameworks to explicitly incorporate small-scale disasters for better policy outcomes (Chapter four)
- ii. The importance of quality information for identifying the impacts of small-scale disasters in a broader spectrum of disasters to deliver effective emergency response and recovery outcomes (Chapter five)

iii. Recommendations for scaling up community-led approaches to pre-determine the emergency response and recovery entry points for equitable service delivery outcomes (Chapter six)

The first research question contributed to the existent knowledge, to the extent that small-scale disasters are addressed in the emergency management policy frameworks. It identified that although the emergency management policies explicitly mention small-scale disasters in the all-hazards approach, in practice, they do not implicitly address them. The main barriers identified therein are: i) gaps in the present risk assessment tools that do not capture the small-scale disasters for risk reduction; ii) challenges in adopting short-term recovery strategies as opposed to long-term solutions; and, iii) the different on-the-ground implications for local level authorities in the absence of high-level policy directives. The two-dimensional disaster risk matrix combines both the consequences and hazard frequency in ranking the disasters to allocate the resources needed for disaster risk mitigation. However, it does not consider cumulative and indirect impacts of disasters that would capture the small-scale disaster for risk mitigation. The risk matrix fails to address the underlying causes of small-scale disasters, which would ultimately lead to chronic conditions. Therefore, risks related to small-scale disasters would not necessarily lead to risk reduction and will result into a ‘bounce back’ resilience. These push small-scale recurring disasters to be managed under short-term resilience strategies. In addition, there is a lack of higher-level policy directives for small-scale disasters, causing problems such as resource allocation for local governments, who are responsible for managing them. This leads to different disaster response and recovery outcomes based on the resource availability of the local governments, confirming the need for clear top-down risk-based policy directives.

The second contribution of this thesis relates to how improved understanding of the impacts of small-scale disasters and their dispersion in the broader spectrum of disasters could help to develop just, consistent and equitable emergency management policies and practice. The major shortcoming identified in this chapter is the lack of consistent historical disaster impact data for small-scale recurring disasters. This is due to: i) lack of coherence in data collection and reporting about disasters; (ii) the limitations of primarily relying on rainfall intensity data for disaster risk reduction and planning; and, (iii) the importance of identifying the economic damages of a range of disaster scales, including small-scale disasters. Disaster data are collected and recorded based on conventional categories that focus on the large-scale impacts of disasters and the severity of the

hazard events. This leads to the neglect of data and information on the small-scale disasters, and results in lack of evidence to support decisions, which often need to be made under time constraints. Specifically, small-scale disaster data are combined when reported/recorded, making analysis of their impacts difficult. Therefore, there is a greater need for disaggregated data for small-scale disasters, to make informed decisions pertaining to emergency response and recovery. This is due to the fact that many factors contributing to disaster impacts, such as population density and environmental configurations, can be considered contextually when making decisions. This means that the interactions and the behaviour of the sub-systems are monitored over longer timelines to facilitate effective decisions. Thus, a systematic and standardised mechanism to record data is necessary for consistency and to help avoid the threshold biases in obtaining data from international disaster bases. As such, a national repository to record all disaster impact data that is not confined by the intensity parameters of hazards is important. The rationale behind this is that more detailed information about a wider range of disaster scale types and impacts can facilitate the identification of chronic disaster conditions that may otherwise be neglected by disaster mitigation and recovery efforts, or exacerbated by climate change. The key findings from the policy and flood database analyses (i.e., the ambiguity in the existing emergency management framework and the dispersion of the larger number of small-scale disaster events in the broader spectrum of disasters) paved the way to the final research question that wraps up the objective of the study.

A third contribution is the identification of three main issues that affect the on-the-ground management of small-scale recurring disasters. They are: i) gaps in the understanding of what elements characterise small-scale recurring disasters and how to incorporate their cumulative impacts into decision-making; ii) gaps in the existing recovery mechanisms to account for small-scale disasters; and, iii) lack of consistent decision-making criteria for emergency response and recovery. There is no consensus on what constitutes a small-scale disaster in either literature or practice. Therefore, emergency services are activated from response to recovery in different ways, based on contextual interpretations. As time and resources are limited, emergency managers must prioritize which disasters should receive assistance, at what level, especially when large-scale disasters occur concurrently with small-scale disasters, and such aspects are not covered by the all-hazards approach. Therefore, pre-planning against minimum threshold levels for activation of emergency management services is crucial to provide an equitable service to affected communities. Participatory approaches can be used to determine whether communities can

withstand future small-scale disasters or recover from them. A comprehensive assessment of cumulative impacts that includes social indicators, such as community adaptive capacity, resilience, and a deeper understanding of community and regional well-being, may provide a more plausible outcome. Communities can also provide insightful perspectives on their risk appetite and risk thresholds for decision making on risk reduction, emergency response and recovery. In addition, there is a greater need to address long-term community recovery from small-scale recurring disasters, by ensuring that they are addressed by long-term land use planning decisions. It would also be beneficial if the build back better concept was used in recovery to eliminate the ratchet effect on communities. Overall, this calls for the re-examination of disaster risk governance approaches for small-scale recurring disasters to strengthen and scale up community-led initiatives. This would not only provide an entry point for emergency response and recovery for effective and equitable service delivery outcomes for small-scale recurring disasters, but could also support decisions related to disaster risk reduction. A combination of disaggregated disaster impact data and community vulnerability data could provide a basis for making informed decisions on disaster preparedness, while community participation in the process could help build long-term resilience by defining the appropriate threshold levels for emergency response, mitigation, and recovery. For example, the thresholds beyond which the communities could cope with the risk could be translated to disaster risk reduction related decisions. Further research on community interventions for small-scale recurring disasters could bring about more place-based approaches that would help deliver more effective approaches for managing small-scale recurring disasters.

Finally, some may argue that small disasters are not a distinct issue, but a semantic one as they are being tentatively managed by different mechanisms. However, considering it a purely semantic issue risks overlooking how many of the constantly affected communities are overwhelmed by small-scale disasters, and if their recovery mechanisms are primarily through short-term strategies which are not sustainable in the long term. Overall, this research highlights that ambiguity in emergency management policies and frameworks related to small-scale disasters can lead to inconsistent approaches and widen inequalities.

7.5 Research limitations

This research has four main limitations: i) absence of a field research and limited number of interviewees; ii) limitations on disaster impact data; iii) simplification of the analysis; and, iv) generalisation of the results.

Ideally, a field study with people who have been impacted from small-scale recurring disasters would have been beneficial, to gain a deeper understanding of how they have dealt with and recovered from them. This would have given the research more insightful information and perspectives. With the COVID-19 pandemic, however, it was difficult to conduct field research because of frequent lockdowns and the community's fear of encountering outsiders during the pandemic. Therefore, the primary data collection was limited to semi-structured interviews with the emergency management specialists, carried out online. Additionally, during the research period, emergency managers were also occupied responding to the COVID-19 pandemic and multiple other disasters pertaining to natural hazards that limited the number of interviewees for the research. More interviews would have provided more insight into place-based adaptations of communities across different locations.

There was also a limitation related to inconsistent disaster impact data for non-catastrophic disaster events in Aotearoa New Zealand. To bridge the data gap, data from a variety of sources had to be used, however, collecting and analysing the data from a variety of sources not only added time constraints to the research but such data had their own inherited problems. For example, data from different sources were inconsistent or conflicting for the same occurrence, with limited verification capabilities. Therefore, data had to be carefully considered when included for analysis. The research was also limited to the analysis of the flood events only, and other types of disasters that occurred concurrently were not considered due to temporal and spatial considerations.

This research involved a policy analysis of the current emergency management policies and procedures. Nevertheless, in a comprehensive emergency management operations analysis, there are other business-as-usual operations that need to be considered. Additionally, other policies such as social, health and educational policies, and the medium to long term development policies may have direct and indirect influence on local resilience in Aotearoa New Zealand. Their analysis would contribute for the development of a better, holistic policy approach for addressing small-scale recurring disasters and help deliver improved social outcomes to affected communities.

Also, analysing policy documents poses a challenge to determine whether or not the organization has actually implemented the principles and strategies outlined in the documents, since policy documents often refer to concepts such as 'coordination' with other actors and 'capacity building' for local governments (Wach & Ward, 2013). Such aspects need to be triangulated by other means such as semi-structured interviews to determine if the findings of the research study are consistent. In addition, policies and their associated guidelines change over time, and consequently their analysis would not be applicable when revised, and would impact on the research findings as a whole.

The final limitation of this study relates to the generalisation of findings. This study adopted a case study approach and used only Aotearoa New Zealand as the study location. Aotearoa New Zealand has a unique emergency management system and a disaster recovery approach, with a state-supported insurance mechanism. Therefore, these results cannot be generalised world-wide. Nevertheless, the findings of this research may inform other studies that examine community recovery from small-scale recurring disasters.

7.6 Directions for future research

This thesis has provided useful insights for the improvement of disaster risk governance related to small-scale recurring disasters. Climate change is increasing the frequency and intensity of disasters. From 1980 to 2017, smaller-scale disasters of increasing severity have resulted in an overall increase in losses of 5% per year, eroding the economic resilience of the affected communities (Subedi, 2019). Therefore, countries that are subjected to frequent disasters need better planning and preparedness to face them effectively. This thesis has revealed a lack of recognition of the factors that constitute small-scale disasters. Thus, a one-size-fits-all definition for these disasters cannot be developed, as the factors (including community vulnerability, resource availability and community risk acceptance) vary from place to place. The distinction between small-scale disasters will therefore require place-based approaches to identify small-scale recurring disasters that may be early indicators of significant disaster impacts.

According to the analysis, even though the all-hazard approaches are adopted in many contexts, small-scale disasters are easily overlooked, with greater attention been paid to larger-scale disasters. Therefore, future studies could examine policies and associated strategies from elsewhere, to assess how well they actually address these disasters and their impacts. Additionally,

further research is needed to improve risk assessment methodologies, so that the cumulative and indirect impacts of smaller-scale disasters can be captured for policy initiatives. The cumulative impacts should also be operationalised in the emergency management mechanism in conjunction with land use policies, to achieve long-term solutions that also need further examinations. Further, increasing risks as a result of climate change and the impacts of compounding disasters and their cascading impacts are important research areas that need to be addressed.

In addition, this thesis has demonstrated the importance of tracking disaster trends and identifying disaster hot spots to customize local emergency management plans. Thus, a proper mechanism needs to be developed to collect and record these data and share them among stakeholders for decision making. Another important key area that needs further exploration is the short-term resilience strategies used for the recovery from small-scale recurring disasters. As the number of small-scale disasters and their severity is increasing, the coping capacities of the affected communities may continue to erode, making short-term recovery strategies less effective to bring about resilient outcomes in the longer run. Therefore, the short-term resilience strategies in different communities need to be re-examined for their appropriateness.

It is vital to carry out a comprehensive and holistic policy analysis to examine the potential contribution of different policies for the realisation of better outcomes for the affected communities rather than examining the effectiveness of stand-alone policies towards the management of small-scale recurring disasters. As such, further research is necessary to examine the coherence of disaster risk governance policies and other different policies towards the country's development agenda. This would enhance the current disaster risk governance through a multi sectoral and multi-dimensional approach, thereby reducing disaster impacts, and enhancing community coping capacity and resilience.

The rate of development in hazard-prone areas has been on the rise along with the acceleration of climate change, resulting in an increase in residual flood risks (Fu et al,2023). This creates a greater need to develop and support effective delivery of emergency services, preparedness, response, and recovery, along with socioeconomic policies such as safety nets and risk transfer avoidance mechanisms. Therefore, strategies for managing residual risk should be considered beyond emergency management and risk transferring solutions through insurance. If not, this would result in additional financial burden on the affected communities through the increasing insurance

premiums and out of pocket expenditure for reconstruction and recovery. To this end, it is important to avoid potential increase in risk transfer by addressing it through comprehensive non-structural mitigation measures, including land use planning decisions, building codes and the development policies and plans.

A more comprehensive research outcome on community recovery from small-scale recurring disasters can be achieved by collecting primary data from wider group of stakeholders, including people from affected communities. Further research would pave the way for more improved community-led initiatives for community recovery from small-scale recurring disasters.

7.7 Concluding remarks

The purpose of this chapter was to provide an overview of the key findings of the thesis and how they related to the main research questions. In addition, it discussed how these findings related to the existing knowledge and policy, as well as possible future research directions. A collection of evidence presented throughout the thesis chapters contributes to a better understanding of how small-scale recurring disasters should be addressed in policy and practice to enhance community resilience. The thesis identified main gaps in policy, processors and on-the-ground practices related to small-scale recurring disasters, and the main barriers in improving them. Furthermore, the study examined on-the-ground practices that could contribute to better management of small-scale recurring disasters, rather than introducing completely new procedures that may be difficult to implement.

The main challenge that continues beyond this thesis is the need to engage with policy and decision-makers at a greater scale to better address small-scale recurring disasters. In recognition of lower activation thresholds for emergency response and recovery, it might appear difficult to allocate additional resources. These activities, however, are not entirely new, as some of them are already in practice under different organizations (such as the organizations involved in business-as-usual management). These actions need to be re-examined and improved, as well as brought together under a top-down comprehensive strategy. Hence, consideration should be given to broader benefits over short-term challenges.

8 References

- Ahlin, E. M., (2019). Semi-structured interviews with expert practitioners: Their validity and significant contribution to translational research. In Sage Research Methods Cases Part 2. SAGE Publications, Ltd., <https://doi.org/10.4135/9781526466037>
- Alam, E., & Ray-Bennett, N. S. (2021). Disaster risk governance for district-level landslide risk management in Bangladesh. *International Journal of Disaster Risk Reduction*, 59, 1-13. <https://doi.org/10.1016/j.ijdrr.2021.102220>
- Alexander, D. E. (2015). Disaster and emergency planning for preparedness, response, and recovery. In. Oxford University Press. <https://doi.org/https://doi.org/10.1093/acrefore/9780199389407.013.12>
- Amaratunga, D., Malalgoda, C., Haigh, R., Panda, A., & Rahayu, H. (2018). Sound practices of disaster risk reduction at local level. *Procedia engineering*, 212, 1163-1170. <https://doi.org/https://doi.org/10.1016/j.proeng.2018.01.150>
- Ardaya, A. B., Evers, M., & Ribbe, L. (2019). Participatory approaches for disaster risk governance? Exploring participatory mechanisms and mapping to close the communication gap between population living in flood risk areas and authorities in Nova Friburgo Municipality, RJ, Brazil. *Land Use Policy*, 88, 104103. <https://doi.org/https://doi.org/10.1016/j.landusepol.2019.104103>
- Baker, D., & Refsgaard, K. (2007). Institutional development and scale matching in disaster response management. *Ecological Economics*, 63(2-3), 331-343. <https://doi.org/https://doi.org/10.1016/j.ecolecon.2007.01.007>
- Ball, S. J. (2015). What is policy? 21 years later: Reflections on the possibilities of policy research. *Discourse (Abingdon, England)*, 36(3), 306-313. <https://doi.org/10.1080/01596306.2015.1015279>
- Bankoff, G. (2003). *Cultures of disaster: Society and natural hazard in the Philippines*. Routledge Curzon. <https://doi.org/10.4324/9780203221891>
- Basu, M., Srivastava, N., Mulyasari, F., & Shaw, R. (2013). Making cities and local governments ready for disasters: A critical overview of a recent approaches. *Risk, Hazards & Crisis in Public Policy*, 4(4), 250-273. <https://doi.org/https://doi.org/10.1002/rhc3.12039>
- Bates, F. L., & Peacock, W. G. (1987). Disaster and social change. In *The Sociology of Disasters* (pp. 291-330). Franco Angeli. <https://hdl.handle.net/1969.1/175122>
- Bazeley, P., & Jackson, K. (2013). *Qualitative data analysis with NVivo* (second edition ed.). SAGE Publications Ltd. https://us.sagepub.com/sites/default/files/upm-assets/114916_book_item_114916.pdf
- Becker, J., & Saunders, W. (2007). Enhancing sustainability through pre-event recovery planning. *Plann Quart*, 164, 14-18. <https://www.qualityplanning.org.nz/sites/default/files/Enhancing%20Sustainability%20Through%20PreEvent%20Recovery%20Planning.pdf>
- Berke, P. R., Kartez, J., & Wenger, D. (1993). Recovery after Disaster: Achieving Sustainable Development, Mitigation and Equity. *Disasters*, 17(2), 93-109. <https://doi.org/10.1111/j.1467-7717.1993.tb01137.x>
- Birnbaum, M. L., Daily, E. K., & O'Rourke, A. P. (2015). Research and Evaluations of the Health Aspects of Disasters, Part III: Framework for the Temporal Phases of Disasters. *Prehosp. Disaster med*, 30(6), 628-632. <https://doi.org/10.1017/S1049023X15005336>
- Bodas, M., Kirsch, T. D., & Peleg, K. (2020). Top hazards approach—Rethinking the appropriateness of the All-Hazards approach in disaster risk management. *International*

- Journal of Disaster Risk Reduction*, 47, 101559.
<https://doi.org/https://doi.org/10.1016/j.ijdrr.2020.101559>
- Bohle, H.-G. (2001). Vulnerability and criticality: Perspectives from social geography. *IHDP update*, 2(01), 3-5.
- Bohle, H. G., Downing, T. E., & Watts, M. J. (1994). Climate change and social vulnerability: toward a sociology and geography of food insecurity. *Global environmental change*, 4(1), 37-48. [https://doi.org/10.1016/0959-3780\(94\)90020-5](https://doi.org/10.1016/0959-3780(94)90020-5)
- Bosher, L., Chmutina, K., & van Niekerk, D. (2021). Stop going around in circles: Towards a reconceptualisation of disaster risk management phases. *Disaster Prevention and Management: An International Journal*, 30(4/5), 525-537. <https://doi.org/10.1108/DPM-03-2021-0071>
- Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative research journal*. <https://doi.org/10.3316/QRJ0902027>
- Brennan, M. E., & Danielak, S. (2021). Too small to count? The cumulative impacts and policy implications of small disasters in the Sahel. *International Journal of Disaster Risk Reduction*, 102687. <https://doi.org/https://doi.org/10.1016/j.ijdrr.2021.102687>
- Browne, E. (2013). *Impact of extensive disasters* (GSDRC Helpdesk Research Report, Issue 1016). U. G. Birmingham, University of Birmingham.
<https://gsdrc.org/publications/impact-of-extensive-disasters/>
- Bull-Kamanga, L., Diagne, K., Lavell, A., Leon, E., Lerise, F., MacGregor, H., Maskrey, A., Meshack, M., Pelling, M., & Reid, H. (2003). From everyday hazards to disasters: The accumulation of risk in urban areas. *Environment and Urbanization*, 15(1), 193-204. <https://doi.org/https://doi.org/10.1177/095624780301500109>
- Burton, C. (2010). The death of all hazards planning. *Disaster Recovery Journal*, 23(3).
- Cadag, J. R. D., Petal, M., Luna, E., Gaillard, J., Pambid, L., & Santos, G. V. (2017). Hidden disasters: Recurrent flooding impacts on educational continuity in the Philippines. *International Journal of Disaster Risk Reduction*, 25, 72-81. <https://doi.org/https://doi.org/10.1016/j.ijdrr.2017.07.016>
- Cannon, T. (1994). Vulnerability analysis and the explanation of 'natural' disasters. In A. Varley (Ed.), *Disasters, development and environment*, 13-30 Chichester: John Wiley & Sons.
- Cardona, O. D., Van Aalst, M. K., Birkmann, J., Fordham, M., Mc Gregor, G., Rosa, P., Pulwarty, R. S., Schipper, E. L. F., Sinh, B. T., & Décamps, H. (2012). Determinants of risk: Exposure and vulnerability. In *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change* (pp. 65-108). Cambridge University Press.
- Carter, W. N. (2008). *Disaster management: A disaster manager's handbook*. A. D. Bank. <http://hdl.handle.net/11540/5035>
- Cavallo, E. A., & Noy, I. (2009). The economics of natural disasters: A survey. Research Department Publications 4649, Inter-American Development Bank, Research Department.
- Civil Defence Emergency Management Act, Ministry of Civil Defence. Public Act (2002).
- Chowdhury, I. A. (2015). Issue of quality in a qualitative research: An overview. *Innovative Issues and Approaches in Social Sciences*, 8(1), 142-162. <https://doi.org/http://dx.doi.org/10.12959/issn.1855-0541.IIASS-2015-no1-art09>

- Christoplos, I., Mitchell, J., & Liljelund, A. (2001). Re-framing risk: The changing context of disaster mitigation and preparedness. *Disasters*, 25(3), 185-198. <https://doi.org/10.1111/1467-7717.00171>
- Coppola Damon, P. (2015). Chapter 6 - Response. In *Introduction to International Disaster Management (Third Edition)*, pp. 321–404. Elsevier Inc. <https://doi.org/10.1016/B978-0-12-801477-6.00006-X>
- Cottrell, A., & King, D. (2010). Social assessment as a complementary tool to hazard risk assessment and disaster planning. *Australasian Journal of Disaster and Trauma Studies*, 2010(1), 1–15. 2010-16811-007.
- Coughlan de Perez, E., van den Hurk, B., Van Aalst, M., Jongman, B., Klose, T., & Suarez, P. (2015). Forecast-based financing: An approach for catalyzing humanitarian action based on extreme weather and climate forecasts. *Natural Hazards and Earth System Sciences*, 15(4), 895-904. <https://doi.org/10.5194/nhess-15-895-2015>, 2015.
- Crawshaw, J., & Blanch, C. (2016). Framework for psychosocial support in emergencies. Ministry of Health, New Zealand.
- CRED. (n.d.). *EM-DAT*. Retrieved 26.8.2021 from <https://www.emdat.be/frequently-asked-questions>
- Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A., & Sheikh, A. (2011). The case study approach. *BMC medical research methodology*, 11(1), 1-9.
- Cuthbertson, J., Archer, F., Robertson, A., & Rodriguez-Llanes, J. M. (2021). Improving Disaster Data Systems to Inform Disaster Risk Reduction and Resilience Building in Australia: A Comparison of Databases. In *Prehospital and Disaster Medicine* (pp. 1-8). <https://doi.org/10.1017/S1049023X2100073X>
- Cutter, S. L., & Derakhshan, S. (2020). Temporal and spatial change in disaster resilience in US counties, 2010–2015. *Environmental Hazards*, 19(1), 10-29. 10.1080/17477891.2018.1511405
- Damon, P. C. (2015). Chapter 5 - Preparedness. In (Third Edition ed., pp. 275-320). Elsevier Inc. <https://doi.org/10.1016/B978-0-12-801477-6.00005-8>
- Dantas, A., & Seville, E. (2006). Organisational issues in implementing an information sharing framework: Lessons from the Matata flooding events in New Zealand. *Journal of Contingencies and Crisis Management*, 14(1), 38-52. <https://doi.org/10.1111/j.1468-5973.2006.00479.x>
- De Ruiter, M. C., Couason, A., van den Homberg, M. J., Daniell, J. E., Gill, J. C., & Ward, P. J. (2020). Why we can no longer ignore consecutive disasters. *Earth's Future*, 8(3). <https://doi.org/10.1029/2019EF001425>
- Delfin Jr, F. G., & Gaillard, J. C. (2008). Extreme versus quotidian: Addressing temporal dichotomies in Philippine disaster management. *Public Administration and Development: The International Journal of Management Research and Practice*, 28(3), 190-199. <https://doi.org/10.1002/pad.493>
- Department of the Prime Minister and Cabinet. (2015). *The Guide to National Civil Defence Emergency Management Plan*. <https://www.civildefence.govt.nz/assets/guide-to-the-national-cdem-plan/Guide-to-the-National-CDEM-Plan-2015.pdf>
- Desai, B., Maskrey, A., Peduzzi, P., De Bono, A., & Herold, C. (2015). *Making development sustainable: The future of disaster risk management, global assessment report on disaster risk reduction*. Genève, Suisse: United Nations Office for Disaster Risk Reduction (UNISDR), 2015

- Djalante, R., & Garschagen, M. (2017). A Review of Disaster Trend and Disaster Risk Governance in Indonesia:1900–2015. In *Disaster Risk Reduction in Indonesia* (pp. 21–56). Springer International Publishing. https://doi.org/10.1007/978-3-319-54466-3_2
- Djalante, R., & Lassa, S. (2019). Governing complexities and its implication on the Sendai Framework for Disaster Risk Reduction priority 2 on governance. *Progress in Disaster Science*, 2, 100010. <https://doi.org/https://doi.org/10.1016/j.pdisas.2019.100010>
- Enia, J. (2020). Is there an international disaster risk reduction regime? Does it matter? *Progress in Disaster Science*, 7. <https://doi.org/https://doi.org/10.1016/j.pdisas.2020.100098>
- Etkin, D. (2016). *Disaster theory:An interdisciplinary approach to concepts and causes*. Butterworth-Heinemann.
- Ferreira, R. J., Buttell, F., & Ferreira, S. (2015). Ethical considerations for conducting disaster research with vulnerable populations. *Journal of Social Work Values and Ethics*, 12(1), 29-40. <https://jswve.org/download/2015-1/articles/29-JSWVE-12-1-Ethical%20Considerations%20for%20Disaster%20Research.pdf>
- Ferris, E., Petz, D., & Stark, C. (2013). *The year of recurring disasters:A review of natural disasters in 2012*. Brookings Institution.
- Finucane, M. L., Acosta, J., Wicker, A., & Whipkey, K. (2020). Short-Term Solutions to a Long-Term Challenge:Rethinking Disaster Recovery Planning to Reduce Vulnerabilities and Inequities. *International Journal of Environmental Research and Public Health*, 17(2), 482. <https://doi.org/doi:10.3390/ijerph17020482>
- Fischer, H. W. (2003). The sociology of disaster:Definitions, research questions, & measurements. Continuation of the discussion in a post-September 11 environment. *International Journal of Mass Emergencies and Disasters*, 21(1), 91-108. DOI: 10.1177/028072700302100104
- Frame, D., Rosier, S., Carey-Smith, T., Harrington, L., Dean, S., & Noy, I. (2018). *Estimating financial costs of climate change in New Zealand* [New Zealand Treasury Commissioned Report]. <https://www.treasury.govt.nz/publications/commissioned-report/estimating-financial-costs-climate-change-nz>
- Frame, D. J., Rosier, S. M., Noy, I., Harrington, L. J., Carey-Smith, T., Sparrow, S. N., Stone, D. A., & Dean, S. M. (2020). Climate change attribution and the economic costs of extreme weather events:A study on damages from extreme rainfall and drought. *Climatic Change*, 162(2), 781-797. <https://doi.org/https://doi.org/10.1007/s10584-020-02729-y>
- Fraser, A., Pelling, M., Scolobig, A., & Mavrogenis, S. (2020). Relating root causes to local risk conditions:A comparative study of the institutional pathways to small-scale disasters in three urban flood contexts. *Global environmental change*, 63, Article 102102. <https://doi.org/https://doi.org/10.1016/j.gloenvcha.2020.102102>
- French, A., Mechler, R., Arestegui, M., MacClune, K., & Cisneros, A. (2020). Root causes of recurrent catastrophe:The political ecology of El Niño-related disasters in Peru. *International Journal of Disaster Risk Reduction*, 47, 101539. <https://doi.org/https://doi.org/10.1016/j.ijdrr.2020.101539>
- Fu, X., Bell, R., Reu Junqueira, J., White, I., & Serrao-Neumann, S. (2023). Managing rising residual flood risk: A national survey of Aotearoa-New Zealand. *Journal of Flood Risk Management*, e12944.
- Gaillard, J. (2016). Natural hazards and disasters. *International Encyclopedia of Geography: People, the Earth, Environment and Technology:People, the Earth, Environment and Technology*, 1-15. <https://doi.org/10.1002/9781118786352.wbieg0774>

- Gaillard, J., van Niekerk, D., Shoroma, L. B., Coetzee, C., & Amirapu, T. (2019). Wildlife hazards and disaster risk reduction. *International Journal of Disaster Risk Reduction*, 33, 55-63. <https://doi.org/https://doi.org/10.1016/j.ijdr.2018.09.009>
- Gaillard, J. C. (2007). Resilience of traditional societies in facing natural hazards. *Disaster Prevention and Management: An International Journal* 16(4):522-544 2007. <https://doi.org/10.1108/09653560710817011>
- Genovese, E. (2006). A methodological approach to land use-based flood damage assessment in urban areas: Prague case study (Technical EUR Reports, EUR, Issue. https://www.preventionweb.net/files/2678_EUR22497EN.pdf
- Glavovic, B., Saunders, W., & Becker, J. (2010). Land-use planning for natural hazards in New Zealand: The setting, barriers, 'burning issues' and priority actions. *Natural Hazards*, 54(3), 679-706. <https://doi.org/10.1007/s11069-009-9494-9>
- Global Assessment Report. (2013). *Global assessment report on disaster risk reduction 2013; From shared risk to shared value: The business case for disaster risk reduction*. Geneva, Switzerland: United Nations Office for Disaster Risk Reduction (UNISDR).
- Gluckman, P., & Bardsley, A. (2021). Uncertain but inevitable: The expert-policy-political nexus and high-impact risks. <https://doi.org/https://hdl.handle.net/2292/57858>
- Gordy, M. (2016). The Importance of Extensive Risk. In *Disaster Risk Reduction and the Global System: Ruminations on a Way Forward* (pp. 39-41). Springer International Publishing. https://doi.org/10.1007/978-3-319-41667-0_8
- Graves, J. V. (2021). Secondary data and qualitative content analysis in emergency management research. In *Disaster and Emergency Management Methods: Social Science Approaches in Application* (pp. 211-224).
- Green, H. K., Lysaght, O., Saulnier, D. D., Blanchard, K., Humphrey, A., Fakhrudin, B., & Murray, V. (2019). Challenges with disaster mortality data and measuring progress towards the implementation of the Sendai Framework. *International Journal of Disaster Risk Science*, 10(4), 449-461. <https://doi.org/https://doi.org/10.1007/s13753-019-00237-x>
- Gregory, P. A. (2015). Reassessing the Effectiveness of All-Hazards Planning in Emergency Management. *Inquiries Journal/Student Pulse*, 7(06). <http://www.inquiriesjournal.com/a?id=1050>
- Hallegatte, S., Vogt-Schilb, A., Bangalore, M., & Rozenberg, J. (2016). *Unbreakable: Building the resilience of the poor in the face of natural disasters*. World Bank Publications.
- Hamdan, F. (2015). Intensive and extensive disaster risk drivers and interactions with recent trends in the global political economy, with special emphasis on rentier states. *International Journal of Disaster Risk Reduction*, 14, 273-289. <http://dx.doi.org/10.1016/j.ijdr.2014.09.004>
- Hemachandra, K., Amaratunga, D., & Haigh, R. (2018). Role of women in disaster risk governance. *Procedia engineering*, 212, 1187-1194. <https://doi.org/10.1016/j.proeng.2018.01.153>
- Higgins, J., & Goodall, S. (2021). Transforming the wellbeing focus in education: A document analysis of policy in Aotearoa New Zealand. *International Journal of Qualitative Studies on Health and Well-being*, 16(1), 14. <https://doi.org/10.1080/17482631.2021.1879370>
- Huy, Q. N. (2012). Improving the odds of publishing inductive qualitative research in premier academic journals. *The Journal of Applied Behavioral Science*, 48(2), 282-287. DOI: 10.1177/0021886312438864

- IFRC. (2001). *World Disasters Report: Focus on recovery*. <https://www.alnap.org/help-library/world-disasters-report-2001-%E2%80%93-focus-on-recovery>
- IFRC. (2014). *How law and regulation support disaster risk reduction New Zealand: Country case study report*. International Federation of Red Cross and Red Crescent Societies.
- IFRC. (2018). *Leaving no one behind* (ISBN:978-2-9701289-0-8). <https://reliefweb.int/sites/reliefweb.int/files/resources/B-WDR-2018-EN-LR-compressed.pdf>
- Ikeda, S., & Nagasaka, T. (2011). An emergent framework of disaster risk governance towards innovating coping capability for reducing disaster risks in local communities. *International Journal of Disaster Risk Science*, 2(2), 1-9. DOI:10.1007/s13753-011-0006-7
- IPCC. (2012). *Managing the risks of extreme events and disasters to advance climate change adaptation: A special report of working groups I and II of the intergovernmental panel on climate change*. Cambridge University Press. <https://www.ipcc.ch/report/managing-the-risks-of-extreme-events-and-disasters-to-advance-climate-change-adaptation/>
- IPCC. (2022). *Climate change 2022: Impacts, adaptation and vulnerability* (Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Issue. C. U. Press. <https://www.ipcc.ch/assessment-report/ar6/>
- IRGC. (2017). *Introduction to the IRGC risk governance framework*. EPFL International Risk Governance Center Lausanne. <https://irgc.org/wp-content/uploads/2018/09/IRGC.-2017.-An-introduction-to-the-IRGC-Risk-Governance-Framework.-Revised-version..pdf>
- Islam, S., Zobair, K. M., Chu, C., Smart, J. C., & Alam, M. S. (2021). Do political economy factors influence funding allocations for disaster risk reduction? *Journal of Risk and Financial Management*, 14(2), 85. <https://doi.org/https://doi.org/10.3390/jrfm14020085>
- Jacob, S. A., & Furgerson, S. P. (2012). Writing interview protocols and conducting interviews: Tips for students new to the field of qualitative research. *Qualitative Report*, 17, 6. <http://www.nova.edu/ssss/QR/QR17/jacob.pdf>
- Johnston, D., Becker, J., Coomer, M., Cronin, S., Daly, M., Doyle, E., Glassey, S., Glavovic, B., Houghton, R., & Hughes, M. (2011). Exploring elements of an effective recovery process. Proceedings Ninth Pacific Conference on Earthquake Engineering, Auckland, New Zealand,
- Jones, R. L., Guha-Sapir, D., & Tubeuf, S. (2022). Human and economic impacts of natural disasters: can we trust the global data?. *Scientific data*, 9(1), 572. <https://doi.org/10.1038/s41597-022-01667-x>
- Khan, S. (2012). Disasters: Contributions of hazardscape and gaps in response practices. *Natural Hazards and Earth System Sciences*, 12(12), 3775. <https://doi.org/10.5194/nhess-12-3775-2012>
- Khirfan, L., Peck, M., & Mohtat, N. (2020). Systematic content analysis: A combined method to analyze the literature on the daylighting (de-culverting) of urban streams. *MethodsX*, 7, Article 100984. <https://doi.org/10.1016/j.scs.2020.102225>
- Kim, K. (2015). *Planning for post-disaster recovery: Next generation* (Planning Advisory Service Report 576). <https://www.planning.org/research/postdisaster/>
- Kreibich, H., Van Loon, A. F., Schröter, K., Ward, P. J., Mazzoleni, M., Sairam, N., Abeshu, G. W., Agafonova, S., AghaKouchak, A., Aksoy, H., Alvarez-Garreton, C., Aznar, B., Balkhi, L., Barendrecht, M. H., Biancamaria, S., Bos-Burgering, L., Bradley, C., Budiyo, Y., Buytaert, W., . . . Di Baldassarre, G. (2022). The challenge of

- unprecedented floods and droughts in risk management. *Nature*, 608(7921), 80-86.
<https://doi.org/10.1038/s41586-022-04917-5>
- Lassa, J. (2011). *Institutional vulnerability and governance of disaster risk reduction: Macro, meso and micro scale assessment* [Doctoral Dissertation, University of Bonn].
<https://bonndoc.ulb.uni-bonn.de/xmlui/handle/20.500.11811/4714>
- Lavell, A. (2002, 21-23 November, 2002). *Local Level Risk Management. Concepts and Experience in Central America* Disaster Preparedness and Mitigation Summit, New Delhi, India. https://www.desenredando.org/public/articulos/2003/llrmceca/llrmceca_abr-24-2003.pdf
- Lavell, A., & Maskrey, A. (2014). The future of disaster risk management. *Environmental Hazards*, 13(4), 267-280. <https://doi.org/https://doi.org/10.1080/17477891.2014.935282>
- Lavell, A., Oppenheimer, M., Diop, C., Hess, J., Lempert, R., Li, J., Muir-Wood, R., Myeong, S., Moser, S., & Takeuchi, K. (2012). Climate change: New dimensions in disaster risk, exposure, vulnerability, and resilience. In *Managing the risks of extreme events and disasters to advance climate change adaptation: Special report of the Intergovernmental Panel on Climate Change* (pp. 25-64). Cambridge University Press.
<https://doi.org/https://doi.org/10.1017/CBO9781139177245.004>
- Le Masurier, J., Rotimi, J. O., & Wilkinson, S. (2006, 4-6 September). *Comparison between routine construction and post-disaster reconstruction with case studies from New Zealand* Proceedings 22nd Annual ARCOM Conference, Birmingham, United Kingdom.
<http://openrepository.aut.ac.nz/handle/10292/5809>
- Lianxiao, Morimoto, T., Siqin, T., An, C., Yuhai, B., & Fei, G. (2022). Evaluating regional flood disaster resilience based on the DROP model and TOPSIS method: A case study of the Katsushika Ward, Tokyo. *Natural Hazards Review*, 23(3).
[https://doi.org/10.1061/\(ASCE\)NH.1527-6996.0000551](https://doi.org/10.1061/(ASCE)NH.1527-6996.0000551)
- Lindell, M. K. (2013). Disaster studies. *Current Sociology*, 61(5-6), 797-825.
<https://doi.org/DOI:10.1177/0011392113484456>
- Liu, Y., Feng, G., Xue, Y., Zhang, H., & Wang, R. (2015). Small-scale natural disaster risk scenario analysis: A case study from the town of Shuitou, Pingyang County, Wenzhou, China. *Natural hazards*, 75(3), 2167-2183. <https://doi.org/10.1007/s11069-014-1420-0>
- Lune, H., & Berg, B. L. (2017). *Qualitative research methods for the social sciences*. Pearson.
- Magrath, J. (2007). Climate alarm: Disasters increase as climate change bites.
<https://oxfamilibrary.openrepository.com/bitstream/handle/10546/114103/bp108-climate-alarm-250108-en.pdf;jsessionid=D2704DC3939E8B774C6366F42EC5AC4A?sequence=1>
- Maguire, B., & Cartwright, S. (2008). *Assessing a community's capacity to manage change: a resilience approach to social assessment*. Bureau of Rural Sciences Canberra.
- Mamuji, A. A., & Etkin, D. (2019). Disaster risk analysis part 2: The systemic underestimation of risk. *Journal of Homeland Security and Emergency Management*, 16(1). 10.1515/jhsem-2017-0006
- Marsh, S., Mills, W., Mourot, P., Hume, T., Liefting, R., & Hunt, S. (2022). *Wharekawa coast 2120: Natural hazard risk assessment* (2020/08).
<https://www.waikatoregion.govt.nz/assets/WRC/TR202008.pdf>
- Marulanda, M., Cardona, O., & Barbat, A. (2008). The economic and social effects of small disasters: Revision of the local disaster index and the case study of Colombia. In H.-G.

- Bohle & K. Warner (Eds.), *In Megacities: Resilience and Social Vulnerability* (pp. 110-120). UNU Institute for Environment and Human Security.
- Marulanda, M. C., Cardona, O. D., & Barbat, A. H. (2010). Revealing the socioeconomic impact of small disasters in Colombia using the DesInventar database. *Disasters*, 34(2), 552-570. <https://doi.org/https://doi.org/10.1111/j.1467-7717.2009.01143.x>
- Maskrey, A. (2008). *Global Assessment Report on Disaster Risk Reduction: GAR extensive disaster risk analysis*. <http://www.preventionweb.net/english/professional/networks/private/gar-ext>
- Mason, K., Lindberg, K., Haenfling, C., Schori, A., Marsters, H., Read, D., & Borman, B. (2021). Social vulnerability indicators for flooding in aotearoa New Zealand. *International Journal of Environmental Research and Public Health*, 18(8), 3952. <https://doi.org/https://doi.org/10.3390/ijerph18083952>
- MCDEM. (1990). *Civil defence in New Zealand: A short history*. Ministry of Civil Defence with the assistance of the Historical Branch, Dept. of Internal Affairs.
- MCDEM. (2015a). *CDEM National Capability Assessment Report*. Ministry of Civil Defence & Emergency Management.
- MCDEM. (2015b). *Response Planning in CDEM: Director's Guideline for Civil Defence Emergency Management Groups [DGL 19/15]*. <https://www.civildefence.govt.nz/assets/response-planning-cdem/Response-Planning-in-CDEM-Directors-Guideline.pdf>
- MCDEM. (2017). *Strategic Planning for Recovery Director's Guideline [DGL 20/17]*. <https://www.civildefence.govt.nz/cdem-sector/guidelines/strategic-planning-for-recovery/>
- MCDEM. (2018). *CDEM Group Planning: Director's Guidelines for Civil Defence Emergency Management Groups [DGL 09/18]*. <https://www.civildefence.govt.nz/assets/Uploads/logistics-dgl/DGL-09-18-CDEM-Group-Planning-PDF.pdf>
- MCDEM. (2019). *National Disaster Resilience Strategy*. <https://www.civildefence.govt.nz/cdem-sector/plans-and-strategies/national-disaster-resilience-strategy/>
- MCDEM. (2021). *Draft for Risk assessment: Guidance for CDEM Group planning*. <https://www.lgnz.co.nz/assets/905150ada1/DRAFT-for-Consultation-Risk-Assessment-Guidence-for-CDEM-Group-Planning-V2.0-compressed.pdf>
- Melo Zurita, M. d. L., Cook, B., Harms, L., & March, A. (2015). Towards new disaster governance: Subsidiarity as a critical tool. *Environmental Policy and Governance*, 25(6), 386-398. <https://doi.org/10.1002/eet.1681>
- Ministry for the Environment New Zealand. (2020). *National Climate Change Risk Assessment for Aotearoa New Zealand: Main report – Arotakenga Tūraru mō te Huringa Āhuarangi o Āotearoa: Pūrongo whakatōpū*. <https://environment.govt.nz/publications/national-climate-change-risk-assessment-for-new-zealand-main-report/>
- Mizutori, M. (2020). Reflections on the Sendai framework for disaster risk reduction: Five years since its adoption. *International Journal of Disaster Risk Science*, 1-5. <https://doi.org/https://doi.org/10.1007/s13753-020-00261-2>
- Moftakhari, H. R., AghaKouchak, A., Sanders, B. F., & Matthew, R. A. (2017). Cumulative hazard: The case of nuisance flooding. *Earth's Future*, 5(2), 214-223. <https://doi.org/10.1002/2016EF000494>

- Monteil, C., Simmons, P., & Hicks, A. (2020). Post-disaster recovery and sociocultural change: Rethinking social capital development for the new social fabric. *International Journal of Disaster Risk Reduction*, 42, 101356. <https://doi.org/https://doi.org/10.1016/j.ijdr.2019.101356>
- National Science Challenges. (2023, 2023). *Aotearoa Cumulative Effects (ACE) framework*. <https://www.sustainableseaschallenge.co.nz/tools-and-resources/ace-framework/>
- NEMA. (2019a). *Recovery Preparedness and Management: Director's Guideline for Civil Defence Emergency Management Groups [DGL 24/20] Part A*. <https://www.civildefence.govt.nz/cdem-sector/guidelines/recovery-preparedness-and-management/>
- NEMA. (2019b). *Recovery Preparedness and Management: Director's Guideline for Civil Defence Emergency Management Groups [DGL 24/20] Part C*. <https://www.civildefence.govt.nz/cdem-sector/guidelines/recovery-preparedness-and-management/>
- NEMA. (2022). *Risk assessment: Guidance for CDEM Group planning* National Emergency Management Agency. <https://www.civildefence.govt.nz/assets/Uploads/Risk-Assessment-Guidance-for-CDEM-Group-Planning-Directors/Risk-Assessment-Guidance-for-CDEM-Group-Planning-Directors-Guideline-DGL-2322-PDF-3.03MB.pdf>
- NIWA. (n.d.). Retrieved Sep 8th from <https://niwa.co.nz/natural-hazards/hazards/floods>
- O'Hare, P., & White, I. (2013). Deconstructing resilience: Lessons from planning practice: Special edition of planning practice and research. *Planning Practice & Research*, 28:3, 275-279. <https://doi.org/10.1080/02697459.2013.787721>
- O'Hare, P., White, I., & Connelly, A. (2016). Insurance as maladaptation: Resilience and the 'business as usual' paradox. *Environment and Planning C: Government and Policy*, 34(6), 1175-1193. <https://doi.org/https://doi.org/10.1177/0263774X15602022>
- Osuteye, E., Johnson, C., & Brown, D. (2017). The data gap: An analysis of data availability on disaster losses in sub-Saharan African cities. *International Journal of Disaster Risk Reduction*, 26, 24-33. <https://doi.org/http://dx.doi.org/10.1016/j.ijdr.2017.09.026>
- Owen, S., Noy, I., Pástor-Paz, J., & Fleming, D. (2019). EQC and extreme weather events (part 2): Measuring the impact of insurance on New Zealand landslip, storm and flood recovery using nightlights. *Storm and Flood Recovery Using Nightlights (November 20, 2019)*.
- Pando, L. R. R., & Lavell, A. (2012). Extensive and every day risk in the Bolivian Chaco: Sources of crisis and disaster. *Journal of Alpine Research/ Revue de géographie alpine*(100-1). <https://doi.org/https://doi.org/10.4000/rga.1719>
- Paton, D. (2006). Disaster resilience: Integrating individual, community, institutional and environmental perspectives. In *Disaster resilience: An integrated approach* (Vol. 320, pp. 306-319). Springfield.
- Pautasso, M. (2019). The structure and conduct of a narrative literature review. *A Guide to the Scientific Career: Virtues, Communication, Research and Academic Writing*, 299-310. <https://doi.org/10.1002/9781118907283.ch31>
- Pearson, L., & Pelling, M. (2015). The UN Sendai framework for disaster risk reduction 2015–2030: Negotiation process and prospects for science and practice. *Journal of Extreme Events*, 2(01), 1571001. <https://doi.org/https://doi.org/10.1142/S2345737615710013>
- Perry, R. W. (2007). What Is a Disaster? In *Handbook of Disaster Research* (pp. 1-15). Springer New York. https://doi.org/10.1007/978-0-387-32353-4_1

- Pescaroli, G., & Alexander, D. (2015). A definition of cascading disasters and cascading effects: Going beyond the “toppling dominos” metaphor. *Planet@ risk*, 3(1), 58-67.
- Planning, Q. (2008). *When is enough, enough?: Dealing with cumulative effects under the resource management act*.
https://www.qualityplanning.org.nz/sites/default/files/When_is_Enough_Enough_Dealing_with_Cumulative_Effects_Under_the_RMA.pdf
- Powers, R., & Daily, E. (2010). *International disaster nursing*. Cambridge University Press.
- Raikes, J., Smith, T. F., Jacobson, C., & Baldwin, C. (2019). Pre-disaster planning and preparedness for floods and droughts: A systematic review. *International Journal of Disaster Risk Reduction*, 38, 101207.
<https://doi.org/https://doi.org/10.1016/j.ijdr.2019.101207>
- Raworth, K., Sweetman, C., Narayan, S., Rowlands, J., & Hopkins, A. (2012). *Conducting semi-structured Interviews*. Oxfam.
- Ray-Bennett, N. S., Masys, A., Shiroshita, H., & Jackson, P. (2015). Reactive to proactive to reflective disaster responses: Introducing critical reflective practices in disaster risk reduction. In *Hazards, Risks, and Disasters in Society* (pp. 99-117). Elsevier.
- Reilly, A. C., Guikema, S. D., Zhu, L., & Igusa, T. (2017). Evolution of vulnerability of communities facing repeated hazards. *PLoS one*, 12(9), e0182719.
<https://doi.org/10.1371/journal.pone.0182719>
- Rentschler, J. E. (2013). *Why resilience matters—The poverty impacts of disasters*. The World Bank.
- Rogers, P. (2011). Development of resilient Australia : Enhancing the PPRR approach with anticipation, assessment and registration of risks. *Australian journal of emergency management*, 26(1), 54-58.
<http://classic.austlii.edu.au/au/journals/AUJEmMgmt/2011/14.html>
- Rolland, E., Patterson, R. A., Ward, K., & Dodin, B. (2010). Decision support for disaster management. *Operations Management Research*, 3(1), 68-79.
- Rotimi, J. O. B. (2010). *An Examination of improvements required to legislative provisions for post disaster reconstruction in New Zealand* [Doctoral Thesis, University of Canterbury]. UC Research Repository. <https://ir.canterbury.ac.nz/handle/10092/4145>
- Sai, F., Cumiskey, L., Weerts, A., Bhattacharya, B., & Haque Khan, R. (2018). Towards impact-based flood forecasting and warning in Bangladesh: A case study at the local level in Sirajganj district. *Natural Hazards and Earth System Sciences Discussions*, 1-20.
<https://doi.org/https://doi.org/10.5194/nhess-2018-26>
- Saunders, W. S., & Becker, J. (2015). A discussion of resilience and sustainability: Land use planning recovery from the Canterbury earthquake sequence, New Zealand. *International Journal of Disaster Risk Reduction*, 14, 73-81.
<https://doi.org/http://dx.doi.org/10.1016/j.ijdr.2015.01.013>
- Saunders, W. S., Kelly, S., Paisley, S., & Clarke, L. B. (2020). Progress toward implementing the Sendai framework, the Paris agreement, and the sustainable development goals: Policy from Aotearoa New Zealand. *International Journal of Disaster Risk Science*, 11(2), 190-205. <https://doi.org/https://doi.org/10.1007/s13753-020-00269-8>
- Saunders, W. S., & Kilvington, M. (2016). Innovative land use planning for natural hazard risk reduction: A consequence-driven approach from New Zealand. *International Journal of Disaster Risk Reduction*, 18, 244-255.
<https://doi.org/http://dx.doi.org/10.1016/j.ijdr.2016.07.002>

- Schwab, J. (2014). *Planning for post-disaster recovery:Next generation*. American Planning Association. <https://www.planning.org/publications/report/9026899/>
- Scott, Z., & Tarazona, M. (2011). *Study on disaster risk reduction, decentralization and political economy:Background Paper to the Global Assessment report on disaster risk reduction*. UNISDR.
- Serje, J. (2010). *Preliminary extensive risk analysis for the global assessment report on disaster risk reduction:Case study prepared for the 2011 Global assessment report on disaster risk reduction*. Geneva, Switzerland:UNISDR.
- Shah, A. A., Gong, Z., Pal, I., Sun, R., Ullah, W., & Wani, G. F. (2020). Disaster risk management insight on school emergency preparedness—a case study of Khyber Pakhtunkhwa, Pakistan. *International Journal of Disaster Risk Reduction*, 51, 101805. <https://doi.org/https://doi.org/10.1016/j.ijdrr.2020.101805>
- Shaw, R., Uy, N., & Baumwoll, J. (2008). *Indigenous knowledge for disaster risk reduction:Good practices and lessons learned from experiences in the Asia-Pacific Region*. United Nations, International Strategy for Disaster Reduction.
- Shi, P. (2019). Hazards, disasters, and risks. In *Disaster Risk Science* (pp. 1-48). Springer.
- Shrestha, S. (2016). *Adrista Sangharsaharu, Sthaniya Sabalta:Exploring recovery from small-scale disasters:Examples from remote Nepal* [Doctoral Thesis, The University of Auckland]. Auckland, New Zealand. <https://researchspace.auckland.ac.nz/handle/2292/31699>
- Shrestha, S., & Gaillard, J. (2013, 26-30 May). *Small-scale disasters and the recovery process* [Conference paper]. 6th International i-Rec conference:Sustainable Post-Disaster Reconstruction:From Recovery to Risk Reduction, Ascona, Switzerland.
- Simmons, D., Corbane, C., Menoni, S., Schneiderbauer, S., & Zschau, L. (2017). Understanding disaster risk:Risk assessment methodologies and examples. In K. Poljansek, M. Marin Ferrer, & T. a. C. De Groeve, I (Eds.), *Science for Disaster Risk Management 2017:Knowing better and losing less*. Publications Office of the European Union.
- Smith, G. P., & Wenger, D. (2007). Sustainable disaster recovery:Operationalizing an existing agenda. In *Handbook of disaster research* (pp. 234-257). Springer.
- Song, Y., Li, C., Olshansky, R., Zhang, Y., & Xiao, Y. (2017). Are we planning for sustainable disaster recovery? Evaluating recovery plans after the Wenchuan earthquake. *Journal of environmental planning and management*, 60(12), 2192-2216. <https://doi.org/https://doi.org/10.1080/09640568.2017.1282346>
- Sowry, R. (2017). *Better responses to natural disasters and other emergencies:Ministerial review*. <https://apo.org.au/node/134066>
- Storey, B., Noy, I., Owen, S., Townsend, W., Kerr, S., Salmon, R., Middleton, D., Filippova, O., & James, V. (2017). Insurance, Housing and Climate Adaptation:Current knowledge and future research.
- Tarvainen, T., Jarva, J., & Greiving, S. (2006). Spatial pattern of hazards and hazard interactions in Europe. *SPECIAL PAPER-GEOLOGICAL SURVEY OF FINLAND*, 42, 167.
- Tesso, G., Emanu, B., & Ketema, M. (2012). Analysis of vulnerability and resilience to climate change induced shocks in North Shewa, Ethiopia. *Agricultural Sciences*, 3(06), 871-888.
- The Global Network of Civil Society Organisations for Disaster Reduction. (2013). *Views from the frontline—Beyond 2015:Recommendations for a post-2015 disaster risk reduction framework to strengthen the resilience of communities to all hazards*. www.globalnetwork-dr.org

- Thomas, V. (2017). *Climate change and natural disasters: Transforming economies and policies for a sustainable future*. Taylor & Francis.
- Tierney, K. (2008). Hurricane Katrina: Catastrophic impacts and alarming lessons. In J. Quigley and L. A. Rosenthal (Eds.), *Risking house and home: Disasters, cities, public policy*, (pp.119-136). Berkeley: Berkeley Public Policy Press.
- Tierney, K. (2012). Disaster Governance: Social, Political, and Economic Dimensions. *Annual review of Environment and Resources*, 37(1), 341-363. <https://doi.org/10.1146/annurev-environ-020911-095618>
- Tierney, K., & Oliver-Smith, A. (2012). Social Dimensions of Disaster Recovery. *International Journal of Mass Emergencies & Disasters*, 30(2).
- Tonkin, & Taylor. (2016). *Risk based approach to natural hazards under the RMA* (CR 234). <https://www.mfe.govt.nz/publications/natural-hazards-management/risk-based-approach-natural-hazards-under-rma>
- Twigg, J. (2015). *Disaster risk reduction*. Overseas Development Institute, Humanitarian Policy Group London. https://inee.org/system/files/resources/Twigg_Disaster_Risk_Reduction_2015_ENG.pdf
- UN ESCAP. (2021). Regional situation analysis: The state of production, dissemination, and use of disaster-related statistics in selected countries in Asia and the Pacific. <https://www.unescap.org/kp/2021/regional-situation-analysis-state-production-dissemination-and-use-disaster-related>
- UNDP. (2012). *Issue brief: Disaster risk governance* (https://www.preventionweb.net/files/29974_20121311issuebriefdisasterriskreduc.pdf, Issue. https://www.preventionweb.net/files/29974_20121311issuebriefdisasterriskreduc.pdf
- UNDRR. (2017). Sendai Framework Terminology on Disaster Risk Reduction. Retrieved 24.08.2023 from <https://www.undrr.org/terminology>
- UNDRR. (2019). *Desinventar Sendai 10.1.2 User Manual*. https://www.desinventar.net/documentation/DISendai_DataManagement_2019-2.pdf
- UNDRR. (2020). *Disaster risk reduction in New Zealand: Status report*. United Nations Office for Disaster Risk Reduction (UNDRR), Regional Office for Asia and the Pacific,. [https://www.undrr.org/publication/disaster-risk-reduction-new-zealand-status-report-2020#:~:text=The%20disaster%20risk%20reduction%20\(DRR,Disaster%20Risk%20Reduction%202015%2D2030](https://www.undrr.org/publication/disaster-risk-reduction-new-zealand-status-report-2020#:~:text=The%20disaster%20risk%20reduction%20(DRR,Disaster%20Risk%20Reduction%202015%2D2030).
- UNGA. (2016). Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction. *United Nations General Assembly: New York, NY, USA, 41*.
- UNISDR. (2007). *Hyogo framework for action 2005-2015: Building the resilience of nations and communities to disasters*. file:///C:/Users/wt67/Downloads/1037_hyogoframeworkforactionenglish.pdf
- UNISDR. (2009a). *Global assessment report on disaster risk reduction: Risk and poverty in a changing climate*. <https://www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2009>
- UNISDR. (2009b). *UNISDR terminology on disaster risk reduction*. UNISDR. <https://www.undrr.org/publication/2009-unisdr-terminology-disaster-risk-reduction>
- UNISDR. (2015a). *Global assessment report on disaster risk reduction 2015: Making development sustainable: The future of disaster risk management* (Vol. 4). UN.

- UNISDR. (2015b). *The Pocket GAR 2015. Making Development Sustainable: The Future of Disaster Risk Management*. United Nations.
- UNISDR. (2015c). *Sendai framework for disaster risk reduction 2015–2030*. UNISDR. <https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030>
- UNISDR. (2017). *Words into Action: National Disaster Risk Assessment*. https://www.preventionweb.net/files/52828_nationaldisasterriskassessmentwiagu.pdf
- United Nations Office for Disaster Risk Reduction. (2019). *Global assessment report on disaster risk reduction (GAR)*. <https://gar.unisdr.org/report-2019>.
- Velasquez, A., Rosales, C., & Ramirez, F. (2002). *Comparative analysis of disaster databases: Final report submitted to working group 3: Risk, vulnerability and impact assessment*. https://www.unisdr.org/2005/task-force/working%20groups/wg3/Comparative_Analysis_of_Disaster_Database.pdf
- Voss, M., & Wagner, K. (2010). Learning from (small) disasters. *Natural hazards*, 55(3), 657-669. <https://doi.org/https://doi.org/10.1007/s11069-010-9498-5>
- Wach, E., & Ward, R. (2013). Learning about qualitative document analysis. <https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/2989>
- Wallemacq, P., Herden, C., & House, R. (2015). *The human cost of natural disasters 2015: A global perspective*. CRED & UNISDR.
- 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. <https://doi.org/DOI:10.1177/030913259301700103>
- Weber, M., Krogman, N., & Antoniuk, T. (2012). Cumulative effects assessment: Linking Social, Ecological, and Governance Dimensions. *Ecology and Society*, 17(2). <http://www.jstor.org/stable/26269026>
- Weekes, C., & Bello, O. (2019). Mainstreaming disaster risk management strategies in development instruments (II): Policy briefs for Barbados, Guyana, Saint Lucia, Suriname, and Trinidad and Tobago.
- Wharekawa coast 2120. (n.d.). Community risk thresholds. Retrieved 15.01.2023 from <https://wharekawacoast2120.hauraki-dc.govt.nz/>
- Wilkinson, E. (2012). Transforming disaster risk management: A political economy approach. *ODI Background Notes*.
- Williamson, F., & Courtney, C. (2018). Disasters fast and slow: The temporality of hazards in environmental history. *International Review of Environmental History*, 4(2), 5-11. <https://doi.org/10.22459/IREH.04.02.2018.02>
- Willis, G. (2014). *Managing natural hazard risk in New Zealand: Towards more resilient communities*. LGNZ.
- Wisner, B. (2004). *At risk : Natural hazards, people's vulnerability, and disasters* (2nd ed.). Routledge.
- Wisner, B., & Gaillard, J.-C. (2009). An introduction to neglected disasters. *Jàmbá: Journal of Disaster Risk Studies*, 2(3), 151-158. <https://doi.org/https://hdl.handle.net/10520/EJC51175>
- Wisner, B., Gaillard, J., & Kelman, I. (2012). Framing disaster: Theories and stories seeking to understand hazards, vulnerability and risk. In *Handbook of Hazards and Disaster Risk Reduction* (pp. 47–62). Routledge. <https://doi.org/10.4324/9780203844236-13>
- Wisner, B., Kent, G., Gaillard, J., Willison, Z. D., van Niekerk, D., Bhatt, M., Cook, B., Lassa, J., Cardona, O.-D., & Oxley, M. (2011). *A Contribution to the Review of the draft GAR*

- 2011, Chapters 5, 6 & 7 *Political Will for Disaster Reduction: What Incentives Build It, And Why Is It So Hard To Achieve?* [Concept paper]. <http://www.radixonline.org/>
- Wisner, B., & Luce, H. R. (1993). Disaster vulnerability: Scale, power and daily life. *GeoJournal*, 30(2), 127-140. <https://doi.org/https://doi.org/10.1007/BF00808129>
- Yin, R. K. (2003). *Case study research: Design and methods (Vol. 5)* (4th ed.). Sage Publications, Thousand Oaks.
- Yin, R. K. (2009). *Case study research: Design and methods (Vol. 5)*. sage.
- Yin, R. K. (2017). *Case Study Research and Applications: Design and Methods*. SAGE Publications, Incorporated.
- Yin, R. K., & Campbell, D. T. (2018). *Case study research and applications: Design and methods (Sixth edition. ed.)*. SAGE Publications, Inc.
- Zaidi, R. Z. (2018). Beyond the Sendai indicators: Application of a cascading risk lens for the improvement of loss data indicators for slow-onset hazards and small-scale disasters. *International Journal of Disaster Risk Reduction*, 30, 306-314. <https://doi.org/https://doi.org/10.1016/j.ijdrr.2018.03.022>

Appendix A Codes used for the interview data analysis

Name	Files	References
adaptability & adaptive planning	2	2
BAU	6	12
Build back better	1	1
climate-change	6	6
Community risk acceptance	3	5
consequences	6	10
contextual	3	3
cumulative impacts	3	6
emergency declaration	7	10
evacuation	6	9
frequency	2	2
impacts (local, insignificant, etc.)	7	8
incident management	2	2
insurance	3	6
land use planning	1	2
legislation	2	3
likelihood & recurrence	8	16
recovery	8	19
resilience	4	5
response	8	20
community response and planning	3	3
welfare response	2	3
risk assessment	3	8
scale-based	1	1

Name	Files	References
thresholds	8	18
universal support	1	1
vulnerability	7	16

Appendix B Ethical Approval

Division of Arts, Law, Psychology & Social Sciences | Te Wānanga o Ngā Kete

The University of Waikato
Private Bag 3105
Hamilton 3240
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THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

Kishani Tennakoon

Silvia Serrao-Neumann

Arts

20 October 2020

Dear Kishani

Re: FS2020-60: Understanding and improving the community recovery process from small scale recurring disasters: insights from Aotearoa-New Zealand

Thank you for submitting your application to the ALPSS Human Research Ethics Committee. We have reviewed the final electronic version of your application and the Committee is pleased to offer formal approval for your research activities, as detailed therein.

One review comment for your consideration is that you provide a more detailed timeframe for participants to withdraw their data from the study (from 'upon receiving a copy of the interview transcripts' to a specific time, such as 1 week, 10 days, etc). There is no need to reply to the Committee regarding this.

Please contact the Committee should issues arise during your data collection, or should you wish to add further research activities or make changes to your project as it unfolds. We wish you all the best with your research. Thank you for engaging with the process of ethical review.

Kind regards,

A handwritten signature in black ink, appearing to read 'N. Cooper'.

Nathan Cooper, Chair
Division of Arts, Law, Psychology & Social Sciences Human Research Ethics Committee

Appendix C Information Sheet

Division of Arts, Law, Psychology, & 0800 WAIKATO (924 528)
Social Sciences www.waikato.ac.nz
Te Wānanga o Ngā Kete
The University of Waikato
Private Bag 3105
Hamilton, New Zealand, 3240



Environmental Planning Programme
School of Social Sciences
The University of Waikato
Private Bag 3105
Hamilton 3240
New Zealand

Name Mr.xxxxx

Date 16th August 2021

Dear Mr. Thompson,

Re : Understanding and improving the community recovery process from small scale recurring disasters: insights from Aotearoa-New Zealand

Thank you for taking the time to consider this research. I am a student at the University of Waikato undertaking a Doctor of Philosophy in Environmental Planning. I am researching the post disaster recovery process within New Zealand, with a focus on the recovery from small-scale recurring disasters. The key aim of this study is to examine the implications of two or more flood events that occurred in succession where the impacts overlapped before the recovery from a previous event was considered to be completed.

As part of the research, I am undertaking interviews of practitioners with experience in Civil Defence Emergency Management (CDEM) operations. The purpose of the interviews is to understand and collect information about minimum thresholds of CDEM interventions at the local level, particularly for small-scale recurring disasters. As someone who has detailed knowledge of the topic, I would like to invite you to participate in an interview. The interview should not take longer than 1.5 hours.

If you choose to participate in the interview, you have the right to:

- Decline to answer any question(s)
- Withdraw up to three weeks after the interview
- Ask any questions about the research at any time
- Decline to be audio recorded
- Request that any material be erased
- Request that your participation and responses be kept anonymous through pseudonyms (e.g. Participant 1) in the understanding that the researcher will endeavor to ensure you

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remain anonymous but that, given the small number of working professionals in this area in New Zealand, absolute anonymity cannot be guaranteed.

With respect to confidentiality, your name will not be attributed to any interview responses. I will solely have access to the interview responses, which will be password protected. The results of my research will be used as a component of a research thesis to fulfil the requirements of a Doctor of Philosophy in Environmental Planning, which will be publically available. The findings of this research may also be used in presentations, conferences and journal publications. All records held by myself for the purpose of this Doctoral thesis will be destroyed five years following the completion of the thesis.

If you would like to take part in my research or if you have any questions, please contact either myself or my supervisors (Associate Professor Silvia Serrao-Neumann and Dr Christina Hanna), via the details below.

Kind Regards



Kishani Tennakoon (07)
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kishaniten@gmail.com
wt67@students.waikato.ac.nz

Associate Professor Silvia Serrao-Neumann
silvia.serrao-neumann@waikato.ac.nz

Dr Christina Hanna
christina.hanna@waikato.ac.nz

PARTICIPANT CONSENT FORM

Name of person interviewed: Mr. xxxxxxxx,

I have received a copy of the Information Sheet describing the research project. Any questions that I have, relating to the research, have been answered to my satisfaction. I understand that I can ask further questions about the research at any time during my participation, and that I can withdraw my participation at any time upto three weeks after the interview.

During the interview, I understand that I do not have to answer questions unless I am happy to talk about the topic. I can stop the interview at any time, and I can ask to have the recording device turned off at any time.

When I sign this consent form, I will retain ownership of my interview, but I give consent for the researcher to use the interview for the purposes of the research outlined in the Information Sheet. I understand that my identity will remain confidential in the presentation of the research findings.

Please complete the following checklist. Tick [✓] the appropriate box for each point.	YES	NO
I wish to view the transcript of the interview	<input type="checkbox"/>	<input type="checkbox"/>
I wish to receive a copy of the findings.	<input type="checkbox"/>	<input type="checkbox"/>
I consent to the interview being audio recorded	<input type="checkbox"/>	<input type="checkbox"/>

Participant :		Researcher :	Kishani Tennakoon
Signature :	_____	Signature :	_____
Date :	_____	Date :	_____
Contact Details :		Contact	kishaniten@gmail.com wt67@students.waikato.ac.nz
		Details :	_____
			022 358 3149
			(07) 837 9707

Appendix D Questionnaire

1. The questions below refer to terms and terminology used in the Draft CDEM Guideline for Risk Assessment. They attempt to identify/define the social, economic, environmental and cultural impact thresholds used to determine when Civil Defense response/ interventions/services are activated.
 - a) What is the minimum threshold related to social impacts that trigger the provision of services to an affected community?
 - b) What services are made available once these thresholds are met?
 - c) What does the short-term disruption mean in the context of civil defense?
 - d) What is the minimum threshold/ impact on services and utilities to trigger CDEM intervention?
 - Electricity network
 - Water supply
 - Sewer network
 - Gas
 - Telecommunications
 - Roads, bridges
 - e) What is the minimum level of economic impact on individuals/households which would make them eligible to access CDEM support?
 - f) What would a minimum impact on profitability of a business, commercial entity or an industry be in the context of the civil defense, how is this quantified/assessed?
 - g) How do the affected individuals/households economically recover from events which may not be eligible for assistance?
 - h) What kind of minimum impacts on the natural environment could trigger CDEM interventions?
 - i) What kind of environmental impact may trigger assistance to local communities/households?
 - j) What is the difference between a temporary localised impact and a sustained localised impact to the natural environment as it is referred in the draft guideline for risk assessment?
 - k) In determining the thresholds for activating the services, how is the vulnerability factor of the community taken into account? To what extent are CDEM decisions influenced by the community's vulnerability and adaptive capacity?
 - l)

2. How much weight is given to the likelihood factor when assessing risk?
 - a) Is there an annual recurrence interval that would be considered 'recurrent'?
 - b) Do CDEM interventions recognize events with higher likelihood, such as almost certain and likely events, but with lower consequences?
 - c) Does it consider cumulative impacts of recurring disasters? How is this done?
 - d) Are (or could) frequent flooding events be considered as an early indicator that regions may experience more severe flood impacts in the near future as a result of cumulative impacts? How can this be accounted for?

3. What characteristics of an event may trigger recovery services/ support?
 - e) Are there any policies or operating procedures identifying different disaster thresholds for recovery?
 - f) If so, what are they? How is the recovery support and necessary funding determined, if this is not readily available?
 - g) When insignificant consequences are at play, are interventions based on a BAU scenario?
 - h) (prompt: The Response Planning guide [DGL 19/15] p. 141 states BAU to Refers to structures, practices, and procedures that apply when there is no emergency response; i.e. during normal conditions. Which interprets that these events are normal conditions)

4. Can you name a few locations in your administrative area where you think communities were impacted by recurring small-scale recurring flood events based on what we discussed today?

From a practical point of view, would you like to share your thoughts on my working definition of small-scale recurring disasters.

An event considered as small-scale is one that does not trigger an emergency declaration, only impacts one or two communities, and has a risk level below the major and extreme threshold limits.

In this context, recurring events are those that occurred at least two to three times during the past decade or if it has at least a 10-year return period;

Such events must have social, environmental, economic and cultural impacts as well as long term cumulative impacts.

Economic Environment

No impact or some local management but no special management required outside of BAU	Some local specialised management at district level, may be of interest to regional authorities	Significant local specialised management and multi-district management. Of interest to regional authorities.	Multi-functional, Multi-district specialised management. Regional authorities involved. Of interest to national agencies	Multi-functional, regional and national specialised management. Of significant interest to national agencies, may be of interest to international partners.
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Economic Environment					
Costs to Individuals	No impact	A small number of people affected with minimal financial losses	Many individuals with significant financial losses	Significant number of people affected, with large financial losses	Whole of community impacts with large financial losses
Costs to Businesses, Commercial entities and Industries	No impact	Short term disruption and/or minimal impact to profitability	Medium term disruption and /or moderate impact to profitability	Long term disruption and / or significant impact to profitability	Permanent loss of output and / or widespread business failure
Costs to Local and Central Government	No impact	Short-term increases in costs	Medium term increase in costs, minimal loss of assets	Long term increases in costs, some loss of assets	Long term costs increases, and significant loss of assets
Disruption to the Region's Key Economic Sectors	No Impact	Short term loss of output for a key sector	Medium term loss of output for a key sector	Long term loss of output for a key sector	Closure of key economic sector(s)
Impacts on employment	No Impact	Limited disruption to employment	Temporary reduction in employment	Medium to long term reduction in employment	Widespread job losses
Total financial losses (replace percentage with GRP values - see toolbox for Regional Product Value)	<1% of Gross Regional Product	1-2% of Gross Regional Product	2-3% of Gross Regional Product	3-4% of Gross Regional Product	>4% of Gross Regional Product
Livestock	No impact	A small number of livestock lost with minimal financial losses	Many stock lost with significant financial losses	Significant number of livestock losses, with large financial losses	Whole of livestock sector with large financial losses

No impact or some local management but no special management required outside of BAU	Some local specialised management at district level, may be of interest to regional authorities	Significant local specialised management and multi-district management. Of interest to regional authorities.	Multi-functional, Multi-district specialised management. Regional authorities involved. Of interest to national agencies	Multi-functional, regional and national specialised management. Of significant interest to national agencies, may be of interest to international partners.
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Natural Environment					
Air quality	No impact	Temporary, localised impact	Sustained localised impact	Widespread degradation of air quality	Permanent degradation of air quality
Impacts to biodiversity	No impact	Temporary, localised impact	Sustained localised impact	Short term loss of biodiversity	Permanent loss of biodiversity
Impacts to significant natural areas or iconic species	No impact	Temporary, localised impact	Sustained localised impact	Loss of areas or species	Permanent, widespread loss of areas or species
Freshwater quality (ground and surface water) and associated ecosystem services	No impact	Temporary, localised impact	Sustained localised impact	Widespread degradation of water quality	Permanent degradation of water quality
Marine environment and ecosystem services	No impact	Temporary, localised impact	Sustained localised impact	Widespread loss or degradation of the marine environment	Permanent loss or degradation of the marine environment
Soil quality and associated ecosystem services	No impact	Temporary, localised impact	Sustained localised impact	Short term loss of water quality	Permanent loss of soil quality and productivity

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Appendix E Supplementary Data on flood disaster events

Year	Month and date	Event	Scale of the event	Amount of rainfall/duration	Sub areas	Population per location	Previously affected (add date)	Evacuation	Recorded in the source	Type of flooding	Type of damages	Economic damage (insurance claims or estimated damage) (NZD million)	Others	Source
2021	Aug 30-31	Floods in Auckland (Torential rain)		90 mm in 1 hour Kumeu 208.2 mm (24 hrs)	Kumeu, Huapai, Ranui, Pihā and Henderson Valley.			55	50-60	flash		62.29	Around 12 roads were closed,13 people were rescued,180 affected	https://floodlist.com/tag/new-zealand
2021	July 16-19	West Coast Flooding	1 in 100 year	267mm in 24 hours	Buller District - Westport			800	800	0		97.2	local state of emergency declared.Minister of Agriculture and Rural Communities declared a medium-scale adverse event , 89 houses in Westport town were red-stickered.It was the second time in three years their Snodgrass Rd house had been destroyed by raging waters carrying silt	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters https://www.stuff.co.nz/national/126455763/westport-flood-recovery-build-a-wall-or-move-to-higher-ground https://www.nzherald.co.nz/wild-weather/state-of-emergency-army-deployed-after-torrential-rain-on-west-coast-of-the-south-island/UCKNV5QULH3DLDYTXNWDFGMEFM
2021	July 16-16	Marlborough District		300mm of rain in 48 hours	Marlborough, including in the areas of Renwick, Spring Creek and Tuamarina.			1000	1000	0		17.35	declaration of state of emergency, A boil water notice was in place	https://floodlist.com/tag/new-zealand
2021	July 16-19	Wellington Floods		55mm (24 hrs)				0	0	0		17.88		https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2021	June 20-20	Gisborne flooding		100mm (24 hrs)	Tokomaru Bay,Waipiro Bay	500		225	200-250	flash		0	Self evacuation, isolation of houses, bridge damage	https://floodlist.com/tag/new-zealand
2021	May 29- Jun 1	Canterbury Flooding	1 in 100 year flood	540mm (app. 800m above msl) 185mm (approx. 90m above msl) 6 to 10mm (per hour)	Timaru, Ashburton and Selwyn districts			810	300 homes	0	Infrastructure (bridge) Agriculture	46.44	a community-led emergency centre is was open, 6 people were rescued, declared a state of emergency Agriculture Minister a medium-scale adverse event	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters https://newsline.ccc.govt.nz/news/story/flooding-affecting-parts-of-christchurch-banks-peninsula
2021	March 11-11	Flooding in North Island		28.2 mm in 1 hr	Pōtāruru			0	0	0	infrastructure (roads, bridges)	0	roads blocked , traffic	https://www.stuff.co.nz/national/124514667/h
2021	Jan 2-3	Canterbury Southwards Rain and Hailstorm (torrential rain)		100mm of rain during 18 hours	Otago, Dunedin, Taieri, Clutha, Manuhereka and Kakanui catchments			0	0	0	infrastructure (roads, bridges)	3.84	boil water notices in Otago, road closure	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2021	Jan 2-3	Flooding in Waikato region		40mm (1 hr)	Morrinsville and Whangamata Whakatāne and Opōtiki.			0	0	0	surface	0		https://niwa.co.nz/sites/niwa.co.nz/files/Climate_Summary_December_2019_Final_0.pdf
2020	Dec 26-26	Hail Storms causing flash floods upper South Island			Motueka			0	0	0	flash	50.18		https://www.nzherald.co.nz/wild-weather/news/breaking-news/new-zealands-costliest-natural-disaster/
2020	Nov 29- Dec 1	Greater Wellington Floods		10mm-20mm per hour	Plimmerton, Porirua			5.4	2 homes	0	surface	5.37	Surface flooding, 16 homes uninhabitable	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2020	Nov 25-25	Flash flooding in Waikato , Taranaki		90mm (18 hrs)	Te Awamutu, Taupo, Rotorua			0	0	0	Flash flooding	0	Road closures	https://www.nzherald.co.nz/wild-weather/news/lightning-strikes-plane-tornado-and-flash-flooding-in-waikato
2020	Nov 9- 10	Napier Flooding		54mm (1 hr) 242.4 mm in 24 hrs		589 properties		173	173 ppl	0		87.72	School closure, roads blocked,declared local state of emergency 10,000 power outages recorded, ranging from a few minutes to 26 hours.	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters https://www.napier.govt.nz/assets/Uploads/Napier-Flood-Report.pdf
2020	July 17-20	Upper North Island Flooding	1 in 500 year flood event	220mm rain (Whangarei) 50.8 (1 hour)	Whangarei, Northland (Moerewa,Ohaeawai,Ngungunu)			147.55	65 homes	0		44.19	Road closure,Karetu	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2020	Feb 3-8	Southland Flooding		Milford sound more than 350mm (in 24 hours) 100 cm (1000mm) rain in 60 hrs	South Otago,Milford, Fiordland,Gore, Lumsden,Hollyford,Balclutha, Mataura and Wyndham	2400 affected		195	195 tourists (Milford Sound)	0	dairy farms	29.64	declared state of emergency , boil water notice, road closure,	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters https://hwe.niwa.co.nz/event/February_2020/te_Summary_December_2019_Final_0.pdf
2019	Dec 18-18	Surface flooding in parts of Wellington		30mm in (12 hours)	Khandallah, Churton Park and Hutt Road.			0	0	0	surface	0		https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2019	Dec-2-9	Nation wide stormand southern Lakes floods	One in 20 year (Rangitata)	More than 350mm in 2 days	Rangitata River,Timaru,Wellington City			115	115	Surface		15.29	local state of emergency (Timaru), road closure, \$ 50,000 made available for south canterbury rural support trust	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters https://www.nzherald.co.nz/wild-weather-chaos-up-to-1000-people-stranded-on-west-coast/
2019	Nov 20-20	Timaru Hail storms related floods						0	0	0	Minor	0	economic damages on flood is not available	https://www.stuff.co.nz/timaru-herald/news/117566456/hail-storm-hammers-waikato
2019	Sep 10-11	Coromendal floods		260mm in 24 hours	Thames Coromendal Disctrict			10.8	4 hrs	0	Surface flooding (Gisborne)	0	landslips, road closure	https://floodlist.com/tag/new-zealand
2019	Sep 3-5	Flooding in Gisborne, Auckland		14mm (6 hrs) - Mt Albert	Awanui,Te Hauke area of Hastings			0	0	0	surface flooding (Gisborne)	0		https://www.nzherald.co.nz/nz/more-gale-force-winds-and-heavy-rain-on-way-for-upper-north-island/
2019	April 29-29	Christchurch flooding		11mm (2 hrs)				0	0	0	surface flooding roads	0	power outages	https://www.stuff.co.nz/the-press/news/west-coast-flooding
2019	Mar 24-27	Westcoast Wind and Flooding	1 in 100 year flood (Haas)	Crop river 1086mm (48 hours), 70mm,110mm (24 hours)	West Coast,Waiho Bidge,Arahura River			7	7ppl	0	Bridge damages	4.09	declared local state of emergency , 1 death, bridge damage, busineses affected, road closures ,school closed	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters https://www.nz.co.nz/news/national/385648/ive-updates-west-coast-flooding-day-2
2018	Dec 2-2	Wairapa weather bomb , Flooding in Hamilton		Featherston 75mm in 45 mins, Hamilton 40mm (1 hr)	Featherston, Dinsdale			24	24 ppl	flash		0		https://www.stuff.co.nz/national/109036910/flash-flood-drenches-town-and-takes-out-road
2018	Nov 25-25	Flash flooding in Auckland		70mm (24 hrs) Paeroa catchment				0	0	flash		0		https://www.nzherald.co.nz/wild-weather-chaos-up-to-1000-people-stranded-on-west-coast/
2018		Flooding in southern and eastern parts of South Island		47.7mm Dunedin 6.5mm (24 hour)	Taiari Plains, Dunedin, Mosgiel, Lawrence, Beaumont, Middlemarch and Weston.			0	0	0	surface	0		https://niwa.co.nz/sites/niwa.co.nz/files/Climate_Summary_November_2018_Final.pdf
2018	Nov 19-20	Surface flooding in parts of South Waikato		15mm-20mm (short period of time)	Pōtāruru and Tokoroa			0	0	0	surface	0	school closure, road closure	https://www.stuff.co.nz/national/108742479/flooding-in-waikato
2018	Nov 13-13	Surface flooding in parts of South Waikato			Pōtāruru and Tokoroa			0	0	0	surface	0		https://www.stuff.co.nz/national/108742479/flooding-in-waikato
2018	Nov 8-9	Flooding event in West Coast		112mm (12 hours)	South Canterbury district			0	0	0	surface	0	road closure	https://www.nz.co.nz/news/national/378431/

Year	Month and date	Event	Scale of the event	Amount of rainfall/duration	Sub areas	Population per location	Previously affected (add date)	Evacuation	Recorded in the source	Type of flooding	Type of damages	Economic damage (insurance claims or estimated)	Others	Source
2018	July 14-15	Northland- Bay of Plenty flooding		60mm-90mm (9 hrs)				0			0	3.7		https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters
2018	June 11-12	Gisborne-Hawke's Bay flooding		115mm (24 hrs)				100	100	0		4	Complete cut off of some areas , road damages	https://floodlist.com/tag/new-zealand
2018	June 2-4	Uppernorth Island Hawkesbay flooding , Auckland		25-40mm/hr	Coromandel,Auckland - Howick , Pakuranga street , Casuarina culvert			0				4.3	Road closure	https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters https://www.odt.co.nz/news/national/floodin
2018	Apr 27-29	Nation wide severe weather including flooding in Rotorua etc		51.8 mm (1 hr)	Ngongotaha,Karangahake, Waihi Beach area, Piha		Feb-18	0			0	21.3	local state of emergency, damages to residential properties	https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters https://www.nzherald.co.nz/rotorua-daily-
2018	Mar 7-8	Hawkes Bay flooding	1 in 100 year (Napier)	270mm (12 hrs)	Eskdale area.Rissington (Napier)			100	100	flash		0	building damages	https://floodlist.com/tag/new-zealand
2018	Feb 20-22	Ex Tropical Cyclone Gita	35 year flood	13mm (4 hrs)	Tasman-Nelson, Christchurch,Selwyn, Wellington, (Motueka, Takaka,Marahau, Upper Moutere)			158	158	0		35.6	power lostState of emergency declared in Nelson Tasman District. 2 deaths	https://hwe.niwa.co.nz/event/February_2018_Ex_Tropical_Cyclone_Gita
2018	Feb 9-12	Nelson -Tasman region flooding	116mm(1 day)	124mm	Clouston Bridge			0			0	0	infrastructure damages	https://niwa.co.nz/sites/niwa.co.nz/files/Climate_Summary_February_2018_Final.pdf
2018	Feb 3-3	Flooding event in Piha Auckland		27.mm (1hr)				0				0		
2018	Feb 1-2	Ex Tropical Cyclone Fehi		100mm in 15 hrs	Nelson -Tasman, Otago, Wellington			140	9+30hrs+50	Coastal		45.9	States of Emergency were declared in the Buller district and Dunedin.	https://hwe.niwa.co.nz/event/February_2018_Ex_Tropical_Cyclone_Fehi
2018	Jan 29-Feb 4	Flash flooding in South Island and west Auckland		10.8mm (2 hr)	Buller and Dunedin , Golden Bay			200	200	flash		0	declaration of state of emergency, 2 fatalities, roads blocked, bridge 0 damages	https://floodlist.com/tag/new-zealand https://www.nzherald.co.nz/nz/wet-and-wild-severe-wind-rain-storm-signal-the-end-of-the-
2018	Jan 23-23	Flooding in Aucklands North shore		62.4mm (1 hr)				7	7	flash		0		https://www.stuff.co.nz/auckland/100799627/flash-flooding-hits-upper-harbour
2018	Jan 17-18	Flooding in parts of Nelson Tasman district		20mm (1hr)				0			0	0	road closures	https://niwa.co.nz/sites/niwa.co.nz/files/Climate_Summary_January_2018_Final.pdf
2018	Jan 11-11	Flooding in Hokitika and Greymouth		197mm				12				0		https://niwa.co.nz/sites/niwa.co.nz/files/Climate_Summary_January_2018_Final.pdf
2018	Jan 4-6	January 2018 Storm (Waikato, Kaikoura, Christchurch)	Kaiaua (Extensive)	208.5mm(Waikaura) 24 hrs	Firth of Thames , Auckland city, Kaiaua,Whakatiaui and Miranda	500 affected		0		Coastal		34.2		https://hwe.niwa.co.nz/event/January_2018_New_Zealand_Storm
2018	Jan 2-2	Flooding in Palmerston North and Masterton		42mm (1 hr)				0		Surface/flash		0		https://www.nzherald.co.nz/nz/most-of-north-island-coastline-at-risk-of-flooding-on- https://www.nzherald.co.nz/news/national/346983/wellington-flooding-more-rain-fell-in-one-
2017	Dec 26-26	Flooding in Wellington		15.8mm (1 hr)	Wellington, Kapiti Coast and New Plymouth			0		Surface		0		
2017	Nov 26-27	Flash flooding in Central Otago		22.6mm (1 hr)				0		flash		0	12 building were damaged, Drinking water and wastewater supply has 0 been disrupted	https://floodlist.com/tag/new-zealand
2017	Jul 21-26	South Island flooding		225mm (24 hrs)	Otago, Canterbury, Timaru			594	220 homes	0		31.2	declaration of state of emergency,river flooding , landslides	https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters
2017	July 20-22	Surface flooding in Bay of Plenty and Rotorua		90-110mm(9-12 hrs)				0		surface		20.9		https://hwe.niwa.co.nz/event/July_2017_New_Zealand_Flood
2017	July 12-14	New Zealand Storm		190mm (24 hrs) 70-100mm (lower lying areas)	Manawatu-Wanganui, Masterton, Martinborough			0			Bridge damages	10.3		https://hwe.niwa.co.nz/event/July_2017_New_Zealand_Storm
2017	Apr 13-13	Flood event in Piha Auckland		80.5mm (4 hrs)				0				0		file:///C:/Users/HP/Downloads/Tonkin%20n
2017	Apr 11-14	New Zealand Storm and Ex-tropical Cyclone Cook		BOP and Taupo exceed 200mm (48 hrs)	Whakatane, Thames Coromandel District Coromandel, Te Aroha, Matamata, central and eastern North Island, Marlborough and Canterbury.			114	114	flash		17.2	declaration of state of emergency (Thames- Coromandel), 4 injured , 1 missing	https://www.waikatoregion.govt.nz/assets/WRCWRC-2019/TR201720.pdf
2017	Apr 3-6	Ex Cyclone Debbie including Edgecumbe flooding	Kaiaua (Extensive) Edgecumbe Medium-scale adverse event 1 in 500 year flood	Kaikoura district more than 100mm (36 hrs) Edgecumbe-Over 200 mm rainfall over 2 days	Waikato Kaiaua , Manawatu-Wanganui-Whanganui,Putiki, Marton Pipiriki,Rangitikei, Christchurch, Waikato (Whangamata, Morrinsville, Waihou)			1600	1600	surface		91.46	declared a local state of emergency (Whanganui, Marton,) Affected 580 hrs and population of 1600 ppl, Breached of stop bank, state of emergency (Whakatane District) The flood was declared a medium-scale adverse event, meaning that farmers could get help from Task Force Green teams and the Bay of Plenty Rural Support Trust, as well as receiving tax assistance.	https://hwe.niwa.co.nz/event/April_2017_New_Zealand_Ex_Cyclone_Debbie https://floodlist.com/tag/new-zealand

Year	Month and date	Event	Scale of the event	Amount of rainfall/duration	Sub areas	Population per location	Previously affected (add date)	Evacuation	Recorded in the source	Type of flooding	Type of damages	Economic damage (insurance claims or estimated damage) (NZD million)	Others	Source
2017	Apr 14-17	Christchurch (ex-cyclone cook)		45mm (12 hrs), 17.8 mm (6 hrs)	Aranui, Avondale, Shirley, Hoon Hay, St Martins and Beckenham, as well as Kaiapoi and Kairaki Beach in North Canterbury.			0		0		0		https://www.stuff.co.nz/national/91575836/cyclone-cook-soaks-canterbury-with-up-to-60mm-rainfall-overnight
2017	Mar 7-12	Upper North Island flooding	Kaiaua (Extensive)	259 mm in 24 hours Coromendal 130mm (24 hrs) Auckland 50mm (3 hrs)	Auckland, Northland and Waikato (Kaiaua, Whangamata, Hunua Ranges), surface flooding on Hutt Road between Ngauranga and Petone.			464	464	River flood		61.7	power cuts , 10 ppl rescued, lands lides	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2017	Feb 13-13	Dunedin Flooding		9.5mm (15 mins)				0		flash		1.7	14 houses affected, building damages	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2016	Nov 14-17	Lower North Island Flooding and Wind	10 to 100-year flood event	83.8 mm of rain in a 24 hour period	Wellington town			30	30	Flash flood, Inland flood		9.1		https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters https://floodlist.com/australia/new-zealand-
2016	Oct 2-3	Flooding Auckland to Waikato and Hailstorm Hawkes bay		21mm of rain fell between 9am and 10am	Auckland, Huntly			0		localised		0.6		https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2016	Sep 25-30	Heavy Rain and flooding - Coromendal Bay of Plenty Gisborne and Hawkes Bay		133mm of rain in 24 hours .340mm	Hunua-South Auckland			0			Roads	1.2		https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2016	Sep 17-18	Flooding in lower North Island		73mm (24 hrs)	Kapiti Coast			0		surface		0		
2016	Sep 7-8	Flooding parts of SH 6 from Queenstown to Lumsden						0				0		https://niwa.co.nz/sites/niwa.co.nz/files/Climate
2016	Aug 10-10	upper North Island and Great Barrier Island		110mm of rain in less than 24 hours				0		surface	Roads	0		
2016	June 29-29	Flooding and Gales -Auckland		25.4 mm of rain in 1 hr	Pukekohe			0		surface		2.4		https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2016	June 1-1	Flooding in Golden Bay		127mm (6 hr) torrential rain				0			Roads	0	"That was the fourth time it's happened in six weeks."	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters https://www.stuff.co.nz/dominion-news/80596963/washout-strands-closed
2016	May 5-5	Flooding Lower North Island		32.2 mm rainfall one morning 20.4mm of rainfall (1 hour)	Porirua and Tawa			0		surface flooding	school	3.9		https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters https://www.stuff.co.nz/dominion-news/80596963/washout-strands-closed
2016	Apr 17-18	Flood -Coromendal and Auckland		124mm in (24 hrs)	Whitianga			5.4	2 families	0		0.6	Minor flooding	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2016	Mar 23-25	Flooding and wind-North and South Island	Riwaka river 1 in 50 year	350mm of Rain in 24 Hours	westland, Tasman-Nelson - Motueka, Riwaka Franz.Josef		Feb-16	200	200	inland flood river flood		30.2	river floods,declaration of local state of emergency, boil water notice	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2016	Feb 17-20	Nelson and Tasman flooding	Wairoa river 25 year flood level	67.8 mm (24hrs)	Motueka,Riwaka			0		0		0		https://floodlist.com/tag/new-zealand
2016	Jan 27-27	Flooding in Auckland	1 in 50 year flood	46mm in 24 hours	Papatoetoe, Mangere and Otahuhu			0		0		0		https://floodlist.com/tag/new-zealand
2015	Sep 21-21	Flood -Gisbourne		97.2 mm of rain during 24 hrs	Te Karaka		Mar-15	0		surface flooding		0.8	Road closure.school closure	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2015	Jul 18-19	Flooding and Strom- Upper North Island		51mm of rain in 2 hours	Auckland (West Auckland -Titirangi, New Lynn, Ranui, Kelston, Gen Eden, Green Bay, Te Atatu, Blockhouse Bay and Hendersonand Airport) South Auckland-udge Richardson Drive in Opaheke, Golden Bay			0		localised flooding		6.2	Power outages	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters https://www.weatherwatch.co.nz/content/view/full/2015-weather-review-floods-fire-droughts-and-twisters
2015	June 19-22	Flooding and Storm South Island West Coast			Dunedin		May 2015 (Golden Bay)	0		surface flooding		8.4	Road closure.school closure, power cuts	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2015	June 18-21	Flooding and Strom Lower North Island including Whanganui and Wellington	1 in 100 year	Hokitika 211mm(24 hrs)	Manawatu-Wanganui, Taranaki and the township of Hokitika in the West Coast Region			400	400+	0		41.5	declaration of state emergency (Taranaki), power outage, road and bridge closures	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2015	June 2-5	Flood and Storm North and South Islands	1 in 85 years	142mm(1day)				0		Coastal		3		https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2015	June 2-4	Flooding and storm-Otago	1 in 100 year flood (Dunedin)	Dunedin 175mm (24 hrs)	Dunedin, Otago , Tasman Nelson- Nelson, Cable Bay			75	75	Coastal		28.2		https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters

Year	Month and date	Event	Scale of the event	Amount of rainfall/duration	Sub areas	Population per location	Previously affected (add date)	Evacuation	Recorded in the source	Type of flooding	Type of damages	Economic damage (insurance claims or estimated damage) (NZD million)	Others	Source
2015	May 14-14	Flooding in Wellington		128 mm in 24 hours	Kapiti Coast, Petone, Wellington City, Porirua and Lower Hutt			67.5	25 homes	surface flooding (Kapiti Coast)		16.8	School closure, road closure, 1 fatality	https://floodlist.com/tag/new-zealand
2015	March 16-21	Flooding in Gisborne region		97.2mm in 24 hours	Gisborne district			0				0		https://www.stuff.co.nz/national/67410329/cy
2015	Mar 5-7	West Coast flooding, particularly Westport and surrounds		111mm in 24 hrs	Westport Buller, Greymouth area			0		surface flooding		1.3	schools closure, declaration of state of emergency	https://www.knz.org.nz/natural-disasters/cost
2014	Aug 20-20	Flooding in Rotorua		113.3 over 24 hours				0		flash floods		0	declaration of state of emergency, power cuts, road closures	https://www.nzherald.co.nz/rotorua-daily-post
2014	July 8-12	Flooding at Northland, Waikato & Canterbury		125mm (24hrs)	Northland, Wairua Falls, Haruru, Hamilton and Rangiora, Moerewa, Kawakawa and Kaeo			23	23			15.1	School closures, road closures	https://hwe.niwa.co.nz/event/July_2014_Upper_North_Island_Storm https://www.stuff.co.nz/nelson
2014	June 25-25	Nelson-Tasman Floods		42mm (1 hr)				0		flash flooding		2.7	school closure	https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters
2014	June 9-11	Flooding at Northland		80mm (24 hrs)	Northland, Horeke, Waikato (Kaiaua)			0		River flooding (Kaiaua) Surface flooding (Northland)		29.8		https://www.stuff.co.nz/nelson-mail/10476332/Stormy-year-costs-135m https://www.mre.govt.nz/news/2014/june/per-sistent-heavy-rain-could-bring-surface-floods-slip/
2014	April 29-29	Flooding in Christchurch		50mm in 24 hours				0				0	80 houses were inundated	https://www.stuff.co.nz/southland
2014	Apr 17-19	Easter weekend storm and floods	1 in 50 year event	160mm rainfall in 24 hours (Lyttelton), Te puke 40mm (2 hrs)	West Coast of the South Island, Otago, Maheno, Five Forks, Bay of Plenty, Whakatane			0				55.3	Road closures, power cuts, lands lides	https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters
2014	Mar 3-5	Flooding in Christchurch, Wellington	1 in 100 year	160mm rain in 24 hours	Mairehau, St Albans and Richmond			54	20 families	surface flooding		22.5	Road closures, services (postal) suspended, interruptions to electricity	https://www.stuff.co.nz/the-press/news/your-weather/9790499/One-in-100-year-flood-
2013	Oct 30-31	Flooding in Hutt City						0				0	Road closure, Hutt River burst its banks	http://infocouncil.huttcity.govt.nz/Open/2020/12/DPRS_1512020_AGN_2865_AT.htm
2013	Oct 14-15	Floods - Manawatu - Whanganui	75-year	133mm (24hrs)	Wanganui, Anzac parade, Putiki, Turakina			110	110	Surface flooding river		0	declaration of local state of emergency, road closure	https://www.civildefence.govt.nz/resources/p-amenkes/Civil-Defence-Emergency-Management
2013	Sep 15-16	Whanganui River Flooding			Kowhai Park, Pitiki			378	140 homes			0		https://www.stuff.co.nz/the-press/news/your-weather/9149668/Storms-wreak-havoc-in-
2013	Sep 10-12	New Zealand Storm		170mm (1 day)	Wellington City, Lewis Pass, Reefton (west coast)			2				74.5		https://www.stuff.co.nz/the-press/news/your-weather/9149668/Storms-wreak-havoc-in-
2013	June 20-22	Flooding in Canterbury		110mm (36 hours)	Leeston, Tai Tapu, St Albans, Beckenham, New Brighton, Northwood, Burnside and Sumner.			0				39.3	Affected sewage systems, road closure, school closure	https://hwe.niwa.co.nz/event/June_2013_New_Zealand_Storm
2013	May 4-7	May 2013 Storm		Wellington airport 13mm (10 mins)	Wellington City, Northland (kaipara), Auckland, Kaikoura, Christchurch			0				2.9		https://www.knz.org.nz/natural-disasters/cost
2013	Apr 19-22	Nelson/Bay of Plenty/Waikato storm and floods		Tasman District Council office 113mm (90 mins) Hamilton 31mm (3hrs)	Tauranga, Stoke, Richmond, Hamilton			70	70 ppl (waihi beach resort)	Flash		46.2		https://www.knz.org.nz/natural-disasters/cost
2012	Aug 13-13	Flooding event in Canterbury		50mm in 24 hrs	Christchurch, Lyttelton.			0				0		https://www.stuff.co.nz/the-press/news/your-weather/9149668/Storms-wreak-havoc-in-
2012	July 23-24	Flooding event in North Island		31.4mm (1 hour)	Karanagahake Gorge, Papamoa, Katikati, Cambridge			0		flash		0		https://www.nzherald.co.nz/nz/severe-flooding-cuts-off
2012	July 15-16	Flooding in Westcoast		250mm (24 hrs) Golden Bay cumulative rainfall 49mm less than 2 hours	Westport, Nelson, Marlborough			0		Surface flooding		0	road closure	https://www.watmz.org.nz/Attachment?Action=Download&Attachment_id=777
2012	July 3-3	Auckland (flash floods)			Auckland city			0				0	Shop closures	https://www.stuff.co.nz/national/6155046/Nelson-flooding-Farmer-swept-from-house
2012	June 6-6	Greymouth floods		Greymouth 147mm (24 hrs)				29.7	11 homes	Flash		0	school closure	https://the-press/news/7051781/Flooding-forces-W
2012	Mar 18-21	Flooding in Northland		70mm (6 hours)	Northland, Kaeo, Otaika, Whananaki, Moka u, Whakapara, Ngunguru, Dargaville			0				0	1 road closure, school closure	https://www.fusion.nzherald.co.nz/nz/flash-fl
2012	Mar 1-3	North Island Weather Bomb		10mm (1hr) Auckland	South Taranaki and lower North Island, Waiuionata, Hutt River, Auckland			0				5		https://hwe.niwa.co.nz/event/March_2012_Nd
2011	Dec 15-16	Nelson floods		1 in 250 event (Nelson), 1 in 500 year downpour for Takaka rain in 24 hours are 423 mm rain fell at Takaka, 368mm at Anatok, 329mm at Brook, 205mm at Richmond, and 323 mm at Roding.	golden bay, Nelson city, Wakapuaka Flats (Nelson)			200	200	Coastal/Fluvial (Wakapuaka Flats)	houses dairy	16.8	declaration of state of emergency, road closure	https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters http://www.stuff.co.nz/national/6155046/Nelson-flooding-Farmer-swept-from-house https://hwe.niwa.co.nz/event/December_2011_Tasman-Nelson_Heavy_Rain_and_Flooding

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2011	Nov 21-23	West Coast Flooding and North Island Winds	1 in 26 year flood for the Grey River at Dobson, Waipuna recorded a 1 in 173.7 year flood, t Gorge recorded a 1 in 268 year return period flood	82mm (24 hrs) Greymouth	Ahaura River, Dobson, Waipuna, Arthurs Pass, Lewis Pass, Totara Flat, Greymouth, Kanatua			0			0	stocks		https://www.were.govt.nz/repository/libraries/id/2459/3c361799ser65r/hierarchy/Documents/Publications/State%20of%20the%20Environment/Surface%20Water%20Quantity/West%20Coast%20Hydrometric%20and%20Climatological%20SOE%20Report%202012.pdf https://www.infonews.co.nz/news.cfm?id=81671
2011	Oct 19-19	Canterbury flooding		47mm (16 hrs)				0			0	shops		http://www.stuff.co.nz/the-
2011	Apr 25-28	Flooding Hawkes Bay		50 year flood level 10m 100 year rain (Mahia) Wairoa 332 mm Napier 174 mm Tepuke 116mm (24 hrs)	Te Awanga, Waimarama, Mangakuri, Clifton township			115	100 (Te Awanga and other coastal settlements) 13 (Mangakuri) 2 (Waimarama)	river flood		6.4	declaration of state of emergency (Hawkes Bay)	https://www.knz.org.nz/natural-disasters/cost
2011	Jan 28-29	Storm/Flooding Bay of Plenty to Northland	Extensive (Kaiiua)	200mm Eastern hills in 21 hours (Northland)	Paikia, Piiwai, Auckland City, Bay of Plenty, Tauranga, Towai, Paikia, Kawakawa, Moerewa and Kaeo.			70	70 (Kaeo to Kawakawa)	River flooding (river)	infrastructure, sewerage, water supply systems	19.8		https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters https://www.nzherald.co.nz/ten-of-the-worst-storms-to-hit-nz/
2011	Jan 23-23	Flooding Mid-Upper North Island	Kaiiua (Minor)	140mm (24 hrs)	Auckland, Herald Island, Leigh, Clevedon, Waikato - Kaiiua			81	30 (Herald Island properties)	localised and surface flooding, River & Coastal (Kaiiua)		6.9	road closures, About 300 people were evacuated from a Taupo campground	https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters https://www.wharekawacoast2120.hauraki-de.govt.nz/wp-content/uploads/2021/09/Wider-River-Flood-Assessment-Wharekawa-Coast-2120- https://envirolink.govt.nz/assets/EnviroLink/992-TSDC97-South-Island-storm-and-floods-
2010	Dec 25-28	South Island storm and floods of December 2010	1 in 150 year flood	230mm (24 hrs)	Queensland, Golden Bay			0		river flood	Roads and infrastructure	0		https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters https://hwe.niwa.co.nz/event/October_2010_Gisborne_Flooding
2010	Oct 13-14	Gisborne flooding		Gisborne city recorded up to 300 mm (30.0 cm) of rain in 30 hours, Tolaga Bay 200mm (24hrs)	Gisborne city, Hikuwai River, Kanakanaia, Mangatuna, Ngatapa, Patutahi, Tolaga Bay, Uawa River			0		Surface flooding (Hawkes Bay)		0.25		https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters https://hwe.niwa.co.nz/event/October_2010_Gisborne_Flooding
2010	Sep 17-23	September 2010 Storm (Waikato, Manawatu-Wanganui, Wellington)	10-50 years	89mm (3 days) Waihopai	eastern shore on Lake Taupo between Turangi and Taupo, Huntly, Ngaruawahia, Otorohanga, Whatawhata, Palmerston North, Feilding, Koitiatia, Koitiatia, Wairarapa and Kapiti, Invercargill, Waihopai River			8.1	3 houses			49.3		https://hwe.niwa.co.nz/event/September_2010
2010	Sep 6-6	Central and lower North Island floods		106mm of rainfall within 24 hours, Waimana 276mm (48hrs)	Manawatu, Horowhenua, Fiordland, Southern Alps			0			Livestock	0		
2010	Aug 14-15	Bay of Plenty Flooding		Hikuwai - 330 mm (33.0 cm) of rain in 2 days. 208 mm (20.8 cm) of rain in 24 hours.	Bay of Plenty, Opotiki, Waimana, Hikuwai River		Whakatane's 5th flood this year	15	15 (Whakatane)	Surface flooding (BOP)		0	school closure	https://hwe.niwa.co.nz/event/August_2010_B
2010	July 5-7	Gisborne and Hawke's Bay Flooding		Whitianga - 130 mm (13.0 cm) of rain in 24 hours Coromandel Peninsula received 110 mm to 138 mm (11.0-13.8 cm) of rain in the 24 hours Parts of Bay of Plenty recorded 100 mm (10.0 cm) of rain between 5pm and 7pm on the 1st of June, Auckland 40mm-50mm (2 hrs)	Hikuwai River			0		Surface flooding		0		https://hwe.niwa.co.nz/event/July_2010_Gisborne_and_Hawkes_Bay_Flooding
2010	June 1-1	Upper North Island Flooding		Whakatane recorded 150 mm (15.0 cm) of rain in five hours on the night Hastings 52.2mm rain (7 hrs). Napier 46.8 (in 7 hours)	Auckland city, Whenuakite, Whakatane, Edgecumbe, Matata and Opotiki, Mount Maunganui			80	80			12.5		https://hwe.niwa.co.nz/event/June_2010_Upper_North_Island_Flooding
2010	May 24-31	Flooding North and South Islands	15-36 years???	Whakatane recorded 150 mm (15.0 cm) of rain in five hours on the night Hastings 52.2mm rain (7 hrs). Napier 46.8 (in 7 hours)	Bay of Plenty- Whakatane, Ophope, Hastings, Napier, Wellington, Tihati Bay, Christchurch, Otago, Timaru			0				5.5	power outages	https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters https://hwe.niwa.co.nz/event/May_2010_New_Zealand_Storm
2010	May 14-16	Tasman-Nelson Flooding		Tapawera- 100mm rain in 12 hrs	Sherry River Road, Tapawera, Motueka, Takaka River, New Plymouth			59.4	22 homes			0		https://hwe.niwa.co.nz/event/May_2010_Tasman-Nelson_Flooding

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2010	Apr 23-25	Southland Flooding		200mm in two days	Aparima River, Dipton, Gore, Hedgehope, Invercargill, Lumsden, Oreti River, Fairlight, Manapouri, Mandeville, Taramoa, Te Anau, Whitestone River, Winton			120	120	0		0		https://hwe.niwa.co.nz/event/April_2010_Southland_Flooding
2010	Mar 20-22	Wellington and Southland High Winds		150 mm	Milford Track			120	120	0		0		https://hwe.niwa.co.nz/event/March_2010_Wellington_and_Southland_High_Winds
2010	Jan 30-Feb 1	Gisborne and Hawke's Bay Flooding	50yrs ???	Gisborne more than 280 mm of rain in 36 hours.	Mangatuna, Waipaoa Station, Te Karaka, Tokomaru Bay, Hawke's Bay, Kuripapango, Nuha, Waipawa River, Wairoa			10	10	0		0		https://hwe.niwa.co.nz/event/January_2010_Gisborne_and_Hawkes_Bay_Flooding
2009	Dec 4-5	Flooding in Auckland, Coromendal	coromendal	40mm (1 hr)	Mission Bay and Tamaki Drive, Peninsula-Waikawau Bay campground			0		Surface flooding		0		https://www.sciencemediacentre.co.nz/2009/12/24/new-zealands-weather-in-2009-a-year-in-re
2009	July 23-23	Flooding in Lower Hutt	small flood event (ARI 10 years)	62mm (6 hrs)	Eastem Hutt Road, Silverstream, Greymouth (Sawyers Creek)			13.5	5 houses	0		0		https://www.niwa.co.nz/sites/niwa.co.nz/files/import/attachments/July09sum.pdf https://www.wellingtonwater.co.nz/pinehave https://www.stuff.co.nz/business/3540995/Content-of-natural-disasters-down
2009	July 11-12	Heavy rain and high winds Northland, Auckland, the Waikato and the Bay of Plenty						0		Minor flooding		1.7		https://www.gns.cri.nz/gns/Home/News-and-Events/Media-Releases-and-News/Natural-Disasters20091.pdf
2009	June 29-30	Palmerston North and Linton - Gisborne		90mm (12 hrs)	Mangatuna			9	9	0		0		https://www.unisdr.org/files/13437_NaturalHazards20091.pdf
2009	June 13-13	Upper North Island High Winds and Heavy Rain (Waikato, Northland)			Walhi, near Whangarei			0		0		0		https://hwe.niwa.co.nz/event/June_2009_Upper_North_Island_High_Winds_and_Heavy_Rain
2009	May 19-24	New Zealand Cold Snap (Surface flooding in Christchurch, Otago)		24mm (24 hrs)	Albert Town, Balclutha, Clutha River, Long Beach, Ophir, Palmerston, Taieri Plain, Christchurch			0		Minor surface flooding (Christchurch)		0		https://hwe.niwa.co.nz/event/May_2009_New_Zealand_Cold_Snap
2009	May 15-18	South Island and Lower North Island Storm			Wellington city, Upper Bulker Gorge, Ahuriri River, Kurow, Benmore, Omarama, Opuha Dam, Otamatapaio River, Rakaia River, Rangitata, Skipton Reserve, Waimakariri River, Waitaki River, Franz Josef			34	34	0		0		https://hwe.niwa.co.nz/event/May_2009_South_Island_and_Lower_North_Island_Storm
2009	May 8-14	Bay of Plenty Hail and South Island Snow and Flooding			Arataki, Papamoa, Te Puke, Otago, Balclutha, Caberfeith, Clydevale, Lake Hawea, Lake Wakatipu, Tokomouhi, Tokotiti, Avondale, Bransholme, Browns, Brydone, Dipton, Dipton West etc			0		River flooding (Arataki) Surface flooding	crops	2.3		https://hwe.niwa.co.nz/event/May_2009_Bay_of_Plenty_Hail_and_South_Island_Snow_and_Flooding
2009	Apr 26-29	South Island Flooding (Wellington, West Coast, Canterbury)		Franz Josef 330mm (25h 27th) Greymouth 141.4 (24 hrs)	Hutt river, Porirua, Wellington city, Greymouth, Kaiata, Punakaiki, Stillwater, Husley River, Lake Pukaki, Rangitata Gorge			11	11	Surface flooding		0		https://hwe.niwa.co.nz/event/April_2009_South_Island_Flooding
2009	Mar 17-17	Bay of Plenty Flooding	100 year flood	Tauranga 72mm rain (9hrs)	Onauni, Tauranga,			33	33	0		0		https://www.odt.co.nz/news/weather/raim-
2009	Mar 10-13	Otago cold snap			Keeko, Pomahaka, Tapanui			0		0		0		https://www.odt.co.nz/news/weather/raim-
2009	Mar 5-7	Upper North Island Storm		Kaero 77.5 mm (24 hrs) Whangarei 116 mm (24 hrs)	Kaero, Waikare, Whangarei, Bay of Plenty, Hawkes Bay			0		0		0		https://hwe.niwa.co.nz/event/March_2009_Upper_North_Island_Storm
2009	Feb 27- Mar 1	North Island Storm		Kaero recorded 138 mm (30 hrs), Keikeri 138mm (30 hrs)	Aokautere, Keikeri			40	40	0		0		https://hwe.niwa.co.nz/event/February_2009_North_Island_Storm
2009	Feb 19-21	New Zealand Extropical Cyclone Innis - Bay of Plenty, Manawatu-Wanganui,		62mm Kelburn, 37mm (Auckland), Canterbury 150 mm (36 hours)	Mount Maunganui, Tauranga, Taranaki, Kibimie, Palmerston North, Wellington, auckland			0		surface flooding		0		https://hwe.niwa.co.nz/event/February_2009_New_Zealand_Extropical_Cyclone_Innis
2009	Feb 10-12	North Island and Nelson Flooding (Auckland, Manawatu-Wanganui, Wellington)		Omaha 75 mm (1 hour), Wanangui recorded 64 mm (7 hrs)	Omaha, Palmerston North, Wanganui, Kaiwharawhara, Paekakariki			0		0		0		https://hwe.niwa.co.nz/event/February_2009_North_Island_and_Nelson_Flooding
2009	Jan 17-18	Canterbury Thunderstorms		Ashburton 25.4 mm (1hr)	Ashburton, Christchurch, Lyttelton, Otatara			0		0		0		https://hwe.niwa.co.nz/event/January_2009_Canterbury_Thunderstorms
2009	Jan 14-14	Upper North Island Thunderstorm		20mm in 90 mins	Katikati,			0		0		0		https://hwe.niwa.co.nz/event/January_2009_Upper_North_Island_Thunderstorm
2009	Jan 2-3	South Island Thunderstorms (West Coast, Southland)		100mm in 24 hrs	Callery River, Haast River, Invercargill			0		0		1		https://hwe.niwa.co.nz/event/January_2009_South_Island_Thunderstorms

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2008	Nov 23-25	Upper South Island Flooding (Tasman-Nelson, Marlborough)		Tasman Nelson 300mm (24hrs)	Pelorus Bridge, Rai Valley, Brightwater, Nelson city, West Coast			0		Surface flooding		0.95	school closure ,925,000 (Tasman) \$25,000 (Nelson Street)	https://hwe.niwa.co.nz/event/November_2008_Upper_South_Island_Flooding
2008	Nov 3-4	South Island Cold Snap	20-30 years ??		Pouinau			0		Surface flooding		0		
2008	Oct 17-17	Waikato Tornado (Flooding at West Coast)			Hector			0		0		1.2		https://hwe.niwa.co.nz/event/October_2008_Waikato_Tornado
2008	Oct 4-7	Canterbury High Winds and Manawatu Flooding			Linton, Opiki, Kaupokonui Stream, Marton			0		surface flooding		0		https://hwe.niwa.co.nz/event/October_2008_Canterbury_High_Winds_and_Manawatu_Flooding
2008	Aug 24-27	Flooding North Canterbury, Marlborough		Auckland -32 mm rain 24 hrs	Auckland, Massey East, Remuera, Wellington, Martinborough, Masterton, Picton, Kaikoura, Albany			58.1	3 houses + 10houses + 23 ppl	surface flooding		0.8		https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2008	Aug 14-14	South Island Snow and flooding at Hutt Valley			Waikanae			0		surface flooding		0		https://hwe.niwa.co.nz/event/August_2008_South_Island_Snow
2008	Aug 2-2	Central New Zealand Heavy Rain			Waikato, Hamilton, Huntly, Mangatawhiri, Mercer, Tirau, Marlborough			0		0		0	1 fatality	https://hwe.niwa.co.nz/event/August_2008_Central_New_Zealand_Heavy_Rain
2008	July 29-31	New Zealand Severe Storm	20-30 years ??		Marlborough, Nelson, West Coast, Okakairangi, Tokatoka, Albany, Picton			40	40 ppl	0		4.7	declaration of state of emergency (Marlborough), Sewage overflows, road closure \$1.5 million damage was caused to State Highway 1 from Marlborough south. AMI received 1500 South Island claims totalling \$3.2m from the July 31 storm.	https://www.odt.co.nz/news/national/storm-tums-fury-south
2008	July 26-27	North Island Weather Bomb (Northland,)		Kaero 68 mm (28 hrs) Paeroa 165.8 mm (24 hrs)	Kaero, Maungatapere, Ngawha, Whangarei, Thames-Coromandel district, Paeroa,			0		surface flooding		26.6		https://hwe.niwa.co.nz/event/July_2008_North_Island_Weather_Bomb
2008	July 19-24	Lower North Island Storm			Hutt Valley, Kapiti Coast, Pauatahanui			0		0		0		
2008	July 11-12	Nelson flooding		Nelson city received 35 mm of rain in 1 hour	Ngauranga, Ration Point, Takaka, Motueka			0		surface flooding		0		https://hwe.niwa.co.nz/event/July_2008_Nelson_Flooding
2008	July 4-7	New Zealand Cold Snap (Surface flooding around Christchurch, Wellington)		96.2mm (24 hrs)	Christchurch, streets in New Brighton, Wainanga			0		0		0	road closures	https://hwe.niwa.co.nz/event/July_2008_New_Zealand_Cold_Snap
2008	June 22-29	South Island Snow and North Island Thunderstorms		Christchurch Airport 44 mm 24 hrs Coastal Marlborough 25-30 mm (overnight)	North shore, Christchurch, Taneatua, Taunanga, Hutt Valley, Camborne, Tawa			0		surface flooding		0	road closures	https://hwe.niwa.co.nz/event/June_2008_South_Island_Snow_and_North_Island_Thunderstorms
2008	May 31-31	Wellington Floods			Rimutaka Forest Park			0		flash flood		0	A male Polish tourist died during a tramping trip	https://hwe.niwa.co.nz/event/May_2008_Wellington_Flooding
2008	May 24-26	Central Eastern North Island Heavy Rain			Gisborne, Makaraka			0		0		0		https://hwe.niwa.co.nz/event/May_2008_Central_Eastern_North_Island_Heavy_Rain
2008	Apr 29- May 1	North Island and West Coast Flooding		Stony River 55 mm of rain in 1 hour	Helena Bay, Stony river, Otonga, Whangaparaoa Peninsula, Eastern Bay of Plenty, Rotorua, Hasting, Taranaki, Kapiti Coast			0		surface flooding		0		https://hwe.niwa.co.nz/event/April_2008_North_Island_and_West_Coast_Flooding
2008	Apr 14-17	North Island and Nelson Storm		Opononi 94 mm (3hrs) & 55mm (1hr), Rotorua 108 mm (24 hrs)	Kaiaia, South Waikato, Matamata, Taupo and Turangi districts, Western Bay of Plenty			0		0		0		
2008	Feb 29- Mar 2	New Zealand Storm (Wellington)		Wellington 50 mm, Dunedin 30 mm (24 hrs)	Johnsonville, Dunedin, Kaitangata			0		0		0		
2008	Feb 22-23	Upper North Island Storm (New Zealand Storm)		The hills between Kaero and Kaikohe received 200-240 mm	Northland, Auckland and the Coromandel			0		coastal		0	This was the fourth time Kaero had been flooded in about a year.	https://hwe.niwa.co.nz/event/February_2008_Upper_North_Island_Storm
2008	Feb 10-16	Manawatu-Wanganui (Manawatu-Wanganui)		Lower Hutt 23 mm (1 hour)	Levin, Hutt Valley, Porirua, Selwyn district, Canterbury, Kawaee			0		surface flooding	Bridge	0		
2008	Jan 8-9	Manawatu-Wanganui and Wellington Flooding		200mm in 30 hours (Muhunua)	Manawatu-Wanganui, Kuku beach, Manakau, Muhunua East, Tokomaru, Kapiti, Otahanga, Otaki, Ohau			0		flash flooding	Stop banks breached	2		
2007	Oct 7-9	Lower North Island and South Island Storm		Lower Hutt 150 mm in 6 hours	Upper Hutt, West Coast, Buller River, Waiau, West coast			2.7	1 dwelling	surface flooding, river flooding		0	road closures	https://www.kaikoura.govt.nz/assets/App-1-Waiau-Toa-Clarence-River-Floodplain-Investigation.pdf
2007	Oct 2-5	New Zealand Storm			Queenstown			0		surface flooding		0		
2007	July 30-31	Milton Flooding		75.8mm (24 hrs)	Bruce Ward, Otago and Helensbrook, Clutha district (Milton Township), Palmerston		Anzac day 2006	71.2		0	houses	0	Civil Defence emergency was declared, road closures	https://www.civildefence.govt.nz/resources/previous-emergencies/historical-emergencies/?year=2007&type=&region=

Year	Month and date	Event	Scale of the event	Amount of rainfall/duration	Sub areas	Population per location	Previously affected (add date)	Evacuation	Recorded in the source	Type of flooding	Type of damages	Economic damage (insurance claims or estimated damage) (NZD million)	Others	Source
2007	July 29-29	Flooding event in Piha Auckland						0		0			"the stream at the back of the property is flooding and water is coming up over the lawn and almost entering house."	file:///C:/Users/HP/Downloads/Tonkin%20and%20Taylor%20Piha%20flood%20risk%20assessment%20report.pdf
2007	July 27-28	New Zealand Storm		Morven- 110mm, North and East Otago 100m, 42mm (4 hrs)	Otago and South Canterbury			0		0	Roads, houses	0	State of Emergency was declared	https://hwe.niwa.co.nz/event/July-August_2007_New_Zealand_Storm
2007	July 15-18	Flooding Hawkes Bay		300mm of rain in 48 hours	Thames, Cable Bay, Kaeo, Kaitiaki, Hastings			13.5	5 hrs.	0		1		https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2007	July 9-11	Upper North Island Flooding and High Winds	100 year ??	Kaeo 273 mm (24 hrs)	Northland, Cable Bay, Hikurangi Swamp, Kaeo, Kaitiaki, Kirikopuni, Mangonui, Moerewa, Whakapara, Wellsford, Coromandel	217.5		120+70+14+5 hrs		0	Roads, houses, Bridge, crops	60	Local State of Emergency was declared Hikurangi swamp farmers estimated their losses at about \$15 million. Whangarei's avocado orchardists lost almost their entire export crops, with losses of up to \$20 million.	https://hwe.niwa.co.nz/event/July_2007_Upper_North_Island_Flooding_and_High_Winds
2007	July 4-7	Taranaki, Auckland and Tauranga Tornadoes			Okato			0		0		8.3	Civil Defence emergency declaration	
2007	June 20-25	South Island Snow and Storm Surge			Auckland city			0		0		0		https://hwe.niwa.co.nz/event/June_2007_South_Island_Snow_and_Storm_Surge
2007	May 22-23	Tasman-Nelson and Tannaki Flooding		Taranaki 68mm Dawson falls 100mm Nelson 98mm	New Plymouth, Oakura, Stoke			0		flash floods		1.1	school closure	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2007	Mar 28-30	Northland Flooding	150 year ???	Kaeo 131mm in (24 hrs) One-in-150 year AEP Kaikohe 139.4 mm (24 hrs)	Kaeo, Waipapa, Waitangi, Waiharakeke, Whakapara, Hatea, Doubtless Bay Ruakaka and Waipu, Whangarei, Kaikohe	260		260	0	0		12.5	Sewage spills	Insurance claims for the storm total \$12.5 million.
2007	Mar 17-17	West Coast Flooding and Canterbury Storm	50-60 years ??	Westport 26mm (1 hr)	Christchurch.			0		surface flooding	roads	0.07	Damage to roads cost \$100,000.	https://hwe.niwa.co.nz/event/March_2007_West_Coast_Flooding_and_Canterbury_Storm
2007	Mar 12-15	North Island Storm		Auckland airport- 27mm (1 hr)	Auckland, Manurewa, Wellington, Petone, Tawa, Raumati Beach			0		surface flooding	roads	0		https://hwe.niwa.co.nz/event/March_2007_North_Island_Storm
2007	Feb 5-7	Northland storm		91mm (6 hrs)	Mitimiti Stream, Pahia, Rangiahua, Te Hapua, Te Pahi, Titoki			0		surface flooding		0	Repairs to the Mitimiti bridge would cost about \$100,000.	https://hwe.niwa.co.nz/event/February_2007_Northland_Storm
2006	Nov 29-29	Flooding in Ashburton		over 74mm 50mm (24 hrs)				0		0		0		https://niwa.co.nz/climate/summaries/monthly/december-2006
2006	Nov 13-14	Canterbury and Wellington Storm	10-25 years ??	Arthurs Pass 120mm (6 hrs)	Arthurs Pass, Bealey River, Rakaiia River, Waimakariri River			4	4	0		0	Road closure	https://hwe.niwa.co.nz/event/November_2006_Canterbury_and_Wellington_Storm
2006	Nov 7-9	Upper North Island Winds and South Island Snow			Auckland			0		surface flooding		3.4		https://hwe.niwa.co.nz/event/October_2006_Wellington_Storm
2006	Oct 21-24	Wellington Storm		200 mm at Wainuiomata; 109 mm at Northern Tararua; 89 mm at Manawatu 77mm Wellington (16 hrs)	Wellington, Manawatu, Wairapa, Birchville, Petone			0		surface flooding		0		https://www.nzta.govt.nz/assets/resources/research/reports/378/docs/378-v2.pdf
2006	Oct 1-6	Auckland and Wellington Storm		Auckland city 40mm to 50 mm (1 hr), Auckland airport 45mm (6 hrs) Masterton 65mm (1.5hrs) Onehunga 36mm (1 hr) 1 in 20 year event, Waimakau 129mm (24 hr) 1 in 83 year return event	North shore, Auckland city, Nihotupu Dam, West Harbour, Hamilton, Wairapa, Carterton, Masterton	8.1		3 houses		flash		0		https://www.aucklandcity.govt.nz/council/documents/technicalpublications/Chapter%205%20Hazards%20and%20Heritage%20Overview%20and%20Chapter%205%20-%20Hazards.pdf https://www.metsoc.org.nz/app/uploads/2019
2006	Aug 5-8	North Island Storm	Kaiaua (Minor)	Christchurch 90mm (48 hrs)	Christchurch, Northland- Maungaturoto, Ruakaka, Whakapara, Whananaki, Auckland, Tomarata, Waitei, Wellsford, Thames- Coromandel district, Kaiaua			0		surface flooding River flooding flooding (Kaiaua)		0		https://hwe.niwa.co.nz/event/August_2006_North_Island_Storm
2006	July 21-22	Lower North Island and Otago Storm			Manawatu-Wanganui- Opiki, Wellington			30	30	0		0	road closures	https://hwe.niwa.co.nz/event/July_2006_Lower_North_Island_and_Otago_Storm
2006	July 19-19	Flooding event in Piha Auckland						0		0		0		file:///C:/Users/HP/Downloads/Tonkin%20and%20Taylor%20Piha%20flood%20risk%20as
2006	July 4-7	Lower North Island Flooding		Wairarapa over 100mm (24hrs), Martinborough 130mm (48 hrs)	Tanaki, Manuwatu-Wanganui, Mangamahu, Wairapa, Wainuiomata, Hutt Valley, Wellington city, Martinborough, Carterton and Masterton.	120		120	0	0		2.7	declaration of state of emergency, road closure	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters https://hwe.niwa.co.nz/event/July_2006_Lower_North_Island_Flooding https://www.metsoc.org.nz/app/uploads/2019
2006	June 17-24	North Island Snow		Gisborne 100mm (Areas around Gisborne), 15mm (20 minutes)	surface flooding closed State Highway 2 from Gisborne to Wairoa, Gisborne- East Coast road, Wellington- Paraparaumu			0		surface flooding		0		https://hwe.niwa.co.nz/event/June_2006_North_Island_Snow

Year	Month and date	Event	Scale of the event	Amount of rainfall/duration	Sub areas	Population per location	Previously affected (add date)	Evacuation	Recorded in the source	Type of flooding	Type of damages	Economic damage (insurance claims or estimated damage) (NZD million)	Others	Source
2006	June 11-16	New Zealand Snow and High Winds		Geymouth 149.2 (24hrs)	Northland- Keikeri, Tasman-Nelson-SH7 from Geymouth to Stillwater, Brunner, Grey River, Geymouth, Hokitika, Runanga, Taylorville, Canterbury-Tai Tapu and Kaituna Valley Rd, Wigram area			54	20 houses at Runanga	0		42.5		https://hwe.niwa.co.nz/event/June_2006_New_Zealand_Snow_and_High_Winds_insurance_costs_of_the_South_Island_storms_of_June_were_\$43.91
2006	May 22-22	Surface flooding in Tasman district.		88 mm Mapua	Mapua			0		surface flooding		0		https://www.scoop.co.nz/stories/SC0606/S00001.htm?from-mobile=bottom-link-01
2006	May 12-14	South Island Storm		Hoon Hay 60mm, Lyttelton 66mm	Cantebury-Christchurch.			0		0		0		https://hwe.niwa.co.nz/event/May_2006_South_Island_Storm
2006	May 2-2	Surface flooding in Auckland, Napier-Gisborne		70mm Hicks Bay	Raupunga and Mohaka			0		surface		0		https://www.scoop.co.nz/stories/SC0606/S00001.htm?from-mobile=bottom-link-01
2006	Apr 27-28	Upper North Island Flooding		Paeroa 104mm (24 hrs)	Auckland, Hauraki district, Karangahake Gorge, Pauanui, Te Aroha, Thames, Waahi, Whangamata, Bay of Plenty, Te Puna, Waahi Beach, Whakamarama			0		0		1.5	schools closure	https://hwe.niwa.co.nz/event/April_2006_Upper_North_Island_Flooding
2006	Apr 25-26	Flooding-Oamaru/Dunedin	25 years ??	Oamaru 12.8 cm (24 hrs)	Abbotsford (Dunedin), Oamaru, Waitati, Mosgiel			350	350	surface flooding		1.8		https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2006	Jan 23-25	North Island Storm		Coromendal 206mm (14 hrs)	North shore, Orewa, Renuera, Warkworth, Waikato, Dinsdale, Karangahake Gorge, Waingaro			0		0		0		https://hwe.niwa.co.nz/event/January_2006_North_Island_Storm
2005	Nov 26-28	North Island Hail and Rain			Northland, Topuni, Warkworth, Wellsford, Gisborne, Manutuke			0		0	crop	0	road closures	https://hwe.niwa.co.nz/event/November_2005_North_Island_Hail_and_Rain
2005	Oct 20-22	Gisborne and Hawke's Bay Flooding	Upto 150 years	Northland, Auckland, Comandeland the Bay of Plenty 55-85 mm, Gisborne airport 150.4 mm (24 hrs), Hikuwai 27.3mm (15 hrs) return period about 150 years)	Gisborne, Poverty Bay, Waimate River, Hikuwai River, Mangatereau River, Mangatuna, Manutuke, Te Karaka, Tohaga Bay, Waipaoa River, Waioamatani, Eskdale, Wairoa township			50	50	0	crop, homes,	50	\$ 50 million (Gisborne) \$ 0.9 million insurance claims	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters https://hwe.niwa.co.nz/event/October_2005_Gisborne_and_Hawkes_Bay_Flooding
2005	July 16-17	Waikato Flooding		Auckland 45mm/hr, Coromendal 170mm (24 hrs), Pauanui 160mm (24 hrs), 300mm (overnight) return period more than 150 years, Waihi 179.2 (24hr)	Northland, Auckland, Hikuai, Karangahake Gorge, Pauanui, Tairua, Waihi township.			0		0		0	road closures	https://hwe.niwa.co.nz/event/July_2005_Waikato_Flooding https://www.waikatoregion.govt.nz/assets/WRC/WRC-2019/r05-32.pdf
2005	June 25-25	Auckland Thunderstorm and Tornadoes			Central Auckland, Epsom, Greenlane, Mount Wellington, Renuera			0		0	0	0	road closures	https://hwe.niwa.co.nz/event/June_2005_Auckland_Thunderstorm_and_Tomadoes
2005	May 17-30	Flooding and Landslips Bay of Plenty		Hikuai 300mm (24hrs) 30 return period, 900 mm (72 hrs) 150 year return period, Pauanui 138mm (24 hrs), Whitianga 260mm (24 hrs) 50 return period, Tauranga 217mm (12 hrs) 150 year return period	Edgecumbe-Tarawera Ward, Matata township and Tauranga area, Matata 300mm (24 hrs)			1109	538 (Matata), 400 (Tauranga, Mount Maunganiui and Papamoa) BOP- surface flooding	Waikato localised flooding, BOP- surface flooding		28.5	27 homes destroyed, 87 damaged, 156 homes inhabitable, Local roads, SH2 & rail extensively damaged, State of emergency was declared in Matata, Tauranga	
2005	Mar 29-30	Flooding -Lower North Island		Hawkes Bay -Porangohau 115mm (3.5 hrs), Waipukurau 25-30mm (15 mins) 150 year return period, Wellington- Castlepoint 115mm (3 hrs) 150 tear return period, Wainuiomata 444mm (over 36 hrs)	Wairarapa, Hawkes Bay, Wellington-Riversdale Beach, Wainuiomata River			20	15 adults and 5 children (Eastern Wairarapa)	0	houses bridges roads	0.6		https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2005	Feb 07-07	Otago Flooding		3.4 cm (20 minutes) 1.7 cm (15 mins) return period of 120 years	Dunedin			0		0		5		https://hwe.niwa.co.nz/event/February_2005_Otago_Flooding
2005	Jan 5-7	Flooding - Wellington Region	10-80 years ??	Wellington -Akatara River, north of Upper Hutt, 50-year flood, Hutt River 8.0cm (12 hrs) 26 year flood, Otaki river 23.0 cm (12 hrs) 1 in 40 year flood, Waikanae 12.4 cm (12 hours) 80 year flood, Otago 6.0 cm (1 hr)	Wellington (Horowhenua, Kapiti Coast, Hutt Valley, Golden Bay, Otaki), Tapanui, West Otago			700	700	Surface flooding (Kapiti Coast)	stop banks, bridge, stock losses	2.5		https://hwe.niwa.co.nz/event/January_2005_New_Zealand_Flooding
2004	Oct 17-18	Flooding - Hawkes Bay		Pongaroa 130mm (4 hrs)	Mecanee, Tamatea, Pongaroa			40	40	0		4.8	road closures, school closures	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters

Year	Month and date	Event	Scale of the event	Amount of rainfall/duration	Sub areas	Population per location	Previously affected (add date)	Evacuation	Recorded in the source	Type of flooding	Type of damages	Economic damage (insurance claims or estimated damage) (NZD million)	Others	Source
2004	Oct 10-10	Flooding event in Wellington Region	S.S	400mm (24 hrs)	Tararua, Wairapa			0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
2004	Aug 14-18	New Zealand Storm		Warapa 60mm, Lowe Hutt 80mm (24hrs), Masterton 66mm (24 hrs), Wainuiomata 96mm (24 hrs)	Manawatu-Wanganui-Moutoa, Wellington, Carterton, Hungaroa Stream, Lower Hutt, Masterton, Wainuiomata Stream			0				11.4	road closures, school closures	https://hwe.niwa.co.nz/event/August_2004_New_Zealand_Storm
2004	July 17-19	Bay of Plenty floods	100+ years ??	257 mm (3 days)	Whakatane and Edgcombe urban areas, Opotiki Districts			3300	3200 homes		700 houses, 450 farms and 15 orchards were damaged.	17.6	Widespread road, infrastructure water power, sewage disruptions throughout district, 1 fatality breach of protective embankment on the Rangitiki River (Edgcombe) Declaration of state of emergency, 1 fatality Estimated damages \$ 45 million Roads \$ 5.5 million insurance payouts \$17.6 million 211 homes were declared uninhabitable	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2004	June 29-July 1	Gisborne and Hawke's Bay Storm	16 years ??	Gisborne - Te Puia to Tolaga 150-180mm, Gisborne city 70mm (24 hrs), Wainui 90mm	East Cape, Mangatuna, Gisborne city, Te Araroa, Tolaga Bay			10.8	4 families			0		https://hwe.niwa.co.nz/event/June_2004_Gisborne_and_Hawkes_Bay_Storm
2004	June 19-23	New Zealand Storm			North Island, Waikato- between Taupo and Turangi, Palmerston North, Wellington- Hutt River			0		Surface flooding		0		https://hwe.niwa.co.nz/event/June_2004_New_Zealand_Storm
2004	May 1-2	Auckland Flooding	30 years ??	Auckland Airport 84.4mm (19 hours), Henderson 90mm (24 hours)	Waitakere Ranges			54	20 houses	Fash		0		https://www.nzherald.co.nz/nz/flood-clean-up
2004	Apr 6-6	New Zealand Hail			Wanganui, Wellington city,			0				1.3		https://hwe.niwa.co.nz/event/April_2004_New_Zealand_Hail
2004	Feb 28- March 2	Manawatu- Wanganui Region flooding	100 years ??	Northland 200mm (2 days) Turangi 146mm (36 hrs) Hamilton 93mm (36 hrs)	Northland, Auckland, Huntly, Karapiro, Lake Taupo, Ngauawahia, Oruataua, Okorohanga, Turangi, Hastings, Wellington, Waikanae			162.9	15 homes (Oruataua) 12 homes (Okorohanga), 90 ppl from 50 homes (Turangi)	surface flooding (Auckland)		0	Damages in Waikato (\$ 4 million)	https://hwe.niwa.co.nz/event/February-March_2004_North_Island_Extropical_Cyclone_Ivy
2004	Feb 14-19	North Island Storm	100-year floods in Manawatu-Wanganui and 50-year floods in Wellington	Palmerston North 62.6 (24 hrs), Waiouru 134mm (24hrs), Wanganui 158mm (24 hrs), Wellington 64mm (24 hrs), Hutt river 150mm (24 hrs)	Scotts Ferry, Waitotara, Fielding, Tangimoana, Longburn, Marton and Hunterville, Lower North Island, Hawkes Bay- Tukituki river, Otane, Ngutuwera, Porangahau, Takapau, Waipawa, Waipukurau, Taranaki, Ngutuwera, Tahora, Waitotara, Manawatu-Wanganui			2300	2300		farms, cattle, crops	112	Civil Defence Emergency was declared, road closure insurance claims cost \$148.3 million, 2600 farmers affected damage of economic impact \$ 300 million, fatalities	https://hwe.niwa.co.nz/event/February_2004_North_Island_Storm https://www.nzherald.co.nz/nz/ten-of-the-worst-storms-to-hit-new-zealand/HXDYD2IZUPSGZ2X2M452O5IV4/
2004	Jan 30-Feb 2	New Zealand Flooding		Auckland airport 70mm (10 hrs), Taranaki 9.6mm (1 hr), Wanaka 25 mm (30 minutes)	Northland, Auckland, Castor Bay, Hillsborough, Taranaki, Egmont Valley, Tasman-Nelson, Wanaka			0		flash		0	road closure, 2 fatalities	https://hwe.niwa.co.nz/event/January-February_2004_New_Zealand_Flooding
2004	Jan 19-21	Lower North Island High Winds		100mm (24 hrs)	Wellington			0		surface flooding		0.8	road closure	http://infocouncil.huttcity.govt.nz/Open/2020/12/DPRS_15122020_AGN_2865_AT.htm
2004	Jan 8-9	Upper South Island and Wellington Heavy Rain and Winds	150 years	80mm (1hr)	West Coast- Dobson			0				0		
2003	Dec 28-28	Flash flooding event in Wellington	S.S		Upper Hutt			0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
2003	Dec 16-16	Surface flooding event in Wellington	S.S		Lower Hutt			0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
2003	Nov 7-7	South Island and Wellington High Winds			Otago- Shotover River			0				0		
2003	Oct 3-4	North and South Islands/Storms and Floods	120 years ??	Paekakariki 60mm (1 hr)	Paekakariki town, Coroglen (Waikato), Paremata			54	20+ families			2.5	Declaration of state of emergency, sewerage problems	https://www.icznz.org.nz/natural-disasters/cost-of-natural-disasters
2003	Oct 3-5	New Zealand Storm		60mm in 1 hr, 119mm in 24 hrs (Paekakariki)	Waikato- Coroglen, Paekakariki			0	20 houses			5.5	A Civil Defence Emergency was in place in Paekakariki, sewage issues	https://hwe.niwa.co.nz/event/October_2003_New_Zealand_Storm
2003	Sep 27- Oct 1	New Zealand Storm	20 years ??	10mm in 12 hours (Taranaki)	North Island, West coast, Taranaki			0			Taranaki 100mm (12 hours)	0	Road closure	https://hwe.niwa.co.nz/event/September_2003_New_Zealand_Storm

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2003	Aug 28-28	Surface flooding event in Wellington	S.S					0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBas4824.pdf
2003	June 8-10	Lower North Island Flooding/storm damage		Hamilton 24mm (24 hours) Wellington 66mm (6 hrs) Lower Hutt 123mm (24 hrs) Wainuiomata 200mm (24 hours)	Auckland, Waikato, Hamilton, Wellington, Woburn, Wainuiomata, Marlborough and Tasman-Nelson			0		surface flooding (Auckland, Hamilton)		1		https://hwe.niwa.co.nz/event/June_2003_Northern_Island_and_Upper_South_Island_Storm
2003	April 17-22	Upper North Island Flooding	100 years ??	Coromedndal 360mm (less than 2 days) return period of 100 years	Northland, Coromandel township, Kaueranga River			40.5	15 houses	surface flooding (Northland, Coromandel)		0		https://hwe.niwa.co.nz/event/April_2003_Upper_Northern_Island_Flooding
2003	April 5-6	Flash flooding event in Wellington	S.S		Lower Hutt			0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBas4824.pdf
2003	Mar 27-28	Northland Flooding		Northland 80-100mm (7 hours), Taipa 208mm (38 hrs) Whangere	Northland-Cable Bay, Kaeo, Kaingaroa, Kaitaia, Mangamuka Bridge, Mangonui			60	60	0	roads	0.25		
2003	Jan 8-8	Flash flooding event in Wellington			Hutt valley and Kapiti			0		localised surface flooding	roads	0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBas4824.pdf
2003	Jan 4-11	Upper North Island Flooding		Rainfall totalling 100-200 mm (10.0-20.0 cm) fell throughout eastern Northland, Coromandel, Waikato and Bay of Plenty from the 4th to the 10th, 290.5 (24hrs)	Waikato, Kaueranga River, Ngaruawahia, Ohinemuri River, Okauia, Shaftesbury, Tairua River, Whitianga			0		surface flooding		0		https://hwe.niwa.co.nz/event/January_2003_Upper_Northern_Island_Flooding
2002	Dec 7-8	Flash Flooding in Wellington	S.S					0		flash		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBas4824.pdf
2002	Oct 25-30	North Island and Canterbury Thunderstorms			Auckland-Blockhouse Bay, Bombay, Bay of Plenty- Kapiti coast, Christchurch			0		0		0		https://hwe.niwa.co.nz/event/October_2002_Northern_Island_and_Canterbury_Thunderstorms
2002	Oct 16-16	Auckland flooding			Takapuna			0		0		0	1 fatality	https://hwe.niwa.co.nz/event/October_2002_Auckland_Flooding
2002	Aug 16-16	Surface flooding in northern Wellington.	S.S					0		surface	roads	0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBas4824.pdf
2002	Aug 6-7	Gisborne and Hawke's Bay Flooding		Gisborne 287mm (24 hrs)	Gisborne, Mangatuna, Te Karaka, Uawa River, Hawkes Bay			73.5	5 homes (Mangatuna, near Uawa River.) 60 people in Ngatapa, Papatu, Opou, Manutuke and Taunua Valley areas	Surface flooding (Gisborne)		1	Road closure, school closure	https://hwe.niwa.co.nz/event/August_2002_Gisborne_and_Hawkes_Bay_Flooding
2002	July 14-15	Surface flooding in Wellington.	S.S					0		surface		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBas4824.pdf
2002	July 11-12	Upper North Island Flooding	2-50 years?? The Waikato River at Mercer had a peak flow of 1380 cumecs. This was a 50 year event. The Waipa River at Otorohanga had a peak flow of 380 cumecs. This was a 20-50 year event.		Auckland city, Dome Valley, Northland, Waikato- Huntly, Lake Taupo, Ngaruawahia, Otorohanga, Okahu Bay, Rangiriiri			0		Surface flooding (Auckland city, Dome Valley)		0.2	Estimated cost of Remedial Works to Waikato District Council for 6th-16th July: Total \$50,000 Franklin District Council for 6th-16th July: Total \$100,000 Environment Waikato for 6th-16th July: Total \$15,000	https://hwe.niwa.co.nz/event/July_2002_Upper_Northern_Island_Flooding
2002	June 27-28	West Coast Flooding		132 mm (15 hours.)	Granity			32	32	0		0		https://hwe.niwa.co.nz/event/June_2002_We

Year	Month and date	Event	Scale of the event	Amount of rainfall/duration	Sub areas	Population per location	Previously affected (add date)	Evacuation	Recorded in the source	Type of flooding	Type of damages	Economic damage (insurance claims or estimated damage) (NZD million)	Others	Source
2002	June 18-21	Upper North Island Weather Bomb	150 years ??	Kaitiāi 165mm, Putaruru & Tirau 150 year event, Coromandel 100 year event, Kauaeranga River 5 year event, Putaruru 120mm (2 hours), Tapu 83mm (1 hr) 100 or 150 year event, Waitoa River 20 year event, 120mm Paeroa (24 hrs)	Hikurangi, Putaruru & Tirau Wards, Kaitiāi, Kawakawa, Oiria, Paīhia, Taheke, Tangitoria, Auckland, Thames-Coromandel District - Whangarāhi, Tapu, Waionu, Pohue, Te Pūnū, Tararua, Kauaeranga River, Putaruru, Waitoa River			500	5 homes (Oiria), 200 houses and 500 people were evacuated, including residents from Waikawau, Tapu, Tararua and Te Pūnū. At least 40 people were evacuated from camping grounds on the Coromandel Peninsula.	Surface flooding (Kawakawa, surface)	Properties, houses	21.5	Declaration of state of emergency, nil water supply, no power, road and railway closure, flood bank collapse	https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters https://hwe.niwa.co.nz/event/June_2002_Upper_North_Island_Weather_Bomb
2002	June 17-19	Wellington Flooding	S.S	46mm (5 hours)	Harbour View, Lower Hutt			0		0		0	Fallen trees, one man rescued from a vehicle trapped in 2m of floodwater in Lower Hutt.	https://hwe.niwa.co.nz/event/June_2002_South_Island_Snow_and_Wellington_Flooding https://www.knz.org.nz/natural-
2002	May 25-28	New Zealand Thunderstorms and Snow			Auckland-Otago			0		0		0		https://hwe.niwa.co.nz/event/May_2002_New_Zealand_Thunderstorms_and_Snow
2002	May 23-23	Thunderstorm, surface flooding in Wellington region	S.S					0		surface		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBas4824.pdf
2002	March 21-21	Flooding event in Wellington Region	S.S		Taranua			0		localised surface flooding		0	two people rescued by helicopter from vehicle stuck in Waingawa River	http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBas4824.pdf
2002	March 18-18	Heavy rain, flash flooding in Johnsonville and Newlands	S.S					0		flash		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBas4824.pdf
2002	Feb 21-21	Auckland and Waikato Flooding		Great Barrier Island recorded 233.5 mm (6 hours) 100 year return period rainfall. Whitianga 100mm (5 hours)	Great Barrier Island, Whitianga			0		0		0	road closure	
2002	Jan 11-13	South Island and Waikato flooding	100 years ??	North Canterbury foothills 250 mm, 120 mm (24 hrs), Kaikoura 100mm (24 hours)	Waikato-Maungakīkiri, Tararua, Waitoa River, Canterbury, Kaikōura Coast, North Otago, Akaroa, Glentunnel			220	15 and 25 homes (approx. 100 ppl) from Tararua, Campers at the Glentunnel camping ground evacuated 30 families (approximately 120 people) were evacuated from a camping ground	surface flooding (cantebury)	bridge	0.5	Insurance industry payouts for the event was \$250,000 (Tararua), Canterbury \$250,000	
2002	Jan 17-18	Dunedin Flooding						0		Flash floods		0.3		https://www.knz.org.nz/natural-
2002	Jan 9-10	North Island and Upper South Island Thunderstorms	100 years ??	Auckland 100mm (24 hours), 50mm (1 hour) at Kelburn, Wellington city 40mm (in 30 mins), Totaranui 150mm (12 hrs)	Auckland, Wellington-Kelburn, central city and Hawke's Bay- Hastings, Napier, Manawatu-Wanganui-Mangaweka, Tasman-Nelson, Otago			67.5	25 homes	Flash	bridge	0.6	50mm in 1 hour at Kelburn, central city businesses flooded.	https://niwa.co.nz/climate/summaries/annual/2002 https://hwe.niwa.co.nz/event/January_2002_North_Island_and_Upper_South_Island_Thunderstorms
2002	Jan 1-5	New Zealand Storm		38mm (1 hour) Westport	West Coast- Westport, Karamea, Graymouth, Franz Josef, Christchurch, Arthur's Pass, Rangitāta River, Otago, Waikouaiti River South Branch			0		flash	flash floods (Wellington city)	3		https://hwe.niwa.co.nz/event/January_2002_New_Zealand_Storm
2001	Dec 7-10	Wellington/Wairarapa Floods	30-35 years	Tauranga-Taupo catchment at Kiko Road 51mm (3 hrs), 86mm (6 hrs), 116mm (12 hrs), Hastings 50mm	central North Island, Waikato-Tauranga Taupo River, Bay of Plenty, Gisborne, Wellington, Wairarapa and Hawke's Bay, Napier, Hastings and Havelock North.			0		surface flooding (Hawkes Bay)	fruit crops	0.6		https://hwe.niwa.co.nz/event/December_2001_North_Island_Flooding
2001	Dec 1-2	Northland Flooding		93mm in 37 hours	Northland, Dargaville, Kaitiāi, Keikeri, Tiroki, Whirinaki, Kaikohe			0		surface flooding (Dargaville)		0	road closures	https://hwe.niwa.co.nz/event/December_2001_Northland_Flooding
2001	Nov 22-22	North Island Heavy Rain	S.S	60mm (3 hrs)	Wellington, Lower Hutt, Johnsonville, Tawa, Newlands			0		localised surface flooding		0	properties and roads flooded	https://hwe.niwa.co.nz/event/November_2001_North_Island_Heavy_Rain
2001	Oct 9-10	North Island Storm			New Plymouth			0		0		0	Roads closure, power cuts	http://www.gw.govt.nz/assets/council-
2001	Aug 13-16	North Island Snow and High Winds			Opiki			0		0		0		
2001	May 9-10	Upper North Island Storm		Kaero 100mm (7hrs), Auckland 136mm (8days)	Kaero, Kenikeri, Okaihau, Waikare, Auckland City.			0		0		0.45		https://hwe.niwa.co.nz/event/May_2001_Upper_North_Island_Storm

Year	Month and date	Event	Scale of the event	Amount of rainfall/duration	Subareas	Population per location	Previously affected (add date)	Evacuation	Recorded in the source	Type of flooding	Type of damages	Economic damage (insurance claims or estimated damage) (NZD million)	Others	Source
2001	Apr 12-14	North Island Ex-tropical Cyclone Sose		Kaeo 200mm (18 hrs)	Kaeo, Whangarei, Kaitemoko Stream, McLaren Falls, Welcome Bay			0		0		0		https://hwe.niwa.co.nz/event/April_2001_North_Island_Extropical_Cyclone_Sose
2000	Nov 3-5	Northland and Waikato Flooding		100mm (48 hours)	Whakapara, Hikui			0			roads	0	26 people had to be rescued after 13 vehicles became trapped by the flood waters (Whakapara)	https://hwe.niwa.co.nz/event/November_2000_Northland_and_Waikato_Flooding
2000	Oct 11-13	New Zealand Weather Bomb	40 years	Christchurch 70mm (48 hrs)	Canterbury, Banks Peninsula, Avon and Heathcote Rivers			30	30 ppl (Heathcote River)	surface flooding (Canterbury)		0		
2000	Oct 9-11	Manawatu-Wanganui and Wellington Flooding	50 years	Wellington 300mm (24 hours) Tararua Range	Waiohine, Waingawa, Waipoua			0		Stock losses		1.1		
2000	Oct 2-2	Flooding event in Wellington Region	Otaki river 5-10 year flood	Northwesterly storm -850mm (over 72 hours) Tararua Range, Hutt river 5-10 year flood.	Akatarawa, Lower Hutt, Waitohu, Otaki, Waikanae, Mangaroa, Wainuiomata, Porirua, Ruamahanga, Martinborough, Otaihanga, Canterbury - Queenstown			0				0	roads closed, one house affected, homes isolated	http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
2000	Sep 30- Oct 3	New Zealand Storm	5-30 years	Lake Taupo 340mm Waitanguru 300mm (5 days)	Waikato- Taupo, Waipa, Lower catchment, Ngaruawahia, Otewa, Otorohanga, Taranaki, Manawatu-Wanganui-Atene Pa, Eketahuna, Palmerston North, King, Te Kuiti country, Mangaokewa, Mangapu, and Waitomo Valley floors, Manuwatu-Wanganui,			2.7	1 house (Eketahuna)	Surface flooding (Taranaki), Hutt city	roads, stop bank (Wanganui)	0.45	Approximately \$450,000 (\$560,000 2008 dollars) of roading damage occurred in the King Country and Taupo districts.	https://hwe.niwa.co.nz/event/October_2000_New_Zealand_Storm
2000	Sep 24-26	North Island Snow and High Winds			Wairoa River			0				0		https://hwe.niwa.co.nz/event/September_2000_North_Island_Snow_and_High_Winds
2000	Sep 7-7	Flooding event in Wellington Region	S.S		Hutt Valley			0		localised surface flooding		0	homes and roads flooded	http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
2000	Aug 17-19	South Island Flooding	50 years??	100mm (24 hrs) many places in Canterbury- 50 year return period, 150mm (24 hrs) South Canterbury	Christchurch, Coes Ford, Hinds River, Hurunui River, Kaikoura, Selwyn Huts, Kaikoura, Temuka, Otago			0		Surface flooding (Canterbury)	stock losses, stop bank (Selwyn Huts)	0		
2000	July 1-4	Auckland/Coromandel Floods		Whangarei 130 mm (3 days), Pinnacles 250mm, Whitianga 174mm, Coromandel 100mm (24 hours)	Maungakarema, Whangarei, Waitakere, Whangaparaoa, Coromandel, Cooks Beach, Pinnacles, Whitianga			0		Coastal		7.6	Insurance Industry Payouts for the Auckland / Coromandel floods totalled \$7,600,000 (\$9,515,000 2008 dollars).	https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters https://hwe.niwa.co.nz/event/July_2000_Upper_North_Island_Storm
2000	June 28-29	Upper North Island Storm		Awanui 205mm (24 hrs), Freemans Bay 105mm	Northland, Ahipara, Awanui, Kaitaia, Peria, Taipa, Freemans Bay, Birkenhead, Grey Lynn, Auckland- North Shore, Reemans Bay and Birkenhead			10.8	4 homes (Awanui)	surface flooding (Northland), flash flooding (Grey Lynn)	bridge (Ahipara)	0	road closures, school closures	https://hwe.niwa.co.nz/event/June_2000_Upper_North_Island_Storm
2000	June 2-2	Surface flooding event in Wellington	S.S		Kapiti			0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
2000	Apr 9-10	Tauranga/Eastern Bay of plenty floods		Tauranga 173mm (13 hrs) , 166 (8hrs), 152mm (6 hrs), Wairoa 100mm (24 hrs)	Auckland, Hawke's Bay-Wairoa, Tauranga-The Avenues, Otumotai, Ohautiti, Maungatapu and Mt Manganui.			0		Surface flooding (Auckland)		1.9	Insurance Industry Payouts for the Tauranga and Eastern Bay of Plenty Floods totalled \$1,900,000 (\$2,400,000 2008 dollars).	https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters https://hwe.niwa.co.nz/event/April_2000_Bay_of_Plenty_Flooding
2000	Mar 13-14	New Zealand Storm		Dunedin 74.4mm (11 hrs)	Wellington, Christchurch, coastal Otago highways, Dunedin.			0		Surface flooding (Wellington, Christchurch, Otago)		0	school closure	https://hwe.niwa.co.nz/event/March_2000_New_Zealand_Storm

Year	Month and date	Event	Scale of the event	Amount of rainfall/duration	Sub areas	Population per location	Previously affected (add date)	Evacuation	Recorded in the source	Type of flooding	Type of damages	Economic damage (insurance claims or estimated damage) (NZD million)	Others	Source
2000	Jan 21-24	West Coast and Canterbury Flooding		Greymouth 162.6mm (24 hrs)	West Coast, Greymouth, Canterbury, Rakaia River, Waimakariri River			0		Surface flooding (Greymouth)		1		
1999	Dec 18-19	Flooding event in Wellington Region	S.S		Horowhenua, Otaki			0		localised surface flooding		0	8 homes flooded	http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1999	Nov 27-30	North Island Flooding		Taranaki 75-100 mm Manuwatu 0 Wanganui 75-100mm	Hawke's Bay- Taranaki, Manawatu- Wanganui, Kopane, Marton, Oroua River, Taonui			0		Surface flooding (Taranaki)		0		https://hwe.niwa.co.nz/event/November_1999_North_Island_Flooding
1999	Nov 29-29	Lower North Island flooding event	S.S		Rimutakas			0		localised surface flooding		0	52 people (mainly children) rescued from Rimutakas after being trapped by the Orongorongo River.	http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1999	Nov 14-18	South Island Flooding	150 years return period	600mm (24hrs), Queenstown 100mm (48 hrs), 205mm (72 hrs)	Fiordland, South Westland, Clutha River, Otago and Southland, Balclutha, Clyde, Ettrick, Glenorchy, Kaitangata, Queenstown, Roxburgh, Wanaka, Southland			1000	1000+	Surface flooding (Otago)	road (repairs estimate 2 million)	46	Declaration of Civil defence emergency (Otago & Clutha district, Alexandra, Balclutha, Queenstown)	https://hwe.niwa.co.nz/event/November_1999_South_Island_Flooding
1999	Oct 12-12	West Coast Flooding			West Coast			46	46	0		0	Declaration of Civil defence emergency	
1999	Sep 21-21	Surface flooding event in Wellington	S.S		Lower Hutt			0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1999	Aug 20-25	Minor flooding in Wellington	S.S		Kapiti, Tararua, Hutt Valley			0		localised surface flooding		0	car accident	http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1999	May 14-15	Localised Flooding in Wellington	S.S	60mm (24hrs)	Kapiti			0		localised surface flooding	road closure	0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1999	Apr 30-May 2	Northland and Bay of Plenty Flooding	30 years ??	Whangarei 41.4 mm (24hrs), 120mm (3.5 hrs), 100mm (1 hr), Rotorua 214mm (24hrs), 169mm (5hrs), 47mm (1 hr)	Northland- Hibi, Hikurangi, Kaero, Omanaia, Onaiti, Peria Taupo, Whangaroa, Bay of Plenty, Whangarei, Auckland			81	30 houses (Whangarei)	Surface flooding (Auckland, Rotorua)		2.1	Declaration of Civil defence emergency (Rotorua), school closure, sewage problems	https://hwe.niwa.co.nz/event/April-May_1999_Northland_and_Bay_of_Plenty_Flooding
1999	Apr 16-18	Dargaville Floods	50-60 years ??	Dargaville 10mm, 50-60 year flood	West Coast, Northland, Kellys Bay, Ruawai, Tokatoka, Huia			0		sea flooding (West Coast)	Crops	1.7		https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters
1999	Mar 23-24	Surface flooding in Wellington	S.S					0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1999	Mar 12-12	Flash Flooding in Wellington	S.S		Wainuiomata			0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1999	Jan 21-22	Northland and Pukekohe Floods	A wakino & Bayly's Beach 90mm (Return period more than 150 years)	Opononi 210.5mm (5hrs) return period more than 100 years, Panguru 100mm (3 hrs), Pukekohe 50mm (1 hr), 157.5 mm (2 hrs), 160mm (3 hrs)	Hokianga area, Kaihu river, Kaiwaka, Mitimiti, Omapere, Pakanae, Panguru, Pawarenga, Whirinaki, Pukekohe			270	270	0	crops, school (Panguru)	5	Declaration of emergency (Far North District), 80 in emergency accommodation; 96 sections damaged; 75 houses damaged; 3 houses destroyed.	https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters
1998	Dec 3-4	Waikato Flooding-Coromandel		Tairua 200mm (24 hrs), Whitianga 152mm (12 hrs), 186mm (24 hrs)	Whitianga, Tairua, Pauanui, Whitianga, Whenuakite, Cooks Beach Hikuai.			0		surface flooding (Pauanui)	roads	0	road closure	https://hwe.niwa.co.nz/event/December_1998_Waikato_Flooding
1998	Oct 27-30	Western New Zealand Flooding	10-75 years	Lower Hutt 66mm (3 hrs) 26 year return period, Westport 71.2mm (17 hrs)	Milford Sound to Buller, Kapiti, Hutt Valley, west of North Island, King Country, Taranaki, Manawatu-Wanganui, Ahiiti, Ohura, Waitaanga, Akatarawa River, Horowhenua District, Collingwood, Fentown, Murchison			456	36 ppl from 22 homes (Waikanae and Otahanga), 150 ppl from 60 homes (Anzac Parade), 40-60 ppl from the Kapiti and Horowhenua districts, 36 ppl from 22 homes (Waikanae and Otahanga), 220 ppl 12 at Seddonville, 1 at Mohikanui, 4 at Karamea and 3 at Waimare.	0	houses	2	Declaration of Civil defence emergency, 1 casualty in Wellington region, road closure, 27 uninhabitable properties in Ohura	https://hwe.niwa.co.nz/event/October_1998_Western_New_Zealand_Flooding

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1998	Oct 18-21	New Zealand High Winds and Flooding	2-65 years ??50 year flood at Masterton	620mm (48 hrs)Tarrua Range, 100mm (24 hrs) at Paraparaumu Airport, Lower Hutt 72mm (21 hrs), Ahaura River 77mm (7 days), Arapito 156mm, Inangahua 143mm (12 hr)	Manawatu-Wanganui,Wellington- Kapiti to Horowhenua, Grey town , Hutt river, Waikanae , Akatarawa, Waitohu,Waipoua, Ruamahanga, Otaki, Arapito,Inangahua,Seddonville, Te Kuha			134	13 homes (Waikanae), 68 ppl (Masterton), Wellington 40 homes, Karamea 66 ppl	Surface flooding (Lower Hutt)		6.2	Declaration of Civil defence emergency (Kapiti Coast), road closure	http://www.gw.govt.nz/assets/council_hazards/2564_NaturalHazardsBa_s4824.pdf
1998	Oct 8-10	North Island and Upper South Island Flooding		100mm (24 hours) Nelson	Taranaki,Opunake, Pukeiti Hill,Tataraimaka,Tasman-Nelson			0				0		
1998	Sep 5-6	Localised Flooding in Wellington	S.S ???	more than 200mm (24 hrs)	Taranua range			0		localised surface flooding		0		http://www.gw.govt.nz/assets/council_hazards/2564_NaturalHazardsBa_s4824.pdf
1998	July 8-20	Waikato Flooding	2-130 years Extensive (Kaiaua)	Hamilton 191mm (7 days), Mangatangi 203mm (72 hrs), Maukoro Canal 172mm (7 days), Otewa 196mm (7 days),Te Kuiti 260mm, Rotorua 389mm (July)	Waikato, Hamilton, Huntly, Taupo, Ngaruawahia, Kaiaua, Bay of Plenty - Rotorua, Northland and Auckland, Mangatangi, Maukoro, Otewa, Otorohanga, Pteroa, Piako , Te Kuiti ,Rangiriri,Tahuna,Te Aroha,Te Kuiti, Thames,Turangi, Manawatu-Wanganui			253.8	30 houses(Waikato), 10 homes Turangi 50 hrs (Taupo) 4 homes Te Kuiti	surface flooding (Northland) River flooding	roads, stopbanks, pasture	14,853	Declaration of state of emergency , road closure	https://hwe.niwa.co.nz/event/July_1998_Waikato_Flooding
1998	July 1-2	New Zealand Flooding	S.S	mm (some places), 80mm (24hrs)	Waikato, Bay of Plenty, Wellington, Marlborough, Tasman-Nelson and the West Coast, Ahaura River			0				11.8	Wellington -Small-scale, Sewerage problems	https://hwe.niwa.co.nz/event/July_1998_New_Zealand_Flooding
1998	June 26-26	flash flooding in Wellington	S.S	70mm (1.25 hrs)	Kelburn			0		localised surface flooding		0	power cuts and vehicle submerged	http://www.gw.govt.nz/assets/council_hazards/2564_NaturalHazardsBa_s4824.pdf
1998	June 25-26	Localised Flooding in Wellington	S.S	28mm (15 mins)				0		localised surface flooding		0		http://www.gw.govt.nz/assets/council_hazards/2564_NaturalHazardsBa_s4824.pdf https://hwe.niwa.co.nz/event/June_1998_Wel
1998	June 14-14	Localised Flooding in Wellington	S.S	30mm in (3 hrs)				0		localised surface flooding		0	phone lines damaged.	http://www.gw.govt.nz/assets/council_hazards/2564_NaturalHazardsBa_s4824.pdf
1998	May 26-26	Flooding events in Wellington region	S.S	Hataitai 74.4mm, Miramar 44.2mm	Wellington CBD			0				0	school closed, stormwater systems unable to cope.	
1998	May 22-23	Upper North Island High Winds and Flooding			Auckland, Hamilton,			0		localised flooding (Auckland), Flash flooding (Hamilton)		0		https://hwe.niwa.co.nz/event/May_1998_Upper_North_Island_High_Winds_and_Flooding
1998	Apr 1-1	Flooding event in Wellington Region	S.S		Paraparaumu and Waikanae.			0		localised surface flooding		0		http://www.gw.govt.nz/assets/council_hazards/2564_NaturalHazardsBa_s4824.pdf
1998	Mar 28-29	Southern NZ Extropical Cyclone Yali		100mm (West Coast) 31mm (3 hrs)	Wellington-Paraparaumu,Waikanae, Southland			0		coastal		0		https://hwe.niwa.co.nz/event/March_1998_Southern_NZ_Extropical_Cyclone_Yali
1998	Feb 17-18	South Island High Winds and Flooding		195mm 171 (24 hrs)	West Coast- Hokitika River			0				0		https://hwe.niwa.co.nz/event/February_1998_South_Island_High_Winds_and_Flooding
1997	Dec 14-16	West Coast Flooding and Landslides	2-30 years ??	ipuna 59mm, 79mm, 370 (48 hrs)	West Coast-Ahuara River, Dobson, Greymouth, Inangahua Landing, Kaiata,Te Kuha,Waipuna			54	20 homes		STOCK	0		https://hwe.niwa.co.nz/event/December_1997_West_Coast_Flooding_and_Landslides http://www.localweather.net.nz/smf/indexph
1997	Nov 27- Dec 1	New Zealand Storm			Northland-Mangonui,			0				2.9		
1997	Oct 3-7	Wellington and South Island Storm	10 years	Taranua Range 650mm (48 hours), Hutt river 220mm, Lower Hutt 109mm (27 hrs)	Wellington and Horowhenua, Hutt Valley, Wainuiomata,Orongorongo ,Lower Hutt, Waikanae,Otaki,Porirua			100	100 + ppl from 30 houses	Surface flooding (Hutt Valley and Wellington)	River banks	0	2 fatalities (car aquaplanned into swollen Hutt River).	https://hwe.niwa.co.nz/event/October_1997_Wellington_and_South_Island_Storm
1997	Sep 27-28	Auckland Floods						0				0.7		https://www.icnz.org.nz/natural-
1997	Sep 23-24	Coromendal floods		Whitianga - 50mm (30 mins), 60mm (1 hr), 291mm (24 hrs)	Kennedy Bay, Whangapoua, Kuaotunu, Cooks Beach, Hahei, Hikui, and Tairua.			0		surface flooding Whitianga		0.5		https://hwe.niwa.co.nz/event/September_1997_Waikato_Flooding
1997	Aug 4-5	Localised Flooding in Wellington	S.S					0		localised surface flooding		0		http://www.gw.govt.nz/assets/council_hazards/2564_NaturalHazardsBa_s4824.pdf
1997	July 14-14	Surface flooding in Wellington.	S.S		Wellington Airport			0		localised surface flooding		0		http://www.gw.govt.nz/assets/council_hazards/2564_NaturalHazardsBa_s4824.pdf

Year	Month and date	Event	Scale of the event	Amount of rainfall/duration	Sub areas	Population per location	Previously affected (add date)	Evacuation	Recorded in the source	Type of flooding	Type of damages	Economic damage (insurance claims or estimated damage) (NZD million)	Others	Source
1997	July 10-10	Localised surface flooding in Wellington	S.S					0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1997	June 30-2 July	Upper North and South Island Flooding	20 years ??	Maungaturoto 268mm (24 hrs)	Central Plateau and Bay of Plenty, Northland, Hawkes Bay, Marlborough, Tasman-Nelson, Maungaturoto, Pahia, Russell, Taipa, Tangowahine			0			roads	1.2	road closure, Estimate for road repairs \$ 500,000 Insurance payouts for Whangarei district \$ 1.7 million and \$ 1.2 million	https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters
1997	June 17-18	Localised Flooding in Wellington	S.S	90mm (18 hrs)				0		localised surface flooding		0	road closure	http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1997	June 3-3	Northland and Hawke's Bay Flooding		Mahia Peninsula 109.4 (24 hrs)	Northland, Fairburn, Honeymoon Valley, Horeke, Kerikeri, Nuhaka, Peria, Ruakaka, Ruatanga West, Gisborne, Mahia Peninsula, Nuhaka	166		166 ppl (Nuhaka)	166 ppl (Nuhaka)	0		0.5	Declaration of Civil defence emergency (Northern Hawke's Bay)	https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters https://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf https://www.niwa.co.nz/event/June_1997_Northland_and_Hawkes_Bay_Flooding
1997	May 24-24	Auckland Floods		Auckland airport 77.6mm (12 hrs)				0						https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters
1997	Mar 22-23	Hawke's Bay Hail		13.6mm (1 hr) Hamilton	Waikato and Auckland			0		0	crop	0		https://www.niwa.co.nz/event/March_1997_Hawke's_Bay_Hail
1997	Mar 11-13	North Island Extropical Cyclone Gavin		30-50mm (24 hrs)	Northland, Waikato, Bay of Plenty, Gisborne, Motu area			2.7	1 family			0		https://www.niwa.co.nz/event/March_1997_North_Island_Extropical_Cyclone_Gavin
1997	March 6-6	Localised Flooding in Wellington	S.S					0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1997	Feb 4-8	Canterbury Flash Flood	S.S		Pleasant Point, Opuha River, Strathcona, Masterton			0		flash	crops, stock	0	declaration of civil defence emergency, Masterton small-scale	https://www.niwa.co.nz/event/February_1997_Canterbury_Flash_Flood
1997	Jan 10-12	New Zealand Extropical Cyclone Drena	Extensive (Kaiaua)	Ashburton 45mm	Waikato- Waikawa, Kaiaua Canterbury, Ashburton, Banks Peninsula, Otago- Dunedin, Mosgiel, Southland- Invercargill	194		140 (Thames) & 20 homes		River & Coastal		3.2	three fatalities, road closure	https://www.nzherald.co.nz/nz/ten-of-the-worst-storms-to-hit-new-zealand/HXDTYD2ZUPScZ7X2M45205JW/ https://www.wharekawacoast2120.hauraki.govt.nz/
1996	Dec 28-31	Upper North Island Extropical Cyclone Fergus	10-55 years ??	Whitianga 242mm (24 hrs)	Waikato-Thames Coromandel, Hamilton, Hikuai, Kauaeranga, Ngaruawahia, Pauanui, Whatawhata	20		20	20	0		1.6	declaration of state of emergency (Thames-Coromandel District)	
1996	Nov 18-20	New Zealand High Winds			western and central districts.			0		0		0		https://www.niwa.co.nz/event/November_1996
1996	Nov 12-12	Flash floods in Wellington (Wainuiomata)	S.S					0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1996	Oct 7-8	Local flooding in Wellington	S.S	30mm-50mm (10 hrs)				0		localised surface flooding		0	road closure	http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1996	Sep 13-14	local flooding in Wellington	S.S					0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1996	July 14-14	Waikato Flooding			Thames, Waitakaruru			50	50	0		2.7	declaration of civil defence emergency	https://www.niwa.co.nz/event/July_1996_Waikato_Flooding
1996	July 11-12	flooding in Wellington and Wairarapa.	S.S	More than 100mm (24hrs)				0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1996	July 1-1	Flooding in Wellington region- Wairarapa	S.S	More than 200 mm in Tararua range				0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1996	Mar 16-16	Flash flooding in Otaki	S.S					0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1996	Feb 19-20	Heavy rain north Wellington and Wairarapa.	S.S					0		localised surface flooding		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1996	Feb 7-9	Flash floods in Wellington	S.S					0		flash		0		http://www.gw.govt.nz/assets/council-hazards/2564_NaturalHazardsBa_s4824.pdf
1995	Dec 11-14	South Island Flooding	12-150+ years	Franz Josef 195mm (24 hrs), Otago 100mm (2 days), Haast 101mm (24 hours), Alexandra 103mm (48 hrs)	West Coast Franz Josef, Canterbury, Arundel, Oamaru, Otematata, Rangitata, Canterbury, Arundel, Hakataramea, Rangitata, Queenstown and Wanaka, Alexandra, Baklutha, Becks, Craig Flat			173.5	35 ppl (Oamaru), 35 houses (Otematata), 17 ppl (Hakataramea), Rangitata 10 houses, 6 houses	0	crop	0	Declaration of emergency (Oamaru, Hakataramea)	

Year	Month and date	Event	Scale of the event	Amount of rainfall/duration	Sub areas	Population per location	Previously affected (add date)	Evacuation	Recorded in the source	Type of flooding	Type of damages	Economic damage (insurance claims or estimated damage) (NZD million)	Others	Source
1995	July 14-18	Flooding in North Island	Extensive		Ngaruawahia, Ororohanga, Rangiri, Whatawhata			30	30 ppl	River & Coastal		4	Declaration of emergency (Thames Valley, Thames Ward and Plains Ward)	https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters
1995	Apr 25-25	New Plymouth floods		New Plymouth 134mm (5 hrs), 151mm (6 hrs)	Mangawera Stream			54	20 families	0	Bridge	3.6		https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters
1995	Mar 29-30	Northland Flooding	100 years ??	30mm in 24 hours	Broadwood, Hkurangi, Matiehihi, Rawene, Whangarei			0		0		0		https://hwe.niwa.co.nz/event/March_1995_Northland_Flooding
1995	Feb 23-23	Flooding in Nelson			Riverside, Nelson			0		flash flood		0	Breach of stopbanks	http://www.nzfloodpics.co.nz/
1994	Nov 21-22	West Coast and Wellington Flooding		Wairarapa 550mm, 100mm (12hrs)	Wellington, West Coast-Buller, Kokatahi, Kowhitirangi, Mohikini, Seddonville.			5	5 ppl (Seddonville)	0		0	Declaration of emergency (Buller District, West Coast)	https://www.civildefence.govt.nz/resources/previous-emergencies/historical-emergencies/?year=1994&type=6&region=
1994	Nov 16-16	Manawatu-Wanganui Flooding		Wanganui 31mm (24hrs), 58.9mm (48 hrs)	Bulls, Rangitikei River, Whanganui River			1		1		0		
1994	Nov 5-9	Lower North Island and Upper South Island Storm		Wellington 100mm (12hrs)	Manawatu - Whanganui-Waitotara, Wanganui, Hawkes Bay, Wellington, Featherston, Greytown and Martinborough Marlborough, Kibirnie, Marlborough			157	157	0		0	Declaration of emergency (Wanganui)	https://www.civildefence.govt.nz/resources/previous-emergencies/historical-emergencies/?year=1994&type=6&region=
1994	Nov 1-1	North and South Storm Floods						0		0		6		https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters
1994	Mar 19-21	Canterbury and Otago Flooding	8 years ???	Dunedin 114mm 150mm (48 hrs)	Canterbury-Waimate, Timaru and MacKenzie districts, Middlemarch, Milford Huts near Temuka, and Fairlie, Otago-Dunedin			240	240	0		5.5	Declaration of emergency (Waimate, Timaru and MacKenzie districts.)	
1994	Mar 2-2	Hawke's Bay Hail		15mm in 10 minutes				0		0	crops	0		https://hwe.niwa.co.nz/event/March_1994_H
1994	Feb 19-19	South Canterbury Floods						0		0		1.5		https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters
1994	Jan 19-24	South Island Extropical Cyclone Rewa	10-150+ years	Franz Josef Glacier township 601mm	Otago- Alexandra, Waitaki, Sothland-Invercargill, Cattle Flat, Centre Bush, Clifden			0				0		
1994	Jan 10-12	Alexandra flooding Otago/Canterbury		Hokitika 210mm, Hokitika Gorge 863mm over weekend (523mm on Saturday, 340mm on Sunday).	Hokitika			150	150+	0	livestock	10.7	Declaration of emergency, state highway damages	https://www.civildefence.govt.nz/resources/previous-emergencies/historical-emergencies?start=150&limit=50
1994	Jan 8-10	Milford Flooding- Southland	15-50 years		Alexandra, Clyde, Glenorchy, Lake Wanaka, Makarora, Canterbury, Otago, Clyde, Glenorchy, Lake Wanaka, Makarora, Te Anau.			972	572 (Milford and Mt Cook.) 4 families (Clutha river), 400 ppl (Glenorchy)	0		0	Declaration of emergency (Mount Cook, Alexandra, Te anau)	
1993	Dec 23-30	Kaikoura floods		147mm (10 hrs)				0		0		10	declaration of emergency	https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters
1993	Oct 5-5	West Coast Flooding		Colliers Creek at Paparoa recorded daily totals for 7 days prior to the event of: 98 mm, 201 mm, 16mm, 28 mm, 4 mm, 84 mm, and 0 mm	Colliers Creek, Hokitika, Kanierie, Ross			0				0		
1992	Nov 23-23	Otago Hail Storm			Otago- Roxburgh area			0		flash floods	Orchards	3		https://hwe.niwa.co.nz/event/November_1992
1992	Oct 30-30	Manawatu-Wanganui			Taranua area			0		0	stock	3.4		https://hwe.niwa.co.nz/event/October_1992
1992	Oct 14-17	Lower North Island Storm		103mm 145 mm (48 hours)	Dannevirke, Wellington-Masterton District, Martinborough, Ruamahanga River, Tauera River, Wairarapa			0		0		0		https://hwe.niwa.co.nz/event/October_1992_Lower_North_Island_Storm
1992	Aug 29-29	Flooding in Christchurch			New Brighton, Avonside, and Heathcote			0		0		0	declaration of civil defence emergency (Masterton)	https://www.stuff.co.nz/the
1992	July 22-24	North Island Flooding and High Winds			Northland, Mangakahia River, Titoki, Manawatu-Wanganui, Glen Oroua, Kopane, Rangitoto, Whirokino Cut, Masterton			0			roads	5.2	Estimated loss of floods \$500,000-\$750,000 for road and bridge repair (Far North), Wellington \$296,000 road damage	https://hwe.niwa.co.nz/event/July_1992_North_Island_Flooding_and_High_Winds
1992	June 6-8	Gisborne Flooding		East cape 200mm, Te Araroa 217mm (24 hrs)	East Cape, Onepoto, Te Araroa.			0		Flash	Culverts	0.5	Estimated highway and district council road damage over \$500,000.	https://hwe.niwa.co.nz/event/June_1992_Gisborne_Flooding
1991	Dec 8-8	Marlborough Hail Storm		16mm (2 hours)				0		0		0		https://hwe.niwa.co.nz/event/December_1991
1991	Aug 7-7	Manawatu-Wanganui Storm			Taumarunui			0		0		0		
1991	Apr 8-11	Lower North Island Storm	23-75 years	Wairoa 192.3mm, Tinui 150mm (4 hrs), 200mm (24 hrs), 350mm (48 hrs), Wellington city 99mm (3 days)	Hawke's Bay, Manuamu, Wellington, Tinui, Alfredton, Mangapati Stream, Wairoa.			0		surface flooding (Wairoa)	crops, stocks	2.8		
1991	Apr 2-3	Westland flooding			Franz Josef			75	75	0		0	Declaration of emergency	https://www.civildefence.govt.nz/resources/p

Year	Month and date	Event	Scale of the event	Amount of rainfall/duration	Sub areas	Population per location	Previously affected (add date)	Evacuation	Recorded in the source	Type of flooding	Type of damages	Economic damage (insurance claims or estimated damage) (NZD million)	Others	Source
1991	March 8-11	Flooding in Wairarapa		257mm	Castlepoint, Riversdale, Tinui and Mauriceville.			0		0	stock	0		
1991	Feb 17-18	Otago floods		100mm	Baklutha, Pounawea, Newhaven and Tahakopa.			128	128 (ppl from Pounawea, Newhaven and Tahakopa)	0		4.8	Declaration of emergency, Insurance industry payouts for the flood were \$1,600,000 (\$2,380,000 2009 dollars). Estimated damages \$ 2, 500,000 (Roads), \$ 766,695 (farms)	https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters https://www3.stats.govt.nz/New_Zealand_Official_Yearbooks/1992/NZOYB_1992.html#ids ect2_1_2198
1991	Jan 27-28	West Coast Flooding		Hokitika 146mm (24hrs) Kaniere 700mm	Kaniere Township, Arthurstown, Woodstock and Hokitika, Arahura River, Franz Josef, Kaniere, Ross			180.5	140 (Franz Josef) 15 homes (Kaniere)	0		4	Declaration of emergency (Kaniere Township, Arthurstown, Woodstock and Hokitika)	
1990	Aug 23-25	Hawke's Bay Flooding		103mm 145 mm (48 hours)	Bay View, Hastings, Havelock North, Karamu Stream, Lake Poukawa, Heretaunga Plains, Te Awanga, Waimarama			0		0		0		https://hwe.niwa.co.nz/event/August_1990_Hawkes_Bay_Flooding
1990	Aug 11-13	Nelson-Tasman flooding	100 year	224mm (24 hrs)	Motueka area, Appleby, Brooklyn Valley, Dovedale, Golden Bay, Motueka, Gowan Valley			45	45	0		5.6	Declaration of emergency (Motueka), 1 fatality	
1990	Aug 6-8	Manawatu-Wanganui Flooding		22.8mm (24 hrs)	Manakau			0		0		1.8		https://hwe.niwa.co.nz/event/August_1990_Manawatu-Wanganui_Flooding
1990	Apr 27-27	Tasman-Nelson Storm			Nelson city			0		0		0		
1990	Mar 8-15	Taranaki/Whanganui floods	50-69 years	New Plymouth 324mm Waitara - 25 year flood Lepperton 338mm (24 hrs)	Waitara, Wanganui, Wellington, Lower Hutt, Ohau River, Otaki, Pauatahanui			193	54 ppl (Oukura) 119 ppl from 90 houses (Wanganui), 20 ppl from 5 homes (Wairarapa)			2.1	Declaration of emergency (Taranaki region)	https://www.knz.org.nz/natural-disasters/cost-of-natural-disasters
1990	Jan 16-17	Greytown flooding Wellington	34 years		Ahikouka, Martinborough			30	30 ppl (Ahikouka)	0		0	Declaration of emergency (South Wairarapa District Council.)	

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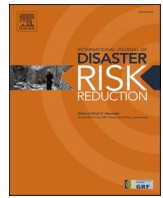
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Appendix G Published Article 1



Examining the incorporation of small-scale recurring disasters in emergency management frameworks: Insights from Aotearoa – New Zealand

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ABSTRACT

Risks pertaining to small-scale recurring disasters are generally not considered by emergency management policies. While their impacts are not immediately recognisable, their recurrent manifestation may result in cumulative as well as indirect impacts. Yet, small-scale recurring disasters both remain under-studied in disaster studies and are often not incorporated in disaster planning and policy. This paper contributes to filling this gap in knowledge by investigating the extent to which the emergency management framework of Aotearoa-New Zealand addresses small-scale recurring disasters through a targeted analysis of high-order policy documents. The findings confirm the incomplete reflection of risk identification related to small-scale recurring disasters in the documents analysed. The paper reaffirms that small-scale recurring disasters should be more explicitly integrated in disaster management policy regimes to eliminate the differences at the lower administrative levels of risk treatment. It also argues for the re-evaluation of short-term solutions (such as insurance coverage) that only improve recovery outcomes temporarily, and the consideration of long-term risk reduction policies for achieving more sustainable recovery outcomes.

1. Introduction

The world is being challenged by an unprecedented increase in the intensity and frequency of natural hazards due to global climate change. While we are seeing a lot of attention paid to large-scale extreme events (e.g., more intense bushfires and floods), small-scale disasters may also become more frequent as a result of climate change [1]. The importance of small-scale disasters has long been recognised in disaster literature dating back to the 1980s [2] in sociological, human-ecological and geographical perspectives. These include the works of Watts and Bohle, Bohle et al., Cannon [3–5], and Wisner and Luce [6] which called for consideration of underlying factors of vulnerability to disasters. Such factors are important because they can potentially exacerbate the impact of small-scale recurring disasters in the local context [7]. The focus on small-scale disasters, however, lost traction in the decades that followed before regaining momentum around 2010 both by research (e.g.,

[8–10]), and practice [11]. Yet, some [1,2] argue that small-scale recurring disasters remain under-studied in disaster literature and, more importantly, fail to be effectively captured by emergency management policy and planning [10,12].

Despite limited empirical research in this area, there is evidence of the difference between the impacts resulting from intensive and extensive² disaster risk [13]. This calls for risks pertaining to different types of disasters to be separately analysed. However, in practice, small-scale recurring disasters tend to be treated through the emergency management regime as static disaster events. Additionally, emphasis is often given to tackle the immediately visible consequences through the application of short-term solutions rather than dealing with the root causes of disaster vulnerability and exposure [1,14].

Disaster literature has argued that recurrent and chronic disasters should be managed in new ways (such as assessment of vulnerabilities), and their associated risks should not be neglected during the pre-disaster

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² Intensive risk refers to high-severity major hazard events that result in catastrophic disaster impacts involving high mortality and asset loss; whereas extensive risk is associated with the high frequency low-severity hazard events that are often localised in nature leading to cumulative disaster impacts [28].

stage [15]. Subsequent studies [1,16] described the importance of disaster risk reduction concerning small-scale recurring disasters as a means to reduce the cumulative impact attributed to the repetitive nature of these disasters. In particular Marulanda et al. [8], suggest that small-scale recurring disasters may obstruct the long-term sustainability of local communities because of their associated implications for economic, environmental and social processes. This calls for disaster management initiatives to pay greater attention to potential long-term recovery challenges posed by small-scale recurring disasters, by addressing the underlying risks communities may be exposed to in the first place [17]. However, literature reveals that small-scale recurring disaster policies remain ambiguous [2] despite the decades of research done in this area. Hence, it is important to investigate the extent to which small-scale recurring disasters are being incorporated into existing disaster management frameworks. This paper contributes to filling this gap in knowledge by investigating how risks related to small-scale recurring disasters are being appraised in Aotearoa-New Zealand's emergency management regime. Following this introduction, relevant literature on small-scale recurring disasters is reviewed. Next, the research methods and key themes guiding this study are explained. Based on findings, we discuss the implications for research and practice if small-scale recurring disasters are not fully considered in disaster management frameworks.

2. Small-scale recurring disasters and emergency management frameworks

There is a tendency for policies and corresponding disaster funding to focus on large-scale disasters with limited attention paid to small-scale ones [2]. A number of reasons are identified in the literature to explain this. First, such limited attention is probably influenced by the lack of a universally accepted definition in terms of both the scale and frequency of small-scale disasters, especially when those are recurrent [2,14]. Various terms such as everyday disasters, silent disasters, neglected disasters, invisible disasters [14], quotidian and chronic disasters [13] have been interchangeably used to describe small-scale recurring disasters.

Second, a number of studies [9,18,19] and organisations (The Global Network of Civil Society Organisations for Disaster Reduction [20]); have attempted to explain the scale component of small-scale disasters. Despite such attempts, in general, it is the magnitude of events - often associated with the number of deaths and larger financial impact, that receives most public attention and visibility [10]. Accordingly, two of the most popular international disaster loss databases consider different thresholds for a disaster event to be entered into their database, but without capturing the nuanced differences of small-scale recurring disasters. EM-DAT, an international database of natural and technological disasters maintained by the Centre for Research on the Epidemiology of Disasters (CRED), requires one of the following criteria to be fulfilled: 10 or more deaths, 100 or more people affected, or declaration by the country of a state of emergency and/or an appeal for international assistance [21]. On the other hand, 'DesInventar' entries are not required to be enlisted based on thresholds [22]. If there are social losses, then an event is eligible for inclusion. It considers a broader spectrum of variables than EM-DAT, so that it can take into account a variety of spatial scales and break down 'small scale invisible disasters' into multiple, distinct types [23]. This terminology ambivalence and threshold inconsistency has implications for both scholarly research and practice.

Third, on the global scale, small-scale recurring hazard events are less likely to be considered as disasters [8,24]. This limits the global understanding about these events and curtails the prospects to further investigate them [13]. For example, there is limited understanding about at what point the level of exposure and vulnerability of places may determine the translation of small-scale hazard events into disasters [25, 26]. Further, the lack of understanding of the social and economic costs

that disrupt the lives of poor and marginalised communities also contributes towards the underestimation of small-scale recurring events [10]. Or, how weak local governance and poor planning issues may exacerbate the root causes of vulnerability, leaving communities and places more exposed to the effects of small-scale recurring disasters [13].

Last, the duration of small-scale events, and corresponding length of disruption they cause to communities, has been identified as a potential temporal factor that leads to their neglect in emergency management policy and planning [10]. It is not uncommon for some communities to be still experiencing the consequences of a previous small-scale disaster when a subsequent disaster occurs [2]. This makes it difficult to determine how much disruption, and for how long, a community experiences from each event.

In parallel, questions remain as to whether the risk component of small-scale recurring disasters are being adequately addressed by disaster management regimes [18]. In particular, the characteristics of the risks associated with small-scale recurring disasters are distinct [27], therefore requiring careful consideration by disaster risk assessments. For example, the United Nations International Strategy for Disaster Reduction (UNISDR) describes the risks embedded in small-scale recurring disasters as 'extensive risks', including risks associated with highly localised, repetitive, low or moderate hazard conditions leading to cumulative disaster impacts [28]. However, the threshold that determines the scale of extensive risks is left arbitrary [14,29], limiting the consistent use of the term.

The Global Assessment Report on Disaster Risk Reduction[29] explains that extensive risks are a result of development related factors, which are both manageable and avoidable through the application of suitable disaster risk reduction measures [30]. A distinctive feature of risk pertaining to small-scale recurring disasters is its cumulative nature due to the continuous exposure of the affected communities [25]. Therefore, risk assessment methodologies should be customised to deal with small-scale recurring disasters in terms of cumulative, complex impacts. Risk assessments use both quantitative and qualitative methods to obtain a comprehensive description of what risks are and their causes [26]. The ISO 31000³ encourages scrutiny of cascading and cumulative effects in risk assessment and to recognise risk as an input for decision making [31]. This will help to curtail decisions being made based on common risk characteristics. In the disaster and emergency management literature, however, there is no single accepted definition of risk, with risk being generally described as a combination of hazard, exposure and vulnerability [32,33]. Additionally, as a general rule, risks associated with small-scale disasters are considered irrelevant [8].

Over the last few decades, global disaster risk reduction frameworks have recognised the application of disaster risk reduction (DRR) to addressing small-scale recurring disasters. For example, the Hyogo Framework for Action[34] provided the wider dissemination of the DRR concept [35]. This was followed by the Sendai Framework for Disaster Risk Reduction (SFDRR) [36] and marked a paradigm shift from reaction to disaster prevention. This means a shift from managing the disaster impact to managing and reducing the risks that create a disaster [37]. The SFDRR annotates that a better understanding of disaster risk and improvement of risk governance is necessary to reduce existing disaster risks. It advocates the promotion of DRR measures at the local level by decentralising, delegating, deconcentrating and empowering local authorities and communities [36].

At its onset, the SFDRR extends its application to small- and large-scale, frequent and infrequent, sudden and slow-onset disasters, caused by natural or human-induced hazards as well as environmental,

³ ISO 31000 is a set of standards that relate to risk management codified by the International Organization for Standardization. Aotearoa-New Zealand has adopted ISO 31000 as its standard for risk assessment in the emergency management system [60].

technological and biological hazards [36]. This suggests that the scale of the disaster would not determine the significance of that event for those affected [14]. While paragraph four of the SFDRR specifically states the term, small-scale recurring disasters and their impacts, it does not define the context in which the term ‘small-scale’ should be used. This ambiguity creates issues for its application, including challenges to reporting progress on the SFDRR’s outcomes and goals [38]. In addition Zaidi [13], reports that indicators proposed by the SFDRR do not seem to sufficiently capture the indirect disaster impacts pronounced by extensive disaster risks. Importantly, without being systematically analysed, secondary and tertiary impacts resulting from potentially extensive risks of small-scale recurring disasters cannot be immediately captured and addressed by DRR policies [13].

Finally, the DRR concept is broadly applied to the development of policies and strategies (e.g., land use and urban development planning) aimed at reducing risks and vulnerabilities through the analysis of causal factors leading to disasters [28,35,39]. By considering small-scale recurring disasters, DRR approaches can have multiple benefits in the long-term. For example, the total cumulative impact of small-scale recurring disasters may be greater than large-scale events. Additionally, as their frequency and territorial spread increases, they may gradually develop into larger events. Hence, by reducing risks associated with small-scale recurring disasters, local disaster management strategies may be better prepared to deal with larger-scale disasters in the long run [40].

3. Methods

This paper adopts a targeted policy analysis of high-order documents to investigate the extent to which small-scale recurring disasters are being addressed by Aotearoa-New Zealand’s emergency management regime. As a starting point, we searched the literature for a definition of small-scale recurring disasters that we could adopt in our research to define the spectrum of small-scale disasters. Although a commonly accepted definition is absent, we based our definition on Voss and Wagner’s [9] work which considers small disasters as incidents that disrupt everyday routines and require adaptation and adjustment to social, cognitive, and material culture. They usually occur in the affected community and can be handled by the collaboration of local groups and stakeholders. For this study, we thus adopt a working definition for small-scale recurring disasters as ‘events that impact a low number of people, have a risk level below the major and extreme threshold limits, or do not pose a threat to life. In this context, recurring events are those that occur at least two to three times during the past decade or at a greater frequency. Such events will often have relatively minor social, environmental, economic and cultural impacts as well as long-term cumulative impacts’.

To illustrate our analysis, we use Aotearoa-New Zealand as our case study. While the country is subject to frequent hydrological events such as droughts and floods, and associated extensive financial losses [41–44], small floods occur more frequently than large floods [45]. These events, however, are underrepresented in cost estimates and studies which focus mainly on the direct insured flood losses [42], creating a knowledge gap. Additionally, Aotearoa-New Zealand has committed to the SFDRR, the Paris Agreement on Climate Change, and the Sustainable Development Goals which demonstrates its commitment to reducing and managing risks [46] thereby, making it a suitable case for analysis.

Aotearoa-New Zealand has been revising its policies and improving governance mechanisms to create a conducive environment for risk reduction and climate change adaptation to meet its international commitments [46]. The local legal mechanism which gives effect to the SFDRR in Aotearoa-New Zealand is mainly coordinated by the National Emergency Management Agency (NEMA) (formerly known as the Ministry of Civil Defence Emergency Management (MCDEM)). The primary statutory instrument giving effect to advocate the implementation of

disaster recovery is the *Civil Defence Emergency Management (CDEM) Act* [47], which is framed around the 4R’s: reduction, readiness, response and recovery [48].

The *CDEM Act* [47] primarily aims to manage hazards, risks, and emergency response and recovery through the coordinated and integrated policy, planning and decision-making processes at the national and local level. It lays out the duties, functions and powers of central government emergency services, lifeline utilities and the general public [47]. The *CDEM Act* has statutory character and mandates both pre- and post-disaster event management [49], and is the primary element of the CDEM framework. The other constituents of the CDEM framework include plans and strategies, guidelines and technical standards and information and tools related to capability development. Under the *CDEM Act*, locally formed CDEM groups are tasked with the identification and understanding of hazards and risks affecting their local administrative areas. The CDEM groups formulate their respective group plans in accordance with the CDEM framework to fulfil its requirements.

3.1. Data collection and analysis

Better understanding of disaster risks provides the basis for the entire DRR process [50]. This includes a clear understanding of how risks are being classified or scaled, and what kind of risk is being considered, or neglected, by risk reduction measures. Under the SFDRR, the DRR process aims to prevent new risks, reduce existing ones and strengthen overall disaster resilience. For this, it outlines four priorities for action: (i) Understanding disaster risk; (ii) Strengthening disaster risk governance to manage disaster risk; (iii) Investing in disaster reduction for resilience; and, (iv) Enhancing disaster preparedness for effective response, and to Build Back Better in recovery, rehabilitation and reconstruction. This paper aims to investigate how risks related to small-scale recurring disasters are being appraised in Aotearoa-New Zealand’s emergency management regime. Therefore, our document analysis primarily focuses on the first priority of the SFDRR - understanding disaster risk. It is important to stress that our analysis only focuses on the national level policies and does not extend to specific procedures implemented at the local level by differing CDEM groups. To this end, three main themes guided the document analysis:

1. How is risk defined in Aotearoa-New Zealand’s emergency management framework?
2. To what extent are risks associated with small-scale disasters considered?
3. To what extent is the recurrent aspect of disasters considered?

We selected thirteen key documents (see [Table 1](#)) to examine the above themes. Qualitative analysis software package NVivo was used for this. Based on ideas, themes and concepts found in the literature [51],

Table 1
Documents analysed.

Title	Year
Civil Defence Management Act (CDEM Act)	2002
Focus on Recovery: A Holistic Framework for Recovery in New Zealand	2005
NCDEM Plan Order	2015
CDEM National Capability Assessment Report	2015
The Guide to the National Civil Defence Emergency Management Plan	2015
Response Planning in CDEM: Director’s Guideline for Civil Defence Emergency Management Groups	2015
Strategic Planning for Recovery - Director’s Guideline for CDEM Groups	2017
CDEM Group Planning Director’s Guidelines for Civil Defence Emergency Management Groups	2018
Recovery Preparedness and Management – Director’s Guideline for Civil Defence Emergency Management Groups (A, B and C)	2019
National Disaster Resilience Strategy	2019
Draft Director’s Guideline: Risk assessment guidance for Civil Defence Emergency Management (CDEM) Group planning	2021

documents were searched for the following terms: ‘small’, ‘small-scale’, ‘risk’, ‘extensive risk’, ‘recurrence’, ‘repeat’, ‘consecutive’, ‘acute’, ‘disaster’, ‘natural hazard’, ‘localised’, ‘continuous’, ‘cumulative’, ‘aggregate’, ‘disruption’, ‘threshold’, and ‘cascading’.

4. Results

This section first reports on the findings related to definitions of risk observed in the documents analysed. This is followed by findings related to how documents incorporate risks associated with small-scale disasters and the recurrent aspect of disasters.

4.1. Risk definition in Aotearoa-New Zealand’s emergency management framework

In Aotearoa-New Zealand, the overarching consideration of risk is established based on an all hazards and all risks approach. The CDEM framework led by the *CDEM Act* [47] implies that any hazard that could create a risk is being acknowledged and considered under the CDEM framework. In comparison with the academic literature that uses the term disaster, Aotearoa-New Zealand’s legislation and policy use the term emergency when describing situations that threaten life or health, and require an immediate coordinated response [52]. Therefore, it appears that the CDEM context does not use the term disaster extensively, with the definition of disasters appearing in two of the documents reviewed as follows (please see Table 2).

The importance of risk management is emphasised in the CDEM National Capability Assessment Report ([53]; p. 5), which recommends managing risk rather than managing the disasters, and brings to attention to the need to build resilience: ‘There is a need for CDEM to shift its attention away from managing disasters to managing risk, and building resilience within organisations and communities ...’.

All documents reviewed touched upon the importance of addressing disaster risks. Notably, for the last two decades, the definition of risk, interpreted as the likelihood and consequences of a hazard, has remained the same (see Table 3). More recent documents, however, have started to expand on this definition by including aspects related to exposure, vulnerability and capacity of affected systems.

As the CDEM framework follows a comprehensive risk management approach, risk is also considered in each of the four phases of the disaster management cycle (i.e., the 4Rs). For example, the Response Planning in CDEM: Director’s Guideline for Civil Defence Emergency Management Groups ([54]; p. 3) calls for the inclusion of risk identification into the response phase planning: ‘Response planning does not have any direct responsibilities relating to reduction. However, planning activities can identify and quantify hazard risks.’ This suggests that hazard scenarios that are being identified in the readiness and reduction phases are expected to be evaluated further during the response planning exercises. In particular, the Strategic Planning for Recovery Director’s Guideline for CDEM Groups states that the recovery process should give adequate consideration to the reduction of risks (e.g., ‘Reduce future exposure to

Table 2
Definitions of disaster in the CDEM framework.

Document	Definition of disaster
Focus on Recovery: A Holistic Framework for Recovery in New Zealand (2005)	<i>An event that causes significant loss or damage and that overwhelms the capability of the community to manage it. Such an event could require significant additional resources (p.24)</i>
National Disaster Resilience Strategy (2019)	<i>A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, social, cultural, economic and environmental losses and impacts (p.6)</i>

Table 3
Definitions of risk in the CDEM framework.

Document	Definition of risk
<i>CDEM Act (2002)</i>	<i>The likelihood and consequences of a hazard (s 4)</i>
National Disaster Resilience Strategy (2019)	<i>The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined as a function of hazard, exposure, vulnerability and capacity (p.6)</i>
Draft for Risk Assessment: Guidance for CDEM Group Planning (2021)	<i>The likelihood and consequences of a hazard (p.7) To determine the likelihood and consequences for particular hazards, the basic components of risk must be understood, namely: Hazard component, Exposure component and Vulnerability component (p.7)</i>

hazards and their associate risks’) ([55]; p. 2). This notion is also followed by the Recovery Preparedness and Management: Director’s Guideline for Civil Defence Emergency Management Groups - Part A and Part (C) which further notes that ‘understanding hazards, risks and consequences’ are required in strategic planning for recovery ([56]; p. 4) and that ‘linking recovery to risk reduction and resilience’ ([57]; p.23) is vital.

Though it is evident that the CDEM framework incorporates the notion of risk into the emergency management framework, it is vital to understand how risk is translated into risk treatment under this process. The Guide to National Civil Defence Emergency Management Plan [58] recommends AS/NZS ISO 31000 risk management standard to be used as the basis for risk assessment and management in Aotearoa-New Zealand. This means that in the risk assessment process, once risks are identified, they are then quantified based on risk attributes or risk analysis. According to the CDEM Group Planning: Director’s Guidelines for Civil Defence Emergency Management Groups ([59]; p. 19), risk analysis is the process where the ‘components of risk – likelihood and consequence – are broken down, and different scenarios are explored’. The CDEM groups are mandated to analyse the hazard risks in their local area based on the likelihood and consequences of the events. They may further analyse these risks based on a detailed methodology weighting the seriousness, manageability and growth factors described in the guideline.

Interestingly, in Aotearoa-New Zealand, risk analysis is also carried out under different methodologies including RiskScape and other methods developed by some of the CDEM groups [59]. Therefore, it is difficult to determine the common gaps pertaining to the risk analysis methods under the CDEM framework. The existing methodology given in the CDEM Group Planning: Director’s Guidelines for Civil Defence Emergency Management Groups recommends the consideration of different scenarios of the risks, risk interdependencies, and cumulative and cascading effects during the risk analysis stage [59]. Although such explanation is provided, it does not translate into implementation as the risk template given in the guideline only proposes the conventional likelihood and consequences risk analysis to assign a risk rating. This is unlikely to capture aspects related to cumulative and cascading relationships.

While there is no consistent risk assessment methodology in the CDEM framework, the (proposed) Draft for Risk Assessment: Guidance for CDEM Group Planning [60] aims at introducing a more comprehensive, uniform risk assessment methodology. The guidance recommends the use of a wider stakeholder group for consultation of risks and provides a detailed risk assessment process. We examine that, although the proposed guidance applies the ‘all hazards’ notion of the *CDEM Act*, it does not provide further assessment of risks that are being managed under business-as-usual scenarios and creates a boundary to risk assessment. The section for group risk assessment thresholds in the Draft for Risk Assessment: Guidance for CDEM Group Planning states that

hazards with lower risks may be excluded from detailed assessments [60].

4.2. Risks associated with small-scale disasters

Risks associated with small-scale recurring disasters are referred to as extensive risks in most of the disaster literature [e.g., 13,29]. However, our word search query didn't find any matches in the documents analysed. Since the application of the term extensive risk may be implicit rather than explicit, we used alternative terms in place of extensive risk such as 'small', 'small-scale', 'localised' and 'disruption' in our search. The term 'small' did not appear in any of the documents, including the *CDEM Act* which does not specifically prescribe nor exclude its scope and applicability to disasters of a certain scale (see Table 4). The Act stipulates that it can be activated in emergency situations, including: (i) natural hazards events that may impact the safety of the public or property that cannot be managed with by emergency services; (ii) or otherwise requires a significant and coordinated response under the *CDEM Act* (part 1 s 4 *CDEM Act*, 2002, p. 9). The term 'disruption' has been cited in twelve out of the thirteen documents we reviewed. The term has been used primarily in the definition of emergency, and implies interruption. Nonetheless, the National Disaster Resilience Strategy [61] provides a more direct interpretation of its meaning as outlined in Table 4. This draws an impending question as to whether small-scale recurring disasters are considered as emergencies or not in the *CDEM Act* as they may not meet the necessary criteria to be considered an emergency.

The only relevant citation pertaining to risks related to small-scale recurring disasters in the CDEM framework was found under the scenario types and their description in the Draft for Risk Assessment: Guidance for CDEM Group Planning [60]. It provides an example of a localised flood event requiring a co-ordinated response by the CDEM Group to be categorized under most likely/mid-range event. In addition, it establishes that frequently occurring events with 'highly negligible consequences' are to be managed 'business-as-usual' and are considered 'day-to-day' events. Appendix D of the Guideline, illustrates a range of different disaster consequence scenarios, including localised impacts. This helps the users to obtain a better understanding of disaster consequences and more appropriately rank disaster events with potential to capture small-scale recurring events. According to the National Disaster Resilience Strategy, disruption refers to events that would disrupt normal life, business, functions, processes, or operations, whether they are planned or unexpected, which can range from being nuisance events to small-scale events [61].

4.3. Recurrence aspects of small-scale disasters

The term recurrence was highlighted in three of the documents analysed. None, however, linked recurrence to small-scale disasters or associated risks. On the other hand, cumulative and cascading impacts were addressed in several documents (see Table 5). Overall, documents captured how cumulative and cascading consequences are to be considered in DRR in a broad manner, without specifically relating them to small-scale recurring disasters. Additionally, the term 'aggregate' was primarily used to discuss the aggregation of risks of different hazards in risk assessment methodologies, again without linking it to small-scale recurrent disasters.

5. Discussion

Marulanda et al. [8] note that risks pertaining to small-scale recurring disasters are not considered as relevant, although their implications are significant. Extensive disaster risks characterise early signs of disaster risk accumulation [62]. Their aggregation could possibly result in large scale disasters [9]. However, emergency management policies do not seem to address small-scale recurring disasters adequately. The

Table 4
Summary of results on terms related to small-scale.

Search term	Document	Extract example
Extensive risks Small-scale	No results were found. Strategic Planning for Recovery Director's Guideline for CDEM Groups (2017)	<i>Support needed for a large-scale emergency is well beyond what would be needed for a small-scale locally managed recovery (p.28)</i> <i>Grouping hazards and risks according to their type, scale and likely consequences. This involves understanding all risks from those that cause small scale, frequent events through to the maximum credible event and possible multiple or cascading events if relevant. (p.21)</i>
Small-scale recurring disasters	Draft for Risk Assessment: Guidance for CDEM Group Planning (2021)	<i>e.g., Localised but disruptive rainstorm which results in flooding of an urban area to be categorized under Most likely/mid-range events (p.38)</i> <i>Frequently occurring events that are managed as a 'business as usual' or routine activity to be categorized under Day-to-day events (p.38)</i>
Localised	Draft for Risk Assessment: Guidance for CDEM Group Planning (2021)	<i>Community with a localised flood risk (p.18)</i>
Small	NCDEM Plan Order (2015) Strategic Planning for Recovery Director's Guideline for CDEM Groups (2017)	<i>Smaller-scale recoveries that require co-ordination at the CDEM Group level will be co-ordinated through the person responsible for recovery management for the CDEM Group (the CDEM Group Recovery Manager) and, where necessary, the establishment of a CDEM Group Recovery Office (p.97)</i> <i>The Civil Defence Emergency Management Amendment Act 2016 (Amendment Act 2016) amends the CDEM Act 2002 to strengthen this requirement, to help communities recover more efficiently and effectively from small to moderate scale emergencies (p.5)</i>
Disruption	<i>CDEM Act</i> (2002) National Disaster Resilience Strategy (2019)	<i>Emergency is a situation that is the result of any happening, whether natural or otherwise, including, without limitation, any explosion, earthquake, eruption, tsunami, land movement, flood, storm, tornado, cyclone, serious fire, leakage or spillage of any dangerous gas or substance, technological failure, infestation, plague, epidemic, failure of or disruption to an emergency service or a lifeline utility, or actual or imminent attack or warlike act (Part 1 s 4)</i> <i>An event that considerably interrupts normal life, business, functions, operations, or processes, whether anticipated or unanticipated (p.6)</i>

results of our analysis provided evidence of this gap in the national emergency management policy of Aotearoa-New Zealand. The main legislative instruments (*CDEM Act*, 2002; National Disaster Resilience Strategy 2019; NCDEM Plan) do not provide specific attention to the risks pertaining to small-scale recurring disasters.

According to the SFDRR, disaster risk management policies and

Table 5
Summary of results for cumulative and cascading terms.

Search term	Document	Extract example
Cumulative/ Cascading	NCDEM Plan Order (2015)	<i>Take a precautionary approach to managing hazards and risks where there is scientific or technical uncertainty about a hazard or risk; or potential for cumulative or cascading risks to arise (p. 69).</i>
	CDEM National Capability Assessment Report (2015)	<i>Over time, this data has attempted to provide evidence for nimble adaptation of interventions to help people recover from the ongoing and cumulative effects of recovery (p.33). Rarely does the Coordinating Executive Group have a collective oversight of this cumulative risk reduction (p.33).</i>
	The Guide to National Civil Defence Emergency Management Plan (2015)	<i>Take a precautionary approach to managing hazards and risks where there is scientific or technical uncertainty about a hazard or risk; or potential for cumulative or cascading risks to arise (17 Reduction p.2). Hazardscape means the net result of natural and man-made hazards and the risks they pose cumulatively across a given area (appendix 2 p.5). Cumulative and Cascading Consequences</i>
	Strategic Planning for Recovery Director's Guideline for CDEM Groups (2017)	<i>The speed at which recovery progresses in one environment will influence recovery in other environments. Therefore to understand all the consequences on the community, consequences in one environment should not be considered in isolation (p.24). Risk analysis Interdependencies of risks, and how risks may become cumulative and cascading, should also be considered (p.19).</i>
	CDEM Group Planning: Director's Guidelines for Civil Defence Emergency Management Groups (2018)	<i>Cumulative consequences occur when individual impacts to a single component of an environment combine to form a significantly larger consequence than the individual impacts on their own. This may occur over time. Cascading consequences occur when consequences in one environment have a flow-on effect or consequence in another environment or location. Cascading consequences can be positive or negative (p.59).</i>
	Recovery Preparedness and Management: Director's Guideline for Civil Defence Emergency Management Groups - Part A (2019)	<i>Cascading consequences need to be considered to ensure the recovery is being holistic and inclusive, and not increasing the impact of the emergency (p.24)</i>
	Recovery Preparedness and Management: Director's Guideline for Civil Defence Emergency Management Groups - Part C (2019)	

practices should be developed based on all disaster dimensions such as vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment ([36]; p. 14). Risk assessment is a process that supports the understanding of the risks [63]. Although the SFDRR states its applicability to small-scale disasters, it remains silent about the extensive disaster risk in its guidance for risk assessment. This may have had a flow-on effect in influencing the emergency management framework in Aotearoa-New Zealand and elsewhere.

In the emergency management system, risk assessment methodologies are created to rank the risks in order to develop risk reduction

strategies and policies and to allocate resources needed [32]. Risk assessment systems comprise quantitative and qualitative methods and different emergency management authorities adopt different methodologies. Risk assessment is an extremely complex process as it requires detailed understanding of many factors [32]. In general, emergency management systems use the two dimensional risk matrix (combining hazard frequency and disaster consequences), which assumes that the probabilities and consequences are well understood and measurable ([32]; p. 4). However, Gordy [62] notes that extensive risks are not sufficiently included in the disaster risk assessments. We observe that the critical elements of extensive risks (cumulative and indirect) are not commonly integrated to be evaluated in the risk assessment methodologies under the emergency management regime although there are some exceptions at the local level depending on their capacities.

The impacts of small-scale recurring disasters do not tend to appear in the short run. This creates a need for new methods to be used so as to capture the cumulative effects existing methodologies are leaving out. Current risk assessment methodologies mostly interpret the present vulnerabilities and capacities rather than interpreting their root causes, promoting the development of short-term policy solutions rather than sustainable disaster reduction measures [1]. Further, the risk assessment methods quite often do not account for the indirect losses that small-scale recurring disasters are associated with [62]. Liu et al. [64] pointed out that the accuracy of risk assessment methodologies in capturing small-scale disasters might decrease when compared with the large and medium spatial scale events. Subsequently, small-scale recurring disasters are not being captured and may go unnoticed by the authorities concerned. As a result, these hazard events are not addressed by DRR approaches. In the long run, this may allow these risks to aggregate and potentially lead to more severe impacts [62].

The manifestations of risk, exposure and vulnerability factors are highly contextual [65,66]. The threshold for small-scale recurring disasters may vary from community to community depending on their level of risk acceptance, risk perception as well as their adaptability. Participatory DRR, which is an integral part of decentralized DRR governance system [67] could be used for decision-making in the risk assessment exercise to minimise this adverse impact. For example, where communities help set the risk thresholds, informed by local knowledge and their experiences in confronting the adverse events.

We identified that the existing two-dimensional CDEM risk assessment system in Aotearoa-New Zealand does not capture the risks of small-scale recurring disasters. Whilst the CDEM framework acknowledges the importance of cumulative and cascading risks, it does not suggest a methodology for how this can be achieved. This gap can be minimised to a certain extent if the proposed Draft for Risk Assessment: Guidance for CDEM Group Planning [60] is fully implemented, because of its multiple implications such as the introduction of a consistent risk analysis tool, inclusion of broader examination of different disaster consequences and wider community participation. However, even the proposed guideline does not provide a methodology to capture cumulative and cascading impacts sufficiently. In addition, the limitation imposed on lower-level risks and some hazards (that do not need coordination or multi-agency response) by eliminating the requirement for full assessments may leave small-scale recurring disasters out altogether. Small-scale recurring disasters may be considered under the 'business-as-usual' threshold in the proposed risk assessment guidelines, thus perpetuating the status quo. Importantly, disaster risk assessments and declaration of threshold limits are linked to funding arrangements [67]. As providers of disaster risk reduction goods and services [68], governments find it challenging to choose (a) which events to focus on, (b) what severity and frequency to plan for, and (c) what investments to make [69]. These decisions are related to the distribution of resources that some [70] see as underlying issues of a political economy nature, and potentially exacerbate the root causes of vulnerability of underprivileged communities. Declaring threshold limits in disaster policies requires the allocation of human, technical, and financial resources for

activities such as emergency response and recovery as DRM policy frameworks and national policy instruments facilitate the necessary resources for implementation [71]. Consequently, in many contexts, these events exceed the funding capacities of both households and local authorities to respond to a larger number of repeated disaster events [12]. This may prevent them from including all small-scale disasters frequently affecting their communities into policies.

The Disaster Risk Reduction in New Zealand: Status Report [72] links the implementation of relevant disaster management strategies to local risk assessments. Hence, if small-scale recurring disasters are not identified in the threshold limits used for funding, they may be neglected from DRR measures and become a burden to affected communities. However, in the wake of predictable and recurring events, there is a clear case for a paradigm shift to occur – that is, an effort needs to be made to put more resources in place before an event occur so as to deal with the risk effectively, prepare for it and better handle the immediate impacts [12]. In their study, Moftakhari et al. [73] show that responding too early to a disaster can waste important resources and undermine public trust, whereas responding too late might also result in financial losses that could have been avoided as well as loss of public confidence in government. Their research suggests that it is crucial to develop tools which can assist policy-makers in determining whether low-cost incidents can aggregate into high-cost impacts, even though it can be difficult to decide at which point to invest heavily in prevention or response.

Small-scale recurring disasters are deeply embedded in the social system of the affected communities [14]. These communities opt to adopt different coping mechanisms through their repeated experiences. However, literature explains that with the reappearance of the small-scale disasters, the coping mechanisms traditionally practiced by the communities may start to erode [74]. Social networks may start to disappear, consequently pushing the affected communities to adopt adverse coping mechanisms. Therefore, the perception of community adaptation to recurring events through long-term practices may need further validation and examination through future studies.

Communities experiencing recurrent disasters may have greater knowledge about the hazard events than decision-makers and experts. Therefore, they tend to adopt a variety of distinctive mitigation measures [75], however these may not be supportive towards DRR [76]. In the short run, when communities face small-scale recurring disasters, they often opt for short-term resilience strategies such as insurance and rebuilding. Nevertheless, in the long run, as these small-scale recurring disasters recur, short-term adaptive strategies become insufficient and eventually, long-term sustainable practices are required [77].

We identified that in Aotearoa-New Zealand the insurance system is being used as a popular mechanism to address small-scale recurring disasters. The *Earthquake Commission Act* [78] introduced a publicly funded insurance mechanism operated through the Earthquake Commission (EQC) to provide funds for disaster recovery [79]. EQC provides insurance coverage to property owners who own a current private insurance policy. Some recovery managers acknowledge that sufficient level of insurance support for effective recovery is available, which is rather difficult to achieve by the risk reduction and resilience strategies [53]. This shows the extent to which insurance mechanisms are well absorbed as a short-term resilience strategy to tackle small-scale disasters.

In contrast, scholars [77] suggest that sustainable recovery from a natural hazard event must ensure the reduction of existing risks, and manage new risks. In this context, it is vital to evaluate how these insurance related mechanisms help reduce risks and losses in the longer run, especially for communities that may be affected by recurring events. Saunders and Becker [77] explain that the insurance scheme in Aotearoa-New Zealand does not correspond to a risk-based pricing system, which otherwise encourages disaster risk reduction investments. In addition, the indemnity principle allows insurance to replace what is only lost, impeding property betterment/improvements which could

help dealing with the next disaster [80]. Glavovic et al. [81] show that a flooded house which requires elevating to reduce future flooding, will only receive an insurance pay-out to reinstate the building presenting a lost opportunity for risk reduction. Such risk reduction activities need to be borne by the affected policyholder who might be vulnerable from facing cumulative events. There is an ongoing debate that insurance practices may discourage application of risk reduction measures [82]. According to Saunders and Becker [77]; insurance covers typically provide short-term resilience; they promote ‘bounce-back’ resilience, rather than building back better in the recovery stage. Further, the risk of subsequent disasters is usually factored in to rise insurance premiums, potentially making it unaffordable for some over time. Therefore, the differences between the short-term resilience measures adopted by the communities and long-term sustainability principles need to be considered carefully [77].

In our study, it was evident that in Aotearoa-New Zealand the top-down policy link for small-scale recurring disasters was missing. This absence may lead to impromptu and obscure practices in the local disaster governance system, which is the focal point for small-scale disasters. Inconsistency in approaches across New Zealand makes it harder to ensure that people are receiving the same level of care across the country, and for the national agency and other groups to support responses [83]. Lassa [84] explains that the recurring nature of disasters and the lack of DRR capacity make it even more difficult for local governments to develop and implement DRR policies. The lack of high-order policy directives creates new challenges as well as exacerbating existing challenges for local governments. Financial scarcity at the local level is a particular challenge [67,85]. The Disaster Risk Reduction in New Zealand: Status Report [72] already notes the struggle local governments are facing to acquire funds to implement risk reduction measures at the local level. The local financing system which follows a property-based rating system constantly has budget constraints in sparsely populated areas due to the low rating base. For example Le Masurier et al. [86], explain that the recovery at Matatā (small-medium scale township flooding) was heavily dependent on the Central Government funding although it was a localised event impacting only a small geographical area. This was due to the fact that the local government had insufficient funds for recovery as the council had only a small number of ratepayers. Local governments are under pressure to rationalise their investments against their recurrent expenditure and other functions, such as safe land development, which may constitute a tension between the revenue and DRR [87]. Hence, allowing local governments to tackle these issues without sufficient top level policy directives may exacerbate vulnerability to small-scale recurring disasters.

DRR implementation varies across lower administrative levels due to resource and technical capacity [67]. This creates constraints to carry out risk assessments [67]. In Aotearoa-New Zealand even though standards on risk assessments are made available, many local authorities carry out different methodologies depending on their capacities, resources and perceptions of risk [72]. This allows most capacitated local authorities to develop comprehensive assessments, while low capacitated ones develop somewhat insubstantial assessments. Finally, this leads to different risk assessment results and DRR implementation across the country. Clear top-down policy directives would ensure greater national consistency.

6. Conclusion

The paper examined the extent to which small-scale recurring disasters are recognised in the emergency management framework in Aotearoa-New Zealand. We analysed 13 documents in the CDEM framework including legislation, plans, strategies and guidelines. Our results provided evidence that the current emergency management framework does not have clear provision for small-scale recurring disasters. We identified that: i) the two-dimensional risk assessment methodologies did not integrate the characteristics (cumulative and

indirect) of small-scale recurring disasters sufficiently; ii) adaptation of short-term solutions for recovery may be prioritised as opposed to long-term solutions; and, iii) several on-the-ground implications for local level authorities in the absence of higher-level policy directives.

Risk assessment is the main tool used in emergency management frameworks to identify risks that need to be treated [88]. If these tools do not incorporate elements to capture different types of risks, such risks will remain neglected. Small-scale recurring disasters are highly localised events that possess different characteristics such as cumulative and indirect impacts. Although the risk assessment methodologies endorse the importance of these effects, in reality the conventional two-dimensional risk analysis methodologies do not seem to capture risks with these events sufficiently. As a result, small-scale recurring disasters remain unnoticed and their risks are tackled as a normal circumstance under a business-as-usual scenario.

Currently, small-scale recurring disasters may be discounted by risk assessments, but they remain important to those who are directly affected [14]. Affected communities can become exhausted by the repetitive confrontations and have misconceptions that the impacts of these events are unavoidable [62]. These lead them to adopt short-term recovery solutions. Through our study, we identified that insurance pay-out is a prominent short-term recovery response from these events. Although short-term recovery is important to return to functional levels quickly, the repetition of events may deplete the community's resilience. Therefore, it is necessary to move beyond the traditional risk management exercises (which rely on structural mitigation, disaster relief, warning and evacuation) and emphasise the importance of utilising land-use planning mechanisms to reduce the adverse impacts of natural hazard events [81]. Furthermore, the insurance mechanism should be re-visited to consider the development of tailored solutions for small-scale recurring disaster events.

International disaster management frameworks do not pay explicit attention to the risks of small-scale recurring disasters [89]. Our study confirmed that this could have a flow-on effect on the national level DRR frameworks, which pursue more or less the same approaches promoted by such international bodies. As a result, the high order level (national) policy guidelines and strategies tend to remain ambiguous leaving it to local level authorities to adapt to their own situations. This results in different levels of DRR applications across a country.

Underestimation by the risk assessments and lack of policy recognition are coupled with other short-comings such as political and economic considerations [89] at the local level, meaning that small-scale recurring events are not being identified for risk treatment. Here we concur with Wisner et al [90] that the combination of top-down and bottom-up actions are necessary to support the effectiveness of DRR.

Small-scale recurring disasters should be considered as a representation of initial risk accumulation and treated as a matter of primary importance ([62]; p. 40). As this requires the development of new methods to capture the long-term cumulative impacts of these risks, they should be integrated into disaster risk assessment methodologies as a starting point. National level policy guidance should inform and provide guidance to the local authorities on how to address these events. Further, local authorities should be cognisant that small-scale recurring disasters are events that are not unavoidable and re-consider their resilience strategies.

In agreement with Moftakhari et al.'s [73] argument, we suggest that the thresholds for responding to small-scale recurring disaster events need to be pre-determined, based on numerous factors to the best extent possible, including known community vulnerability issues such as limited adaptive capacity, levels of risk acceptance as well as institutional capacity to deal with such events. Such arrangements will support the promotion of community resilience [91] to repeated small-scale events and help reduce aggravating them into larger losses.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- [1] A. Fraser, M. Pelling, A. Scolobig, S. Mavrogenis, Relating root causes to local risk conditions: A comparative study of the institutional pathways to small-scale disasters in three urban flood contexts, *Global Environ. Change* 63 (2020), <https://doi.org/10.1016/j.gloenvcha.2020.102102>.
- [2] S. Shrestha, J. Gaillard, Small-scale disasters and the recovery process [Conference paper], in: 6th International I-Rec Conference: Sustainable Post-Disaster Reconstruction: from Recovery to Risk Reduction 26–30 May, Ascona, Switzerland, 2013.
- [3] M.J. Watts, H.G. Bohle, The space of vulnerability: the causal structure of hunger and famine, *Prog. Hum. Geogr.* 17 (1) (1993) 43–67, <https://doi.org/10.1177/030913259301700103>.
- [4] H.G. Bohle, T.E. Downing, M.J. Watts, Climate change and social vulnerability: toward a sociology and geography of food insecurity, *Global Environ. Change* 4 (1) (1994) 37–48.
- [5] T. Cannon, Vulnerability analysis and the explanation of 'natural' disasters, *Disasters, Develop. Environ.* 1 (1994) 13–30.
- [6] B. Wisner, H.R. Luce, Disaster vulnerability: scale, power and daily life, *Geojournal* 30 (2) (1993) 127–140.
- [7] F.G. Delfin Jr., J.C. Gaillard, Extreme versus quotidian: addressing temporal dichotomies in Philippine disaster management, *Publ. Adm. Dev.: Int. J. Manag. Res. Pract.* 28 (3) (2008) 190–199, <https://doi.org/10.1002/pad.493>.
- [8] M.C. Marulanda, O.D. Cardona, A.H. Barbat, Revealing the socioeconomic impact of small disasters in Colombia using the DesInventar database, *Disasters* 34 (2) (2010) 552–570, <https://doi.org/10.1111/j.0361-3666.2009.01143.x>.
- [9] M. Voss, K. Wagner, Learning from (small) disasters, *Nat. Hazards* 55 (3) (2010) 657–669, <https://doi.org/10.1007/s11069-010-9498-5>.
- [10] B. Wisner, J.-C. Gaillard, An introduction to neglected disasters, *Jamba J. Disaster Risk Stud.* 2 (3) (2009) 151–158, <https://doi.org/10.4102/jamba.v2i3.23>.
- [11] The Global Network of Civil Society Organisations for Disaster Reduction, Views from the frontline—Beyond 2015: recommendations for a post-2015 disaster risk reduction framework to strengthen the resilience of communities to all hazards. www.globalnetwork-dr.org, 2013.
- [12] IFRC, Leaving No one behind, 2018, 978-2-9701289-0-8, <https://reliefweb.int/site/s/reliefweb.int/files/resources/B-WDR-2018-EN-LR-compressed.pdf>.
- [13] R.Z. Zaidi, Beyond the Sendai indicators: application of a cascading risk lens for the improvement of loss data indicators for slow-onset hazards and small-scale disasters, *Int. J. Disaster Risk Reduct.* 30 (2018) 306–314, <https://doi.org/10.1016/j.ijdrr.2018.03.022>.
- [14] S. Shrestha, *Adrista Sangharsaharu, Sthaniya Sabalta: Exploring Recovery from Small-Scale Disasters: Examples from Remote Nepal* [Doctoral Thesis, The University of Auckland, Auckland, New Zealand, 2016. <https://researchspace.auckland.ac.nz/handle/2292/31699>.
- [15] I. Christoplos, J. Mitchell, A. Liljelund, Re-framing risk: the changing context of disaster mitigation and preparedness, *Disasters* 25 (3) (2001) 185–198, <https://doi.org/10.1111/1467-7717.00171>.
- [16] A. Lavell, A. Maskrey, The future of disaster risk management, *Environ. Hazards* 13 (4) (2014) 267–280, <https://doi.org/10.1080/17477891.2014.935282>.
- [17] E. Ferris, D. Petz, C. Stark, *The Year of Recurring Disasters: A Review of Natural Disasters in 2012*, Brookings Institution, 2013.
- [18] M. Marulanda, O. Cardona, A. Barbat, The economic and social effects of small disasters: revision of the local disaster index and the case study of Colombia, in: H.-G.B. a. K. Warner (Ed.), *In Megacities: Resilience and Social Vulnerability*, UNU Institute for Environment and Human Security, 2008, pp. 110–120.
- [19] P. Shi, Hazards, disasters, and risks, in: *Disaster Risk Science*, Springer, 2019, pp. 1–48.
- [20] UNISDR, Global assessment report on disaster risk reduction: risk and poverty in a changing climate. <https://www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2009>, 2009.
- [21] CRED, EM-DAT, 26.8.2021, <https://www.emdat.be/frequently-asked-questions>.
- [22] UNDRR, Desinventar Sendai 10.1.2 user manual. https://www.desinventar.net/documentation/DISendai_DataManagement_2019-2.pdf, 2019.
- [23] A. Velasquez, C. Rosales, F. Ramirez, Comparative Analysis of Disaster Databases: Final Report Submitted to Working Group 3: Risk, Vulnerability and Impact Assessment, 2002.
- [24] K. Kim, *Planning For Post-disaster Recovery: Next Generation* (Planning Advisory Service Report 576, 2015. <https://www.planning.org/research/postdisaster/>.
- [25] IPCC, Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, Cambridge University Press, 2012. <https://www.ipcc.ch/report/managing-the-risks-of-extreme-events-and-disasters-t-o-advance-climate-change-adaptation/>.
- [26] A. Lavell, M. Oppenheimer, C. Diop, J. Hess, R. Lempert, J. Li, R. Muir-Wood, S. Myeong, S. Moser, K. Takeuchi, Climate change: new dimensions in disaster risk, exposure, vulnerability, and resilience. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the

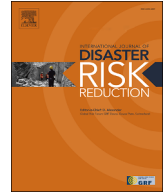
- Intergovernmental Panel on Climate Change, Cambridge University Press, 2012, pp. 25–64.
- [27] O.D. Cardona, M.K. Van Aalst, J. Birkmann, M. Fordham, G. Mc Gregor, P. Rosa, R. S. Pulwarty, E.L.F. Schipper, B.T. Sinh, H. Décamps, Determinants of risk: exposure and vulnerability, in: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, 2012, pp. 65–108.
- [28] UNISDR, UNISDR Terminology on Disaster Risk Reduction, UNISDR, 2009.
- [29] A. Maskrey, Global Assessment Report on Disaster Risk Reduction: GAR Extensive Disaster Risk Analysis, 2008. <http://www.preventionweb.net/english/professional/networks/private/gar-ext>.
- [30] UNISDR, The Pocket GAR 2015. Making Development Sustainable, The Future of Disaster Risk Management, United Nations, 2015.
- [31] Tonkin, Taylor, Risk based approach to natural hazards under the RMA (CR 234). <https://www.mfe.govt.nz/publications/natural-hazards-management/risk-based-approach-natural-hazards-under-rma>, 2016.
- [32] A.A. Mamuji, D. Etkin, Disaster risk analysis part 2: the systemic underestimation of risk, *J. Homel. Secur. Emerg. Manag.* 16 (1) (2019), <https://doi.org/10.1515/jhsem-2017-0006>.
- [33] J. Serje, Preliminary Extensive Risk Analysis for the Global Assessment Report on Disaster Risk reduction: Case Study Prepared for the 2011 Global Assessment Report on Disaster Risk Reduction, UNISDR, Geneva, Switzerland, 2010.
- [34] UNISDR (United Nations Office for Disaster Risk Reduction). 2005. Hyogo framework for action 2005–2015: Building the resilience of nations and communities to disasters. Geneva: UNISDR. Retrieved Sep 30, 2021 from https://www.unisdr.org/files/1037_hyogoframeworkforactionenglish.pdf.
- [35] M. Basu, N. Srivastava, F. Mulyasari, R. Shaw, Making cities and local governments ready for disasters: a critical overview of a recent approaches, *Risk Hazards Crisis Publ. Pol.* 4 (4) (2013) 250–273, <https://doi.org/10.1002/rhc3.12039>.
- [36] UNISDR, Sendai Framework for Disaster Risk Reduction 2015–2030, UNISDR, 2015. <https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030>.
- [37] M. Mizutori, Reflections on the Sendai framework for disaster risk reduction: five years since its adoption, *Int. J. Disaster Risk Sci.* (2020) 1–5, <https://doi.org/10.1007/s13753-020-00261-2>.
- [38] H.K. Green, O. Lysaght, D.D. Saulnier, K. Blanchard, A. Humphrey, B. Fakhruddin, V. Murray, Challenges with disaster mortality data and measuring progress towards the implementation of the Sendai Framework, *Int. J. Disaster Risk Sci.* 10 (4) (2019) 449–461, <https://doi.org/10.1007/s13753-019-00237-x>.
- [39] J. Twigg, Disaster risk reduction. Overseas development institute, humanitarian policy group london. https://inee.org/system/files/resources/Twigg_Disaster_Risk_Reduction_2015_ENG.pdf, 2015.
- [40] L. Bull-Kamanga, K. Diagne, A. Lavell, E. Leon, F. Lerise, H. MacGregor, A. Maskrey, M. Meshack, M. Pelling, H. Reid, From everyday hazards to disasters: The accumulation of risk in urban areas, *Environ. Urbanization* 15 (1) (2003) 193–204, <https://doi.org/10.1177/095624780301500109>.
- [41] D. Frame, S. Rosier, T. Carey-Smith, L. Harrington, S. Dean, I. Noy, Estimating financial costs of climate change in New Zealand [New Zealand Treasury Commissioned Report. <https://www.treasury.govt.nz/publications/commissioned-report/estimating-financial-costs-climate-change-nz>, 2018.
- [42] D.J. Frame, S.M. Rosier, I. Noy, L.J. Harrington, T. Carey-Smith, S.N. Sparrow, D. A. Stone, S.M. Dean, Climate change attribution and the economic costs of extreme weather events: a study on damages from extreme rainfall and drought, *Climatic Change* 162 (2) (2020) 781–797, <https://doi.org/10.1007/s10584-020-02729-y>.
- [43] K. Mason, K. Lindberg, C. Haenfling, A. Schori, H. Marsters, D. Read, B. Borman, Social vulnerability indicators for flooding in Aotearoa New Zealand, *Int. J. Environ. Res. Publ. Health* 18 (8) (2021) 3952, <https://doi.org/10.3390/ijerph18083952>.
- [44] Ministry for the Environment New Zealand, National climate change risk assessment for Aotearoa New Zealand: main report – arotakenga tūrarū mō te huringa ahuarangi o aotearoa: pūrongo whakatōpū. <https://environment.govt.nz/publications/national-climate-change-risk-assessment-for-new-zealand-main-report/>, 2020.
- [45] NIWA, Retrieved sep 8th from. <https://niwa.co.nz/natural-hazards/hazards/floods>.
- [46] W.S. Saunders, S. Kelly, S. Paisley, L.B. Clarke, Progress toward implementing the Sendai framework, the Paris agreement, and the sustainable development goals: Policy from Aotearoa New Zealand, *Int. J. Disaster Risk Sci.* 11 (2) (2020) 190–205, <https://doi.org/10.1007/s13753-020-00269-8>.
- [47] Civil Defence Emergency Management Act, Ministry of Civil Defence. Public Act, 2002.
- [48] J.O.B. Rotimi, An Examination of Improvements Required to Legislative Provisions for Post Disaster Reconstruction in New Zealand, Doctoral Thesis, University of Canterbury, 2010. UC Research Repository, <https://ir.canterbury.ac.nz/handle/10092/4145>.
- [49] G. Willis, *Managing Natural Hazard Risk in New Zealand: towards More Resilient Communities*, LGNZ, 2014.
- [50] A. French, R. Mechler, M. Arestegui, K. MacClune, A. Cisneros, Root causes of recurrent catastrophe: the political ecology of El Niño-related disasters in Peru, *Int. J. Disaster Risk Reduct.* 47 (2020) 101539, <https://doi.org/10.1016/j.ijdrr.2020.101539>.
- [51] L. Khirfan, M. Peck, N. Mohtat, Systematic content analysis: a combined method to analyze the literature on the daylighting (de-culverting) of urban streams, *Article 100984, MethodsX* 7 (2020), <https://doi.org/10.1016/j.mex.2020.100984>.
- [52] J. Crawshaw, C. Blanch, *Framework for Psychosocial Support in Emergencies*, 2016.
- [53] MCDEM, CDEM National Capability Assessment Report, Ministry of Civil Defence & Emergency Management, 2015.
- [54] MCDEM, Response planning in CDEM: Director's guideline for Civil defence emergency management groups [DGL 19/15], <https://www.civildefence.govt.nz/assets/response-planning-cdem/Response-Planning-in-CDEM-Directors-Guideline.pdf>, 2015.
- [55] MCDEM, Strategic planning for recovery Director's guideline [DGL 20/17], <https://www.civildefence.govt.nz/cdem-sector/guidelines/strategic-planning-for-recovery/>, 2017.
- [56] NEMA, Recovery preparedness and management: Director's guideline for Civil defence emergency management groups [DGL 24/20] Part A. <https://www.civildefence.govt.nz/cdem-sector/guidelines/recovery-preparedness-and-management/>, 2019.
- [57] NEMA, Recovery preparedness and management: Director's guideline for Civil defence emergency management groups [DGL 24/20] Part C. <https://www.civildefence.govt.nz/cdem-sector/guidelines/recovery-preparedness-and-management/>, 2019.
- [58] Department of the Prime Minister and Cabinet, The guide to national civil defence emergency management plan. <https://www.civildefence.govt.nz/assets/guide-to-the-national-cdem-plan/Guide-to-the-National-CDEM-Plan-2015.pdf>, 2015.
- [59] MCDEM, CDEM group planning: Director's guidelines for Civil defence emergency management groups [DGL 09/18], <https://www.civildefence.govt.nz/assets/Uploads/logistics-dgl/DGL-09-18-CDEM-Group-Planning-PDF.pdf>, 2018.
- [60] MCDEM, Draft for Risk assessment: guidance for CDEM Group planning. <https://www.lgnz.co.nz/assets/905150ada1/DRAFT-for-Consultation-Risk-Assessment-Guidance-for-CDEM-Group-Planning-V2.0-compressed.pdf>, 2021.
- [61] MCDEM, National disaster resilience strategy. <https://www.civildefence.govt.nz/cdem-sector/plans-and-strategies/national-disaster-resilience-strategy/>, 2019.
- [62] M. Gordy, The importance of extensive risk, in: *Disaster Risk Reduction and the Global System: Ruminations on a Way Forward*, Springer International Publishing, 2016, pp. 39–41, https://doi.org/10.1007/978-3-319-41667-0_8.
- [63] D. Simmons, C. Corbane, S. Menoni, S. Schneiderbauer, L. Zschau, Understanding disaster risk: risk assessment methodologies and examples, in: K. Poljansek, M. Marin Ferrer, T.a.C. De Groeve, I (Eds.), *Science for Disaster Risk Management 2017: Knowing Better and Losing Less*, Publications Office of the European Union, 2017.
- [64] Y. Liu, G. Feng, Y. Xue, H. Zhang, R. Wang, Small-scale natural disaster risk scenario analysis: a case study from the town of Shuitou, Pingyang County, Wenzhou, China, *Nat. Hazards* 75 (3) (2015) 2167–2183, <https://doi.org/10.1007/s11069-014-1420-0>.
- [65] H.-G. Bohle, Vulnerability and criticality: perspectives from social geography, *IHD Update* 2 (1) (2001) 3–5.
- [66] S.L. Cutter, S. Derakhshan, Temporal and spatial change in disaster resilience in US counties, 2010–2015, *Environ. Hazards* 19 (1) (2020) 10–29, <https://doi.org/10.1080/17477891.2018.1511405>.
- [67] Z. Scott, M. Tarazona, Study on disaster risk reduction, decentralization and political economy: background Paper to the Global Assessment report on disaster risk reduction, UNISDR, 2011.
- [68] E. Wilkinson, Transforming disaster risk management: A political economy approach, ODI Background Notes January (2012) 1–8.
- [69] P. Gluckman, A. Bardsley, Uncertain but Inevitable: the Expert-Policy-Political Nexus and High-Impact Risks, 2021.
- [70] S. Islam, K.M. Zobair, C. Chu, J.C. Smart, M.S. Alam, Do political economy factors influence funding allocations for disaster risk reduction? *J. Risk Financ. Manag.* 14 (2) (2021) 85, <https://doi.org/10.3390/jrfm14020085>.
- [71] C. Weekes, O. Bello, *Mainstreaming Disaster Risk Management Strategies in Development Instruments (II): Policy Briefs for Barbados, Guyana, Saint Lucia, Suriname, and Trinidad and Tobago*, United Nations publication, United Nations, Santiago, 2019.
- [72] UNDRR, Disaster risk reduction in New Zealand: status report. United Nations office for disaster risk reduction (UNDRR), regional office for asia and the Pacific. [https://www.undrr.org/publication/disaster-risk-reduction-n-new-zealand-status-report-2020#:~:text=The%20disaster%20risk%20reduction%20\(DRR,Disaster%20Risk%20Reduction%202015%2D2030,2020](https://www.undrr.org/publication/disaster-risk-reduction-n-new-zealand-status-report-2020#:~:text=The%20disaster%20risk%20reduction%20(DRR,Disaster%20Risk%20Reduction%202015%2D2030,2020).
- [73] Hamed R Mofkharhi, et al., Cumulative hazard: The case of nuisance flooding, *Earth's Future* 5 (2) (2017) 214–223, <https://doi.org/10.1002/2016EF000494>.
- [74] G. Tesso, B. Eman, M. Ketema, Analysis of vulnerability and resilience to climate change induced shocks in North Shewa, Ethiopia, *Agric. Sci.* 3 (6) (2012) 871–888, <https://doi.org/10.4236/as.2012.36106>.
- [75] S. Khan, Disasters: contributions of hazardscape and gaps in response practices, *Nat. Hazards Earth Syst. Sci.* 12 (12) (2012) 3775–3787, <https://doi.org/10.5194/nhess-12-3775-2012>.
- [76] R. Shaw, N. Uy, J. Baumwoll, *Indigenous Knowledge for Disaster Risk Reduction: Good Practices and Lessons Learned from Experiences in the Asia-Pacific Region*, United Nations, International Strategy for Disaster Reduction, 2008.
- [77] W.S. Saunders, J. Becker, A discussion of resilience and sustainability: land use planning recovery from the Canterbury earthquake sequence, *New Zealand, Int. J. Disaster Risk Reduct.* 14 (2015) 73–81, <https://doi.org/10.1016/j.ijdrr.2015.01.013>.
- [78] Earthquake Commission Act, The Treasury. Public Act (1993). <https://www.legislation.govt.nz/act/public/1993/0084/latest/DLM305968.html>.
- [79] Earthquake Commission (EQC), Retrieved Sep 30, 2021 from <https://www.eqc.govt.nz/about-eqc/our-role/ndf>.
- [80] P. O'Hare, I. White, A. Connelly, Insurance as maladaptation: resilience and the 'business as usual' paradox, *Environ. Plann. C Govern. Pol.* 34 (6) (2016) 1175–1193.

- [81] B. Glavovic, W. Saunders, J. Becker, Land-use planning for natural hazards in New Zealand: the setting, barriers, 'burning issues' and priority actions, *Nat. Hazards* 54 (3) (2010) 679–706.
- [82] P. O'Hare, I. White, Deconstructing resilience: lessons from planning practice: special edition of planning practice and research, *Plann. Pract. Res.* 28 (3) (2013) 275–279, <https://doi.org/10.1080/02697459.2013.787721>.
- [83] R. Sowry, Better responses to natural disasters and other emergencies, *Ministerial Rev.* (2017). <https://apo.org.au/node/134066>.
- [84] J. Lassa, *Institutional Vulnerability and Governance of Disaster Risk Reduction: Macro, Meso and Micro Scale Assessment* [Doctoral Dissertation, University of Bonn, 2011. <https://bonndoc.ulb.uni-bonn.de/xmlui/handle/20.500.11811/4714>.
- [85] D. Amaratunga, C. Malalgoda, R. Haigh, A. Panda, H. Rahayu, Sound practices of disaster risk reduction at local level, *Procedia Eng.* 212 (2018) 1163–1170, <https://doi.org/10.1016/j.proeng.2018.01.150>.
- [86] J. Le Masurier, J.O. Rotimi, S. Wilkinson, Comparison between Routine Construction and Post-disaster Reconstruction with Case Studies from New Zealand Proceedings 22nd Annual ARCOM Conference, 4-6 September, 2006. Birmingham, United Kingdom, <http://openrepository.aut.ac.nz/handle/10292/5809>.
- [87] IFRC, How law and regulation support disaster risk reduction New Zealand: Country case study report, International Federation of Red Cross and Red Crescent Societies, 2014 June, pp. 1–72.
- [88] A. Cottrell, D. King, Social assessment as a complementary tool to hazard risk assessment and disaster planning, *Australas. J. Disaster Trauma Stud.* (1) (2010) 1–15, 2010.
- [89] F. Hamdan, Intensive and extensive disaster risk drivers and interactions with recent trends in the global political economy, with special emphasis on rentier states, *Int. J. Disaster Risk Reduct.* 14 (2015) 273–289, <https://doi.org/10.1016/j.ijdr.2014.09.004>.
- [90] B. Wisner, G. Kent, J. Gaillard, Z.D. Willison, D. van Niekerk, M. Bhatt, B. Cook, J. Lassa, O.-D. Cardona, M. Oxley, A Contribution to the Review of the Draft GAR 2011, Chapters 5, 6 & 7 Political Will for Disaster Reduction: what Incentives Build it, and Why Is it So Hard to Achieve? [Concept Paper], 2011. <http://www.radixonline.org/>.
- [91] B. Maguire, S. Cartwright, *Assessing a Community's Capacity to Manage Change: a Resilience Approach to Social Assessment*, Bureau of Rural Sciences, Canberra, 2008.

Appendix H Published Article 2

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Enhancing disaster risk governance for small-scale recurring disasters through pre-determining emergency response and recovery entry points for improved social outcomes

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ABSTRACT

There is growing recognition that climate change is increasing the frequency of disasters globally. Historical disaster data show that the majority of disasters are non-catastrophic. However, these less severe disasters can occur in quick succession and affect the resilience of the communities, and their long-term impacts can be just as severe. Nevertheless, emergency management policies are largely developed around larger-scale disasters, along with related institutional arrangements and operational decisions that establish resource availability for affected communities. This often results in *ad hoc* emergency response and recovery mechanisms, leading to inconsistent approaches to assist affected communities. Drawing on empirical data from emergency management specialists operating across Aotearoa New Zealand, this paper investigates how current emergency response and recovery approaches account for small-scale recurring disasters, and how these could become more comprehensive and equitable for improving local adaptation capacity. Findings indicate the absence of an agreed definition of what comprises a small-scale disaster; the lack of a clear methodology to capture cumulative impacts of disasters; unavailability of resources to establish a formal recovery phase for small-scale disasters; and, ambiguity around the methodology used to activate emergency response operations for small-scale disasters. Our paper concludes by suggesting the establishment of tailored community-based interventions for small-scale disasters, for more effective and equitable service delivery.

1. Introduction

In the present trajectory of global climate change impacts, disasters are becoming more frequent, exerting pressure on existing disaster governance systems [1–3]. Climate variability and climate change can cause small disasters [4] and it is particularly concerning to see a rise in small and medium-scale disasters [5] and the economic losses pertaining to them [6]. This calls for more comprehensive disaster data to enable decision-makers to identify changing disaster risk patterns and their impacts, and plan for effective use of resources to minimise disaster risks [7]. However, due to the absence of systematically collected, long-term disaster data covering broad areas and impacts, it has been difficult to make informed emergency management decisions that are context-specific. In particular, data are mostly available on the larger, more catastrophic disasters that have immediate impacts. Additionally, research and policy focused on small-scale recurring disasters is limited [8]. This lack of scholarly research and practice has disproportionately influenced how, and if, disaster risk governance accounts for less severe, smaller-scale disasters.

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Disaster risk governance refers to the coordination of public authorities, public sector employees, media, private sector, and civil society to manage and reduce disasters and climate related risks at local, regional, and national levels [9]. It emphasises the horizontal connections between government ministries and departments, as well as vertical connections between local, regional, and departmental governments, and specific roles assigned to related institutions [10]. Disaster risk governance is also defined as an emerging version of integrated risk management focused on improving coping capacity under complex and uncertain environments, and the manner in which various actors respond to uncertainties, complexity, and ambiguity [11,12]. A key consideration underpinning disaster risk governance is multi-stakeholder participation to support informed decision-making under high risks and uncertainties. This is vital to minimise the negative effects of trade-offs and encourage decisions that reflect the needs of communities and vulnerable groups [10].

Nevertheless, the focus on small-scale recurring disasters is limited in current international disaster governance frameworks, making proactive planning in disaster risk governance revolve heavily around large-scale disasters [13]. Despite the lack of research on small-scale recurring disaster governance mechanisms across different countries, available examples suggest the need to improve disaster risk governance mechanisms related to these events [14–17]. For example, despite dedicating its second priority action to better managing disaster risk and integrating governance issues throughout the disaster cycle [18], and explicitly considering its application to small and large-scale, frequent and infrequent, sudden and slow-onset disasters, the Sendai Framework for Disaster Risk Reduction 2015–2030 (SFDRR) does not provide sufficient guidance to help address small-scale disasters, such as systematic reporting indicators [19]. Another example of this shortcoming is the International Risk Governance Centre (IRGC) Risk Governance Framework. This framework is set to guide the management of multi hazards and risks through the early identification and handling of risks, and with the involvement of a variety of stakeholders [12]. It consists of a set of interconnected elements and three cross-cutting themes, ranging from risk pre-assessment to risk management and communication [10,12]. While this helps with understanding, analysing, and managing critical risks, the framework lacks detail on the application processes and is silent on the risks relating to small-scale disasters.

Additionally, the consideration of small-scale disasters in disaster risk governance is hindered by the lack of consensus on disaster definitions used to guide allocation and activation of resources. This is problematic, because the way in which disasters¹ are defined influences the actions taken in response to any events, policy decisions, and research [20]. The absence of a definition hinders the decisions made regarding the distribution of capacity and resources allocated to the prevention, preparation, response, and recovery measures for small-scale disasters.

It is also important to highlight that some studies (e.g. [14,19]), show that cumulative and indirect recurring impacts of small-scale disasters (such as loss of access to essential services and educational continuity) can significantly affect communities' resilience [15,21]. For example, communities that encounter small-scale disasters may face a subsequent disaster before recovering from the former. As a result, peoples' ability to cope with small disasters can be continually eroded and, in the end, leave them at greater risk of increased vulnerability. Over time, small and frequent disasters can create a vicious cycle that further marginalises those affected [8]. In the absence of proactive approaches for managing small-scale recurring disasters, these are managed in a reactive manner.

Furthermore, in recent years, there has been an increasing trend toward privatising risk management, where the individual assumes the responsibility to protect themselves [1]. However, studies [15,22] have shown that most of the communities affected by small-scale disasters belong to the vulnerable and marginalised segments of society, who are often not able to rally resources in a timely manner. Thus, communities affected by small-scale disasters, particularly small, isolated communities, frequently deal with disasters on their own without outside support or attention, which can cause unnecessary and severe suffering [23].

On the operational side, current emergency response systems revolve around scale-based perspectives, threshold-based responses and the All-Hazards-Approach (AHA). For example, scaled responses to disasters have gained recognition in both academia and practice and the term 'scale' has been used to refer to both the level of governance (national, regional and local) and the services delivered during the response [24]. However, there is ambiguity regarding the application of these ideas in relation to small-scale recurring disasters. While it is known that the cumulative impacts of small-scale disasters on people's lives and livelihoods can be similar or greater than those from large-scale ones [25], less is known about how the cumulative and indirect impacts from small-scale disasters are considered in emergency response activities. Additionally [26], institutional frameworks for emergency management are tailored to tackling disasters through top-down command chains that often restrict the ability to deal with small-scale recurring disasters. This pattern reflects the disaster risk governance system which, although it should be holistic and developed across all scales, is guided by key elements concentrated in certain disaster impact levels [27], such as those related to catastrophic disasters. This further contributes to the oversight of small-scale recurring disasters.

Hence, it is necessary to revisit approaches to disaster risk governance at the local level to mitigate gaps pertaining to small-scale recurring disasters and achieve better outcomes in the future, especially in light of a changing climate which is already testing our adaptation capacity [28]. This paper aims to contribute to this by investigating the approaches used to guide emergency response and intervention to small-scale recurring disasters in Aotearoa New Zealand. For this purpose, we define a small-scale disaster as one that impacts a low number of people and imposes a risk level below the major and extreme thresholds, meaning there may not be a direct threat to human life. While these disasters can have relatively minor to moderate social, environmental and cultural impacts, these can result in long-term cumulative impacts.

¹ The United Nations define disasters as “a serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts” (UNISDR, 2009, page 9).

To this end, the paper draws on empirical data from emergency management specialists operating across Aotearoa New Zealand to examine the following research questions.

- i) To what extent do current emergency response and recovery approaches account for small-scale recurring disasters?
- ii) How can current practices enable a more comprehensive and equitable entry point for local emergency response and recovery, and thus improve our adaptation capacity?

The paper is structured as follows. First, we present our data collection methods and the results. We then discuss how current emergency response pertaining to small-scale recurring disasters is practiced in Aotearoa New Zealand to extract insights into how disaster risk governance can better account for small-scale recurring disasters.

2. Methods

This paper adopts a case study approach [29] focused on Aotearoa New Zealand. The country is prone to a number of disasters including earthquakes, volcanoes, landslides and floods due to its geography and location [30]. Flooding is the country's most common disaster which severely impacts infrastructures and communities, and is expected to be amplified by climate change, land subsidence, and socioeconomic developments [31,32].

Broadly, the governance structure of Aotearoa New Zealand consists of national, regional and territorial governments (district and city councils). The National Emergency Management Agency (NEMA) is the lead agency for emergency management. The Civil Defence Emergency Management Act (CDEM) 2002 [33] governs emergency management and is instrumental in managing risks as part of the statutory framework for managing the system. It delegates responsibility to local territorial authorities to establish CDEM groups to carry out CDEM activities at the local level, such as initial reduction, readiness, response and recovery initiatives. Among its key aims, the CDEM Act provides a foundation for integrating national and local planning through a national strategy and plan; it also encourages coordination across a wide range of agencies, realizing emergencies are multi-agency events that impact every aspect of society [34]. Aotearoa New Zealand's emergency management framework procedures are based on the Coordinated Incident Management System (CIMS) which outlines the key functions (control, intelligence, planning, operations, logistics, PIM and welfare) and the response levels (national, CDEM group or regional level, local and incident site level). Nevertheless, there is ambiguity regarding how the CDEM framework applies to the emergency response and the management of smaller scale disasters, which warrants examination of how its functioning is determined at the local level [35].

Data collection for this study was primarily undertaken through a qualitative approach using semi-structured interviews. The semi-structured interviews were carried out in 2021 with nine emergency management specialists in Aotearoa New Zealand, including eight practitioners representing national, regional and local level from different geographical locations who were involved in emergency response on different scales of disasters and an experienced researcher. Interview participants were mainly recruited using snow-balling techniques [36]. Interviews lasted between 30 and 60 min and were recorded using the Zoom technology that supported transcribing. Interview questions aimed to extract insights related to the extent to which current emergency response and recovery approaches in Aotearoa New Zealand account for small-scale recurring disasters, and how current practices could enable a more comprehensive and equitable entry point for local emergency response and recovery, to improve adaptation capacity of communities.

Interview transcripts were analysed in NVivo 10 software to gain an understanding of the practical application of emergency response and recovery operations related to small-scale recurring disasters in Aotearoa New Zealand, and the approaches adopted to potentially improve local adaptation capacity. Applying a content analysis approach [37], the interview transcripts were read several times to identify themes that contributed to answering the main research questions. This included the development of a coding system using an inductive coding approach to identify themes from emergent data related to the research questions. These themes included: adaptability and adaptive planning; business as usual; build back better; climate change; community risk acceptance; consequences; contextual; cumulative impacts; emergency declarations; evacuation; frequency; impacts (local, insignificant); incident management; insurance; land use planning; legislation; likelihood and recurrence; recovery; resilience; response; community response and planning; welfare response; risk assessment; scale-based thresholds; universal support; and, vulnerability.

3. Findings

Our findings identified a number of issues that affect how small-scale recurring disasters are being considered by current emergency response and recovery approaches in Aotearoa New Zealand. These include: (i) the absence of an agreed definition and understanding of what comprises small-scale disasters; (ii) the lack of a clear methodology to capture the cumulative impacts of disasters; (iii) unavailability of resources to establish a formal recovery phase for small-scale disasters; and, (iv) ambiguity around the methodology used to activate emergency response operations for small-scale disasters.

3.1. The absence of an agreed definition and understanding of what comprises small-scale disasters

When asked to describe their understanding of a practical definition for small-scale recurring disasters, participants described events that would be dealt with 'at a local level' (Participant 5) or those that 'only impact one or two small communities' (Participant 1). Additionally, they confirmed that these disasters may be responded to through the 'incident management systems' (CIMS) which do not necessarily identify them as requiring a recovery phase because the CIMS is 'more concerned with the response phase' (Participant 2). Part of these discussions involved framing small-scale disasters as having less impact on communities than other disasters. As one participant described, an example of a small-scale recurring disaster would include:

“... one stream and a town that frequently floods, you know, three houses, and as a nuisance for them, you know, so that means you might be taking into account those kind of events” (Participant 4)

Part of the context for this approach is that there is no clear definition provided in the CDEM framework for small-scale disasters, as the framework adopts an AHA approach. This scenario is similar to the global level, where there is no universal consensus on the scale and frequency of small-scale disasters, especially when they occur repeatedly [22,38]. Additionally, in the Aotearoa New Zealand context, the terms emergency and hazard are commonly used, as opposed to disaster. The term disaster was replaced with emergency in the 1960s [39] providing local authorities with the opportunity to declare a state of emergency in contrast to a disaster. The current CDEM Act (2002, p. 9) defines emergency as a situation:

“that is the result of any happening, whether natural or otherwise, including, without limitation, any explosion, earthquake, eruption, tsunami, land movement, flood, storm, tornado, cyclone, serious fire, leakage or spillage of any dangerous gas or substance, technological failure, infestation, plague, epidemic, failure of or disruption to an emergency service or a lifeline utility, or actual or imminent attack or warlike act; and causes or may cause loss of life or injury or illness or distress or in any way endangers the safety of the public or property in New Zealand or any part of New Zealand; and cannot be dealt with by emergency services, or otherwise requires a significant and co-ordinated response.”

On the other hand, hazard is defined as a “process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation” ([34]; p. 6). Because the term disaster is rarely used in the context of emergency management in Aotearoa New Zealand, one participant explained that using the term disaster for a small-scale event presents challenges:

“In New Zealand, you don't use the term disasters much, whereas we use the term hazards. So, it's different to match with the literature. It is partly because we try and mitigate the hazard before the disaster occurs, so a lot of our focus is on the hazards, the impacts of planning ... and we only talk about that being a disaster if it was so huge, it was unmanageable.” (Participant 4).

This change in terminology is a result of the global paradigm shift under which disasters became considered more of a social phenomenon, moving away from the idea they are triggered only by natural factors [40]. However, in the absence of consistent parameters for classifying and evaluating the impacts of disasters, practitioners working on-the-ground interpret and plan for disasters, including small-scale ones, based their own experiences and local context.

Another issue within the discussion of small-scale disasters is that from a participant's experience, the term ‘small-scale’ had not been widely discussed in the disaster governance space in Aotearoa New Zealand. For example, ‘scale’ could refer to a wide range of factors such as ‘the scale of severity/magnitude (e.g., flood depth; cyclone wind speed), geographical extent, duration of the hazardous event or the resulting impacts (severity – number of fatalities; extent – area or number of communities/people actually impacted; duration – length of time that the impacts are disrupting people's lives)’ (Participant 4). The same participant further suggested that the scale could also be defined in terms of the ‘emergency response taking place (e.g., whether a declaration is made) or the level of response required by the community’. This means that there is not a clear and concise interpretation of what comprises the scale of a disaster.

The criterion for a declaration of a state of emergency is one parameter used to distinguish the scale of a disaster. For example, the Centre for Research on the Epidemiology of Disasters (CRED) use this as one of the criteria to qualify which disasters are entered into their database [41]. However, participants were divided on their opinion as to whether a declared state of emergency should be used as a criterion to distinguish the scale of disasters, with one supporting it and others disagreeing or doubting it. One opinion was that an ‘emergency declaration is not based on how significant the event is’ and that it is based on whether the emergency managers have the power they require for their actions (Participant 3). Another participant added that ‘I've never felt the declaration of an emergency is a good yardstick for anything. Because some councils will never declare an emergency’ (Participant 8). Based on these experiences, using an emergency declaration to demarcate the scale of disasters does not seem to be effective.

A previous study [42] confirmed that in Aotearoa New Zealand, the majority of disaster events are non-catastrophic. However, as our participants pointed out, disaster scales are not clearly laid out, and therefore the emergency response levels required for varied disaster scales are difficult to determine. This also suggests that there isn't a strong connection between the identification of small-scale disasters in the disaster risk governance regime in Aotearoa New Zealand – an issue also observed by other studies (e.g., Ref. [14]).

Small-scale disasters also have distinct characteristics compared to other disasters, such as those with cumulative and indirect impacts that cannot be identified immediately. One participant described: ‘in recent years, cumulative impacts have been a key consideration for response planning’ (Participant 1). While some participants acknowledged cumulative impacts in response planning, another said they are likely to be considered in future emergency responses, due to climate change:

“Climate change is happening, and we're going to be involved in more and more events at a macro level, and that's what we're really starting to look at.” (Participant 2)

Despite the fact that participants acknowledged the importance of the role of cumulative impacts, many were unaware of how they should be captured and incorporated in response planning. For example, one participant said that they didn't ‘know if you could directly align them’ in emergency response or recovery (Participant 5). Nevertheless, another participant confirmed that progress was being made on this issue and that they are ‘using the dynamic adaptive planning and pathways tool, in terms of having the conversations with the communities’ (Participant 8). Community engagement at the centre of the decision-making process is seen as an impor-

tant tool to identify cumulative impacts. While the risk pertaining to small-scale recurring disasters is often considered small, participants also confirmed that frequent flooding events could be considered an early indicator of what regions might experience in terms of more severe impacts in the near future, including the escalation of related cumulative impacts.

3.2. Unavailability of resources to establish a formal recovery phase for small-scale disasters

Participants acknowledged the fact that the CDEM approach is ‘about consequence management’ and that ‘there’s a significant amount of budget and time being spent on major and unlikely events, because they have more consequences’ (Participant 5). They also noted that when the consequences are insignificant ‘BAU [business-as-usual] agencies like FENZ [Fire and Emergency New Zealand] or Police would handle them’ (Participant 5). Additionally, it was noted that ‘CDEM recovery is not pre-emptively activated in itself’ (Participant 7).

Nevertheless, some local councils have mechanisms for recovery in place, such as Mayoral relief funds,² but this is not the case for all local authorities. Additionally, a number of government and non-government organisations (e.g., the Ministry for Business Innovation and Employment, Lottery Grants Board, Rural Support Trust) also assist with recovery support and funding after disasters occur; hence, it is difficult to determine how much funding is available upfront, as it is often reactive. Importantly, for small-scale disasters, ‘Insurance would be first port of call for recovery’ (Participant 1) – although this may not be a sustainable choice in the long run, as challenges arise in maintaining insurance for higher risk communities [43]. As one participant discussed:

“Insurance companies become increasingly weary of the impacts of frequent flooding and sea level rise and climate change ... a few years later insurance companies may withdraw from certain areas, leaving whole communities without the ability to insure.” (Participant 8)

In addition to the lack of sufficient funds, community vulnerability in the aftermath of a disaster also affects how communities can improve their resilience [38] as opposed to ‘just build [ing] back the same’ (Participant 4) and experiencing recurring impacts. When it comes to small-scale recurring disasters, this is what some scholars [8,22] have called the ratcheting effect – that is, the process of generating a vicious spiral of impacts, vulnerabilities, and risks through a series of events [44].

As one participant suggested, ‘perhaps when communities adapt or ‘build back better’ the impacts decrease over time’ (Participant 4). When considering the recovery from small-scale recurring disasters, participants suggested that better land-use planning may be more effective than using funds to build back better, because it can reduce the amount of people placed at risk of disasters in the first place.

3.3. Unavailability of an agreed methodology to trigger emergency response for small-scale disasters

As discussed above, agencies are often activated by the emergency management system to deal with small-scale disasters in a BAU fashion. There are, however, differences in how those agencies are activated across the country. One participant confirmed that those agencies are often a part of the emergency response but ‘not always the lead for it’ (Participant 3). They also noted that the ‘CDEM is not an organisation, it’s a system of management. So, it’s really about coordination between the agencies who have responsibilities for providing services’ (Participant 8). Additionally, the CDEM does not set a minimum threshold for the BAU service activation. It only provides ‘universal support’ – that is, it activates support for anyone in need at any time, especially as the threshold levels for activation of services are ambiguous and considered on a case-by-case basis:

“The threshold for us getting involved in the flooding in Westport was much lower than us getting involved in similar flooding, say in Canterbury, and it’s simply because the West Coast has far fewer resources than in Canterbury.” (Participant 3)

This shows that current disaster governance mechanisms don’t have any nation-wide consistent thresholds available to clearly account for small-scale recurring disasters, hence how, and if, those disasters are considered depends on the capacity and capability of local authorities.³ From the interviews, it appears that emergency response mechanisms have a more community-based approach seeking to establish what are their risk tolerance levels. In particular, Participant 1 described how, in their work, they are ‘canvassing the community to give the level of information, what the community ... think, are the minimum thresholds’ and that they are ‘working through this on a couple of projects’. Another participant said that they involve the community and come up with a plan that also looks at community vulnerabilities and involves discussions about the community response planning process. In this case, the local community has also established response groups to activate and look after themselves until help can arrive. This approach relies on their local knowledge to inform authorities of disasters or risks they are unaware of. Additionally, local authorities are enhancing awareness of the communities about their own ability to ‘respond and look after themselves’ (Participant 5).

Importantly, it was noted that the ‘CDEM legislation is best described as a bit of a gap filler, effectively when a situation can’t be dealt with via normal BAU mechanisms’ (Participant 3). While there aren’t any minimum threshold limits for the activation of emergency services, there are key triggers for such activation, which is dependent on the situation. For example, one participant explained that the key trigger for the activation of emergency services was ‘no accessibility (community isolation)’ (Participant 5). Another said

² Mayoral relief funds are a type of a disaster relief fund that is administered by a local authority formulated to support the disaster impacted communities in Aotearoa New Zealand (NEMA, 2019).

³ It is important to note that since data collection and analysis was completed, Aotearoa-New Zealand has introduced a risk tolerance methodology in order to enable a consistent robust decision-making approach for risk tolerance in the country (<https://www.eqc.govt.nz/resilience-and-research/research/search-all-research-reports/risk-tolerance-methodology/>). It is still unknown, however, how such methodology will help small-scale recurring disasters to be better accounted for.

that the 'scale of our responses is hugely dependent on the vulnerability of the community' (Participant 3). While most participants agreed that community vulnerability is a key consideration in the emergency services decisions, this is sometimes considered a one-off situation and may not include communities that encounter repeated small events. However, one participant contradicted this perspective by suggesting that it is not the vulnerability that really matters in the activation of emergency services but the impact of the disaster.

Another central theme that we identified in the interview data encompassed community choices to accept living in areas with recurring risks such as flooding. As one participant explained, some communities could expect:

"... to have water left in their doorstep or in the house. But the consequences were such that they were willing to take that risk in live there. So that was the kind of personal choice from an organisational perspective." (Participant 8)

Another participant reported that they are starting to discuss with the affected communities whether they should remain in the location where they are currently living at risk or whether they should move elsewhere. This suggests that some affected communities living in recurring disaster areas are either aware or made aware about the associated risks, and then make decisions around the extent to which they are prepared to accept this risk. It also confirms a known trend of shifting responsibilities to communities [45], as opposed to strengthening how disaster governance systems can and should account for small-scale recurring disasters which may become more frequent due to climate change.

4. Discussion

Much of the scholarship on small-scale recurring disasters has shown the importance of understanding the risks, impacts and recovery processes related to these disasters (e.g., Refs. [4,14–16,22,46,47]). This study sought to investigate the extent to which current emergency response and recovery approaches in Aotearoa New Zealand accounted for small-scale recurring disasters, and how current practices could enable a more comprehensive and equitable entry point for local emergency response and recovery, and thus improve communities' adaptation capacity. These considerations are important, both in light of the increasing frequency of small-scale recurring disasters as a result of climate change, and because disaster risk governance aims to build coping capacity under complex and uncertain conditions [11,12]. Our findings confirmed that small-scale recurring disasters are not fully considered in current emergency response and recovery approaches due to a lack of recognition of what small-scale disasters are and a failure to capture factors such as their cumulative impacts. In addition, our findings also point to the absence of effective recovery mechanisms and standardised methodology to trigger emergency services for small-scale disasters at the time of data collection. Hence, to overcome these shortcomings and enable a more comprehensive and equitable entry point for local emergency response and recovery to account for small-scale recurring disasters, and thus improve communities' adaptation capacity, we need to: i) have a clear understanding of what elements characterises small-scale recurring disasters, and how to incorporate their cumulative impacts into decision-making; ii) review existing recovery mechanisms to also account for small-scale disasters; and, iii) establish more consistent decision-making methodology for emergency response and recovery.

4.1. Understanding small-scale recurring disasters and their cumulative impact

Our research confirms the findings from other studies (e.g. Refs. [15,22]), regarding the lack of consensus on what constitutes a small-scale disaster, and whether they should be considered as disasters. This uncertainty is likely borne from past deliberations regarding the level at which a natural hazard event and its impacts qualify as a 'disaster' [48]. This is further compounded when there are conceptual differences about what being impactful means in different contexts (for example, an infrastructure service disruption or broader community resilience impacts). This results in diverse and contextual interpretations, which affect the activation of emergency services from response to recovery. As our findings indicate that the activation of emergency services for disasters are made on a case-by-case basis, and are locally specific, their recognition may also depend on the local adaptive capacity and/or resource availability. Additionally, when faced with significant limitations of resources and time, emergency managers have the difficult task of prioritising which disasters promptly receive assistance, and how much assistance is provided [49]. Our findings concur with those from [14] who found that disaster risk governance is largely based on short-term consequences and impacts, and smaller-scale disasters are often left out when their impacts are not directly identifiable, cumulative, or they occur at the same time as large-scale ones.

This could perpetuate inconsistencies in how emergency services are activated, leaving some affected communities out of the equation. Hence, a better understanding of the characteristics of small-scale disasters and their impacts is needed. Consequently, when these events are assessed, it is possible to determine whether their cumulative effects may be equivalent to other large-scale disasters, or the increasing impacts are a result from climate change. In either case, such understanding could help trigger support for response and recovery to affected communities in a more efficient manner.

Such understanding may require a participatory approach, where the community is supported to identify the problems and potential interventions they need if affected by those disasters. In particular, a participatory approach would enable greater identification of the community's ability to withstand or recover from further and recurring exposures to small-scale disasters. A more comprehensive assessment of cumulative impacts that incorporates social indicators, such as community adaptive capacity, resilience, and deeper understanding of community and regional well-being, may result in more plausible outcomes [50].

Our findings concur with [14] study which found that the cumulative impacts of small-scale disasters have not been well understood. In particular, while our study observed that the importance of cumulative impacts is acknowledged by participants and guidelines alike (e.g., Recovery Preparedness and Management guidelines, section 7.2.) [51], the operationalisation of what comprises the response to cumulative impacts is missing from both practice and policy. Participants were unsure how to capture cumulative impacts

in practice, and were not aware of any guidelines to address them. Hence, as highlighted by [14]; disaster risk governance needs to better account for cumulative impacts, especially as those could become more frequent and coupled with small-scale disasters.

On a positive note, there are a number of efforts that are being implemented in Aotearoa New Zealand concerning cumulative impacts. These include 'The Aotearoa Cumulative Effects Framework' [52], making cumulative effects assessment a key element of impact [53] and risk-based planning assessments [54]. Further efforts, however, are needed to include the consideration of cumulative effects into policy frameworks, especially for small-scale recurring disasters so as to ensure more equitable distribution of emergency management resources. This may start with improved management of small-scale recurring disasters through a stronger approximation between disaster risk governance frameworks and land-use planning. As suggested by [14]; greater focus and investment in disaster preparedness and mitigation targeting small-scale disasters needs to be embedded in land-use planning to minimise disaster risks, because poor land-use planning can undermine local capacity and community resilience by increasing their vulnerability to those risks.

4.2. Review existing recovery mechanisms to account for small-scale disasters

Although existing international disaster governance frameworks (e.g., Sendai Framework for Disaster Risk Reduction; International Risk Governance Centre Framework) emphasise the post disaster recovery phase, our findings suggest that small-scale recurring disasters often don't undergo a complete recovery phase in contrast to larger-scale ones. This is due to a number of reasons, including lack of institutional frameworks and recognition of the impacts of small-scale events. Our findings showed some consensus among the participants that this may be due to the fact that the CIMS framework guiding emergency response focuses more on response rather than recovery. Nevertheless, the recovery preparedness and management guideline under the CDEM specifies that 'recovery should be flexible and scalable', be applied to disasters of any scale and provide individuals and households with opportunities to access recovery services ([51]; p. 8). In practice, however, this recovery mechanism does not seem to be fully functioning, because access to insurance is a well-established recovery strategy for smaller-scale disasters.

The availability, and affordability, of insurance for some localities may be short-lived however, as climate change may increase the number and frequency of disasters [55]. This will result in higher insurance premiums and the withdrawal of insurance coverage from certain areas in the future [56]. Additionally, our findings concurred with those of [57] who also found that not only are insurance premiums and excess payments increasing, but this will also be an issue for recurring disasters. Furthermore, insurance may not necessarily support long-term community resilience strategies that seek to 'build back better', as insurance indemnity principles prohibit significant property improvements [43]. This leads to a ratchet effect, as affected communities encounter the impacts repeatedly multiple times [8,22]. In failing to recover, affected communities become more vulnerable to new risks [22].

4.3. Establish more consistent decision-making methodology for emergency response and recovery

Our results showed the absence of consistent methodology to activate emergency services for small-scale disasters. While this enables some degree of creativity and flexibility on-the-ground, it creates inconsistency in operating procedures and systems across the country [58]. Adding to this is the adoption of the AHA, which doesn't require decisions to be guided by pre-determined threshold or scale-based criteria. As large-scale disasters attract more attention when they occur simultaneously with small-scale disasters [15], a lack of methodology for acknowledging the latter not only further compounds such inconsistencies, but also may contribute to the exacerbation of the above-mentioned ratchet effect. Hence, disaster risk governance needs to consider planning for, and developing, service-delivery solutions that are specific to small-scale recurring disasters.

A key solution to this might be greater involvement of affected communities in emergency response and recovery planning. In particular, both the International Risk Governance Council framework and the disaster literature have shown the important role of local authorities and communities as first responders to disasters [12,59], especially in the case of small-scale disasters [17]. In addition, the recovery process of small-scale disasters can also be framed from the perspective and experience of those affected, as opposed to external actors as in large-scale disasters [22]. This notion emphasises that community engagement can improve the relevance of the decision-making and performance of disaster risk governance outcomes [12]. Importantly, Aotearoa New Zealand's disaster governance approach follows this concept, with emergency management specialists becoming increasingly encouraged to involve the community in disaster risk governance, by obtaining information on their risk acceptance levels and developing community response plans. This ensures that perspectives from a range of stakeholders are incorporated, and helps to better understand and manage disaster risk, resulting in more effective, fair, and acceptable decisions [12].

Furthermore, the IRGC [12] emphasises that risk evaluation and management need to go beyond a scientific risk assessment to also include affected communities' understanding of risks and their consequences. Notably, the 'Wharekawa Coast Project –2120' in the Waikato region of Aotearoa New Zealand is one important example of this practice [60]. The project aims to examine a broader range of issues affecting the area by studying historical river flooding events and related community impacts, to inform a long-term resilience strategy for the sustainable management of the coast. This is done through the involvement of local communities, who assist authorities to assess the risks associated with natural hazards and determine the thresholds at which coastal and stream flooding become intolerable to local residents.

Insights gained from the communities are set to be useful to evaluate mitigation options and to determine community's appetite for risk [61]. However, this is a challenging exercise, as risks cannot simply be accepted because a community does not wish, or does

not have the means, to mitigate them [62]. Community decisions related to risk appetite and risk thresholds⁴ are determined by the community characteristics, such as their vulnerability, which can affect when they reach intolerable levels. In addition, choosing the level of risk acceptance can be difficult when there are benefits and trade-offs involved (e.g., restrictions on land-use zoning regulations or development constraints). It is therefore important to strike a balance between the benefits and the costs involved in risk mitigation. Such exercises would shed light on the extent to which communities are willing to accept risk and conceptualise the entry point for disaster risk reduction measures.

Finally, there is a need for disaster risk governance approaches to move beyond a technical emphasis and provide a more on-the-ground community-based approach, to account for small-scale recurring disasters. In the absence of consistent and tailored emergency management policies for small-scale recurring disasters, strengthening the adaptation capacity of communities is paramount, especially because those disasters are likely to increase in frequency due to climate change. The creation of participatory community risk acceptance thresholds would not only provide insights for a more comprehensive and equitable community emergency response and recovery process. These thresholds could also inform disaster risk reduction decisions based on the risk tolerance of communities with, or without, risk reduction interventions. As a result, small-scale disasters can be identified as early warning signals which need to be mitigated and monitored before the risk accelerates [63]. It is important to stress, however, that such community engagement does not mean shifting all responsibility to communities to deal with those disasters on their own, but to provide the necessary support and resources to assist them to improve their disaster resilience.

5. Conclusion

In this study, Aotearoa New Zealand's current emergency response and recovery practices were examined to understand the extent to which they accommodate small-scale recurring disasters, and to suggest ways forward to enable a more comprehensive and equitable entry point for local emergency response and recovery, and thus improve adaptation capacity of communities and localities experiencing similar circumstances. Drawing on empirical data from emergency management specialists, our results offered a number of insights for scholarship and practice that are useful to improve disaster governance mechanisms for small-scale recurring disasters beyond Aotearoa New Zealand. As a starting point, we found that disaster risk governance mechanisms in Aotearoa New Zealand do not sufficiently address small-scale recurring disasters, although the AHA is expected to be applied to a full spectrum of disasters. As such, there is a need to identify what constitutes a small-scale disaster to develop policies and practices that are consistent across countries and jurisdictions following the AHA. Further, we have identified a gap in the emergency response mechanisms regarding the identification of cumulative impacts from small-scale disasters. This contributes to some types of disaster impacts going under the radar, and being ineligible to obtain emergency response and recovery assistance. Thus, it is necessary to operationalize the concept of cumulative impacts in emergency management frameworks to enable small-scale disasters to effectively portray the need for response and recovery assistance and resources.

Second, we recognised that the trajectory for the recovery from small-scale recurring disasters need to be re-examined. Short-term recovery strategies that are currently available for small-scale disasters appear to work well, since repetitions of these events can be well predicted, thus allowing risk transfer to be practical. We identified that for some individuals and communities, there has been a choice to live with small-scale recurring disasters. However, the projections of a growing number of disasters due to climate change suggest that communities encountering small-scale recurring disasters may become increasingly vulnerable to future disasters. When small-scale disaster cycles keep repeating, there is an impact on the recovery process; therefore, a long-term sustainable mechanism needs to be introduced to break the cycle of events interfering with the recovery process. In particular, this consideration is important for communities that have ad hoc or informal recovery strategies.

Third, we identified that a consistent policy for responding to small-scale recurring disasters is unavailable due to a number of factors. This includes the application of different response mechanisms under the BAU operations of various organisations, and the absence of a top-down policy direction. Another reason we identified was the flexibility provided to emergency services through governance mechanisms that create room for inconsistencies and prevent the delivery of standardised minimum levels of support to affected communities. This needs to be re-addressed to ensure the availability of consistent and coherent emergency management resources for the affected communities.

To conclude, this study suggests that a best practice disaster risk governance approach for managing small-scale recurring disasters entails a community-led approach to determine the level of risk accepted by communities. This would give emergency management practitioners a practical way of initiating their response and recovery services, as well as decisions regarding disaster risk reduction. Using this bottom-up approach to scale up disaster risk governance mechanisms will enable small-scale recurring disasters to be managed more pro-actively, instead of reactively in, and by, any community.

This study was conducted in 2021 during the COVID 19 pandemic and other subsequent disasters pertaining to natural hazards. It is therefore important to stress that the emergency management specialists who participated in the study were dealing with multiple stressors at that time. Due to this, there was a limited number of participants willing to participate in the interviews, leading to limitations to the study's results in terms of exploring different community interventions in different localities. In the future, more broad scale studies related to small-scale disaster response and recovery will help overcome these gaps and identify potential improvements for shortcomings in policy and practice, as well as potential innovative practices.

⁴ "The community risk threshold is the point at which a community can no longer tolerate the impacts of the risk, which is defined by the frequency of how often can a given set of impacts occur before they no longer are tolerable." [57]. *Wharekawa coast 2120: Natural hazard risk assessment* (2020/08). <https://www.waikatoregion.govt.nz/assets/WRC/TR202008.pdf> p.29.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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Data availability

Data will be made available on request.

References

- [1] J. Raikes, T.F. Smith, C. Jacobson, C. Baldwin, Pre-disaster planning and preparedness for floods and droughts: A systematic review, *Int. J. Disaster Risk Reduc.* 38 (2019) 101207, <https://doi.org/10.1016/j.ijdrr.2019.101207>.
- [2] IPCC, Climate Change 2022: Impacts, Adaptation and Vulnerability (Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Issue, C. U. Press, 2022. <https://www.ipcc.ch/assessment-report/ar6/>.
- [3] United Nations Office for Disaster Risk Reduction, Global Assessment Report on Disaster Risk reduction (GAR), 2019. <https://gar.unisdr.org/report-2019>.
- [4] M.C. Marulanda, O.D. Cardona, A.H. Barbat, Revealing the socioeconomic impact of small disasters in Colombia using the DesInventar database, *Disasters* 34 (2) (2010) 552–570, <https://doi.org/10.1111/j.1467-7717.2009.01143.x>.
- [5] J. Magrath, Climate alarm: disasters increase as climate change bites, *Oxfam Policy and Practice: Climate Change and Resilience* 3 (2) (2007) 1–28. https://oxfamlibrary.openrepository.com/bitstream/handle/10546/114103/bp108-climate-alarm-250108_en.pdf;jsessionid=D2704DC3939E8B774C6366F42EC5AC4A?sequence=1.
- [6] V. Thomas, *Climate Change and Natural disasters: Transforming Economies and Policies for a Sustainable Future*, Taylor & Francis, 2017.
- [7] E. Osuteye, C. Johnson, D. Brown, The data gap: an analysis of data availability on disaster losses in sub-Saharan African cities, *Int. J. Disaster Risk Reduc.* 26 (2017) 24–33, <https://doi.org/10.1016/j.ijdrr.2017.09.026>.
- [8] J. Gaillard, D. van Niekerk, L.B. Shoroma, C. Coetzee, T. Amirapu, Wildlife hazards and disaster risk reduction, *Int. J. Disaster Risk Reduc.* 33 (2019) 55–63, <https://doi.org/10.1016/j.ijdrr.2018.09.009>.
- [9] UNDP, Issue brief: Disaster Risk Governance, 2012. https://www.preventionweb.net/files/29974_20121311issuebriefdisasteriskreduc.pdf. Issue.
- [10] K. Hemachandra, D. Amaratunga, R. Haigh, Role of women in disaster risk governance, *Procedia Eng.* 212 (2018) 1187–1194, <https://doi.org/10.1016/j.proeng.2018.01.153>.
- [11] S. Ikeda, T. Nagasaka, An emergent framework of disaster risk governance towards innovating coping capability for reducing disaster risks in local communities, *International Journal of Disaster Risk Science* 2 (2) (2011) 1–9, <https://doi.org/10.1007/s13753-011-0006-7>.
- [12] IRGC, Introduction to the IRGC risk governance framework, <https://irgc.org/risk-governance/irgc-risk-governance-framework/>, 2017.
- [13] P. Shi, Hazards, disasters, and risks, in: *Disaster Risk Science*, Springer, 2019, pp. 1–48.
- [14] M.E. Brennan, S. Danielak, Too small to count? The cumulative impacts and policy implications of small disasters in the Sahel, *Int. J. Disaster Risk Reduc.* (2021) 102687, <https://doi.org/10.1016/j.ijdrr.2021.102687>.
- [15] J.R.D. Cadag, M. Petal, E. Luna, J. Gaillard, L. Pambid, G.V. Santos, Hidden disasters: recurrent flooding impacts on educational continuity in the Philippines, *Int. J. Disaster Risk Reduc.* 25 (2017) 72–81, <https://doi.org/10.1016/j.ijdrr.2017.07.016>.
- [16] A. Fraser, M. Pelling, A. Scolobig, S. Mavrogenis, Relating root causes to local risk conditions: a comparative study of the institutional pathways to small-scale disasters in three urban flood contexts, *Global Environ. Change* 63 (2020), 102102 <https://doi.org/10.1016/j.gloenvcha.2020.102102>, Article.
- [17] L.R.R. Pando, A. Lavell, Extensive and every day risk in the Bolivian Chaco: sources of crisis and disaster, *J. Alpine Res. | Revue de géographie alpine* (100–1) (2012), <https://doi.org/10.4000/rga.1719>.
- [18] L. Pearson, M. Pelling, The UN Sendai framework for disaster risk reduction 2015–2030: Negotiation process and prospects for science and practice, *J. Ext. Events* 2 (1) (2015) 1571001.
- [19] R.Z. Zaidi, Beyond the Sendai indicators: Application of a cascading risk lens for the improvement of loss data indicators for slow-onset hazards and small-scale disasters, *Int. J. Disaster Risk Reduc.* 30 (2018) 306–314, <https://doi.org/10.1016/j.ijdrr.2018.03.022>.
- [20] D. Etkin, *Disaster theory: An Interdisciplinary Approach to Concepts and Causes*, Butterworth-Heinemann, 2016.
- [21] T.M. Logan, S.D. Guikema, Reframing resilience: equitable access to essential services, *Risk Anal.* 40 (8) (2020) 1538–1553.
- [22] S. Shrestha, J. Gaillard, Small-scale Disasters and the Recovery Process, 6th International i-Rec conference: Sustainable Post-Disaster Reconstruction: From Recovery to Risk Reduction, Ascona, Switzerland, 2013, 26–30 May [Conference paper].
- [23] B. Wisner, J. Gaillard, I. Kelman, Framing disaster: theories and stories seeking to understand hazards, vulnerability and risk, in: *Handbook of Hazards and Disaster Risk Reduction*, Routledge, 2012, pp. 47–62, <https://doi.org/10.4324/9780203844236-13>.
- [24] C. Pokarier, Scales of Disaster: Conceptual Reflections on 11.3. 11 11th Annual Conference of Asian Studies, Tel Aviv, Israel, 2012.
- [25] J. Gaillard, *Natural Hazards and Disasters*. International Encyclopedia of Geography: People, the Earth, Environment and Technology: People, the Earth, Environment and Technology, 2016, pp. 1–15.
- [26] J.C. Gaillard, Resilience of traditional societies in facing natural hazards, *Disaster Prev. Manag.: An Int. J.* 16 (4) (2007) 522–544 2007, <https://doi.org/10.1108/09653560710817011>.
- [27] M.d.L. Melo Zurita, B. Cook, L. Harms, A. March, Towards new disaster governance: Subsidiarity as a critical tool, *Environ. Policy and Govern.* 25 (6) (2015) 386–398, <https://doi.org/10.1002/eet.1681>.
- [28] R. Djalante, M. Garschagen, A review of disaster trend and disaster risk governance in Indonesia: 1900–2015, in: *Disaster Risk Reduction in Indonesia*, Springer International Publishing, 2017, pp. 21–56, https://doi.org/10.1007/978-3-319-54466-3_2.
- [29] R.K. Yin, D.T. Campbell, *Case Study Research and Applications: design and Methods*, sixth ed., SAGE Publications, Inc, 2018.
- [30] UNDRR, Disaster risk reduction in New Zealand: Status report, United Nations Office for Disaster Risk Reduction (UNDRR), Regional Office for Asia and the Pacific, 2020. [https://www.undrr.org/publication/disaster-risk-reduction-new-zealand-status-report-2020#:~:text=The%20disaster%20risk%20reduction%20\(DRR,Disaster%20Risk%20Reduction%202015%2D2030](https://www.undrr.org/publication/disaster-risk-reduction-new-zealand-status-report-2020#:~:text=The%20disaster%20risk%20reduction%20(DRR,Disaster%20Risk%20Reduction%202015%2D2030).
- [31] K. Mason, K. Lindberg, C. Haenfling, A. Schori, H. Marsters, D. Read, B. Borman, Social vulnerability indicators for flooding in Aotearoa New Zealand, *Int. J. Environ. Res. Publ. Health* 18 (8) (2021) 3952, <https://doi.org/10.3390/ijerph18083952>.
- [32] Ministry for the Environment New Zealand, National Climate Change Risk Assessment for Aotearoa New Zealand: Main Report – Arotakena Tūrarū Mō Te Huringa Āhuarangi O Aotearoa: Pūrongo Whakatōpū, 2020. <https://environment.govt.nz/publications/national-climate-change-risk-assessment-for-new-zealand-main-report/>.
- [33] Civil Defence Emergency Management Act, Ministry of Civil Defence, Public Act, 2002.
- [34] MCDem, National Disaster Resilience Strategy, 2019. <https://www.civildefence.govt.nz/cdem-sector/plans-and-strategies/national-disaster-resilience-strategy/>.
- [35] K. Tennakoon, S. Serrao-Neumann, C. Hanna, Examining the incorporation of small-scale recurring disasters in emergency management frameworks: insights from Aotearoa–New Zealand, *Int. J. Disaster Risk Reduc.* 66 (2021) 102595, <https://doi.org/10.1016/j.ijdrr.2021.102595>.
- [36] K. Raworth, C. Sweetman, S. Narayan, J. Rowlands, A. Hopkins, Conducting semi-structured interviews (2019). <https://oxfamlibrary.openrepository.com/bitstream/handle/10546/252993/ml-guideline-conducting-semi-structured-interviews-221112-en.pdf;jsessionid=>.
- [37] P. Bazeley, K. Jackson, *Qualitative Data Analysis with NVivo*, second ed., SAGE Publications Ltd, 2013. <https://us.sagepub.com/sites/default/files/upm->

- assets/114916_book_item_114916.pdf.
- [38] S. Shrestha, Adrista Sangharsaharu, Sthaniya Sabalta: Exploring Recovery from Small-Scale disasters: Examples from Remote Nepal [Doctoral Thesis, The University of Auckland, Auckland, New Zealand, 2016. <https://researchspace.auckland.ac.nz/handle/2292/31699>.
- [39] MCDem, Civil Defence in New Zealand: A Short History. Ministry of Civil Defence with the Assistance of the Historical Branch, Dept. of Internal Affairs, 1990.
- [40] A. Oliver-Smith, Anthropological research on hazards and disasters, *Annu. Rev. Anthropol.* 25 (1996) 303–328. <http://www.jstor.org/stable/2155829>.
- [41] CRED. (n.d.). EM-DAT. Retrieved 26.8.2021 from <https://www.emdat.be/frequently-asked-questions>.
- [42] K. Tennakoon, S. Serrao-Neumann, C. Hanna, R. Cretney, Identifying and classifying broader scale of disaster impacts to better inform disaster management policies and practice. *Natural Hazards*, 2023 (under review).
- [43] P. O'Hare, I. White, A. Connelly, Insurance as maladaptation: resilience and the 'business as usual' paradox, *Environ. Plann. C Govern. Pol.* 34 (6) (2016) 1175–1193, <https://doi.org/10.1177/0263774X15602022>.
- [44] B. Wisner, *At Risk: Natural Hazards, People's Vulnerability, and Disasters*, second ed., Routledge, 2004.
- [45] J. Garrido, W.S.A. Saunders, Disaster risk reduction and land use planning: opportunities to improve practice, in: A. Shakoob, K. Cato (Eds.), *IAEG/AEG Annual Meeting Proceedings*, vol. 5, Springer, Cham, San Francisco, California, 2018. https://doi-org.ezproxy.waikato.ac.nz/10.1007/978-3-319-93136-4_20.
- [46] S. Boubacar, M. Pelling, A. Barcena, R. Montandon, The erosive effects of small disasters on household absorptive capacity in Niamey: a nested HEA approach, *Environ. Urbanization* 29 (1) (2017) 33–50, <https://doi.org/10.1177/0956247816685515>.
- [47] Y. Liu, G. Feng, Y. Xue, H. Zhang, R. Wang, Small-scale natural disaster risk scenario analysis: a case study from the town of Shuitou, Pingyang County, Wenzhou, China, *Nat. Hazards* 75 (3) (2015) 2167–2183, <https://doi.org/10.1007/s11069-014-1420-0>.
- [48] K.J. Tierney, M.K. Lindell, R.W. Perry, *Facing the Unexpected: Disaster Preparedness and Response in the United States*, The National Academies Press, 2001.
- [49] J. Handmer, Emergency management thrives on uncertainty, *Earthscan*, 2008, pp. 231–243.
- [50] M. Weber, N. Krogman, T. Antoniuk, Cumulative effects assessment: linking social, ecological, and governance dimensions, *Ecol. Soc.* 17 (2) (2012). <http://www.jstor.org/stable/26269026>.
- [51] NEMA, Recovery Preparedness and Management: Director's Guideline for Civil Defence Emergency Management Groups, 2019 [DGL 24/20]. <https://www.civildefence.govt.nz/assets/Uploads/recovery/DGL24-20/Recovery-DGL24-20-Full-Version.pdf>.
- [52] National Science Challenges, Aotearoa cumulative effects (ACE) framework, <https://www.sustainableseaschallenge.co.nz/tools-and-resources/ace-framework/>, 2023.
- [53] Q. Planning, When is enough, enough?: Dealing with cumulative effects under the resource management act, https://www.qualityplanning.org.nz/sites/default/files/When_is_Enough_Enough_Dealing_with_Cumulative_Effects_Under_the_RMA.pdf, 2008.
- [54] W.S. Saunders, M. Kilvington, Innovative land use planning for natural hazard risk reduction: A consequence-driven approach from New Zealand, *Int. J. Disaster Risk Reduc.* 18 (2016) 244–255, <https://doi.org/10.1016/j.ijdrr.2016.07.002>.
- [55] B. Storey, I. Noy, S. Owen, W. Townsend, S. Kerr, R. Salmon, D. Middleton, O. Filippova, V. James, *Insurance, Housing and Climate Adaptation: Current Knowledge and Future Research*, 2017.
- [56] S. Owen, I. Noy, J. Pástor-Paz, D. Fleming, EQC and extreme weather events (part 2): Measuring the impact of insurance on New Zealand landslip, storm and flood recovery using nightlights, *Storm and Flood Recovery Using Nightlights* (2019) November 20, 2019.
- [57] S. Marsh, W. Mills, P. Mouro, T. Hume, R. Liefing, S. Hunt, Wharekawa Coast 2120: Natural Hard Risk Assessment (2020/08, 2022. <https://www.waikatoregion.govt.nz/assets/WRC/TR202008.pdf>.
- [58] R. Sowry, Better Responses to Natural Disasters and Other emergencies: Ministerial Review, 2017. <https://apo.org.au/node/134066>.
- [59] A. Lavell, Local level risk management. Concepts and experience in Central America, *Disaster Preparedness Summit* (2002) 21–23 November 2002. New Delhi India.
- [60] Wharekawa coast 2120. (n.d.), Community Risk Thresholds, Retrieved 15.01, 2023 from. <https://wharekawacoast2120.hauraki-dc.govt.nz/>.
- [61] NEMA, Risk Assessment: guidance for CDEM Group Planning National Emergency Management Agency, 2022. <https://www.civildefence.govt.nz/assets/Uploads/Risk-Assessment-Guidance-for-CDEM-Group-Planning-Directors/Risk-Assessment-Guidance-for-CDEM-Group-Planning-Directors-Guideline-DGL-2322-PDF-3.03MB.pdf>.
- [62] Ministry for the Environment, Preparing for future flooding. Wellington, <https://environment.govt.nz/assets/Publications/Files/preparing-for-future-flooding.pdf>.
- [63] M. Gordy, The importance of extensive risk, in: *Disaster Risk Reduction and the Global System: Ruminations on a Way Forward*, Springer International Publishing, 2016, pp. 39–41, https://doi.org/10.1007/978-3-319-41667-0_8.