A FRAMEWORK FOR MEASURING LIVELIHOOD PREPAREDNESS: A KAIKŌURA, NEW ZEALAND PERSPECTIVE

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Abstract

Over the past decade, the cost of disasters on lives and livelihoods has significantly increased. However, few tools are available to measure the level of livelihood preparedness for disruptions caused by natural hazards. By studying the experience and perceptions of communities affected by the 2016 Kaikōura earthquake in New Zealand, this research aims to develop an assessment tool for measuring livelihood preparedness for unexpected disastrous events. A mixed-method approach was applied, combining a systematic review approach, a pilot study, and a survey of 140 individuals who lived through the 2016 earthquake in Kaikōura. Using t-tests, principal component analysis, and structural equation modelling, the results identified the structural relationships between the four indicators of livelihood preparedness, illustrated the importance of resource accessibility, and highlighted eleven critical factors for livelihood preparedness in Kaikōura. Access to livelihood infrastructure in Kaikōura was highlighted as the most vital factor for livelihood preparedness.

Additionally, through the application of a principal component analysis, factors influencing livelihood preparedness in Kaikōura were reduced to seven components, all of which influence different indicators of livelihood preparedness. A combination of results and discussion from these statistical instruments was applied to develop a framework for measuring livelihood preparedness. This framework could assist disaster risk reduction policymakers, business owners, and individuals to formulate new or improve existing strategies and initiatives for people to better prepare their livelihoods for future disruptions caused by disasters.

Dedication

To God Almighty, Mum and my family.

Acknowledgement

All glory be to the Almighty for His guidance and protection thus far. You have been my Rock and Comfort to those that I left behind to embark on this journey. Special thanks to my main supervisors Dr. Alice Chang-Richards and Prof Suzanne Wilkinson for her guidance from the beginning of my programme to date. I would also like to acknowledge other staff at the University of Auckland who have been instrumental to completing my studies. Many thanks to the University of Auckland for admitting me into the doctoral programme and the New Zealand government for allowing me to live among her people. A heartfelt thanks to the people of Kaikōura for their assistance and hospitality during my data collection.

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Chapter 1 Introduction

This chapter aims to provide a brief overview of the entire research. It starts with a summary of pioneering and relevant literatures in livelihood studies. These are meant to illustrate the evolution of livelihood studies to date, as well as shortcomings that have been highlighted thus far. Given that the 2016 Kaikōura earthquake plays a significant role in this study, a brief overview of the livelihood impacts of the earthquake will be highlighted within this chapter. Subsequently, the research questions, as well as the research methods and methodology guiding current research, will be highlighted. The current chapter will end with a high-level summary of the dissertation outline.

1.1 Background

It is often argued by genealogies that livelihood thinking emerged in 1992 from a publication by Chambers and Conway (1992); however, its origins can be traced back by at least 50 years to the fields of agriculture and developmental studies (Scoones, 2009). Nonetheless, after decades of academic research on the livelihood-related subject, there seems to be a diverse array of methods developed to index livelihoods (Angelsen et al., 2011; Jemimah Njuki et al., 2011). In part, this may be due to the multidisciplinary nature of livelihood studies spanning from agriculture (Nkala et al., 2011), developmental studies (Sagir et al., 2013; Scoones, 2009) to disaster risk reduction and sustainability (Farrington, 1999).

At its core, livelihood reflects the capability of people to meet their basic needs by drawing on a diverse array of resources at their disposal (Bobrowsky, 2013; Luqman et al., 2018). In a disaster context, individual needs will entail having a job or means to earn income, as well as being alive and well. This was deduced from a series of case studies provided by (Morse & McNamara, 2013). Current indicators on livelihood are focused on measuring the ability of individuals or communities to meet their needs in the event of a crisis (Akter, 2012; Donohue & Biggs, 2015; Lin & Polsky, 2016). However, due to the increased cost of disasters (CRED, 2021), there is an additional need to measure the extent to which individuals have prepared their livelihoods prior to a disaster. Disaster preparedness in itself are actions undertaken prior to a disaster in order to mitigate, respond to and recover faster from disaster incidents

(Tierney et al., 2001). It encourages prevention, protection, and promotion endeavours (Chang-Richards et al., 2013). Hence individual livelihood preparedness can be defined in this research as a state of readiness of livelihood in the face of potential disasters. It may well entail actions taken by individuals to prepare their means of earning a living from unforeseen circumstances.

Livelihood indicators and frameworks suggested by Li et al. (2020); Pandey et al. (2017) have often been a derivative of the sustainable livelihood index proposed by Scoones (1998) or livelihood resilience (Folke, 2006). Frameworks based on the sustainable livelihood index (Scoones, 1998) focus on livelihood assets, strategies, outcomes, institutional investments, and vulnerability contexts (Kamaruddin & Samsudin, 2014). On the other hand, indicators and frameworks based on resilience seemed to be focused on coping or adaptation (Nyamwanza, 2012).

It could be argued that both approaches provide a holistic view of livelihoods in the face of disruption. However, this is not without criticism. Critics of the sustainable livelihood index, among other things, have argued that greater attention was given to the micro-level at the expense of macro influences and power dynamics that could exist between people of different social strata (De Haan, 2012). On the other hand, the ubiquitous use and ambiguous definition of resilience (Folke, 2006) might have impacted livelihood indicators and frameworks designed to measure livelihood resilience. Hence, depending on the context under examination, livelihood resilience indicators vary slightly across different livelihood and disaster-focused literature (Ifejika Speranza et al., 2014; Nyamwanza, 2012; Sina et al., 2019). Heeding the call by De Haan (2012) for a meta-analysis of livelihood literature, this study will attempt to analyse individual livelihoods from the perspective of individuals who have lived through disasters rather than the developmental approach that forms the basis of sustainable livelihood studies (Morse & McNamara, 2013), while limiting the ambiguity associated with defining resilience in livelihood and disaster research (Ifejika Speranza et al., 2014; Nyamwanza, 2012). These would be addressed through the input of individuals recovering from the 2016 earthquake in Kaikōura.

On 14 November 2016, a 7.8 magnitude earthquake occurred in Kaikōura, a small tourist town on the South Island of New Zealand (McDonald et al., 2017; Ministry of Civil Defence & Emergency Management, 2017). The earthquake caused significant damage to infrastructure, with the estimated

cost reaching 2 billion NZD (approx. 1.4 billion 2016 USD) (Hatton et al., 2017). The effects of the earthquake were not limited to Kaikōura; it was also felt in nearby cities and towns. During the first 25 weeks after the earthquake, the economy of Wellington, the capital city of New Zealand, located 258 km from Kaikōura, suffered a loss of 1.25 million NZD per week (approx. 850,000 USD in 2016) (Deloitte, 2017). Many employers and employees in Wellington had to shoulder recovery costs through pay cuts and other cost reduction measures (Sampson et al., 2017). The earthquake also caused significant loss to the wine industry in the nearby Marlborough Region, threatening the livelihoods of 4% of the regional population working in the wine sector (Dizhur et al., 2019; Infometrics, 2018; Stevenson et al., 2017). The hardest hit by the earthquake was those who lived and worked in Kaikōura, the epicenter of the earthquake. In the aftermath of the earthquake, residents' lives and livelihoods were put on hold because of disruptions to economic infrastructure and the natural environment, which are the backbones of its tourism industry (Ministry of Civil Defence & Emergency Management, 2017; Stevenson et al., 2017). This study will be guided by research questions and objectives highlighted in the next section.

1.2 Research questions and objectives

To fill the gap outlined in the previous section, this study will be guided by a central research question, which is as follows***: "Is there an operational tool to measure individual livelihood preparedness for disasters caused by natural hazards?*** Current research would focus on the feedback of Kaikōura residents in the labour market who lived through the 2016 earthquake. The central research question is further expanded into three specific research questions, which are as follows:

1. What are the indicators of livelihood preparedness and factors influencing them?
2. What are the lessons learned from the 2016 Kaikōura earthquake in New Zealand?
3. How can the level of livelihood preparedness be measured in the context of a disaster event?

To address the research questions, seven objectives were set as below:

1. To identify the indicators of livelihood preparedness and factors influencing them;
2. To investigate the lessons learned from the 2016 Kaikōura earthquake in New Zealand

3. To illustrate the context in which different livelihood preparedness indicators and factors were discussed.
4. To determine the most critical livelihood preparedness indicator from the perspective of Kaikōura residents affected by the 2016 earthquake.
5. To highlight factors critical for livelihood preparedness in Kaikōura from the perspective of Kaikōura residents
6. To suggest a framework for livelihood preparedness in Kaikōura
7. To develop a tool for measuring livelihood preparedness in Kaikōura

Due to the unique nature of livelihoods and disaster contexts, it is vital to note that the tool and framework developed within this study may be mostly applicable to Kaikōura. The next section will provide a high-level overview of the research methods adopted in this research.

1.3 Research methods

For a research outcome to be valid, the researcher is obligated to explain the steps taken to conduct a study and the rationale behind those steps (Crotty, 1998). A pragmatic research philosophy will be adopted for this study, as this aligns with the suggestions highlighted by (Saunders et al., 2019; Smith, 2020). To the pragmatist, concepts are regarded as relevant where they support action (Kelemen & Rumens, 2008). The pragmatist philosophy attempts to build a bridge between facts and values, as well as objectivism and subjectivism (Rasmussen & Glăveanu, 2020). it also strives to reconcile empirical knowledge and different contextual experiences (Smith, 2020). These are achieved through the evaluation of ideas, concepts, hypotheses, theories and detailed research findings focused on thought and action as well as contextual practical consequences (Saunders et al., 2019).

For research fields in which there are a vast number of publications in one context, but a limited amount of information on a particular topic within the field Halpin and Richard (2021); Saunders et al. (2019) suggested the adoption of an abductive approach to theory development. Under different contexts, such as sustainability, resilience, business continuity, etc., different aspects of livelihoods have been studied in different contexts and locations. To the best of the researcher's knowledge, an operational framework

for preparing individual livelihoods for a disaster has not been undertaken. Hence, an abductive approach to theory development will be adopted for this study. According to Ketokivi and Mantere (2010), the abductive approach to theory building starts with the discovery of a startling fact, from which a set of premises are developed to explain the conclusion. Hence rather than going from theory to data as is the case with deduction or data to theory in induction, an abductive approach to research moves back and forth between data and theory (Suddaby, 2006).

A three-step approach would be adopted to achieve the stated objectives and provide answers to highlighted research questions. The first step would be problem identification. This step would involve a conventional literature review followed by a systematic review of literature. The conventional literature review would acquaint the researcher with previous publications in livelihood research. It would also assist the researcher to formulate a strategy to conduct a systematic review of literature. More information on the steps involved in conducting the systematic review will be discussed in a subsequent chapter.

The second step in this study will be to establish the optimal research methodology that facilitates the provision of answers to the research questions and fulfills current research objectives. An in-depth examination of the adopted research philosophy will also be conducted. A mixed-method approach will be adopted in data collection, entailing a combination of interviews and surveys. Justification for the implementation of a mixed-method approach will be discussed in the methodology chapter.

Lastly, obtained results will be synthesised in the final stage of this research to provide recommendations to individuals, business owners, and policymakers. Figure 1.1 illustrates the steps involved in conducting current research and the methods adopted to achieve different objectives and answer different research questions.

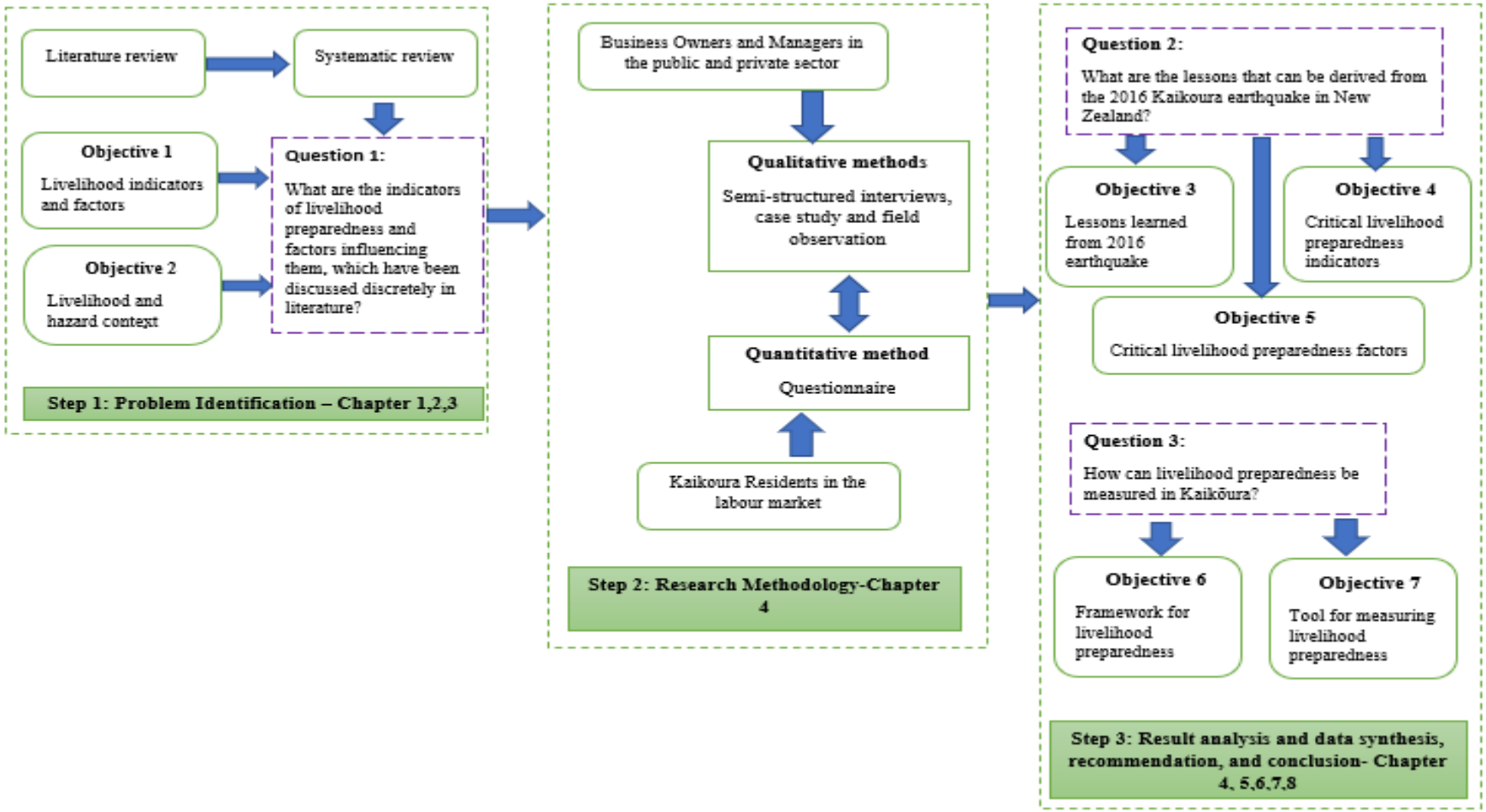


Figure 1. 1 Research design

1.4 Ethical consideration

Current research followed the suggestions of Bryman and Bell (2007), which highlighted several ethical considerations for researchers. For the research participants, Bryman and Bell (2007) highlighted the importance of obtaining consent as well as ensuring the safety and dignity of the participants. Prior to the field trips, ethical approval was issued by the University of Auckland Human Participants Ethics Committee (reference number 014782). City councils in the research locations were also informed of the visits in advance. A brief introduction of the research was given on the front page of the questionnaire used for the surveys. Similarly, before interviewing any participant, the research topic was introduced briefly, and oral consent was received from the interview and survey participants.

During interviews, the personal safety of participants was guaranteed by ensuring that the research location was hazard-free. Culturally appropriate language was also adopted to protect the dignity of the participants. To ensure confidentiality and privacy of the discussions, digital recorders were not used; however, responses were recorded in writing. Codes were used to record the identity of the participants to ensure their anonymity. Concerning the authenticity of the data collected, Bryman and Bell (2007) noted that it is the researcher's ethical responsibility to ensure the authenticity of primary data. Three trained researchers collected data for current research. The authenticity of the records was assured by comparing and combining the notes taken by different researchers at the end of each interview and observation session. Results of the surveys were collated into SPSS by a single researcher; however, entry was reviewed by 2 other researchers. Lastly, Bryman and Bell (2007) highlighted the importance of transparency in the declaration of affiliations and funding. The doctoral researcher is self-funded. This was also declared in peer-reviewed publications

1.5 Research scope

Since the year 2000, there have been at least 29 disasters propagated by natural hazards in New Zealand (CRED, 2021). However, geological disasters alone (volcanic eruptions and earthquakes) have accounted for approximately 90% of all losses to lives and livelihood attributable to disasters caused by natural hazards in New Zealand (CRED, 2021; New Zealand Government, 2022). Due to the

disproportionate impacts of geological disasters in New Zealand, current study will attempt to develop a tool to assess livelihood preparedness by working with people who lived through the most recent geological disaster in the country. The 2016 Kaikōura earthquake was the most recent geological disaster that had occurred prior to the commencement of this research hence, it served as the focal point for this research.

Compared to other locations affected by the 2016 earthquake, Kaikōura was most affected due to its relative proximity to the earthquake's epicentre (Arcgis, 2022). Consequently, tsunami waves got to Kaikōura within the first 10 mins after the earthquake, and at its peak, water walls were at least 3.5 meters, which were higher than levels in other affected locations (EQC, 2017). Due to the level of destruction in Kaikōura, as highlighted by Stevenson et al. (2017), this research will analyse the responses of Kaikōura residents who were in the labour market in 2016 and lived through the effect of an earthquake.

Similarly, individuals are the fundamental building block of any family, community, government or business (Elias, 2001; Hier, 2005). Hence, current study focuses on livelihood preparedness for individuals while acknowledging that certain livelihood outcomes are beyond the capability of an individual (Cannon, 2006; Linnerooth-Bayer & Mechler, 2007). Even though the word livelihood is mainly attributed to "earning a living" (Chambers & Conway, 1992; Scoones, 1998), an in-depth evaluation of the case studies presented by Morse and McNamara (2013) highlights the importance of life and individual wellbeing. Hence, in a disaster context, there should be a balance between saving lives and protecting livelihoods (Morse & McNamara, 2013). The livelihood preparedness framework and tool developed in this study aims to prepare lives and livelihoods for disasters caused by natural hazards.

1.6 Thesis outline

This thesis consists of 7 chapters. Contents of these chapters has been summarised below:

Chapter One: The first chapter attempts to provide background knowledge on livelihood studies and mainstream metrics used to index livelihood. The research questions and objectives are also stated in

this chapter. A brief overview of the research methodology and an outline for this thesis are presented in this chapter.

Chapter Two: This chapter consists of a detailed literature review on all facets of livelihood studies, including the origins and concepts of livelihood sustainability, resilience, and business continuity. A literature review on sustainability and resilience was particularly important in this study, as the peer review process highlighted a misunderstanding between livelihood preparedness, sustainability, and resilience. The peer-review process also highlighted a potential relationship between business continuity and livelihood preparedness. A brief description of disaster contexts in New Zealand and frameworks applied to mitigate or eliminate the effects of disasters on lives and livelihood was also included in Chapter two.

Chapter Three: A systematic review of literature is conducted in Chapter Three to derive indicators of livelihood preparedness and the factors influencing them. This chapter also highlights the global disaster and livelihood contexts as well as factors prevalent across livelihood preparedness indicators.

Chapter Four: This chapter consists of the research methodology. It provides information on the research design and philosophy, data collection process, statistical tools used for data analysis, and the guiding principles and justification employed for these processes.

Chapter Five: Chapter Five presents a case study on the 2016 Kaikōura earthquake, the demographics of the respondents, and data obtained from interviews and questionnaires. Results from different statistical tools and a framework for livelihood preparedness in Kaikōura are also presented.

Chapter Six: This chapter presents a detailed discussion of obtained results and comparison to previous results in livelihood publications as well as the implication of current study in Kaikōura. An in-depth discussion of the lessons learned from the 2016 earthquake is also included.

Chapter Seven: The research summary is presented in Chapter Seven, the final chapter of this study. This chapter focuses on recommendations for individuals and business owners who earn their livelihoods in Kaikōura as well as policymakers whose decisions directly or indirectly influence livelihoods**.** It will reiterate the findings of this research and its potential implications on individual

livelihood and preparedness. Shortcomings of this study will be highlighted, as well as areas of further research.

Chapter 2 Literature review

This chapter consists of a detailed literature review of all facets of livelihood studies, including the origins and concepts of livelihood sustainability, resilience, and business continuity. A literature review on sustainability and resilience was particularly important in this study, as the peer review process highlighted a misunderstanding between livelihood preparedness, sustainability, and resilience. An attempt would also be made to highlight a potential link between business continuity and livelihood preparedness. The concept of sustainability was included in this study because it aims to structure current livelihoods in a manner that does not compromise the future generation. On the other hand, resilience fosters livelihood continuity through adaptation or coping mechanisms. Individuals earn a living by delivering value to society through different business entities. Hence, proper business continuity measures could enhance individual livelihood preparedness. This chapter will also highlight a brief description of disaster contexts in New Zealand and frameworks applied to mitigate or eliminate the effects of disasters on lives and livelihood.

2.1 The concept of sustainability

Prior to the 1980s, within the global south, livelihood intervention hinged on integrated rural development (IRD), which entailed the development of agriculture as a source of income while fostering the provision of education, healthcare, and other livelihood services (Morse & McNamara, 2013). At its core, IRD was associated with micro-scale intervention projects scheduled to run within a specified timeframe and cost (Basler, 1979). This later evolved into programmes that are long-term intervention processes aimed to satisfy the needs of the poor. The advent of urbanisation combined with other societal evolution resulted in calls for good governance, accountability, and stakeholder participation by aid agencies which resulted in the birth of sustainable livelihoods in the 90s (Morse & McNamara, 2013; UNDP, 1990).

The word ‘Sustainability’ is synonymous with maintaining consistency within a system into the future while accounting for consumption and other externalities (Kwary, 2014). From the perspective of Edelman (2003), the concept of sustainability is associated with secondary consciousness where an

individual can think beyond the past and present and into the future. Sustainability could be viewed as a tool to secure the future of humanity (Lubchenco et al., 2016; Mensah, 2019) or a tool to live within one's means (Wynveen, 2015). On the other hand, it could be perceived to be more focused on the environment than on the people who live in these environments (Ahmed et al., 2010; Wynveen, 2015). Nonetheless, Morse and McNamara (2013) argued that sustainability focuses on humans as they factor into our present and future needs. From the perspective of Chambers and Conway (1992); Scoones (1998) sustainability is composed of environmental, social, and economic facets. Sustainability is attained when there is a balance between these three facets, as placing one facet above the other would have an adverse effect on the components less focused upon (Altman & Finlayson, 1993; Tao & Wall, 2009). Placement of the economy over society and the environment leads to weak sustainability (Morse & McNamara, 2013). On the other hand, increased focus on society and/or the environment results in strong sustainability (Morse & McNamara, 2013). Nevertheless, both forms of strong sustainability would require financing to last into the future.

It is important to note that components of all three facets of sustainability would vary in different places and could evolve over time. An ideal example of these variations could be seen in the rise of renewable energy to foster sustainability. From the perspective of users of these technologies (mostly in developed countries), the renewable energy paradigm is a step in the right direction in terms of sustainability. However, poorer countries from which minerals are mined to build renewable technology might have a different opinion, as externalities resulting from the extractive activities could strain their lives and livelihood (Carvalho, 2017; OECD, 2009). Worse still, people from these poorer countries might lack the capital to acquire the technology made from resources in their environment (OECD, 2009). Thus, a practical implementation of the three facets of sustainability in a manner that works for all remains a challenge (UN, 2013). However, a concerted effort between individuals at the local level and policymakers alike would be required for the development of sustainable principles that work for all (Maas et al., 2015).

Regardless of the implementation challenges, Morse and McNamara (2013) perceive the context-neutral nature of sustainability as an ideal tool for the improvement of individual livelihoods

irrespective of the location and the context from which they earn a living. Livelihoods are means adopted by individuals or people to earn a living (Chambers & Conway, 1992) and enjoy their lives (Morse & McNamara, 2013). It becomes sustainable when people meet their current needs in a manner that does not compromise the ability of future generations to do so (Carney, 1998). This could be attributed to societal evolutions highlighted earlier in this material. From an individual or family perspective, a direct correlation could be drawn between the economic and societal facets of sustainability in the short term. The economic dispensation of a household would directly influence their ability to satisfy their current basic needs (UN, 2013). Wielding the social components of sustainability, people can directly influence the conditions in which they live. For instance, in a democratic dispensation, individuals could use their votes to elect an administration that is willing and capable of providing basic amenities which would influence their lives and livelihood. Although equally important as other two facets of sustainability, it could be argued that the effect of the environmental component of sustainability has an increased time frame before its effects are felt on individual lives and livelihoods (Morse & McNamara, 2013). Unsustainable environmental practices could, in the mid- to long-term, result in increased frequency of natural hazards, pollution, and limited access to natural resources, all of which would influence people's ability to earn a living (Clark, 2012; Rosa et al., 2019). Tao and Wall (2009) highlighted the difficulty of measuring sustainability as its different facets are measured differently. While the success of the economy is measured in monetary terms, environmental sustainability is judged by indicators such as species diversity. The societal component of sustainability is determined by the responses to questionnaires on socio-cultural matters. The next section will delve into the sustainable livelihood approach framework.

2.2 The sustainable livelihood approach (SLA)

To operationalise sustainable livelihoods, the sustainable livelihood approach (SLA) framework was developed (Helmore & Singh, 2001). According to Mazibuko (2013) the SLA is regarded as a framework rather than a theory because it neither explains nor describes occurrences; rather, it assists in the consideration of phenomena and recognition of patterns. SLA is a people-centred approach used to bring about sustainable development by accounting for all the facets of sustainability while keeping

in perspective the context within which individuals earn a living as well as institutions capable of influencing their livelihood (Walker et al., 2001). It assists with understanding the complex nature of poverty while proffering solutions to overcome it (DFID, 2000). According to DFID (2000), SLA should be holistic and dynamic to account for different strategies adopted by individuals to earn a living, as well as factors that could influence those livelihood strategies. Additionally, it must be capable of building upon the areas of competitive advantage of a people through the creation of synergy between individuals and policymakers as well as institutions to enhance livelihood outcomes (DFID, 2000). It is important to note that SLA outcomes will differ between locations and across different livelihood endeavours (E. H. Allison & B. Horemans, 2006; Morse & McNamara, 2013; Tao & Wall, 2009).

According to Morse and McNamara (2013), the formulation of SLA hinges upon an intentional approach to development. Unlike immanent development where developmental endeavours are propagated by advancement in human societies compelled by scientific revolutions and other factors, an intentional or interventionist approach to development is a conscious effort by government and non-governmental organisations to execute developmental projects and programmes aimed to assist the poor in the society (Cowen & Shenton, 1998). Schuurman (2000) was critical about an intentional approach to development as it attempts to divide individuals and societies into developed and undeveloped cadres rather than focusing on the true meaning and outcome of development. Sidaway (2007) suggested that the concept of intentional development seemed more like a reconfiguration of colonialism as wealthy and more developed countries dictated the pace and direction of development in poorer nations. In other words, intentional developmental projects are mostly applied in developing countries by individuals and organisations based in developed countries, who might be less knowledgeable on the guiding principles behind the livelihood strategies adopted by people living in developing countries (Morse & McNamara, 2013). Consequently, the success rate of interventional developmental projects has been abysmal, particularly in the African continent (Matthews, 2004).

Within the context of intentional development, the sustainable livelihood approach (SLA) was imbibed as an analytical framework, applied to direct intervention projects with the aim of delivering a sustainable livelihood outcome (E. H. Allison & B. Horemans, 2006; Tao & Wall, 2009). SLA is aimed

at the assessment of different forms of capital available to an individual, while accounting for vulnerabilities in the form of stress or shocks capable of disrupting livelihoods, as well as the institutional contexts within which livelihoods exist (Scoones, 1998; Tao & Wall, 2009). The results of SLA could assist individuals to implement informed changes to their livelihood strategy without the need for further assistance. From the perspective of Morse and McNamara (2013), livelihood interventions that hinge upon the results of an SLA are more likely to deliver better outcomes than otherwise, as informed decisions are made to either improve an individual's asset/s base or limit their vulnerability. In some situations, both improved access to capital and vulnerability reduction will be required (E. Allison & B. Horemans, 2006). In all, SLA is viewed as an all-encompassing developmental tool propagated by the analysis of current livelihood conditions to guide developmental interventions (DFID, 2000).

The analysis of an individual's access to natural, human, social, physical and financial capitals form the core of an SLA framework (Scoones, 1998) as limited capital is synonymous with greater poverty and increased vulnerability (Erenstein, 2011). For the rest of this research, capital, assets and resources will be used interchangeably. While all three might have different meanings, it could be argued that they are similar from a livelihood perspective. For example, a land rich in precious metals and other solid minerals would be referred to as a resource. On the other hand, it becomes an asset to individuals who have access to it and depend on it for their livelihood. When the resources available on this land are leveraged to acquire or develop an alternative livelihood strategy, the land and its valuables become capital. Capital by itself could be viewed as a tool for earning a living and making life meaningful, while challenging the structures upon which individuals earn their livelihoods ((Bebbington, 1999). The access and use of capital are dependent on other factors such as institutions and vulnerability contexts in the SLA framework (Mazibuko, 2013). Natural capital encompasses natural resources such as soil, water, air, plants and animals as well as environmental phenomena like hydrological cycles and pollution sinks (Daily et al., 1997; Norberg, 1999). Human skills, knowledge labour, and other physical capacities are classified under human capital. Social capital are networks, associations and affiliations an individual is involved with (Pandey et al., 2017). Infrastructure, production equipment and

technologies are classified under physical capital while cash, credit, loans and other financial instruments are referred to as economic assets.

Even though all forms of capital are vital for individual livelihoods, the level of importance attached to a specific asset class would vary over time, resulting in possible substitution of different asset classes as situations evolve (Bebbington, 1999). It is vital to note that boundaries between different forms of capital could be blurred; an example of this was the suggestion of Odero (2006), which highlighted the distinction between intellectual capital (a form of human capital) and information. According to Odero (2006), information should be classified as a separate form of capital independent of human capital. Additionally, transport infrastructure is mostly classified as physical capital (Scoones, 1998); however, Trotter and Ivory (2019) highlighted the socio-technical aspects of transport infrastructure. In essence, clear distinctions between different forms of capital could be challenging as certain items can be used as different forms of capital (Odero, 2006; Serageldin & Steer, 1994).

Vulnerability and institutional contexts are another vital component of the sustainable livelihood analysis framework; as it enables the exploration of trends, stresses, and shocks capable of influencing individual lives and livelihood. Shocks are associated with sudden events, while stresses are slower yet persistent occurrences, both of which are capable of obstructing lives and livelihood (Serrat, 2017). In both cases, single or multiple forms of capital could be affected. Trends provide an overview of current and future happenings capable of influencing lives and livelihood. An example of a trend would be an increased rate of population growth and consumption in a society; if not stabilised, this could compromise people's livelihood and wellbeing (Speidel, 2000), as it could influence asset levels accessible to individuals to prepare for disruptions and to develop a livelihood strategy. With respect to institutional context, Team (2003) noted the importance of a clear understanding of the legal framework within a system as well as potential interrelationships or lack thereof between institutions.

Additionally, Challies and Murry (2011) illustrated the role of institutions as governors of relationships and power structures with the example of raspberry growers whose output and market share was optimised through institutional aid. It is vital to note that institutions can be governments or non-governmental organisations. Cherni and Hill (2009) highlighted that while certain policies could

improve the livelihood outcome of the poor and assist a government in achieving its set goals, Tefera (2009) noted that this may not always be the case. This was exemplified in the criminalization of the khat crop in Ethiopia (Tefera, 2009). Even though the crop is a precursor for making addictive substances, it served as a source of livelihood to its growers; hence a government ban on the crop would adversely affect the lives and livelihood of the farmers (Tefera, 2009). In all, an in-depth evaluation of vulnerabilities and institutional contexts upon which individuals earn a living would be valuable for the development of a positive livelihood outcome (DFID, 2000; Morse & McNamara, 2013; UN, 2013).

2.2.1 Merits of SLA

Chang and Tipple (2009); Glavovic (2006); Høgh-Jensen et al. (2010); Mercer and Kelman (2010) highlight a people-centred approach of SLA, as it allows for the involvement of locals whose knowledge base could contribute to the formulation of developmental or intervention projects and policies. Similarly, the practical nature of SLA also encourages knowledge sharing among individuals living in a community as well as with outsiders (Butler & Mazur, 2007). Consequently, SLA is rooted in practical development, skills and technics perfected over time by stakeholders (Morse & McNamara, 2013). Rather than focusing solely on poverty or hazards, it encourages a holistic approach to addressing livelihood challenges through the assessment of vulnerabilities as well as institutions whose policies could directly influence livelihood (Allison & Ellis, 2001; Krantz, 2001). Where necessary, it could be applied in the assessment of opportunity costs associated with developmental projects or livelihood endeavours (McLennan & Garvin, 2012). Through the assessment and inclusion of historical data, SLA facilitates a dynamic modelling of livelihood strategies adopted by individuals (Pons Cortes, 2008). Finally, it is a valuable tool for the development of livelihood indicators capable of shaping developmental and intervention projects (Norton & Foster, 2001; Pons Cortes, 2008).

2.2.2 Challenges of SLA framework

Firstly, the inability of the SLA to explain or describe a phenomenon (Krantz, 2001; Mazibuko, 2013) makes the concept difficult to implement (Tao & Wall, 2009). Even though the sustainable livelihood framework highlighted the relevance of human capital, from the perspective of Tao et al. (2010), an in-depth analysis of a people's culture was not explicitly included. This could limit the ability of

policymakers and practitioners alike from understanding livelihood contexts and potential areas of intervention (Daskon & Binns, 2009). Similarly, an example by (Brinson et al., 2009), in which recreational fishing influenced the overall supply of fish stock in an area, highlighted a lack of consideration for leisure activities in the sustainable livelihood framework. From the perspective of Mazibuko (2013, p. 175), the SLA is "strength-based rather than needs-based"; in other words, it focuses on "what should happen rather than what needs to happen" thereby unintentionally fostering a top-to-bottom approach to development rather than the other way round. Consequently, it fails to challenge the status quo of inequality as the poor are forced to make do with what they have (Satgé et al., 2002).

Although not unique to the sustainable livelihood framework, (Morse & McNamara, 2013) noted the subjectivity in the measurement of capital as well as the effectiveness of substituting different forms of capital. For instance, financial assets, in most cases, can be used to acquire other assets. However, it could be argued that the conversion of other forms of capital (e.g., natural capital) to financial capital or the conversion of natural capital to social capital is relatively more complicated. As noted by Lapeyre (2011), the accuracy of results obtained from an SLA framework is dependent on trust and openness between the SLA participants and individuals or organisations conducting the study, as participants may be less incentivised in certain situations to accurately declare assets belonging to them. As a result of the participatory nature of the SLA framework as well as the unique nature of individual livelihoods, the implementation of SLA results could be challenging (Toner & Franks, 2006). This was illustrated by (Ahmed et al., 2010), in which the SLA results obtained from a community favoured the placement of restrictions on fishing. However, this could not be implemented due to a lack of an alternative livelihood option for fishermen in the community.

De Haan (2012) criticised the sustainable livelihood approach framework for increased concentration on livelihood at the micro level while disregarding the power dynamics that exists in a society. Lastly, although holistic, the SLA framework is less optimal for in-depth analysis of individual livelihoods in the context of multiple vulnerabilities, particularly at a macro-scale and a longer time frame (van Dillen, 2003). It is important to note that some of the criticisms placed on the SLA might not necessarily be

unique to the framework while others may be attributed to limited clarity in certain areas (Mazibuko, 2013). Consequently, it is vital to note that a relatively larger list of challenges associated with the SLA, when compared to its merits, is not aimed at diminishing the usefulness of the framework, rather it is indicative of the complex nature of individual livelihood analysis. The next section will focus on livelihood resilience.

2.3 The concept of resilience and its origins

Resilience comes from a Latin word resilire, which translates to "to recoil or rebound" (Hoddinott, 2014). From a livelihood perspective, Carr (2020) argues that resilience is an extension of sustainable livelihoods, as sustainability alone does not provide adequate explanation to livelihood continuity in situations of extreme stress or shock expected to capitulate livelihoods or at the very least prompt changes. Even though resilience thinking is "implicit in the sustainable livelihood approach" (Ifejika Speranza et al., 2014, p. 109), the concept of resilience complements sustainability as it captures transformation and long-term changes (Scoones, 2009; Thulstrup, 2015). In all, connecting livelihood approaches to resilience thinking provides an insight into livelihood dynamics of people and possible means of enhancing livelihoods in the event of a stress or shock (Marschke & Berkes, 2006; Sallu et al., 2010; Scoones, 2009).

The concept of resilience can be traced back to the field of ecology, as reflected in Holling (1973), where it was adopted to analyse the persistence and ability of a system to absorb disruption while maintaining the relationships with state variables. Within the fields of ecology, it facilitated the study of predator-prey interactions as well as their functional responses in relation to the stability of the eco-system (Folke, 2006). On the contrary, Hoddinott (2014) believed that the application and adoption of resilience were visible in 19th-century shipbuilding as well as in the fields of civil and mechanical engineering. From the engineering perspective, resilience reflects the ability of a system to return to its initial state after trepidation (Alinovi, D'Errico, et al., 2010). Resilience with respect to engineering focuses on attributes near equilibrium and the time it takes a system to return to stability after a disruption. On the other hand, from an ecological perspective, resilience represents the level of disturbance a system can withstand before a move to an alternative state becomes necessary (Hoddinott,

2014). In other words, ecological resilience is the capacity of a system to handle change through reorganisation, thereby retaining its function, structure, identity and feedbacks (Folke, 2006; Walker et al., 2002).

2.3.1 Ubiquitous nature of resilience

The concept of resilience appears to be somewhat ubiquitous as it has been applied to various fields ranging from food systems and agriculture in (Schipanski et al., 2016; Tendall et al., 2015) and (Milestad & Darnhofer, 2003) respectively to economics in (Walker et al., 2010) and anthropology in (Ungar, 2005). Consequently, the definition of resilience appears to vary slightly to reflect the ideals and risk context of a particular discipline. Similarly, indicators applied to assess resilience seem to vary as well. For instance, Sina et al. (2019) in a framework to assess livelihood in a relocation context, adopted individual coping ability, wellbeing, socio-physical robustness and access to resources as indicators of livelihood resilience. On the other hand, in a comparative analysis of livelihoods in Kenya and Cameroon, Awazi and Quandt (2021) adopted the five forms of capital (financial, human, social, physical and natural) as indicators of livelihood resilience. Hence, Ifejika Speranza et al. (2014) suggests that resilience indicators are context-dependent. Regardless of how resilience is viewed, system stability and transformation following disruption remain fundamental (Alinovi, Mane, et al., 2010; Atara et al., 2020). Resilience attempts to ensure good outcomes and sustained competence as well as the ability to recover from shock and stresses (Boyden & Cooper, 2007).

2.3.2 Livelihood resilience

The socio-ecological systems (SES) approach to resilience proposed by Folke (2006) might be most suited for individual livelihoods, as this viewpoint includes the idea of adaptation, learning and self-organization. Like socio-ecological systems, optimal functioning of individual livelihoods will not solely depend on persistence but would require flexibility in the face of stress and shocks (Atara et al., 2020; Carr, 2020). Consequently, proper assessment of potential disruption to individual livelihood is essential (Atara et al., 2020). Livelihood resilience refers to the ability of livelihoods to cushion disruptions and maintain or improve essential properties and function (Ifejika Speranza et al., 2014). It focuses on individual wellbeing in a manner that “preserves existing system of meaning, order, and

privilege" (Carr, 2020, p. 1). Livelihood resilience is aimed at limiting the potential of a critical decline in productivity and wellbeing (Ifejika Speranza et al., 2014). It draws attention to processes and factors that ensure a functioning livelihood despite disruptions (Atara et al., 2020). The concept of livelihood resilience enhances the understanding of transformation in developmental settings while accounting for adaptive interventions aimed at spurring positive livelihood change while factoring in power dynamics that could exist in a society (Carr, 2020).

Ifejika Speranza et al. (2014) proposed a framework for livelihood resilience which consist of three dimensions assessed by different indicators. These dimensions include buffer capacity, self-organisation, and the capacity for learning. The buffer capacity of a system refers to its ability to absorb change while maintaining its structure, identity, functions, and feedback (Carpenter et al., 2001). From a livelihood viewpoint, it is the ability of a people or an individual to cushion changes and achieve better livelihood outcomes through optimal utilisation of emerging opportunities (Ifejika Speranza, 2013). The buffer capacity of an individual is dependent on different forms of assets accessible to them (Ifejika Speranza et al., 2014).

Self-organisation refers to spontaneous re-creation of societal rules, values, norms, and organisation through the combination of a top-down process, informed by the contributions of everyday people without constraints imposed by external forces (Cumming, 2011). It refers to the extent to which a system, structure or network can direct its actions and outcomes (Ifejika Speranza et al., 2014). Self-organisation explains the influence of power, human agency, adaptive capacity and social interactions on resilience (Obrist et al., 2010). According to Ifejika Speranza et al. (2014), self-organisation can be assessed through the analysis of institutions, cooperation, and networks, network structures, as well as self-reliance. Institutions can boost or limit the adaptive capacity of an individual which is essential for building resilience (Malakar, 2012; Yaro et al., 2015). Cooperation and networks highlight the interaction between actors in an SES, thereby fostering the creation of rules, norms, and values, all of which build trust in a system and limit dependence on external actors (Ifejika Speranza, 2010). The analysis of network structures could illustrate connections capable of enhancing resilience (Janssen et

al., 2006). Self-reliance assesses the ability of a people to take protective or preventive actions without the need for external assistance (Ifejika Speranza et al., 2014).

According to Ifejika Speranza et al. (2014), the capacity to learn is another dimension of livelihood resilience. It is depicted by a person's ability to apply previous experiences to current challenges and actions (Argyris & Schön, 1978; Compas, 2007). The capacity to learn depends on the individual and their interaction with the wider socio-ecological system (Ifejika Speranza et al., 2014). This entails constant awareness of existing threats and potential opportunities that surround an individual (Kitagawa, 2021). Similarly, the ability to identify and share relevant knowledge is essential to improve learning capacity and ultimately build livelihood resilience (Weichselgartner & Pigeon, 2015). To foster livelihood transformation leading to a resilient livelihood, a shared societal vision reinforced by an inclusive decision-making process is required (Ifejika Speranza et al., 2014). A feedback mechanism is essential for improving learning capacity. This was illustrated by Milestad (2003), where farmers collected signals from the ecosystem and used the data to optimise farming processes.

In all, even though the concept of resilience is a useful complement to the sustainable livelihood approach framework, its meaning seems negotiable (Obrist et al., 2010) as it depends on the field of study under review as well as the context in which the study is conducted. The next section will provide a brief overview of the disaster context in New Zealand as well as the frameworks adopted to prepare, protect and improve livelihoods in the event of a disaster.

2.4 Disasters in New Zealand

New Zealand is a geologically active coastal nation located in the southwest of the Pacific Ocean and influenced by weather patterns from Antarctica, Australia, and the tropics (Saunders et al., 2020). In the last two decades, New Zealand has witnessed 30 disasters propagated by natural hazards (CRED, 2021; NZHistory, 2019). Apart from 2008, 2009, and 2014 in which no naturally propagated disasters were recorded, the country encounters an average of two natural hazards leading to disasters per annum. Figure 2.1 illustrates the frequency of different kinds of natural hazards resulting in disasters encountered in New Zealand.

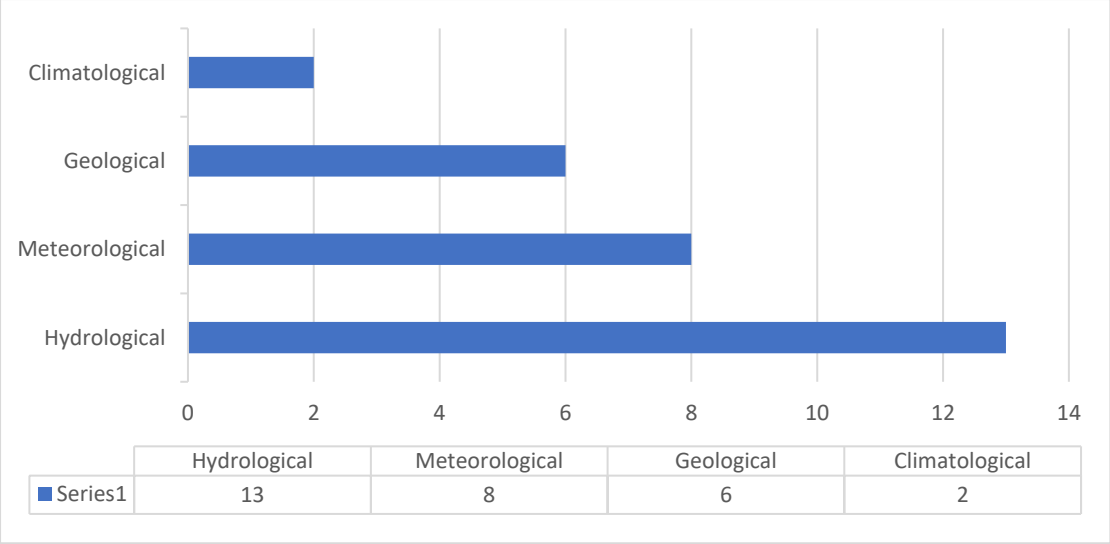


Figure 2.1 Frequency of different forms of hazards leading to disasters (2000 -2020) (adapted from (CRED, 2021)

Figure 2.1 depicts a relatively high prevalence of hydrological hazards resulting in disasters, as New Zealand witnessed 13 disaster events of hydrological origin in the past 20 years. This was followed by disasters propagated by meteorological events at eight and climatological events at two. Based on the classification outlined by the Centre for Research on the Epidemiology of Disasters (CRED, 2021), hydrological events are flood occurrences, while meteorological events manifest in the form of storms and extreme heat. Climatological hazards take the form of drought and wildfire. Just six hazards associated with geological disasters were recorded in New Zealand in the past 20 years. However, disasters propagated by geological events such as an earthquake and/or volcanic eruption have accounted for over 90% of lives and livelihood interrupted or terminated due to disasters. (CRED, 2021). With this in mind, the next section highlights the frameworks adopted in New Zealand to protect lives and livelihood.

2.5 Frameworks adopted to protect livelihoods in New Zealand

To limit the effect of hazards on lives and livelihoods, New Zealand has committed to the sustainable development goals, Sendai framework for disaster risk reduction and the Paris agreement on climate change (Saunders et al., 2020); as Murray et al. (2017) suggested that combining these frameworks produces an all-encompassing resilience agenda. The sustainable development goals are a collection of 17 individual goals composed of 303 indicators and targeting 169 different facets of lives and

livelihoods (Hák et al., 2016). Owing to the broad nature of the SDG, its successful operationalisation is dependent on constant monitoring and evaluation by experts (Hák et al., 2016). As a follow-up to the Hyogo framework for action (2005 -2015), the Sendai framework for disaster risk reduction was designed to serve as a bridge between disaster risk reduction policy and the SDGs as well as an integration to the broader development plan (Pearson & Pelling, 2015). It focuses on preventing new and reducing existing disaster risks by understanding risk, strengthening governance to manage disaster risk, investment in disaster risk reduction for resilience as well as the enhancement of disaster preparedness for optimal response and building back better (UNISDR, 2015).

The Sendai framework has been criticised for not meeting expectations, partly due to its less action-oriented approach (Mysiak, 2015). Pearson and Pelling (2015) further argue that the issues associated with the Sendai framework could be attributed to its non-legally binding nature as well as a lack of political will. Lastly, the Paris agreement on climate change is a legally binding treaty to limit global warming and has been adopted by 196 countries, including New Zealand (UN, 2019). The adoption of these international frameworks to the New Zealand context required the enactment of new laws or the modification of existing ones as well as development of national frameworks (Saunders et al., 2020). One such framework is the living standards framework (LSF) developed by New Zealand Treasury in 2018 (T. Treasury, 2019).

The LSF was designed to assist New Zealand Treasury in the provision of comprehensive policy advice to the government (T. Treasury, 2019). It encompasses 12 domains of wellbeing outcomes in New Zealand, four capital stocks (financial and physical capital were combined as one) needed to sustainably support wellbeing while accounting for risk and resilience across people, places, and generations (T. Treasury, 2019). To assist the government's ambition of adopting a well-being approach to strategic decision-making in matters of life and livelihoods, a suite of 100 indicators were developed encompassing 22 topics by (StatsNZ, 2019). According to StatsNZ (2019), this suite of indicators encompasses conventional economic measures such as GDP and measures of wellbeing and sustainable development. With respect to the laws developed or modified to align New Zealand with international frameworks and policies highlighted earlier, Saunders et al. (2020) suggested a modification of the

Resource Management Act (RMA) to account for vulnerability as well as a coherence across different legislative tools to ensure sustainable and resilient lives and livelihoods among New Zealanders. The next section will attempt to illustrate the relationship between business continuity and individual livelihoods.

2.6 Business continuity

A business is a collection of processes, strategies, and activities adapted to create value in the form of goods or services (Gibb & Buchanan, 2006). Businesses are occasionally directly or indirectly disrupted by disasters that halt value creation (Asgary et al., 2012). This could potentially compromise the lives and livelihoods dependent on the value created by the business (Asgary et al., 2012; Herbane et al., 2004). In the event of a disaster, business continuity is vital for the preservation of lives and livelihoods (Power & Forte, 2006). According to Speight (2011, p. 529), "*Business continuity is a management process that identifies potential factors that threaten an organization and provides a framework for building resilience and the capability for an effective response*." In simple terms, it requires out-of-the-box thinking (Ginn, 1989). Business continuity calls for the implementation of contingency plans while working tirelessly to guide against disasters (Borodzicz, 2005). It is fostered through a combination of resilience management, crisis management, disaster recovery, and business redemption, as well as contingency management (Hinson & Slade, 2011). it is aimed at preserving the competitive advantage of an organisation, through the identification of internal and external threats as well as the formulation of strategies and resources required to prevent, recover and preserve the values and ensure operational continuity despite disruptions (Gibb & Buchanan, 2006; Herbane et al., 2004). In other words, it aims to foster organisational resilience (Speight, 2011; Zeng & Zio, 2017).

2.6.1 Implementation of a business continuity plan

Botha and Von Solms (2004) likened the implementation of a business continuity strategy to building a twenty-foot wall around a city to secure it from invaders and other externalities. The wall builders could choose to build each section to the 20-foot mark before moving over to another section. However, this strategy would be less optimal as the entire city will remain vulnerable until all the sections are completed. An alternative to this arrangement is to build all the sections of the wall gradually but

simultaneously. This strategy ensures that the risk profile of the city uniformly decreases as the height of the wall increases. In other words, the implementation of a business continuity plan should follow a stepwise and cyclic process (Botha & Von Solms, 2004).

According to ILO (2009), business continuity starts with the identification of business priorities. This requires extensive knowledge of products and/or services provided by the business, as well as the critical activities required to produce and deliver these services (Herbane et al., 2004; ILO, 2009). A well-thought-out plan to sustain those critical activities is also vital (ILO, 2009). Hinson and Slade (2011) emphasised the need to have a workforce with a diverse skillset that would enable them to take up alternative roles where a colleague is incapacitated due to a disaster incident. The next step in ensuring business continuity is the analysis of risks capable of affecting a business (Hinson & Slade, 2011; ILO, 2009). This involves an assessment of risk impact on a business and its stakeholders, as well as the assignment of ratings to different risks. Sequel to risk analysis is the formulation of steps to mitigate against risk effect. This will require knowledge management, workplace flexibility, supply chain management, effective communication and clear policies on insurance and security measures, as well as the inclusion of redundancies in a system (Hinson & Slade, 2011). An unambiguous and standardised set of policies (Hinson & Slade, 2011) will facilitate effective communication and a clear action plan for personnel and customers alike for crisis adaptability needed for business continuity (Herbane et al., 2004). As soon as a business continuity plan is formulated, it should be clearly communicated both within the organisation and externally (Hinson & Slade, 2011; ILO, 2009). Additionally, a business continuity plan needs to be periodically tested to ensure its continual viability (ILO, 2009; Timms, 2018). Hinson and Slade (2011) argue that the testing process should devote equal attention to both customer-facing operations and aspects of the continuity plan that would affect staff welfare.

Staff welfare and protection in disaster situations are of particular importance for business continuity, as without them, recovery and restoration activities will prove challenging (Gibb & Buchanan, 2006; Herbane et al., 2004; Serrano & Kazda, 2020). This was highlighted by the 2011 Christchurch earthquake, in which businesses found it difficult to resume operations due to loss of staff members

who either left the city or were injured or killed after the disaster (Hinson & Slade, 2011). Hence, Hinson and Slade (2011); Serrano and Kazda (2020) called for increased sensitivity on the part of businesses as post-disaster periods are usually traumatic for most employees. In addition to encouraging healthy lifestyle practises, where necessary, psychological counselling should be provided for staff post-disasters (Serrano & Kazda, 2020). Staff on their path should aim to maintain social connections within the workplace and family members, as speaking to people in the same situation could limit the stresses associated with disruptions (Serrano & Kazda, 2020).

2.6.2 Factors influencing business continuity

The extent of losses suffered by a business is dependent on internal factors such as owning vs. renting a business facility, the type, size, age of the business and the gender of the business owner, as well as their financial standing pre-disaster and external factors such as the availability of social and institutional support (Asgary et al., 2012). Dahlhamer and D'Souza (1995); Dahlhamer and Tierney (1996); Turner et al. (1986) found that businesses who owned their operating facility were likely to invest in disaster preparedness measures pre-disaster, thereby limiting the likelihood of significant disruptions post-disaster. The benefits of good financial standing and size were illustrated by Tierney and Dahlhamer (1997), where smaller businesses in Southern California with limited financial capital struggled to prepare for earthquakes in spite of their awareness of the dangers it poses to their businesses. Larger businesses tend to be older and more financially stable (Asgary et al., 2012). Dahlhamer (1998); Kroll et al. (1991) concluded that smaller businesses suffered greater losses when compared to their larger counterpart in the same location and industry. On the contrary, Griffin (1990) suggested that smaller businesses performed better financially than larger organisations and also noted that their survival is essential for the continuity of larger businesses, as they facilitate the distribution of goods and services produced by larger organisations. Additionally, smaller businesses tend to be more innovative (Barrow, 1993) and also have a less complex infrastructural setup (Botha & Von Solms, 2004) both of which are essential for business continuity. With respect to the gender of the business owner, Auster (1988); Loscocco and Robinson (1991); Morrow and Enarson (1996) argued that female owned, and operated businesses were less likely to recover post-disasters when compared

to those owned and operated by men due to sociological factors mostly around gender equity. With regards to social and institutional support for businesses post-disaster, (Mead & Liedholm, 1998) linked these to the location of the business, as businesses in rural areas within developing countries received limited support.

2.6.3 The success of business continuity

For business continuity to be successful, a speedy recovery is essential following an operational disruption due to unforeseen circumstances, as faster recovery time will limit transaction delays and loss of goodwill (Botha & Von Solms, 2004; Herbane et al., 2004). Nonetheless, a thorough recovery should not be sacrificed for speed as this could lead to other long-term issues (Herbane et al., 2004). An optimal business continuity plan should be tailored to cater to disasters peculiar to a location but robust enough to handle mundane ones (Hinson & Slade, 2011). Herbane et al. (2004) further highlighted the importance of a resilient supply chain and called for the inclusion of the entire workforce in the continuity planning rather than leaving the entire process to IT or management (Gibb & Buchanan, 2006). In other words, the business continuity plan should be absorbed into the organisation culture and activities to the point that every employee knows and understands their role by heart in the event of a disaster (Lindström et al., 2010). A successful business continuity plan requires optimal management of the recovery process aimed at managing surprises and complexities associated with disruptions (Zeng & Zio, 2017). Disaster prevention is the preferred option for business continuity, but a protection strategy tailored to mitigate against potential threats is a desirable second option (Herbane et al., 2004; Zeng & Zio, 2017). In the event of a disaster, Hinson and Slade (2011) highlighted the need to effectively manage communication with the media and other external bodies to establish a narrative that protects the goodwill of the organisation, without underplaying or misrepresenting the losses sustained in a disaster. In all, post-disaster, the true indicator of a successful business continuity plan is the survival of both the staff and the reputation of the business.

2.7 Summary

So far, it could be argued that most livelihood frameworks have been formulated from a developmental perspective and adapted to assist governments in formulating and implementing policies that are

perceived to limit or eliminate the effects of disasters on lives and livelihoods. Additionally, an attempt was made to highlight the interrelationship between business continuity and individual livelihoods in a disaster. The extensive literature review on livelihood sustainability and resilience has not delivered any operational framework that can be used to assess how prepared people's livelihoods are for disasters propagated by natural hazards. This study will attempt to fill this gap, starting with a systematic review of literature in the next chapter. The systematic review of literature will attempt to derive indicators of livelihood preparedness as well as factors influencing them from the perspective of individuals living in vulnerable situations and those who have lived through disasters. Results of the systematic literature will inform the development of a tool that can be used to measure livelihood preparedness within a specified location. Due to the unique nature of disasters and livelihoods, it is essential to note that the tool developed in this study might be only applicable within a particular location. Further studies may be required to understand how best it can be modified for use in other places.

Chapter 3 A systematic review of literature

This chapter applies a systematic review of literature to identify the indicators of livelihood preparedness and factors that influence these indicators in hazard settings. It starts with the adoption of the PRISMA protocol, which guides the establishment of search terms and patterns as well as the identification of relevant databases that will be consulted. Subsequently, indicators and factors highlighted in the search will be analysed across different geolocations as well as in different hazard and livelihood contexts. Finally, an attempt will be made to highlight factors that seem to influence multiple livelihood indicators.

3.1 Protocol of a systematic review

To identify indicators of livelihood preparedness and factors affecting them in a hazard setting, we used a flow diagram for systematic review and meta-analysis (PRISMA) protocol (Moher et al., 2009; Walker, 2010) (See Figure 3.1). Compared to conventional literature review, a systematic review entails the identification, analysis, and interpretation of relevant results to a research question (Budgen & Brereton, 2006). It provides a broad, clear, and repeatable search of literature (Walker, 2010) through an exhaustive and scientific search of published and unpublished studies while limiting biases in the review process (Tranfield et al., 2003). Additionally, it improves the examination process through the provision of an objective summary of evidence concerning a topic or phenomenon (Budgen & Brereton, 2006). As shown in Figure 3.1, the systematic review is composed of the following four steps:

1) Article identification,

2) Article screening,

3) Eligibility,

4) Inclusion of articles and data synthesis

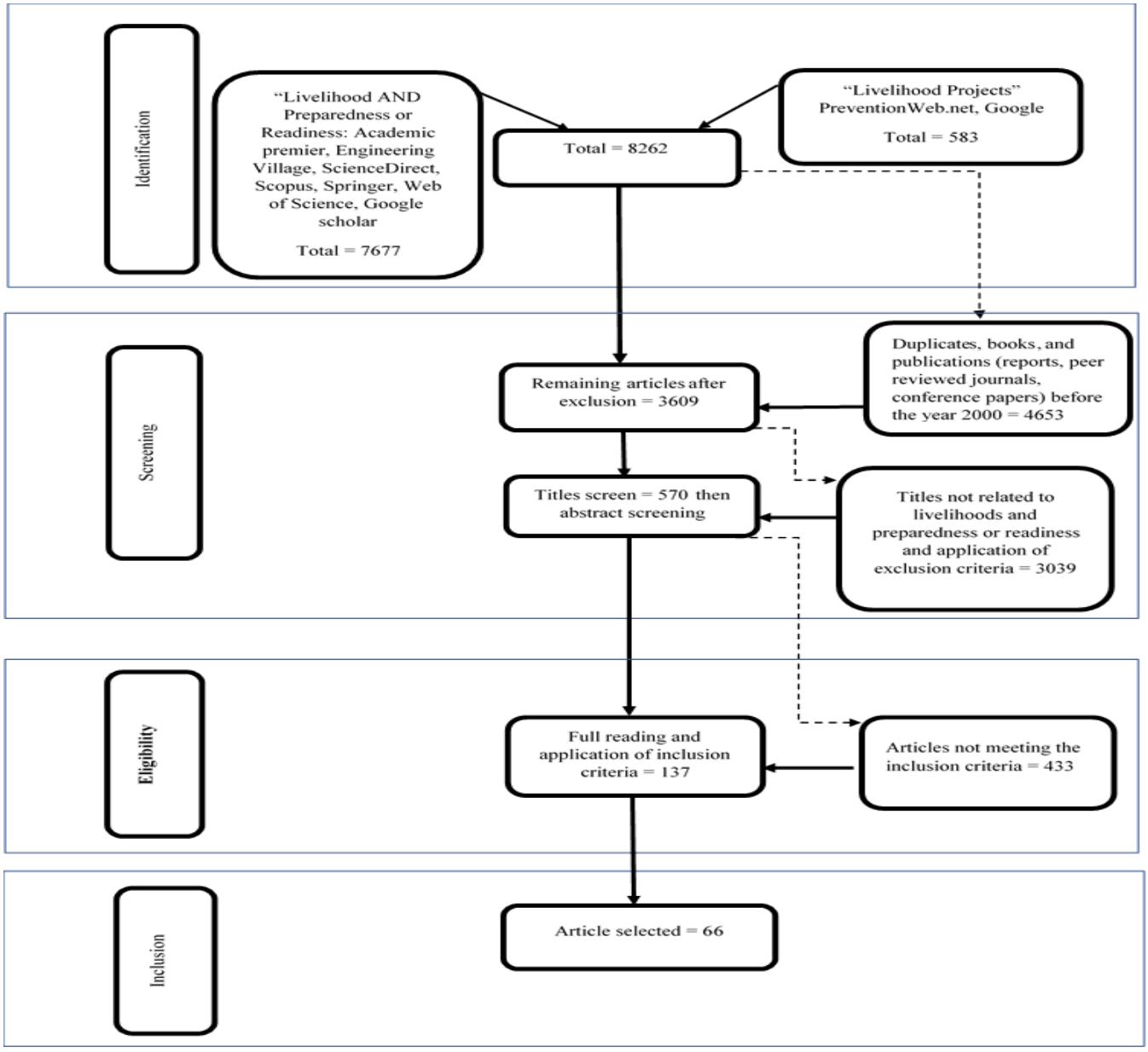


Figure 3.1 PRISMA diagram of literature search and inclusion

Step 1: Article identification: This step focused on the identification of relevant articles from available literature. Between October 2018 and September 2019, a search of literature was conducted to identify relevant literature. To ensure that relevant and current articles are considered in the systematic review, articles that were published before 2000 were not considered; only papers published between 2000 and 2019 were selected for this study. To standardise the identification process and limit the number of irrelevant articles obtained, keywords "Livelihood AND Preparedness OR Readiness" were formulated

at the stage of article identification. These keywords were then applied to seven databases, namely, Academic Premier, Engineering village, Science Direct, Scopus, Web of Science, Springer, and Google scholar. The first six databases were used because they publish high-quality peer-reviewed journals in wide-ranging fields, including studies on livelihood and disaster preparedness. In addition, Google Scholar was used as it contains other academic publications that were not indexed in the other six databases mentioned above. The initial search across the seven databases resulted in 7677 articles identified.

It was also important to consult grey literature for facts, statistics, additional information relevant to the topic defined in this research but were not available in academic literature. Google and Preventionweb.net were used as main sources of grey literature because they contained policy and consulting documents published from most governments and reputable Non-government Organisations (NGOs). However, the search term was modified to "Livelihood Project" as it will suit the nature of the work undertaken by these agencies when using Google and Preventionweb.net. Another 583 articles were added to the list, which resulted in a total of 8262 publications from the initial identification stage.

Step 2: Article screening: At this stage, the focus was on quality checking and screening of identified articles. During the screening, publication year and completeness of the articles were checked. Articles without full text (i.e., abstracts only) or written in languages other than English were also excluded. After removing these and duplicates, the number of articles was down to 3609 papers.

Nonetheless, attention was given to pioneer papers in the fields of livelihood studies and disaster preparedness, which assisted the authors with an improved understanding of livelihood research. We then screened the abstracts to check the relevance of the article to the research questions set out for this review. Those articles that focused solely on disaster impact, business continuity, community resilience and government interventions post-disaster were further excluded. The number of identified articles was then reduced to 137.

Step 3: Eligibility – At the eligibility stage, articles were read thoroughly to assess if they met the inclusion and exclusion criteria. These selection criteria include:

- **Source of articles:** Only articles published in peer-reviewed journals or by governments and reputable NGOs will be included. This was to meet the quality criteria set out by (Patriksson & Larsson, 2014), which focused mostly on article relevance, background, methodology, motivation, and analysis.

- **Focus of the article:** Articles that focus on the livelihoods of individuals, households, or communities will be included. Those with a sole focus on registered cooperation or business entities will be excluded.

- **Type of event discussed in the article:** Those articles that have a context of natural hazards will be included. According to Marzo and Mori (2012), the impact mechanism of natural hazards on individuals differs from other events such as economic crisis, disease/epidemic, and human conflict. So, for the purpose of this research, articles that are related to other types of events, such as economic crisis, disease/epidemic, and human conflict, were excluded.

Of the 137 articles evaluated, during the eligibility stage, an additional 71 articles were excluded when applying the above selection criteria. This left 66 papers to be included in the review.

Step 4: Inclusion and data synthesis – To answer the research questions set out before the literature search, this step focused on derivation of information from all the 66 articles. In particular, data extraction from each paper included such information as the year of publication, the source of publication, the country where a disaster event or a series of disaster events occurred, the type of natural hazard discussed in the article, the livelihood preparedness indicators and the factors affecting each indicator, as well as the context of the research or of a practical aid work that was undertaken. Data on hazard types, indicators, and factors were examined across different geolocations for patterns. These contents were extracted from each article into an Excel Spreadsheet.

The review of all the articles and analysis of their contents generated both quantitative and qualitative results. Quantitative data about the included articles, such as the year of publication, source of publication and country where a disaster event or a series of disaster events occurred, and type of natural hazard, was analysed using frequencies, percentages, and ranking. Qualitative data about the indicators

and factors affecting each indicator were analysed using thematic content analysis. The results are presented using tables, figures, and texts in the following section. The percentage representation of each item presented in the following section was arrived at through the number of articles in which the item was discussed divided by the total number of articles included in this review.

3.2 Outcome of the systematic review of literature

The plotting of the publication year of all the 66 articles shows that over 80% of the included articles were published after 2010 (See Figure 3.2). However, it should be noted that for most publications, there is a significant time lag from the research stage to publication (Augustine et al., 2019; Nguimalet, 2018). Research or practical work on livelihood preparedness seemed to be static between 2000 and 2010, but, from 2011 onward, this topic seemed to have drawn attention from academia and practitioners, with the highest number of 14 publications recorded for 2018.

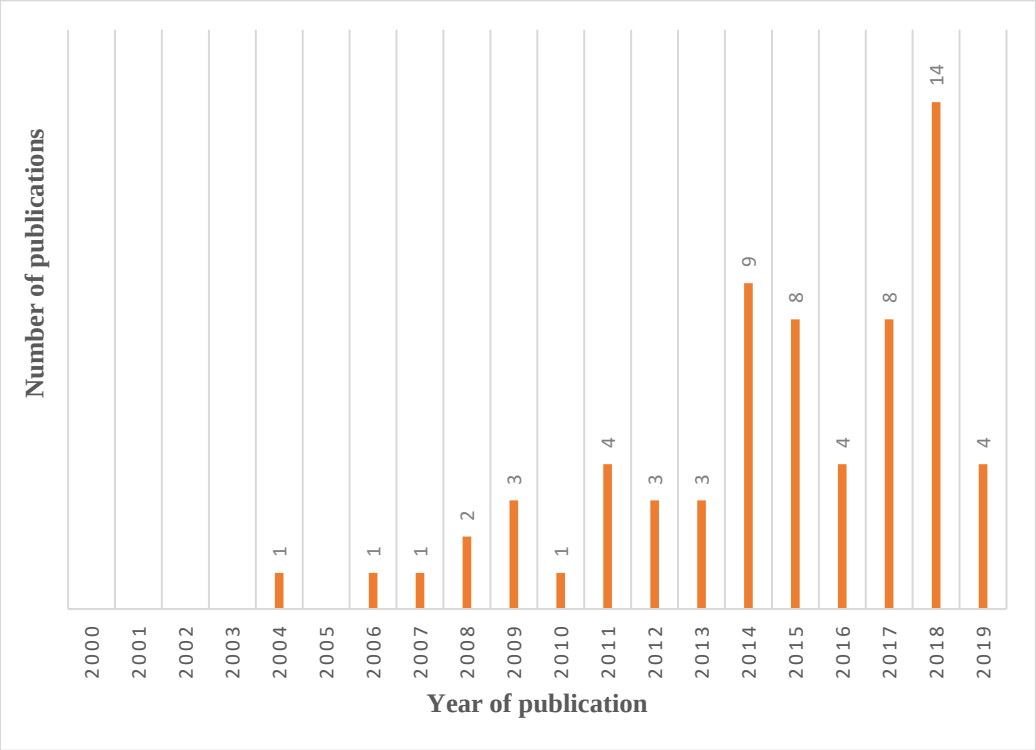


Figure 3.2 Distribution of the included articles

When analysing the distribution of the country of origin where a disaster event or a series of events took place, Table 3.1 presents a list of the countries discussed in the included publications. Of the 40 nations highlighted in Table 1, 47% of articles focused solely on Asia. Within the Asian region, Bangladesh alone accounted for almost a third of included articles.

Table 3.1 Number of articles that focused on each country

No	**Countries**	**Number of Publications**	**No**	**Countries**	**Number of Publications**
1	Afghanistan	2	21	Jordan	1
2	Australia	2	22	Kenya	3
3	Bangladesh	9	23	Mexico	1
4	Bhutan	1	24	Morocco	1
5	Botswana	1	25	Namibia	2
6	Cameroon	1	26	Nepal	4
7	Central African Republic	1	27	Nepal	4
8	China	5	28	New Zealand	1
9	Columbia	1	29	Nicaragua	1
0	Costa Rica	1	30	Nigeria	4
11	DRC	1	31	Pakistan	5
12	Ecuador	1	32	Philippines	1
13	Ethiopia	2	33	Sri Lanka	2
14	Ghana	2	34	Syria	1
15	Guatemala	1	35	Tunisia	1
16	Honduras	1	36	Uganda	1
17	Iceland	3	37	Vanuatu	1
18	India	7	38	Vietnam	1
19	Indonesia	4	39	Zambia	2
20	Iran	1	40	Zimbabwe	2

When grouping these 40 nations into five regions, as shown in Figure 3, both the Australian and Pacific region and South and Central America had equal representation (6.06% respectively) in the number of articles that met the inclusion criteria. Over a quarter of included articles (27.27%) focused on disaster

events that happened in the African continent. Europe, on the other hand, was least represented in Figure 3.3 at 3.03%, while publications from North America were absent.

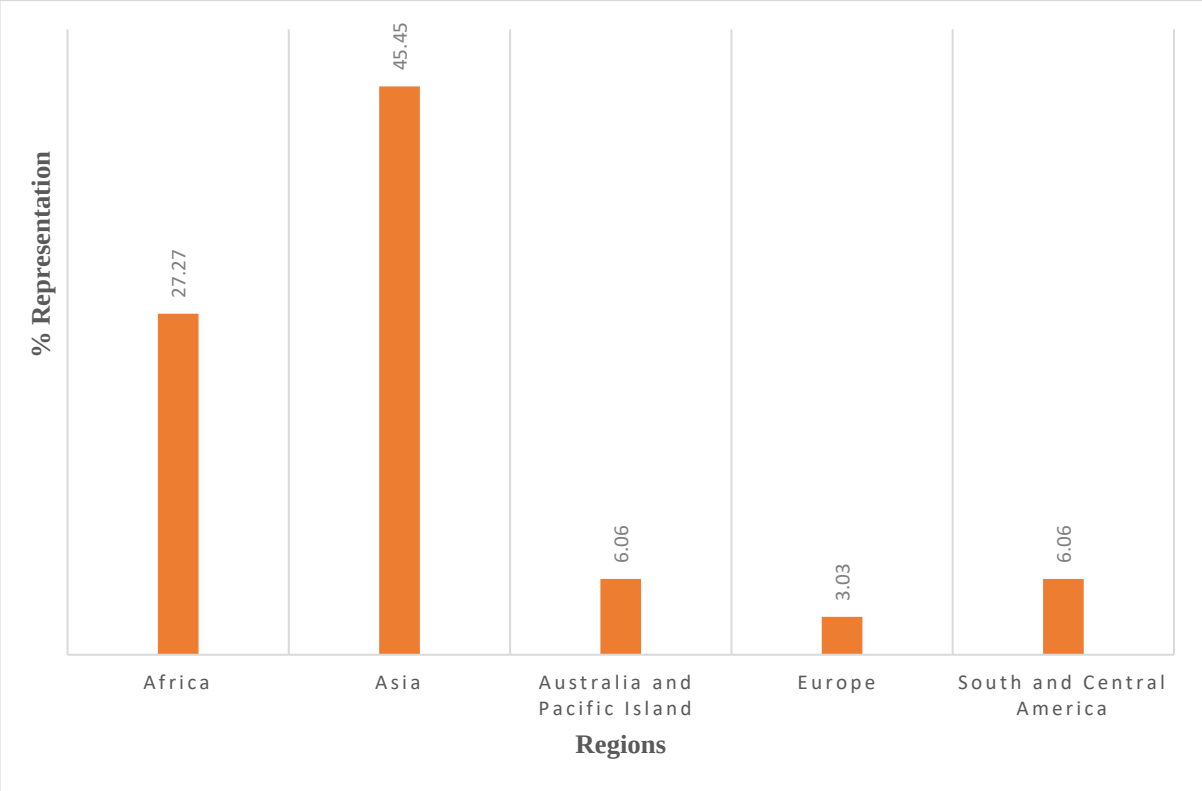


Figure 3.3 Percentage representation of included articles by regions

Additionally, livelihood strategies adopted in most of the included studies focused on primary industries. This is possibly due to the vulnerable nature of livelihoods dependent on primary industries (Sujakhu et al., 2018). In all, there seems to be an ongoing discussion globally on the necessity to prepare livelihoods for potential disruptions.

Figure 3.4 shows the percentage representation of different disasters as classified by CRED (2021) with slight modifications. While the Centre for Research on the Epidemiology of Disasters (CRED, 2021) classified hydrological and meteorological disasters separately, in this paper, hydrological and meteorological disasters were grouped together (termed as hydro-meteorological disasters) as most included articles that featured meteorological perturbation also highlighted hydrological disasters.

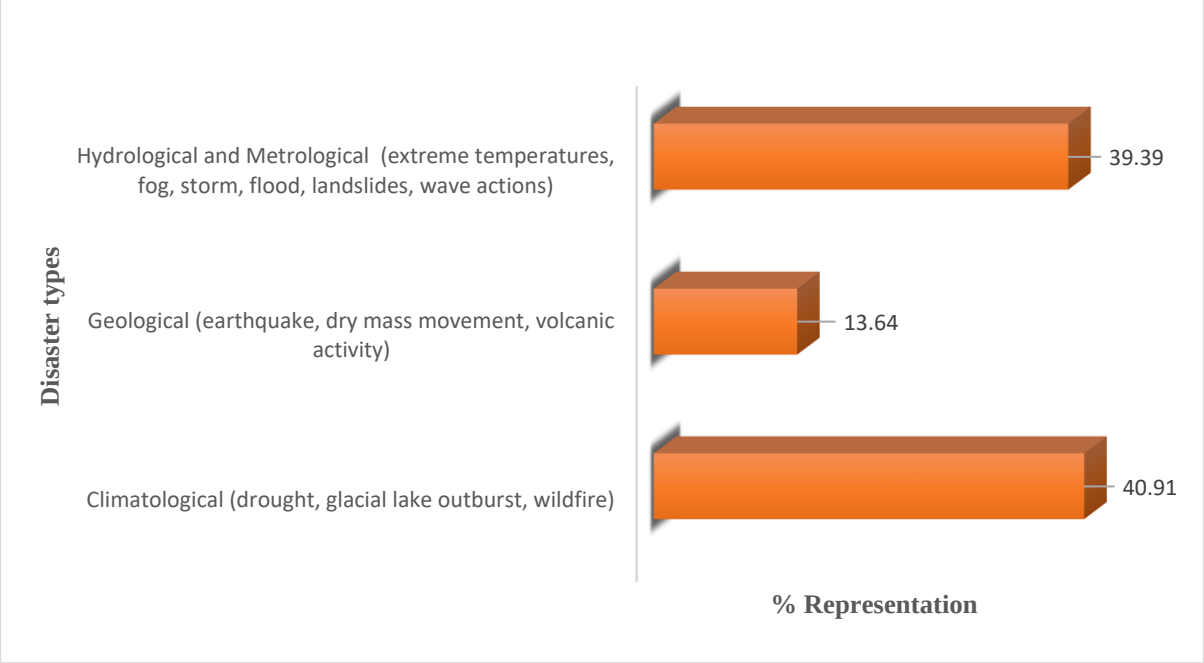


Figure 3.4 Percentage representation of different disasters as highlighted in literature

Approximately 40% of articles discussed the livelihood preparedness indicators and factors in the context of climatologically related disasters such as drought, glacial lake outburst, and wildfire, while the other near 40% of articles focused on livelihood discussion in settings of hydro-meteorological disasters such as extreme weather conditions, floods, storms, landslides, and tsunamis. Only about 13% of articles were related to livelihood preparedness in the context of geological disasters such as earthquakes and volcanic eruptions.

Table 3.1 illustrates the source and percentage composition from each source of articles selected in the systematic review. It shows that peer-reviewed journals contributed 86.4% of selected articles, followed by reports by NGOs at 10.6% and academic conference papers at 3%. Among 36 journal sources, the largest number of articles came from the International Journal of Disaster Risk Reduction at 22.8%, while two journals (Environmental Science and Policy and Journal of Mountain Science) each contributed 5.3% to the total number of journals selected. A combination of 28 different peer-reviewed journals represented 49.1% of the total number of journals. With respect to seven reports, Oxfam

contributed four, followed by Practical Action (two reports) and Unnayan Onneshan (one report). There is no government publication included for the review. However, two conference papers were included.

Table 3.2 Source of the included articles

Source	Number of articles from source	Percentage	Percentage of article type in included literature
Peer-reviewed journals			
International Journal of Disaster Risk Reduction	13	22.8%	86.4%
Environmental Science and Policy	3	5.3%	
Journal of Mountain Science	3	5.3%	
Environmental Science and Policy	2	3.5%	
Land Use Policy	2	3.5%	
Natural Hazards	2	3.5%	
Environmental Hazards	2	3.5%	
Weather and Climate Extremes	2	3.5%	
Others	28	49.1%	
Total number of journals	57		
Reports from government agencies and NGOs			
Oxfam	4	57.1%	10.6%
Practical Action	2	28.6%	
Unnayan Onneshan	1	14.3%	
Total number of reports	7		
Conference papers			
International Conference on Disaster Management	1	50%	3%
RISK21 – Coping with Risks Due to Natural Hazards in the 21st Century	1	50%	
Total number of Conference papers	2	100%	

The illustration in Table 3.2 suggests that studies on individual livelihood and preparedness are neither confined to the academic field nor NGOs. Even though an overwhelming majority of included articles came from peer-reviewed journals and academic conferences, policy papers in the form of reports released by NGOs also featured individual livelihoods and preparedness matters.

3.3 Indicators of livelihood preparedness

Livelihood and disaster preparedness may be uniquely important because they could shorten the time spent on recovery (Cannon, 2006). Hence the formulation and application of livelihood indicators could facilitate the evaluation and monitoring of individual or communal livelihoods through the provision of vital information to policymakers and individuals alike (Niedritis et al., 2011; J. Njuki et al., 2011). An in-depth examination of literature suggests the following four indicators can be used to measure the level of livelihood preparedness in a disaster context: (1) resource accessibility, (2) livelihood diversity, (3) individual adaptive capacity, and (4) effectiveness of individual DRR measures. Figure 3.5 depicts the percentage distribution of included literature that highlighted various indicators for livelihood preparedness.

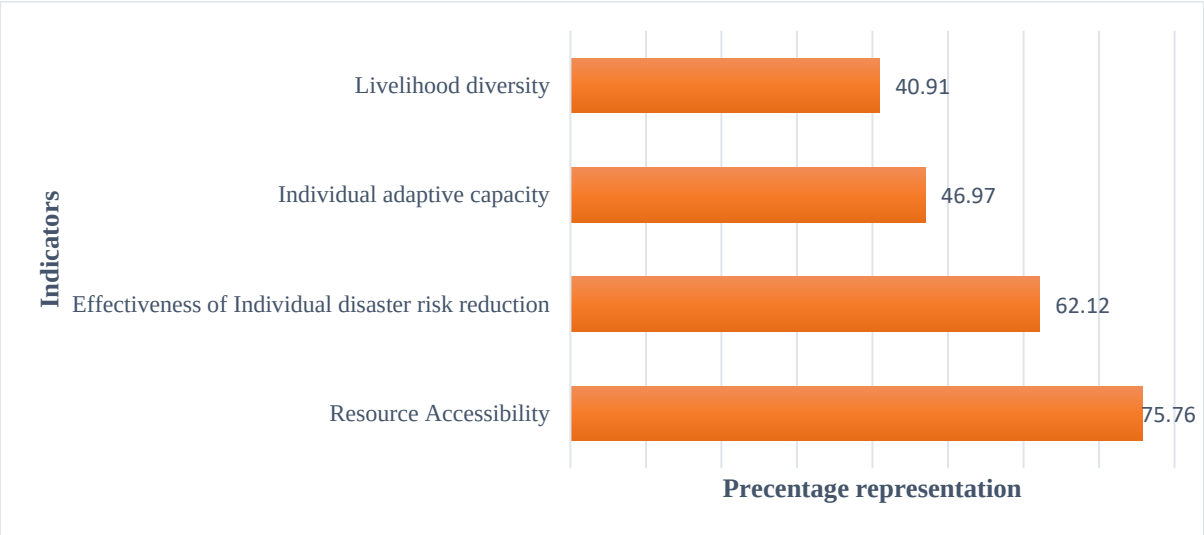


Figure 3.5 Percentage representation of indicators in included articles

There are four categorisations of indicators identified in a natural hazard environment, which included: 1) livelihood diversity, 2) individual adaptive capacity, 3) effectiveness of disaster risk reduction measures and 4) Resource accessibility which was most highlighted in selected literature at (75.76%). This was followed by the effectiveness of disaster risk reduction measures at (62.12%). Individual adaptive capacity and livelihood diversity were highlighted in 46.97% and 40.91%, respectively. Starting with resource accessibility, the next few sections will provide an overview of these indicators of livelihood preparedness.

3.3.1 Resource accessibility

Resource accessibility is defined as the ability to access a collection of resources when confronted with unforeseen circumstances (Rampengan et al., 2014; United Nations International Strategy for Disaster Reduction, 2004). According to Ahsan (2017), productive assets comprises of financial, physical, and human assets. Financial assets in this context include remittances, savings, income, and other money-related attributes. Financial assets are particularly unique in that they can be used to acquire other asset classes (Manlosa et al., 2019). Limited access to financial resources is a significant contributor to poverty and vulnerability to hazards globally because it limits individuals' ability to adapt to or reduce the effects of hazards on their livelihood (Baffoe & Matsuda, 2018; De Silva & Kawasaki, 2018). Physical assets in this context mostly consist of livelihood infrastructure, as well as producer goods, services, and technology. As seen in the 2016 Kaikōura earthquake, limited access to physical assets such as livelihood infrastructures could compromise the livelihood and wellbeing of individuals who live through and recover from a disaster (Stevenson et al., 2017). However, Yang et al. (2018) suggested that, through information technology, individuals can access information that could assist in the acquisition of other asset classes for livelihood preparedness. In examining appropriate technology to reduce risks and protect assets in Bangladesh, Clot (2014, p. 253) advocated that technology such as "smart hardware" could also enable individuals to adapt to or reduce the effects of an impending disaster.

Human assets encompass labour, skills, experience, age, knowledge, literacy, and other human attributes (Rampengan et al., 2014; Zhang et al., 2012). The age and literacy of individuals may affect their accessibility to resources since people of different age groups, and educational levels likely have access to different asset classes (Venugopal et al., 2019). The literacy level of individuals also influences their ability to adapt to an evolving situation or take effective DRR measures (Wan et al., 2019). A lack of human capital, such as knowledge and skills, also limits people's use of other asset classes (Baffoe & Matsuda, 2018; Fang, 2013).

An individuals' location determines, to some extent, the kinds of assets readily available to them as well as their ability to adapt to or mitigate against disaster risks (Jagnoor et al., 2020). For instance,

individuals in the Char community of Assam whose livelihoods are threatened by flood noted that they had to travel far to access certain livelihood assets that were not available in their locality (Jagnoor et al., 2020). In examining emergency preparedness for people with disability, Smith and Notaro (2009) suggested that discrimination of any form in a society creates social inequality and limits resources available to individuals to protect their livelihoods from disruptions. While individuals' access to resources could indicate their preparedness levels, it also influences other indicators of livelihood preparedness, one of which is livelihood diversity (Kimengsi et al., 2019).

3.3.2 Livelihood diversity

Livelihood diversity indicates the range of different livelihood strategies employed by an individual to earn a living (Kimengsi et al., 2019). As an indicator of livelihood preparedness, it seeks to measure the level of interdependence and variance between different livelihood strategies adopted by an individual. Individuals may choose to diversify their livelihood as a hedging tool (Ning et al., 2014) or a means to adapt their livelihoods in turbulent times (Le Dé et al., 2018). As a livelihood diversification strategy, people may be inclined to create multiple income streams (Molua, 2009). However, it is imperative to note that income diversification may not translate into livelihood diversification, but a diversified livelihood strategy could deliver different income sources. Livelihoods can be diversified within the same sector (internal diversification) or away from the core business of an individual (external diversification) (Ning et al., 2014).

Assets such as technology combined with knowledge and skills in livelihood endeavours could determine the ability of individuals to diversify their livelihoods internally or externally (Castellanos et al., 2013; Newport et al., 2016; Ning et al., 2014). Where possible, individuals may choose to migrate in search of a better livelihood option (Fakhruddin & Rahman, 2015). Nonetheless, irrespective of the kinds of resources available innovation has a role to play in individual livelihood diversity because it enables the creative use of assets to promote and protect individual livelihoods, thereby mitigating against disaster impacts (Chang-Richards et al., 2013; Molua, 2009).

3.3.3 Individual adaptive capacity

Individuals' adaptive capacity denotes their ability to adjust their lives and livelihood options to thrive during and after a disaster (Daramola et al., 2016). It may be partly dependent on the adaptive capacity of the household, as an individual is the smallest component of a household (He et al., 2018). According to Daramola et al. (2016), a decrease in adaptive capacity often results in an increase in vulnerability to disasters which can lead to a compromised livelihood. This may well be influenced by their local knowledge about the societal beliefs, culture, language, norms and hazards peculiar to a place (Daramola et al., 2016). However, risk perception that is shaped by previous disaster experiences may also affect the way individuals adapt to disruptions (Anushka et al., 2018; Eiser et al., 2012). Moreover, (Ademola et al., 2016) found that, because of the physical and psychological impacts of a disaster, the health and mental wellbeing of individuals prior to a disaster could also influence their livelihood adaptation options. Lastly, the presence of dependants and loved ones could inhibit or propel an individual's ability to adapt to turbulent situations (He et al., 2018).

3.3.4 Effectiveness of individual disaster risk reduction measures

The effectiveness of individual DRR measures seeks to ascertain preparedness measures that are put in place by an individual to mitigate or eliminate the effects of hazard on lives and livelihood (Gebrehiwot & van der Veen, 2015; Kumar et al., 2013; Løvholt et al., 2014). In combination with other factors, mutual support among individuals living in the same locality assists in the development and implementation of a communal disaster reduction strategy (Mabuku et al., 2018). Governments and NGOs can also influence DRR measures because certain preparedness measures could be beyond the capacities of an individual or a community (Armijos et al., 2017). Nonetheless, Garai (2017) suggested that communal residents should be involved in the formulation of DRR measures propagated by the government. Early warning systems, as well as effective hazard communications, would give individuals time to take measures to reduce the effects of hazards (Akwango et al., 2017). Belle et al. (2017) demonstrated that better DRR outcomes could be achieved if individuals were trained to conduct DRR exercises or drills.

Some DRR measures might require the infusion of local and modern DRR techniques, especially in areas of structural preparedness and technology (Garai, 2017). Nevertheless, it is noted that caution should always be employed to avoid creating a false sense of security in relation to structural preparedness (Augustine et al., 2019). In some situations, migration or relocation might be the only option available to individuals to save their lives and livelihoods (Kelman et al., 2017). Therefore, how the relocation or displacement takes place will affect people's lives and livelihoods following a disaster (Jagnoor et al., 2020). In all, individual livelihood preparedness may depend on a person's will to take preparedness actions (Barclay et al., 2015; Cannon, 2006).

3.4 Factors affecting indicators of livelihood preparedness and percentage representation in literature

3.4.1 Factors affecting livelihood diversity

Figure 3.6 shows that an overwhelming majority of articles that indicated the relevance of livelihood diversity stressed the influence of access to resources (92.59%). This trend was affirmed in a case study conducted by Walsh and Fuentes-Nieva (2014), in which the European Union (EU) and OXFAM worked to limit the impacts of disaster on individual lives and livelihood. While parts of the project succeeded, it was unable to assist individuals in diversifying their livelihood endeavours because of peoples' limited access to resources.

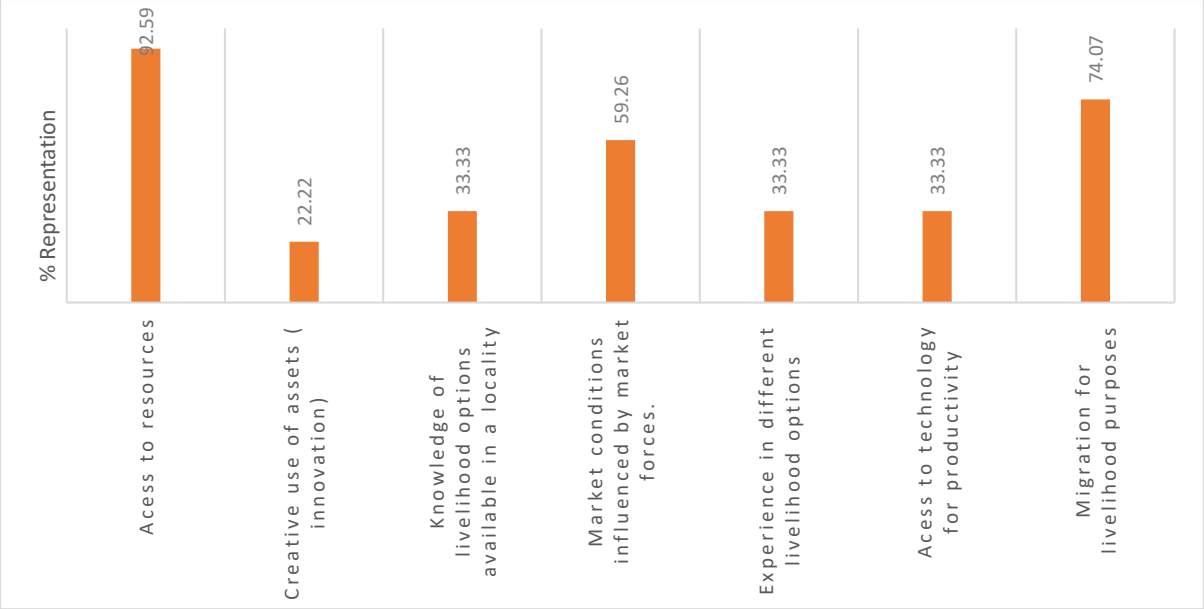


Figure 3.6 Percentage representation of factors that influence livelihood diversity

Migration for livelihood purposes was also highlighted in significant numbers of included articles (74.07%). In the included literature, it was found that individuals tend to migrate for two main purposes; either for apparent economic benefits or to relocate following disasters. Migration influences livelihood diversity as Chapagain and Gentle (2015) and Manandhar (2016) found that people may expect to diversify the income sources of themselves as well as that of their dependents by migrating to another place. It is somewhat a double-edged sword as excess emigration could limit the collective ability of a community to diversify its economy (Baffoe & Matsuda, 2018) while potentially increasing livelihood strains in the migrant's destination (Senapati & Gupta, 2015). Migration for economic benefits is often initiated in the hope to secure new jobs which may not exist in the new destinations (Kumasi et al., 2019).

Similarly, the choices to diversify individual livelihood are dependent upon the market conditions of a certain livelihood option. This was signified by just over half of the articles that pointed out the importance of livelihood diversity. Market conditions often influence people's choice to either expand their leverage in their current livelihood strategy or invest in alternative endeavours (Castellanos et al., 2013). Ning et al. (2014) suggested a correlation between market conditions and migration as the perceived availability of a better life draws individuals to migrate. Nonetheless, migration has the ability

to provide markets and livelihood endeavours (both for the sojourner and their host) that were not available prior to migration (Ning et al., 2014).

The influence of technology was either depicted for productive purposes (Castellanos et al., 2013; Newport et al., 2016) or a tool for disaster risk reduction (Clot, 2014). In some cases, it can be applied for both purposes (Hansen et al., 2019). Approximately 33% of included articles highlighted the influence of technology for productive purposes as an influencer of livelihood diversity. In particular, Rampengan et al. (2014) depicted a link between migration, access to technology for production, and skills acquired for different livelihood endeavours by examining Laingpatehi migrants; who moved from their community to other locations (Laolalang, Halmahera Island, Bolaang Mongondow) in order to earn a living from fishing and tree crop harvesting or participating in government's resettlement programmes. A particularly underrepresented factor, yet arguably one of the most important, is the innovative use of assets. It was represented in above 22% of the included articles. This factor focused on various ways in which individuals could use their assets for other income-making purposes, such as using part of their house to provide commercial accommodation or a farmland for eco-tourism (Castellanos et al., 2013; Onneshan, 2008; Solh & van Ginkel, 2014).

3.4.2 Factors affecting individual adaptive capacity

Figure 3.7 presents factors that influence individual adaptive capacity for livelihood preparedness and their percentage representation in included literature. Local knowledge about culture, language, norms, beliefs, laws as well as hazards within an individual's society was signified most by over 64 percent of included articles. As highlighted by Belle et al. (2017), such knowledge has the potential to influence life and livelihood. In particular, the knowledge of hazards peculiar to a location is of significant importance in that it can assist an individual to take adaptive measures for his or her livelihood (Ademola et al., 2016; Anushka et al., 2018; Daramola et al., 2016).

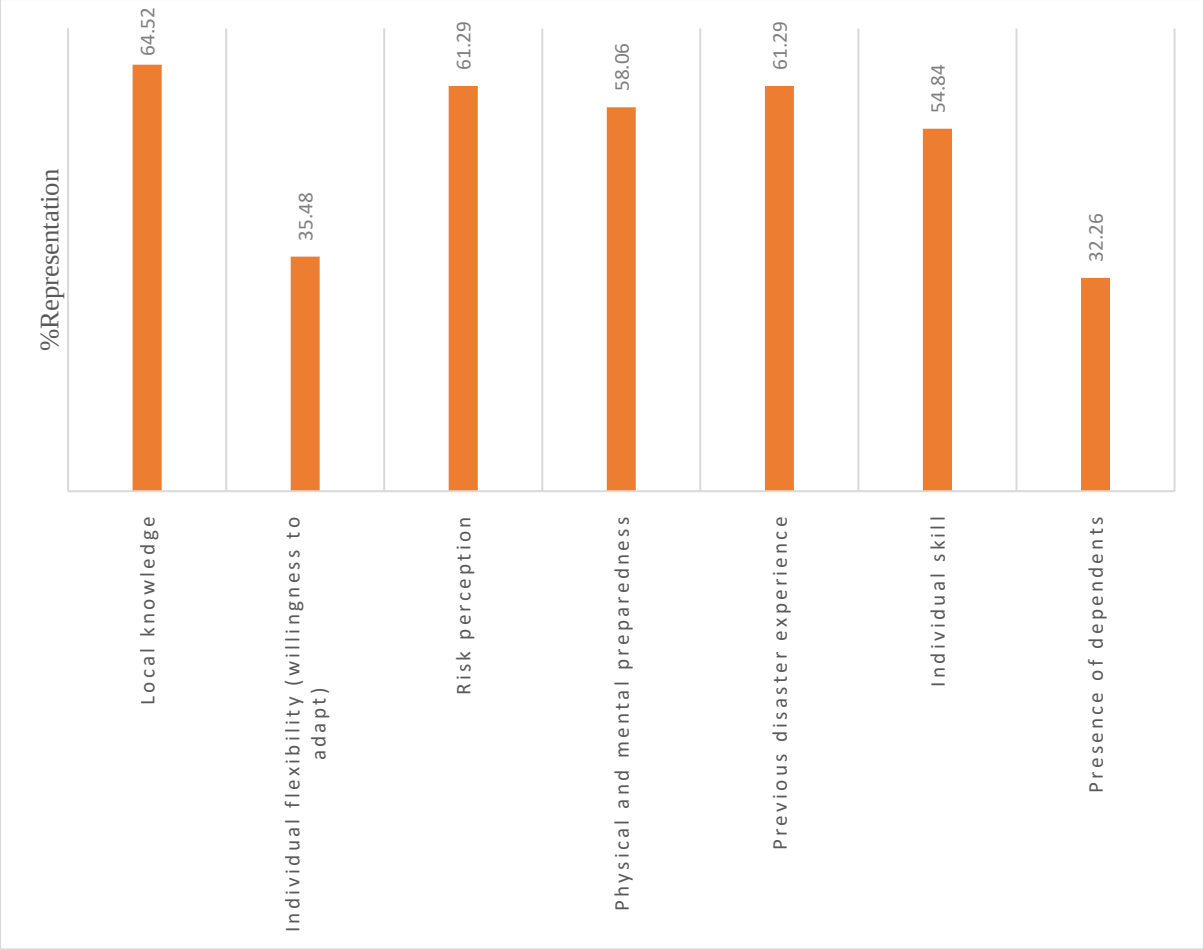


Figure 3.7 Percentage representation of factors that influence individual adaptive capacity

Risk perception and previous disaster experience were represented in equal measures (61.29%). The level of physical and mental preparedness of those living in at-risk areas was highlighted by approximately 58% of included articles. As explained by some scholars, an individual's previous disaster experience could shape their perception of risk, which will, in turn, persuade or dissuade them from preparing their livelihood both physically and mentally for a disaster (Fakhruddin & Rahman, 2015; Islam et al., 2018; Kelman & Mather, 2008; Paton & Johnston, 2015). Adaptive measures taken by an individual may be dependent on the skills they possess (Nhuan et al., 2016), as well as their willingness to adapt to changes (Jianjun et al., 2015); each was represented by approximately 54% and 35% of included articles, respectively.

Additionally, the willingness of an individual to adapt their lives and livelihood to any changes may also be linked to market conditions, which is identified as a factor mentioned in the previous section.

This was illustrated by Belle et al. (2017) and Le Dé et al. (2018), where individual livelihoods were dependent upon the dictates of the market rather than livelihood options suited to disaster situations. The presence of dependants, though important, however, was least represented (32.26%) in Figure 3.7. This was exemplified by He et al. (2018) that some parents were reluctant to move farther away in search of livelihood options as their caring responsibilities for their young children might limit their ability to adapt to other types of jobs.

3.4.3 Factors affecting the effectiveness of individual disaster risk reduction measures

There is a relatively greater number of factors affecting the effectiveness of individual disaster risk reduction (DRR) measures when compared to three other indicators (See Figure 3.8). Mutual support among individuals living in the same locality was the most highlighted factor at over 82%. This may be attributed to its potential relationship with other factors, as implied by (Løvholt et al., 2014). Similarly, the access to financial assets as well as the input of governments and NGOs in disaster risk reduction featured at 70.73% and 65.85%, respectively. Financial assets in this context encompass cash, savings as well as insurance (Iwasaki, 2016; Kumar et al., 2013; Manandhar, 2016; Practical Action Nepal, 2010). Nonetheless, financial assets are particularly unique in that they can be used to acquire other types of assets. Limited access to financial assets is a significant contributor to poverty and vulnerability globally as it compromises an individual's ability to take preparedness measures (Baffoe & Matsuda, 2018; Belle et al., 2017; Wilkinson, 2011).

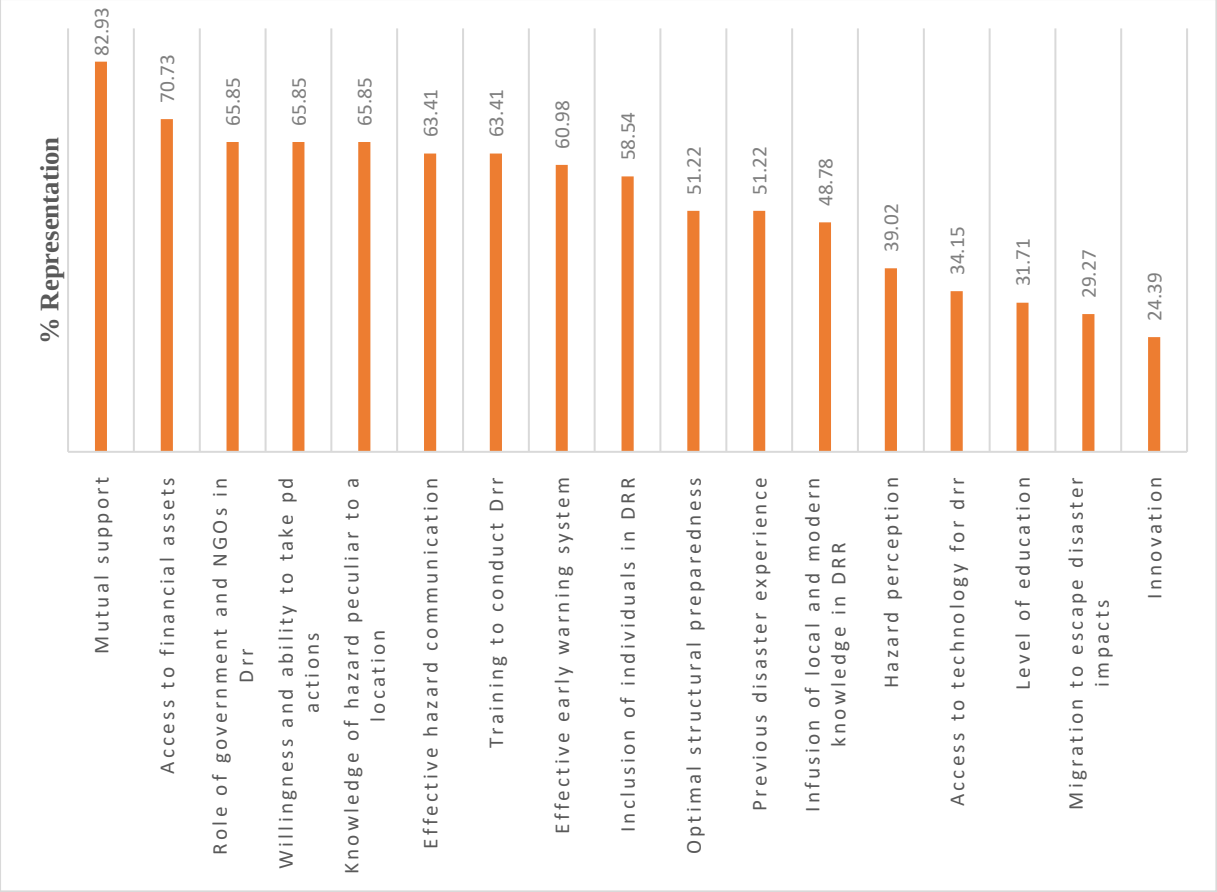


Figure 3.8 Percentage representation of factors that influence effectiveness of DRR Measures

In relation to the role of governments and NGOs, a potentially linked yet less represented factor is the inclusion of individuals in DRR plans (58.54%). Cannon (2006); Clot (2014); Garai (2017) emphasised that certain DRR measures, such as labour market social protection and infrastructural preparedness, are beyond the capacity of individuals, requiring assistance from governments and NGOs. Hence Iwasaki (2016); Qin et al. (2019) advocated that, where complementary measures are taken by the governments and/or NGOs, individuals should be consulted as regards to whether certain interventions could influence their lives and livelihood.

Approximately 65% of articles highlighted the need for individuals to be aware of potential hazards unique to their environment as it could assist them in taking proper actions for risk mitigation. The knowledge of potential hazards peculiar to an individual's surroundings can also aid in limiting or eliminating damage to lives and individual livelihoods if the individual is capable and willing to implement risk-reducing measures (Gebrehiwot & van der Veen, 2015; Okayo et al., 2015; Oxfam,

2009). The willingness and ability of individuals to take preparedness actions were equally highlighted by approximately 65% of included articles.

The effectiveness of DRR measures can also be influenced through DRR training (63.41%), effective hazard communication (63.41%) and effective early warning systems (60.98%) (Akwango et al., 2017; Anushka et al., 2018; Armijos et al., 2017; Barclay et al., 2015; Belle et al., 2017). Inclusion of local residents in DRR campaigns and planning was also highlighted by over half of the included articles (58.54%). Similarly, the influence of structural preparedness for DRR was highlighted by over 51% of the included articles. While structural preparedness, such as fastening objects onto a wall or ceiling and retrofitting buildings to new standards, have the ability to reduce the effect of a disaster on lives and livelihood, Clot (2014); Kelman and Mather (2008) cautioned against an over-reliance on structural preparedness as it could create a false sense of safety.

Previous disaster experience was depicted by 51.22% of included articles as a factor that influenced effective DRR. Garai (2017) highlighted a connection between an individual's previous disaster experience as well as their perceptions about hazards. These factors were equally noted in Figure 7 as factors that influenced individual adaptive capacity for livelihood preparedness. In addition, Garai (2017); Mabuku et al. (2018) called for the infusion of local and modern knowledge for DRR. The combination of local and formal knowledge may help with learning of technology and tactics for improving individual livelihoods and protecting them from disasters (Suri, 2018; Venugopal et al., 2019). The infusion of local and formal knowledge was highlighted in approximately 48% of included articles.

Access to technology and the level of education were highlighted by 34.15% and 31.71% of articles, respectively, as a factor that influences the effectiveness of DRR for livelihood preparedness. Venugopal et al. (2019) suggested a link between the level of education and access to technology. Due to the limited level of education, for instance, the older generation in Kandikuppa India had to rely on younger and more educated people to teach them how to use modern technology, such as GIS and GPS, both for livelihood purposes and as a tool for disaster risk reduction (Venugopal et al., 2019). Similarly, access to technology for DRR as well as the level of education could be vital in enabling individuals in

disaster risk reduction. As stated previously, a distinction was drawn between technology for DRR and technology for productivity. For example, technologies like social media, radios, and mobile phones can serve both purposes; however, items like fire alarms and community tsunami alarms are chiefly designed for disaster risk reduction purposes only.

Where possible or as a last resort, individuals might choose to migrate to another place for effective risk reduction (Birkmann et al., 2013; Rahut & Ali, 2018). This was noted by approximately 29.27% of articles. Innovation was the least highlighted factor that influenced the effectiveness of DRR measures at approximately 24%. It implies the innovative use of available assets to mitigate or prevent disasters from occurring. Innovation as an influencer of individual DRR measures was best depicted by Kumar et al. (2013), who showed that individuals lacked the finance to pay for a water storage facility; however, they applied other assets at their disposal to achieve the needed ends.

3.4.4 Factors affecting resource accessibility

As shown in Figure 3.9, individual skills and knowledge (78%) were most represented as a factor that influenced resource accessibility for livelihood preparedness, as they were considered as essential human capital (Rampengan et al., 2014; Zhang et al., 2012). According to Baffoe and Matsuda (2018); Fang (2013), a lack of human capital often limits the use of other types of assets such as social capital. Hence without the right skill and knowledge, an individual might be unable to use assets and resources to prepare their livelihoods for a disaster. Other forms of human capital highlighted in Figure 9 include age and literacy, both of which are represented by approximately 22% and 58% of articles, respectively.

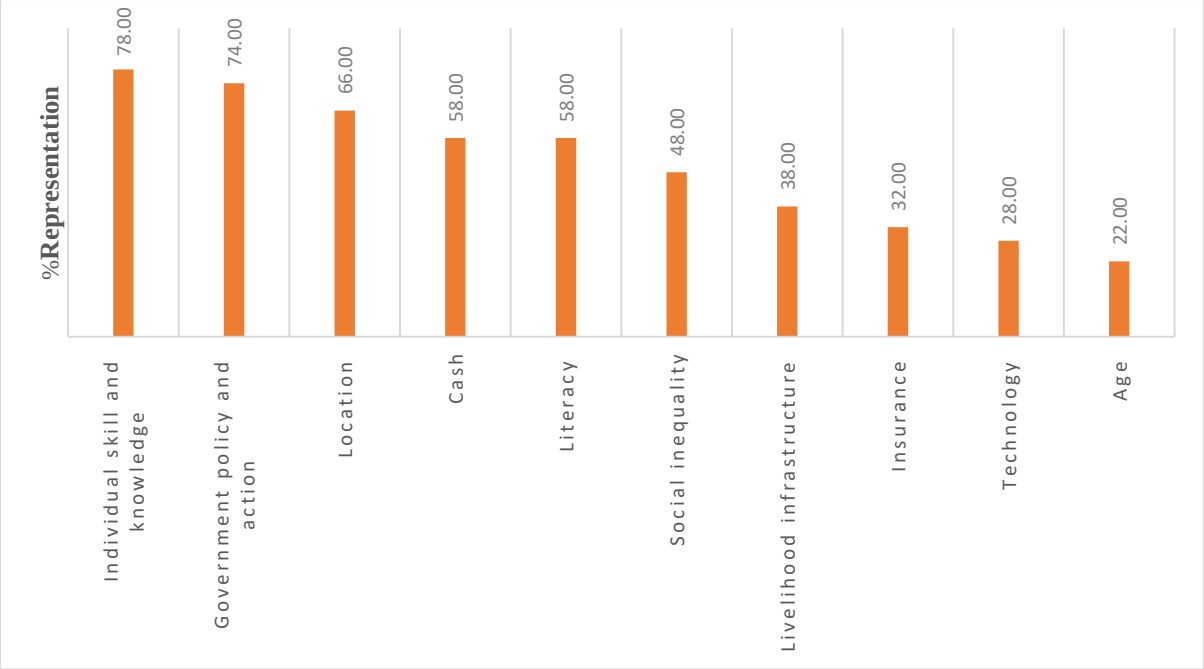


Figure 3.9 Percentage representation of factors that influence resource accessibility

Consequently, the way in which the older generation prepares their lives and livelihood varies significantly from that of younger ones (Mabuku et al., 2019). While the older generation tends to be more experienced in livelihood endeavours (Gebrehiwot & van der Veen, 2015), they may be less willing or unable to take preparedness actions (Barclay et al., 2015). In concert with other factors, little to no education of the older generation is the main reason for their limited ability to take preparedness actions or to use modern technology to evade hazards (Venugopal et al., 2019). Nonetheless, according to about 38% of the included articles that highlighted accessibility to resources for livelihood preparedness, the lack of infrastructures, such as roads, power, and schools, will also limit the ability of individuals (irrespective of their age) to take livelihood preparedness actions.

Government policies and actions (74%) were the second most highlighted factor that influences individual access to capital. Government agencies, through actions and/or policies, influence the distribution of assets in a society (Ahsan, 2017; Caudell et al., 2015; Fakhruddin & Rahman, 2015; Garai, 2017; Mabuku et al., 2019). They can also provide preparedness measures that are beyond the capability of individuals or the private sector (Cannon, 2006; Linnerooth-Bayer & Mechler, 2007). Consequently, through their actions or inactions, governments can influence how and when individuals

take preparedness actions to protect their lives and livelihood (Birkmann et al., 2013; Whittaker et al., 2012).

According to approximately 66% of the included articles, an individual's location has a significant influence on their accessibility to assets. Location determines the potential hazards faced by an individual and will likely influence how people can access resources available to prepare their livelihoods for unforeseen circumstances (Bogardi, 2004; Fahad & Jing, 2018; Mishra et al., 2010a; Motsholapheko et al., 2011; Qin et al., 2019). Possession of assets or resources vulnerable to hazards in an individual's current location could initiate migration aiming for reduced vulnerabilities to hazards (Chapagain & Gentle, 2015).

Bird et al. (2011) also highlighted a relationship between location and risk perception as well as perceived level of preparedness. Moreover, there seems to be a relationship between location and social inequality. Within this article, social inequality refers to discrimination based on race, religion, culture, and gender. In certain parts of the world, an individual's accessibility to resources is dependent on gender and race. Females, as well as people discriminated against, had limited access to resources (Baffoe & Matsuda, 2018; Deen, 2015; Kumasi et al., 2019; Walsh & Fuentes-Nieva, 2014). Social inequality was represented by approximately 48% of included articles.

Furthermore, financial assets, such as cash through savings, loans, and remittances as well as insurance (OECD, 2013), were represented by approximately 58% and 32% respectively of the included articles. Cash influences access to resources in that it can be used to purchase other assets (Baffoe & Matsuda, 2018). On the other hand, insurance provides a risk transfer mechanism that can be called upon to replace lost assets after a disaster (Fahad & Jing, 2018; Luqman et al., 2018; Ng'ang'a et al., 2016). Cash is somewhat linked to migration in that people move to new locations in search of better-paid jobs (Chapagain & Gentle, 2015). There seems to be a divergence in opinion on the optimal manner to provide affordable insurance; however, most options have much in common with the public-private-partnership model proposed by Linnerooth-Bayer and Mechler (2007) or an index-based system highlighted by (Akter et al., 2017).

3.5 Livelihood preparedness indicators across geographical locations

Figure 3.10 compares numbers of articles across regions in different disaster situations. Cross-region comparison suggests an increased interest in livelihood preparedness globally. Heightened research interests in livelihood preparedness were seen for climatological disasters in Africa relative to Australia and the Pacific nations. There seems to be a greater focus on the preparation of livelihoods for hydro-meteorological disasters in Asia and geological disasters in South America. For Europe, the sole research focus seems to be the preparation of livelihoods for geological disasters.

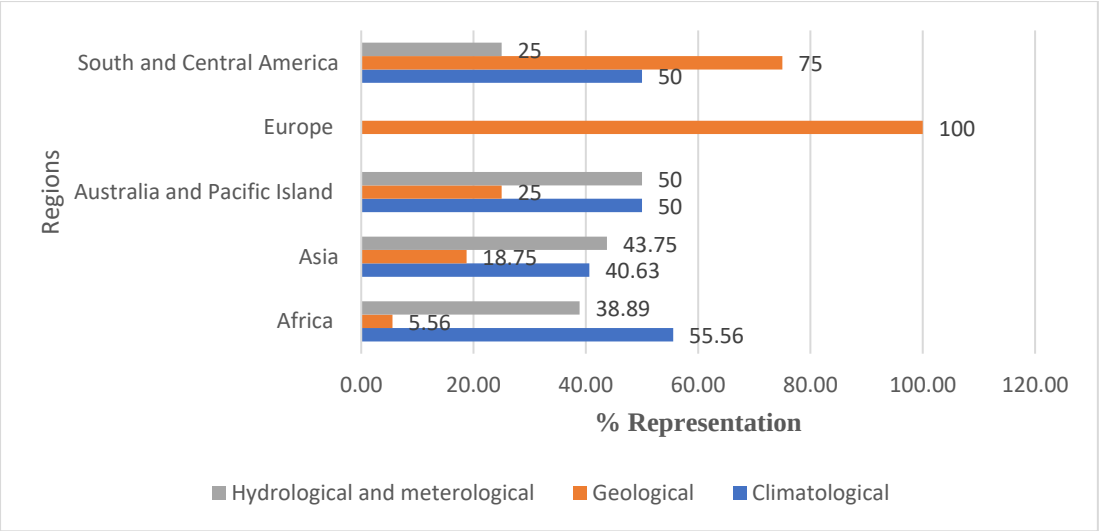
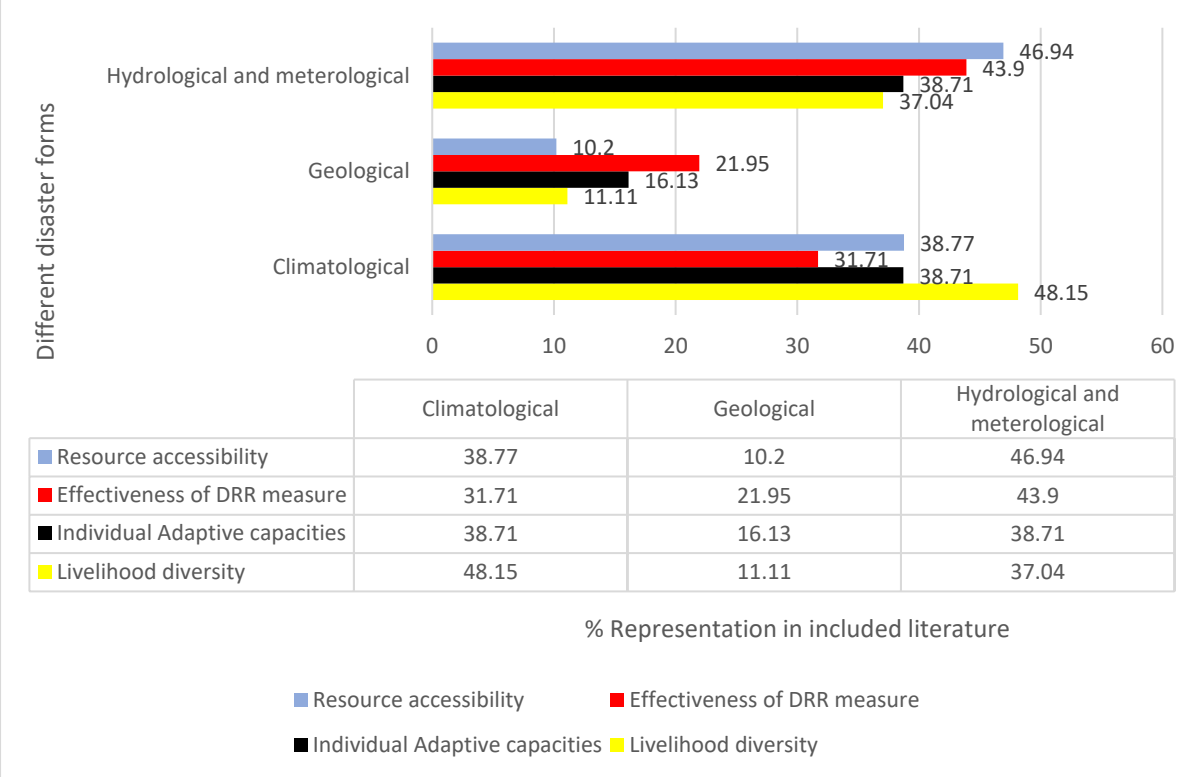


Figure 3.10 Percentage representation of regions by included articles and types of disasters

Figure 3.11 shows the trend of livelihood indicators distributed across different types of disasters. While all four indicators seemed to be highly cited in articles related to hydro-meteorological hazards, accessibility to resources (46.94%) slightly outweighed the other three indicators. Primary data will be required to ascertain the reason for a seemingly higher affinity for accessibility to resources with regards to hydro-meteorological hazards. A higher percentage of articles related to climatological disasters have highlighted the need for livelihood diversity (48.15%). This is not surprising because diverse livelihood strategies could provide those who are heavily reliant on natural resources, such as in the farming industry, with other options and limit the effects of a changing climate on their livelihoods (Ng'ang'a et al., 2016). Effectiveness of DRR measures seemed to be dominant in the literature that was related to geological hazards. This is possibly due to the fact that the occurrence of most geological hazards

such as earthquakes, volcanic eruptions, and landslides is hard to predict USGS (2019); thus, reducing the risks posed by those hazards seems to be a sensible option to protect livelihood.



	Climatological	Geological	Hydrological and meterological
Resource accessibility	38.77	10.2	46.94
Effectiveness of DRR measure	31.71	21.95	43.9
Individual Adaptive capacities	38.71	16.13	38.71
Livelihood diversity	48.15	11.11	37.04

Figure 3.11 Percentage representation of indicators in different disaster literature

Figure 3.12 illustrates the percentage representation of indicators of livelihood preparedness across different geographical regions (location of disaster featured in the article). All four indicators seemed to be equally featured in most articles, apart from the fact that livelihood diversity was not cited in articles that talked about disaster livelihood preparedness in Europe. This absence may be in part due to the exclusion of articles not written in English as outlined in the systematic review methodology section. Figure 3.12 shows that effectiveness of disaster risk reduction measures appeared to be the most cited indicator in articles related to hazards in South and Central America and in Asian countries. However, in the Australia and Pacific region and in Africa, livelihood diversity was a dominant indicator cited in literature. Livelihood diversity is only 3.7 % in South and Central America. This might be due to the small representation of number of papers in the sample. Therefore, caution should be exercised for the interpretation of the evidence illustrated in Figure 3.12. The question of whether

certain indicators are actually less relevant in certain geographical locations or whether it is simply due to the scarcity of research attention to this topic is an area that merits further research and exploration.

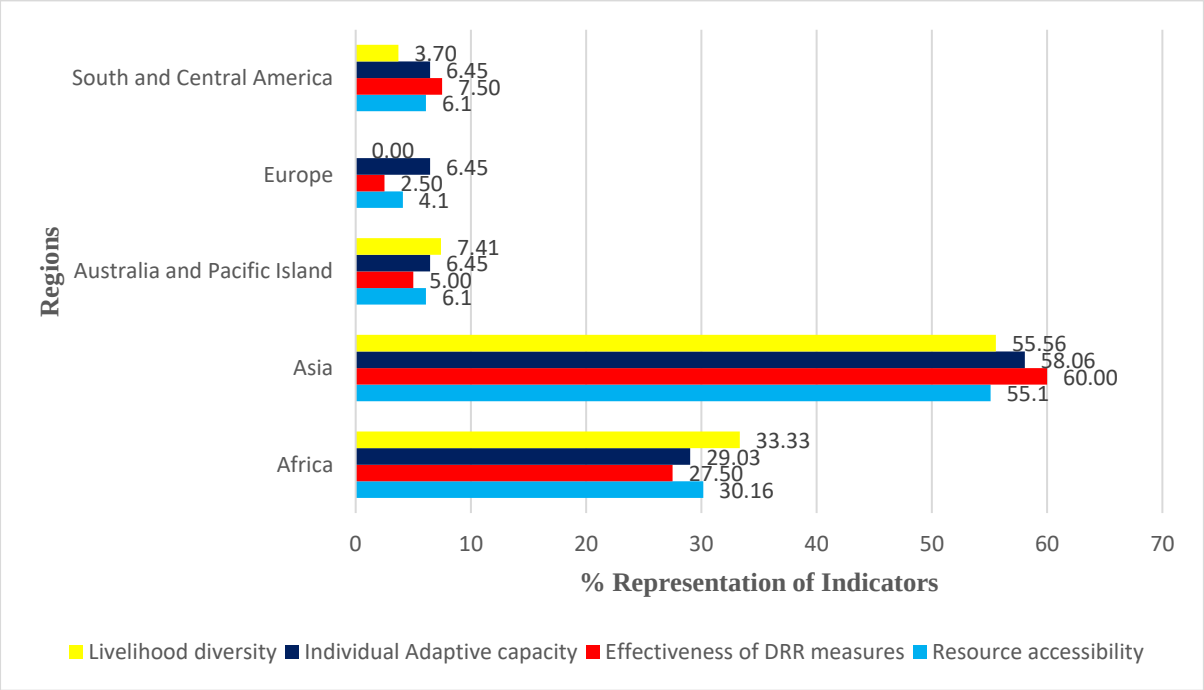


Figure 3.12 Percentage representation of indicators across various geographic regions

3.6 Comparison of key factors across livelihood preparedness indicators

One of the goals of this research is to examine the factors that affect each indicator in measuring the livelihood preparedness against natural hazards. As can be seen in Tables 8.1 – 8.4 in Appendix A, certain factors seemed to influence many indicators in different ways. For instance, migration was highlighted as an influencing factor on people's decision to either diversify their livelihood or take measures to reduce disaster risks. As illustrated by Chapagain and Gentle (2015), displacement in the form of migration often requires efforts to diversify an individual's livelihood, as they may be unable to access the resources and job markets that existed in their previous location. Technology seemed to play a large role in livelihood diversity and disaster risk reduction. However, the types of technology vary in the identified literature, and the role of emerging technology, such as the new social media tools and e-business, needs to be examined in the future.

The review also suggests some interrelationships among factors that influence different livelihood indicators. With respect to livelihood diversity, Ning et al. (2014) suggested a link between market

conditions and migration. Rampengan et al. (2014) implied that the above link also extended to technology, skills, and other resources used by individuals to diversify their livelihood. In other words, a perceived better market condition or opportunity in an alternative location may propel an individual to move to a new location for better job opportunities. It is therefore important to provide policy support measures to help new migrants to acquire new skills, technology and training needed in creating new markets or taking an advantage of existing market conditions in new destinations.

Compared to the results for livelihood diversity, there is an even greater hint of inter-connections within factors that influences an individual's adaptive capacity. This was especially true with risk perception, local knowledge, previous disaster experience as well as physical and mental preparedness (Ademola et al., 2016; Anushka et al., 2018; Barclay et al., 2015; Belle et al., 2017; Daramola et al., 2016; Paton & Johnston, 2015). In the literature, there was a consensus that individuals who possessed local knowledge and previous disaster experience had a unique perception of livelihood risks and tools to prepare them if they were willing to take the necessary steps.

The review highlighted a relatively higher number of factors with respect to the effectiveness of individual DRR measures. This may well be attributed to the complex nature of hazards (leading to disasters), as noted by (Twigg, 2004). A greater effort of collaborative and combined DRR measures is therefore needed. Factors such as mutual support, combined with effective communication, and inclusion of individuals in government's or NGOs' DRR endeavours were cited highly and considered to have a significant impact on DRR outcomes (Iwasaki, 2016; Løvholt et al., 2014; Qin et al., 2019). In terms of knowledge, the review also highlighted the influence of infusing local and modern knowledge for the evolving and emerging risks, such as unexpected effects like droughts and water contamination issues caused by a changing climate (Garai, 2017; Mabuku et al., 2018).

As illustrated by Walsh and Fuentes-Nieva (2014), limited access to resources is likely to challenge an individual's ability to diversify their livelihood. With respect to individual adaptive capacity, an individual with limited or outdated skills (a form of resources/capital) may be unable to take adaptive measures to protect lives and livelihood (Nhuan et al., 2016). In consonance with other factors, the availability of financial assets eases the process of disaster risk reduction (Belle et al., 2017; Wilkinson,

2011). This might explain why access to resources has the greatest influence on other indicators of livelihood preparedness. The next chapter will focus on the methodology adopted to carry out this research.

3.7 Summary

Four indicators of livelihood preparedness were derived from the systematic review of literature. These include resource accessibility, effectiveness of disaster risk reduction, individual adaptive capacity, and livelihood diversity. Greater emphasis appears to be placed on resource accessibility relative to other indicators; however, more factors seem to influence the effectiveness of disaster risk reduction. Across all geolocations and different disaster contexts, the least emphasis seems to be placed on livelihood diversity. Among all five continents, significant attention appears to be on disasters and livelihood preparedness in the Asian continent. Similarly, substantial focus seems to be on climatological hazards such as drought, glacial lake outburst, wildfires etc, when compared to other natural hazards. The trends highlighted above could be attributed to multiple factors. The next chapter will focus on research methods and methodology adopted in this study.

Chapter 4 Research Methodology

This chapter presents the underpinning principles that would guide the current study and the techniques adopted to answer our research questions. The next four sections and subsections will focus on research paradigms and philosophy that would guide this research. These will be followed by a sub-section that looks to explain the research questions and the objectives designed to answer those questions. A detailed overview of the study location will be illustrated in section 4.6 of the current chapter. The last three sections will focus on the process of data collection and sampling, case selection, and techniques adopted for data analysis.

4.1 Research design

4.1.1 Research paradigms

Either consciously or unconsciously, certain assumptions are made at every stage in a research process (Burrell & Morgan, 2019). These assumptions could be a product of a researcher and the research subject's belief, values, and ethics (axiological assumptions), realities encountered by the researcher during a study which shapes the way they perceive and study research objects (ontological assumptions) or those made about human knowledge to determine constituents of legitimate, acceptable and valid knowledge as well as the best way to communicate it to others (epistemological assumptions) (Burrell & Morgan, 2019). Epistemological assumptions are particularly important as they influence the choice of data to be included in the research (Saunders et al., 2019).

These assumptions are made either from an objectivist or subjectivist stance. From an objectivist stance, physical and social phenomena are universal, enduring, and independent of an individual's perspective. On the other hand, a subjectivist perceives social construct as relative and a product of individual perceptions and actions (Böhme et al., 2012; Hamati-Ataya, 2014). In other words, the subjectivist is interested in individual views and opinions rather than universal truths, as is the case of an objectivist.

An axiological objectivist tends to conduct studies in a manner that attempts to eliminate personal values to mitigate against bias in the findings (Saunders et al., 2019). However, the subjectivist acknowledges and actively reflects on and questions their own values as they are unable to detach their personal values

and beliefs from a study (Roose, 1987). Epistemological objectivist works to uncover universal truths about the social world through observations and measurable facts to formulate a generalisable theory or framework (Sankey, 2021; Saunders et al., 2019). On the contrary, an epistemological subjectivist believe that truth is relative (Siegel, 1986). Ontological objectivism perceives social constructs and physical entities as one and the same, while ontological subjectivism draws a distinction between social constructs and physical entities, as reality is created by social actors (Saunders et al., 2019).

Research outcomes are also influenced by either regulation or radical change paradigms. According to (Saunders et al., 2019), paradigms are basic assumptions taken for granted which serve as reference points for theory formulation and operationalisation of results. The regulation paradigm assumes the existence of a unified and cohesive societal system and structure. However, the radical change stance tends to be disruptive as it attempts to explore alternatives to current reality (Burrell & Morgan, 2019). Burrell and Morgan (2019) combined the objectivist-subjectivist perception with the regulation-radical change paradigms into the matrix depicted in Figure 4.1.

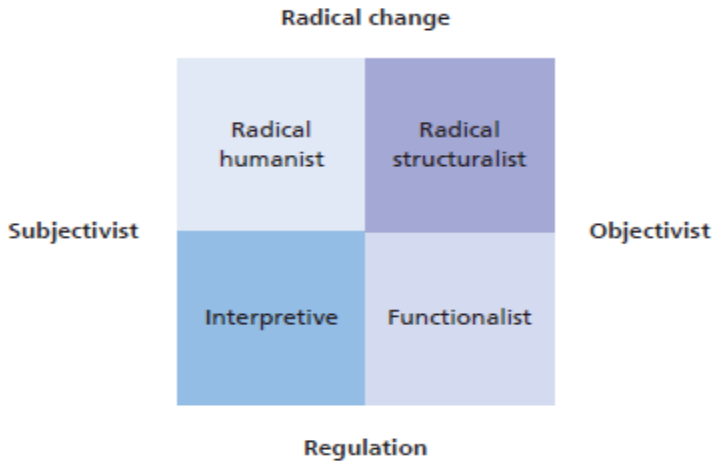


Figure 4.1 Research paradigms (Burrell & Morgan, 2019)

At the bottom right of Figure 4.1 is the functionalist paradigm. Research conducted within this paradigm attempts to provide a rational explanation and formulate recommendations within the current status quo. With proper implementation and monitoring, research outcomes in this paradigm are generalisable (Kelemen & Rumens, 2008). The researcher within the functionalist paradigm assumes that individuals

and organisations are rational entities; hence rational explanations are expected to answer rational problems (Saunders et al., 2019). Research conducted within this paradigm is mainly supported by the positivist research philosophy, which will be explained later in the chapter.

On the other hand, research conducted within the interpretive paradigm attempts to explain individual experiences (Saunders et al., 2019). The researcher is required to interact with the research subjects to better understand the current situation of things and why they are so, rather than attempting to make changes (Kelemen & Rumens, 2008). However, research conducted within the radical structuralist paradigm, located on the top right of Figure 4.1, seeks to analyse current structures in existence and instigate fundamental changes.

According to Saunders et al. (2019), research within the radical structuralist paradigm is usually underpinned by a critical realist research philosophy. Like the radical structuralist, the radical humanist seeks to change the current status quo from a subjectivist rather than the objectivist stance adopted by the radical structuralist. Hence, research conducted within the radical humanist perspective stresses the importance of individual contexts, social constructs, processes, and language (Kelemen & Rumens, 2008). Similarly, it is important to understand the different research philosophies in existence to choose the right one for the current study. A proper choice for a research philosophy enables the formulation of a coherent research design, in which different elements of the research are properly fitted together (Saunders et al., 2019).

4.1.2 Research philosophy

Guided by a research philosophy, research is embarked upon to develop knowledge. In other words, a research philosophy "*refers to a system of beliefs and assumptions about the development of knowledge" (Saunders et al., 2019, p. 130).* Prior to conducting the current study, five research philosophies were evaluated. This includes positivism, critical realism, interpretivism, postmodernism, and pragmatism. These philosophies were considered because they seemed ideal for disaster and livelihood studies. The positivist philosophy adopts the natural scientist's approach, which works with measurable practical and social constructs to develop universally accepted theories (Fuller, 2001; Keuth, 2015; Outhwaite, 2015; Saunders et al., 2019). For the positivist, truth is universal, regardless

of the context, and knowledge is obtained through scientific methods (Crotty, 1998). The positivist philosophy adopts an objectivist stance as the research is independent of the researcher's personal values (Gray, 2014). Studies guided by a positivist philosophy are structured and typically analysed quantitatively (Gray, 2014). Additionally, although not in all cases, existing theories could be used to develop a new hypothesis which will be tested after data is collected (Saunders et al., 2019). While generalisable theories can be developed by adopting the positivist philosophy, critics believe that the very attempt to limit the researcher's influence on a study sample could be regarded as an influence in its own right (Saunders et al., 2019).

Postmodernism stresses the role of language and power relations while questioning accepted methods of thinking and provides a platform to explore marginalised alternative views (Patton, 2015; Saunders et al., 2019). In contrast to positivism and objectivism, postmodernism emphasises the chaotic nature of reality in which order is imposed through different forms of language while acknowledging the inadequacies of language (Chia, 2003). In other words, even though language can be applied to explain reality, it is less likely to provide a balanced view. To the postmodernist, the truth cannot be assessed by any abstract measure however it originates from a collective decision that is influenced by power dynamics and ideologies that dominate a particular context (Foucault & Sheridan, 1991). Saunders et al. (2019) argue that the dominant perspectives might not always be the best, just that they are perceived as so by the majority in a particular timeframe.

Consequently, other suppressed views could be as valuable and are able to create an alternative narrative. Through the deconstruction of realities and reassessment of dominant views, the postmodernist researcher attempts to explore and question the power dynamics that sustain dominant realities (Calás & Smircich, 2019; Derrida, 2016). The end goal of the postmodernist philosophy is to radically challenge established approaches to thinking and knowing while lending a voice and legitimacy to suppressed perspectives (Chia, 2003; Kilduff & Mehra, 1997). This is achieved through qualitative research that employs a critical evaluation of literature and other forms of data (Preda, 2015).

As a middle ground between positivism and postmodernism, critical realism explains personal experiences within existing structures that influence individual observation (Reed, 2005). In other

words, the critical realist attempts to provide explanations for observable events by ascertaining the underlying causes and mechanisms which shape daily events (Saunders et al., 2019). For the critical realist, the nature of reality is stratified between the empirical events that were observed, actual events that may not have been observed, and real events with enduring properties (Bhaskar, 2008; Fleetwood, 2005). Hence, to better understand the world around us, reality is first experienced then processed in our minds (Reed, 2005). Bhaskar (2008) further argued that a better understanding of the events taking place around us is facilitated by understanding the social trends and structures that have given rise to them. To the critical realist, knowledge is transient (Sorrell, 2018). Unlike the positivist who attempts to discount the influence of personal biases, the critical realists acknowledge personal biases, but highlight measures taken to limit the influence of those biases on a study (Saunders et al., 2019). Retrodictive methods of data collection and analysis, which involves the acquisition and utilisation of historical data, are mostly adopted in research works guided by critical realism (Reed, 2005).

In contrast to the positivist philosophy, interpretivism adopts the subjectivist stance. From the interpretivist perspective, humans differ from physical phenomena in that they create meanings (Packard, 2017; Saunders et al., 2019). In other words, reality is perceived as complex and knowledge cannot be distilled into generalisable theories and concepts. Consequently, people and their surroundings cannot be studied in the same manner as physical phenomena (Saunders et al., 2019). Hence, research methods adopted in social sciences should differ from those applied to natural sciences. An interpretivist research aims to create a novel insight and interpretation to different worldly events by focusing on what is important to the research subjects (Kankam, 2019; Saunders et al., 2019). Interpretivists stress the importance of history, language and culture in shaping individual expectations and experiences (Crotty, 1998). The interpretivist philosophy, while empathic towards the beliefs and values of the research subject, allows room for the values and belief of the researcher (Saunders et al., 2019). Research based on the interpretivist philosophy usually requires a relatively smaller sample size acquired through in-depth interviews and adopt qualitative methods of data analysis.

The last research philosophy that was considered for this study is pragmatism. To the pragmatist, concepts are regarded as relevant where they support action (Kelemen & Rumens, 2008). The

pragmatist philosophy attempts to build a bridge between facts and values, as well as objectivism and subjectivism. (Rasmussen & Glăveanu, 2020). It also strives to reconcile empirical knowledge and different contextual experiences (Smith, 2020). These are achieved through the evaluation of ideas, concepts, hypotheses, theories, and detailed research findings focused on thought and action as well as practical contextual consequences (Saunders et al., 2019). To the pragmatist, ideas leading to knowledge are as valuable as actions to bring the ideas to reality. Hence a pragmatist initiates research by clearly stating the research problem, then works to formulate practical solutions that could inform future practice (Saunders et al., 2019). A sense of doubt initiated by the value of the pragmatic researcher propagates the study until a negative or positive conclusion is reached (Elkjaer & Simpson, 2011). Additionally, the level of subjectivity or objectivity employed in the research will depend on the research question and the implementation of a potential result. Ultimately, the pragmatist research philosophy fosters the operationalisation of the best research method or a combination of methods that is expected to deliver an optimal research outcome (Kelemen & Rumens, 2008).

4.1.3 Research design and theory development

Choosing the right approach to theory development is essential as it facilitates the formulation of a research design while accounting for constraints (Easterby-Smith et al., 2012). According to Saunders et al. (2019), a deductive, inductive, or abductive approach could be employed in theory development. In a deductive approach, conclusions are derived from a rational set of premises in which the conclusion is only true if all the premises are found to be true (Ketokivi & Mantere, 2010). Assuming a research project is looking to determine how vulnerable livelihoods in New Zealand are to disasters, two premises can be developed: firstly, livelihoods dependent on primary industries are vulnerable to disasters; secondly, over 70 percent of New Zealand's working population directly or indirectly depend on primary industries for their livelihood. If premises one and two are true, deductively, a conclusion could be drawn that the livelihoods of a significant number of new Zealanders are vulnerable to natural disasters. A deductive approach to theory development often starts with a review of literature from which data is collected to test any theory formed from the literature review. This approach is applied to validate or falsify hypotheses related to existing theories (Cramer-Petersen et al., 2019). It requires a

large measurable dataset, and it is mostly underpinned by a positivist research philosophy (Saunders et al., 2019).

On the contrary, for an inductive approach to research, there is a gap between the premises and conclusion in which the accuracy of a conclusion must be supported by observations (Ketokivi & Mantere, 2010). Two premises will be employed to exemplify an inductive approach to theory building. Premise one: New Zealand witnessed three major earthquakes in the past decade; premise two: unemployment increased by 10% in the past decade. Inductively, it could be concluded that the high unemployment rate could be due to the destructive effects of the earthquake. In other words, while the deductive approach moves from general to specific, the inductive approach moves from specific to general. With regards to the set of premises used to illustrate an inductive approach, factors other than the disasters could explain the increase in unemployment figures. However, for the deductive approach, this would not be the case as the theory would only hold true if all the premises were true and no other explanation could be offered (Cramer-Petersen et al., 2019). In all, an inductive approach to theory development often starts with the collection of data to explore a phenomenon, after which a conceptual framework is developed. It is underpinned by an interpretivist research philosophy, requires relatively less data (mostly qualitative data), and is frequently applied in social science research (Saunders et al., 2019).

According to Ketokivi and Mantere (2010), the abductive approach to theory building starts with the discovery of a startling fact, from which a set of premises are developed to explain the conclusion. Hence, rather than going from theory to data, as is the case with deduction or data to theory in induction, an abductive approach to research moves back and forth between data and theory (Suddaby, 2006). Going back to the example on the vulnerability of livelihoods in New Zealand, assuming the government made a sudden discovery that unemployment figures in New Zealand have increased by 10% in the past decade. This discovery could be attributed to several hazard-propelled disasters in the last decade; however, multiple data iterations will be required to back any explanation. Consequently, an abductive approach to theory development starts with data collection applied to identify and explain new trends that could propagate the formulation or modification of existing theories, which are further

tested through the collection of more data (Van Maanen et al., 2007). The generalisability of findings is achieved through the interaction between the specific and general (Folger & Stein, 2017; Saunders et al., 2019). The abductive approach to theory development can be shaped by either pragmatism, postmodernism, or critical realism and is mostly applied in theory modification (Saunders et al., 2019).

4.1.4 Research philosophy, paradigm, and design adopted for this study

According to Saunders et al. (2019), there seems to be a relationship between assumptions backed by beliefs, research philosophies, and research design. This relationship is illustrated in Figure 4.2.

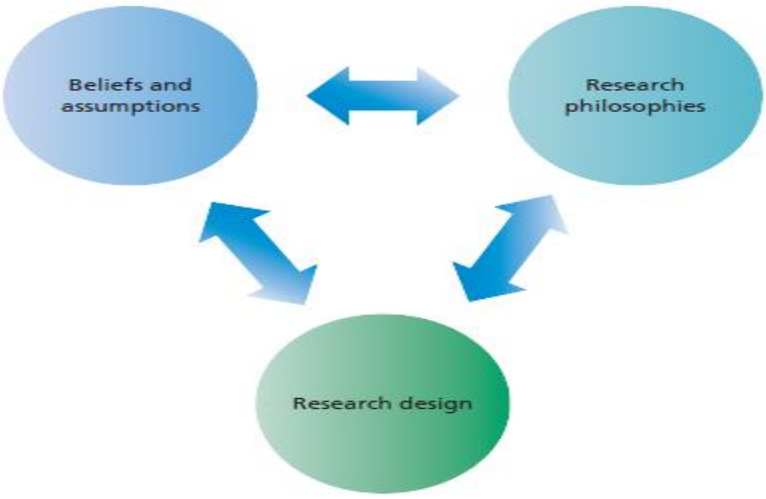


Figure 4.2 Different aspects of a research (Saunders et al., 2019)

A researcher's belief and assumptions influence and is influenced by their research philosophy and the research design choice. According to Haynes (2012), Self-reflection is a prerequisite step for choosing a research philosophy as this enables the researcher to question their actions and reasoning in the same manner that they would question the actions and beliefs of others. To facilitate the reflective process, the "Heightening your Awareness of your Research philosophy tool" (HARPS) developed by (Saunders et al., 2019) was applied by the researcher. This suggested the researcher's inclination towards critical realism.

However, for research fields in which there is a vast number of publications in one context, but a limited amount of information on a particular topic within the field Halpin and Richard (2021); Saunders et al.

(2019), suggested the adoption of an abductive approach to theory development. Under different contexts such as sustainability, resilience, business continuity, etc., different aspects of livelihoods have been studied in different contexts and locations. To the best of the researcher's knowledge, an operational framework for preparing individual livelihoods for a disaster has not been undertaken. Hence for this study, an abductive approach to theory development will be adopted.

Even though Burrell and Morgan (2019) argued the incompatibility of all four paradigms, Saunders et al. (2019) believed connections between different paradigms and philosophies or lack thereof should not be viewed as absolute, as this will depend on the field of study. Current research lies between the fundamentalist and interpretivist paradigm as it aims to provide rational explanations and recommend solutions to existing challenges while acknowledging the contextual nature of disasters and livelihood.

A pragmatic research philosophy will be adopted for this study as this aligns with the suggestions highlighted by (Saunders et al., 2019; Smith, 2020). Kaushik and Walsh (2019) and Yvonne Feilzer (2010) highlighted the difficulty in choosing the right research method for a study guided by a pragmatic philosophy, especially in research with multiple layers of participants. Additionally, Saunders et al. (2019) highlighted the time constraint and challenge of obtaining a non-discernible pattern if an abductive approach to research is adopted. To address the challenge of multiple layers of participants Kaushik and Walsh (2019); Yvonne Feilzer (2010) suggested the combination of a quantitative and qualitative research method. A mixed-method approach will be adopted in this research, and further justification for this will be explained in subsequent sections. The time constraint issue was addressed through the implementation of a rigid time management plan in which different tasks were scheduled at specific times. No immediate solution could be ascertained in a situation where no useful data could be obtained.

For a research outcome to be valid, the researcher is obliged to explain the steps that have been taken to conduct a study, as well as the reasoning behind those steps (Crotty, 1998). This will be highlighted within the remaining sections of this chapter.

4.2 Research hypothesis, questions, and objectives

The current study is guided by three hypotheses which are as follows

1. Individual Livelihood preparedness can be assessed using indicators.
2. Due to the complex nature of disasters and livelihood, these indicators of livelihood preparedness are influenced by different factors.
3. Lessons learned from a disaster could be instrumental in fostering preparedness for future disruptions.

In addition to the overarching research question highlighted in Chapter 1, these hypotheses led to the formulation of three research questions to be addressed by unique objectives and at various stages of this study. The first question focuses on the derivation of livelihood preparedness indicators and factors influencing them, which were discretely discussed in the literature. Two objectives were adopted to provide answers to this question. The first objective was to identify livelihood preparedness indicators and factors that influence these indicators. For the second objective relating to the current research question, it was vital to illustrate the hazard context in which different indicators and factors were discussed. These objectives were achieved through a systematic review of literature on livelihoods and disaster preparedness.

The second research question focused on the derivation of lessons learned from the 2016 earthquake in Kaikōura, New Zealand. This question was addressed with three objectives, the first of which was to illustrate the livelihood lessons learned from the 2016 earthquake from the perspective of business owners and managers. To achieve this objective, interviews were conducted at the preliminary stages of this study. The interview was restricted to groups mentioned above to understand the perspective of business owners, their businesses, and the people that worked for them. It also assisted the researcher in better understanding the livelihood strategies adopted in Kaikōura. The next objective was to determine the livelihood preparedness indicator most critical to working-class individuals who lived through the 2016 earthquake. Similarly, critical factors influencing livelihood preparedness and unique indicators were also assessed. The last objective, as it relates to the second research question, focused on the illustration of the influencing mechanism for each factor on different indicators of livelihood

preparedness. Objectives in research question two will be addressed using questionnaires, whose outcome will be subjected to T-test, MANOVA, principal component analysis, and structural equation modelling. Justification for the adoption of the statistical tools mentioned above will be discussed in subsequent sections.

The third and final question for this study focused on how livelihood preparedness can be measured in Kaikōura. This was addressed by two objectives. Firstly, applying the results of different statistical tools, a framework for livelihood preparedness was derived for Kaikōura. This was followed by the last objective that focused on the development of a tool to measure livelihood preparedness in Kaikōura. Like the framework, the tool applied results obtained from various statistical analysis. More explanation will be provided in subsequent sections of this research. Table 4.1 provides a summary of the research questions and objectives guiding current research, while Figure 4.3 shows the interconnection between all research questions, objectives, different selected methods (mixed methods), data collection instruments and peer-reviewed publications.

Table 4.1 Research questions and objectives

Research questions	**Objectives**
1. What are the indicators of livelihood preparedness and factors influencing them which have been discussed discretely in literature?	• To highlight indicators of livelihood preparedness and their influencing factors • To illustrate the context in which different livelihood preparedness indicators and factors were discussed.
2. What are the lessons that can be derived from the 2016 Kaikōura earthquake in New Zealand?	• To illustrate the livelihood lessons learned from the 2016 Kaikōura earthquake from the perspective of business owners and managers • To determine the most critical livelihood preparedness indicator from the perspective of Kaikōura residents affected by the 2016 earthquake. • To highlight factors critical for livelihood preparedness in Kaikōura from the perspective of Kaikōura residents
3. How can livelihood preparedness be measured in Kaikōura?	• To suggest a framework for livelihood preparedness in Kaikōura • To develop a tool for measuring livelihood preparedness in Kaikōura

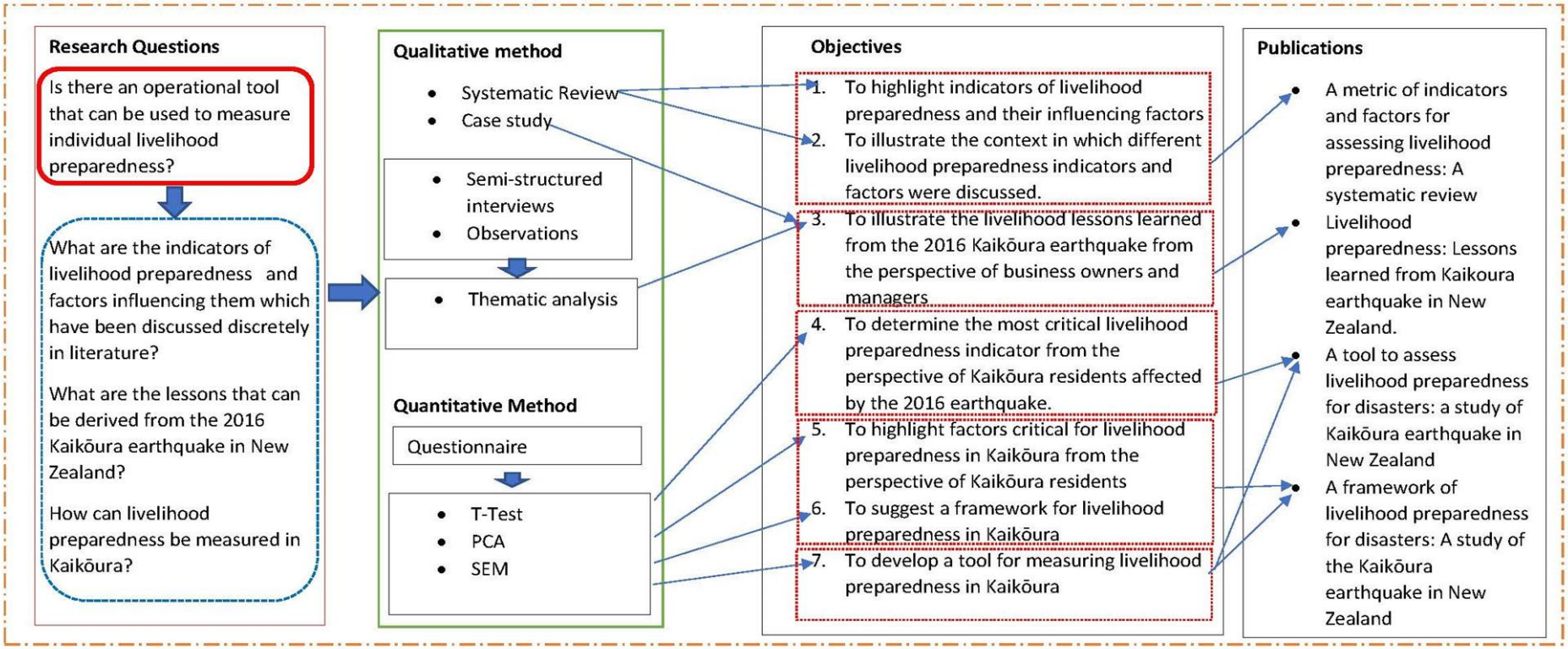


Figure 4.3 Pictorial representation of the thesis methodology

4.3 The study of Kaikoura and methods used

4.3.1 Case selection

An extreme method of case selection was adopted for this work as Kothari (2004) notes that this approach should be adopted for exploratory and open-ended probes. Kaikōura was selected for this case study because it was the latest earthquake disaster that occurred in New Zealand prior to this study. Furthermore, compared to other locations visited (Christchurch, Kaiapoi, and Lyttleton), Kaikōura is relatively isolated from the rest of New Zealand, a challenge that was worsened by the 2016 earthquake as all land access to the community was destroyed by the earthquake.

Case studies are empirical inquiries that investigate contemporary phenomena in an in-depth manner within the real-world context, especially in situations where the boundaries between phenomenon and context seem blurry (Yin, 2014). It is a detailed description and evaluation of a bounded unit (Merriam, 1998). It mostly entails a careful observation of social units (Kothari, 2004). In some respects, it could be regarded as a social microscope (Odum & Jocher, 1929). It can be applied as part of larger explanatory information, a primary evaluation method, or part of a dual-level evaluation arrangement (Yin, 2014).

Owing to the multiplicity of perspectives that could guide the design of case studies (Stake, 1995), its quality hinges on the situation coupled with the researcher's skill and expertise (Yin, 2014). It is composed of a study question, propositions, units of analysis, the linking data, and criteria for interpreting the findings (Yin, 2014). Case studies provide an insight into a people's behaviour and motivations in response to tension (Cooley, 1928) while easing the process of studying societal changes (Kothari, 2004).

To understand the true livelihood impacts of the 2016 Kaikōura earthquake, data was collected across major locations in which the impact of the earthquake was felt. This included Christchurch, Lyttleton, Picton, and Kaiapoi. However, the focus was on Kaikōura as the town witnessed greater destruction when compared to other locations. Kaikōura is a small town located on the east coast of New Zealand's

South Island, approximately 180 kilometres north of Christchurch (see Figure 4.3). To obtain a large sample size, data collection would focus on Kaikōura city because of its relatively high population density when compared with the rural area. Figure 4.3 highlights the study location within Kaikoura.

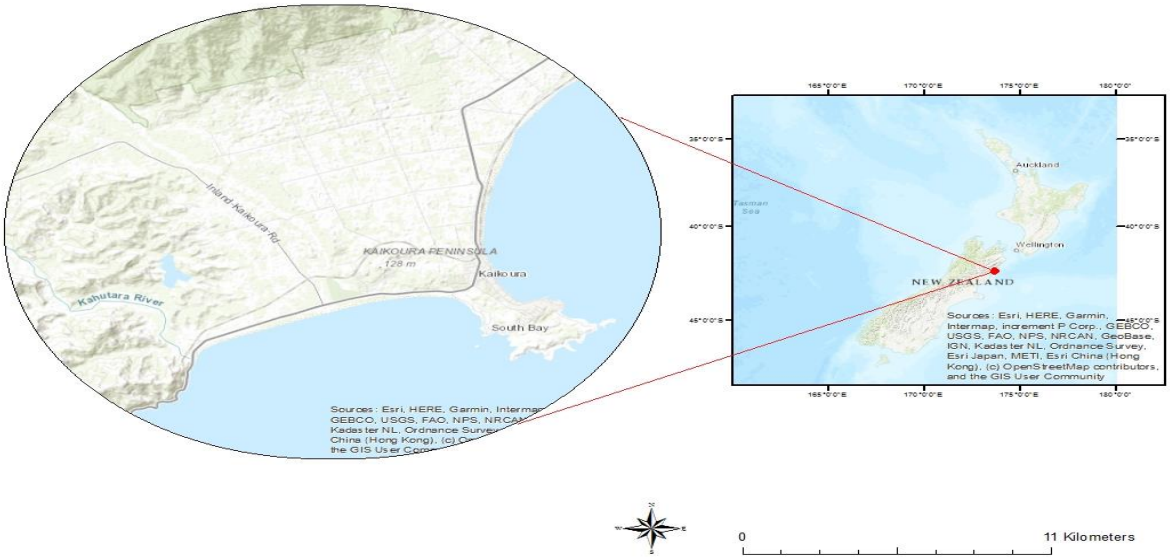


Figure 4.4 Geolocation of Kaikōura in New Zealand (Arcgis, 2022)

Detailed information of the research participants is included in Table 4.2.

Table 4.2 Interview respondents and coding

Interview respondents and codes	
Equipment Store owner	K1
Eatery owner	K2
Electronics store sales officer 1	K3
Electronic store sales officer 2	K4
Hospitality business owner	K5
Grocery store manager	K6
Motel owner and manager	K7
Auto Mechanic shop owner	K8
Owner of real estate firm	K9
Fish and chips store manager	K10

Sales and Marketing Manager	K11
Souvenir store owner	K12
Artist and Arts store owner	K13
Book store salesperson	K14
Art gallery store owner	K15
Manger at Kaikoura district office	K16
Respondents for other locations affected by the 2016 Kaikōura earthquake	
Motel housekeeper in Christchurch	CH1
Family Store manager	KA1
Flower store manager	KA2
Seasonal Worker	KA3
Household store manager	KA4
CEO of Enterprise North Canterbury	KA5
Store Owner	L1
Supermarket owner	L2
Gifts, crafts, and clothes store owner	L3

4.3.2 **Data collection and sampling**

For this research work, a qualitative and quantitative research approach was adopted at various stages of the research. At the preliminary stages of this work, the qualitative research approach was adopted predominantly as it was suitable for rapport building between the researchers and the study population. It was also suited for deriving livelihood lessons from the previous disaster as well as for the design of questionnaires that would be used at the later stages of the research. The advanced stages of this research required a combination of both qualitative and quantitative research approaches as the research goal evolved to the formulation of index frameworks. As implied by Amaratunga et al. (2002), a combination of quantitative and qualitative research methods compensates for the shortcomings of either method and facilitates data triangulation. Data collection was done in two phases to limit associated costs. A preliminary field trip was carried out between July and September 2018, while the latter part of this study was conducted between June to September 2019.

Qualitative research aims to ascertain the meaning or knowledge individuals attach to their experiences (Merriam, 1998). It seeks to accumulate a precise account of human behaviour and beliefs within a specific context (Rubin & Rubin, 2005). Additionally, it is holistic, empirical, interpretive, and emphatic (Stake, 1995). On the other hand, quantitative research entails the systematic investigation of real-world phenomena through the application of statistical and numerical data (Goertzen & TechSource, 2017; Sukamolson, 1996; Watson, 2015). A qualitative and quantitative method of research was adopted to account for both the subjective parts of this research that may be applicable only to Kaikōura residents as well as the realist portions of the study applicable to other locations.

- **Qualitative method for data collection and analysis**

At the preliminary stages of this research, a semi-structured interview was adopted, which is in line with (Rubin & Rubin, 2005) as it gave room for in-depth probing of the interviewee; while accruing answers to a standard list of questions as suggested by (Berg & Lune, 2014). Furthermore, Eisenhardt and Graebner (2007) argued that interviews, in general, are well suited for gathering rich empirical data in a highly episodic and infrequent situation (Eisenhardt & Graebner, 2007). It provides an in-depth understanding of the topic under investigation (Kothari, 2004), by taking advantage of the interviewee's perspectives (Schostak, 2005). It involves the presentation and response to oral, verbal stimuli (Kothari, 2004). Interviews are useful "for exploring the construction and negotiation of meaning in a natural setting" (Cohen et al., 2007, p.29); in other words, it makes allowance for the participant's social life (Kothari, 2004). A good interview must have an established value, guarantee trust and be void of ambiguity (Barbour & Schostak, 2005). The answer people provided to an interview question was dependent on how it was shaped (Hammersley & Gomm, 2008). Therefore, before the field trip to Kaikōura, a meeting was held among researchers to agree upon the intended value of the interview. A thorough re-evaluation of questions was also conducted to eliminate any ambiguity while ensuring that the questions were worded in the most culturally appropriate and effective manner.

Furthermore, Hammersley and Gomm (2008) noted the importance of timing in an interview as it could influence the answers obtained. To account for the potential effects of timing on our interview, on getting to Kaikōura, the first step was to investigate how the Kaikōura locals spent their daytime hours.

It was discovered that people were more willing to speak with us an hour just before lunch or two hours after lunch. For most establishments in Kaikōura, lunch is between 12 pm and 1 pm. We also endeavoured to keep the core interview sections under 30 minutes, and by doing so, we combated the issue of boredom raised by (Berg & Lune, 2014). To establish trust with potential participants, we cultivated an informal relationship with the locals of Kaikōura, which eased the process of securing interview appointments. The data collection was approved by the University of Auckland Human Participants Ethics Committee (reference number **014782**).

Additionally, Alshenqeeti (2014) suggested that interviews should be used in conjunction with other methods of data collection; for this reason, we adopted observation as another means of collecting data to complement the results obtained from interviews. Observation becomes a scientific tool "when it serves a formulated research purpose, is systematically planned, recorded and it is subjected to checks and controls on the validity and reliability"(Kothari, 2004, p. p.96). For this research, we adopted a structured participatory and uncontrolled observation method. According to Kothari (2004), an observation is structured where advanced thought was given on who or what to observe, method of recording data, standard conditions for the observation, and necessary data to be collected. It is participatory when the researcher attempts to integrate into the study sample and uncontrolled when the study is carried out in the sample population's natural environment (Kothari, 2004).

Prior to conducting the research in Kaikōura, previous studies were carried out at Christchurch, Kaiapoi, and Lyttleton. This assisted us in structuring our mode of observation, who to observe, what information we hoped to gather and how it would be recorded. We adopted a participatory mode of observation where an attempt was made to develop rapport with residents of Kaikōura to learn how they earn a living currently and to ascertain if they made any changes after the 2016 earthquake. Participatory observation was also adopted to understand how different factors highlighted in the systematic review manifested in Kaikōura. Each researcher made notes of their observation, after which the group met to highlight common and unique trends. We observed and interacted with 470 residents of Kaikōura, which composed of 15 government workers and 455 individuals of different age bracket and varied works of life.

Kothari (2004) highlighted that a participatory uncontrolled observation gives the researcher an opportunity to record the natural behaviours of a group while gathering more data than would be possible in a non-participatory type of observation. However, Kothari (2004) noted that this approach to research could lead to loss of objectivity on the part of the researcher; additionally, the interpretation of data could be subjective. To mitigate against errors resulting from the observation method, the observation data was collected as a team, and outcomes had to be agreed upon by all team members. Data collected by team members through interviews and observation were thematically analysed to identify common patterns. The findings were later validated by an informal section with disaster recovery experts as well as individuals who lived through the earthquake.

- **Quantitative method for data collection and sampling**

As stated earlier, the advanced stages of this research were a combination of quantitative and qualitative research. This stage was initiated by approaching 16 randomly selected individuals on the streets of Kaikōura. According to Kelly et al. (2003), a random sampling approach to research produces generalisable results. Hence, this approach was adopted in the design, testing, and administration of the questionnaire. The researchers asked 16 randomly selected individuals to comment on the questions in the draft questionnaire (developed through a combination of the preliminary field trip and literature review) in terms of the relevance of the factors and indicators derived from the literature. Respondents highlighted the relevance of all the indicators and factors we included in the initial draft of our questionnaire. However, to improve comprehension, they suggested the use of less technical terms. The questionnaire was redrafted to align with these inputs.

The target population for participating in the questionnaire had to meet the following sampling criteria: (1) they were working people who live in Kaikōura, and (2) they were in the labour market at the time of the Kaikōura earthquake in 2016 and by the time of the questionnaire survey in 2019 were recovering from the earthquake. Prior to distributing the questionnaire, the researcher worked with the local newspaper in Kaikōura to inform and educate residents about the research and its potential benefits to the community. Similarly, digital links to the survey were also posted on Kaikoura Notice Board on Facebook, which had over 3000 members. Afterwards, the questionnaire survey was distributed using

a door-knocking approach (as highlighted by Davies (2011)) to residential properties and business premises in Kaikōura. This approach was used to avoid a negative response from local communities due to reluctance to participate in this research because they had been over-surveyed by researchers and other agencies (McNaughton et al., 2015).

Through the door-knocking approach, we had the opportunity to explain in person the purpose of the project and benefits of participation, especially highlighting that the individual responses collectively will help the researchers to gain a big picture of what worked and what did not for better livelihood preparedness for future disaster disruptions. A sample of 236 individuals in Kaikōura were approached for the survey through the door-knocking approach. Individuals were given the option to complete either the printed copy of the survey, which would be collected later by the researchers, or an online version of the survey, using their own computer or electronic device. Of the 236 people contacted for surveys, 140 individuals attempted the questionnaire, of which 134 individuals completed the survey, leading to a response rate of 57% as of October 2019. Data from paper and online responses were later compiled in Qualtrics and SPSS for further analysis. To validate the questionnaire findings, we emailed a report to those participants who had indicated that they would like to receive the final report. Most participants who received the report commented that the results aligned with their perspective.

4.3.3 **Quantitative data analysis**

Preliminary analysis was conducted to determine the reliability of the scale used to obtain data on people's responses to different indicators and factors. According to Watson (2015), the reliability of a measurement instrument or scale highlights its ability to obtain consistent results. This is a prerequisite for most of the statistical tools that would be applied in this research. With respect to indicators, a Cronbach's alpha of 0.650, which is within the marginally adequate value suggested by Yockey (2016) but lower than the value indicated by (Field, 2009), was obtained. However, Field (2009) noted that Cronbach alpha values are sensitive to the number of items in a scale, as scales with more items could have higher alpha values and vice versa. Since there were four items in our scale representing the four indicators under investigation, Briggs and Cheek (1986), supported by Pallant (2011), suggested the assessment of mean inter-item correlation for scales with fewer than 10 items. They were of the view

that mean inter-item correlation of .2 to .4 also showed the reliability of the scale. A mean inter-item correlation of 0.321 was obtained for the scale that measured the indicators of livelihood preparedness.

Regarding the scales applied to assess factors that influenced different indicators of livelihood preparedness, the largest Cronbach's alpha value was obtained for the effectiveness of disaster risk reduction measures at .840 with an item 13 scale. Resource accessibility registered the second alpha value of .814 with five items on the scale. A Cronbach's alpha values of .755 and .741 were obtained for individual adaptive capacity (eight items in the scale) as well as livelihood diversity (five items scale), respectively. Except for resource accessibility, the alpha values seem to increase with the number of items on the scale. A relatively high Cronbach's alpha value, seemingly less influenced by the number of in-scale items, suggests relatively greater scale reliability for scale applied for measuring factors that influenced resource accessibility when compared to scales used for other indicators. Nonetheless, Kline (1999) suggested the suitability of scales with Cronbach's alpha values > .7; hence current scales are sufficiently reliable for our analysis.

Using the overall mean value of 4.054, a one-sample T-test was conducted to determine the most significant indicator of livelihood preparedness in Kaikōura. Indicators with statistically significant P values ($P < 0.05$) and mean values above the overall mean were considered as critical for livelihood preparedness in Kaikōura. To determine the critical factors that influenced individual livelihood preparedness in Kaikōura, a one-sample T-test analysis was conducted in SPSS using the overall mean of factors obtained from the survey on factors. Factors with higher mean values (> 4.26) and statistically significant P values ($P < 0.05$) were considered critical to livelihood preparedness in Kaikōura. A mean value of 4.26 was chosen because it was the least mean value above the overall mean of the factors (4.09) that recorded a statistically significant P value in the dataset. A statistically significant P value < 0.05 is in line with the suggestions of Field (2009) and Pallant (2011).

To affirm the applicability of indicators and factors highlighted in the systematic review section, as well as to develop a framework for livelihood preparedness in Kaikōura, a principal component analysis using SPSS version 25 and structural equation modelling using AMOS version 26 was conducted. SEM is a "class of methodologies that seeks to represent hypotheses about the means, variances and

covariances of observed data in terms of a smaller number of 'structural' parameters defined by a hypothesized underlying model"(Kaplan, 2000, p. 1). it is a combination of different statistical tools consisting of multiple regression analysis, path analysis, and factor analysis, all of which make it a robust and yet complicated modelling tool (Nachtigall, 2003).

SEM provides a unifying framework for fitting numerous linear models while accounting for structural and empirical errors (DSSC, 2012). However, in addition to its large data requirement for complex models, obtained solutions may not always conform to reality (Nachtigall, 2003; Werner & Schermelleh-Engel, 2009). It allows for the evaluation of complex models to determine their compatibility with data (Werner & Schermelleh-Engel, 2009). Even though SEM is sensitive to data kinds and could generate different unique solutions depending on the restrictions imposed by a researcher, it accounts for latent variables (variables that cannot be easily measured) (Jeon, 2015).

Successful execution of SEM is dependent on theory, and in its absence, it would be difficult to identify variables that would be included in a Model (Zou et al., 2018). The systematic review of literature section provided the theoretical framework for the structural equation modelling in this research. Livelihood preparedness serves as the latent variable while resource accessibility, livelihood diversity, individual adaptive capacity, and effectiveness of disaster risk reduction and factors influencing each indicator are the observed variable. Figure 4.2 illustrates the hypothesised model for livelihood preparedness, excluding the influencing factors.

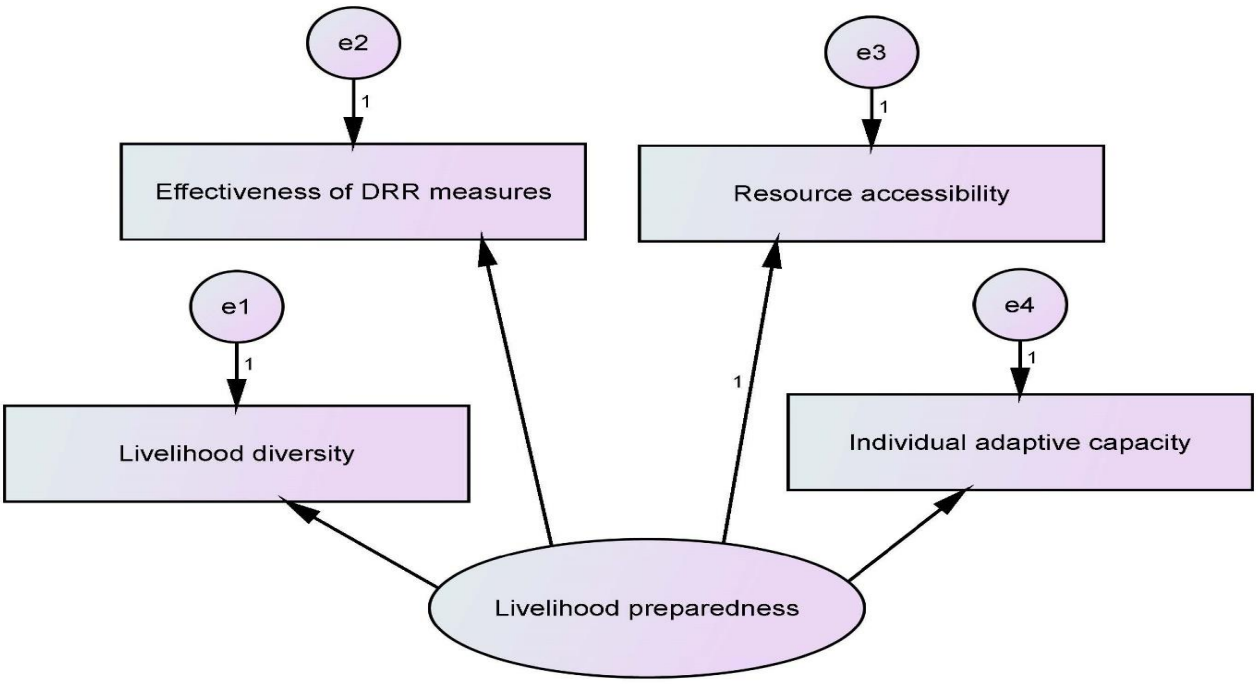


Figure 4.4 Hypothesised model for livelihood preparedness

A reflective and recursive SEM model was hypothesised for livelihood preparedness and its four indicators. In other words, these indicators reflect a prepared livelihood rather than a reason for livelihood preparedness. For instance, an individual may be motivated to diversify their livelihood for economic reasons; however, in doing so and combined with enforcing DRR measures, their livelihoods could be secured in the event of a disruption. Similarly, a self-employed person working from home may undertake a risk-reducing measure like the installation of a power backup system to ensure energy security for the family in the event of a grid outage; however, in doing so, they could carry on with their work longer than their peers in the event of a disaster that resulted in a power grid failure. With respect to recursivity, a feedback loop was not expected between indicators in the model; nonetheless, the model was tested for non-recursivity, and obtained results were less optimal. The model depicted in Figure 2 consists of five unobserved variables, which include error terms e1 – e4 and livelihood preparedness as the latent variable. The four indicators of livelihood preparedness are the observed variable. A listwise approach was adopted in the deletion of incomplete data for SEM, as this ensured the analysis of uniform data cases (Kline, 2016).

To obtain a solution for SEM, the model needs to be over-identified (Beaumont, 2015; Kline, 2016). Loehlin (1992) suggested the use of over-identified models, especially because they allow for testing statistical hypothesis such as global model fit. While the model proposed in Figure 4.2 is structurally over-identified with one degree of freedom, on an initial attempt to run the model, it was discovered that the model was empirically under-identified (DSSC, 2012; Kline, 2016; Nachtigall, 2003). Hence following the instruction of DSSC (2012), the estimated regression value of a variable was restricted to 1. At the initial attempt to obtain a solution for the model, the regression value of livelihood diversity was restricted to one. However, the output of the regression estimates highlighted a value > 1 for resource accessibility which was greater than values obtained from other indicators of livelihood preparedness. Hence, for subsequent solutions, estimated regression value for resource accessibility was restricted to one, which increased the degree of freedom to two and delivered an optimal model.

Even though SEM encompasses PCA (a kind of factor analysis), to improve the understanding of the current data set (especially with regards to factors influencing different livelihood preparedness indicators), a separate principal component analysis was conducted. According to Abdi and Williams (2010); Bro and Smilde (2014), PCA is ideal for the derivation of constructs that explain variations in a dataset. At the initial stage of this study, a potential inter-relationship between derived components was hypothesised; hence, following the suggestions of Field (2009), Tabachnick and Fidell (2007), and Pallant (2011), a direct oblimin rotation was adopted. Nonetheless, a varimax rotation (a preferred type of orthogonal rotation (Field, 2009)) was also conducted to test for potential non-correlation of derived constructs.

Prior to conducting the PCA, the suitability of the data for factor analysis was assessed. An inspection of the correlation matrix highlighted the presence of many correlation values .3 and above as well as determinant values > .00001 (Field, 2009; Pallant, 2011). The core aim of PCA is to reduce the number of items in a dataset while increasing interpretability and reducing information losses (Jolliffe & Cadima, 2016). However, it is the duty of the researchers to ensure that derived components conform to reality because PCAs do not always highlight relevant patterns (Lever et al., 2017). Our target was

to obtain an optimal number of components with constructs that were aligned with livelihood and disaster literature.

On these bases, three SPSS 25 outputs were considered; these included the Kaiser's criteria for eigenvalues > 1, scree plot diagrams, and the construct of the generated pattern matrix. Field (2009); Pallant (2011); and Tabachnick and Fidell (2007) suggested the extraction of components with eigenvalues > 1, and that is located above an inflexion point of a scree plot because these would be the optimum number of components for a specific dataset in a PCA. This was adopted in the current research; however, in situations with multiple eigenvalues > 1 and more than one inflexion point, the output of the pattern matrix for components on and above the last inflexion point with a value > 1 was examined to ascertain the construct that aligned with livelihood and disaster literature.

The pattern matrix was chosen because it depicts an estimated but unique contribution of each item to the variance in derived components (Tabachnick & Fidell, 2007). In other words, it illustrates the construct of any component. If only a single component has eigenvalues > 1 as well as above an inflexion point, SPSS will be unable to produce a pattern matrix. Therefore, in this situation, outputs on the component matrix would be presented because the former represents the loading values of each item (Field, 2009). Because of the size of our dataset, the significance level was set at .4, which is in line with the suggestions made by Field (2009). Hence, the pattern matrix only included loading values > .4 on each component.

From the findings at the preliminary stage of the research, the authors saw the need to collect demographic information on sex, education level, ethnicity, sector of employment, age, presence of dependents, and views on climate change. Data for the first six variables were collected based on the template used by StatsNZ (2020b). Please see Appendix D for a sample of the questionnaire. This demographic information served as independent variables while indicators of livelihood preparedness were used as dependent variables to conduct a multivariate analysis of variance (MANOVA). A MANOVA was needed to search for variations in response within different demographics in the sample population. Prior to conducting a MANOVA, the data were tested to ensure that it met the necessary assumptions listed by (Pallant, 2011), and where necessary, different adjustments were made. These

adjustments will be discussed further at the results stage. The next section will illustrate the results obtained from this study.

4.3.4 Approach to result validation

A two-step approach will be adopted to validate the findings of this research. Expert judgement approach is adopted for research validation (Brownstein et al., 2019). The first step will involve a semi-structured interview of experts in disasters and livelihood preparedness studies. These experts will also have to be conversant with the statistical tools adopted for this study. The experts will be asked to evaluate the fitness of the statistical tools adopted to obtain results. By applying their knowledge in disaster and livelihood studies, they will also be asked to critique the findings and suggest ways it could be improved. The second stage in the validation step will involve input from Kaikōura residents who lived through the 2016 earthquake. Results of this research will be shared with them, and they will be asked to weigh in on the accuracy of our findings as well as areas of further research

Chapter 5 Results

This chapter presents a case study on the 2016 Kaikōura earthquake, the demographics of the respondents, and data obtained from interviews and questionnaires. Response from the interview will be applied to derive lessons learned from the 2016 Kaikōura earthquake. Data from the questionnaires will be subjected to various statistical tools to develop a framework for livelihood preparedness while accounting for critical factors that influenced livelihood preparedness in the community during the last earthquake.

5.1 Case study of Kaikōura

The town of Kaikōura is located about 180 km north of Christchurch on the east coast of the South Island of New Zealand. The name Kaikōura is a Māori word for "eating crayfish." Kaikōura is famous for whale, dolphin, and seal watching and is a popular leisure destination for both local and international travellers (Cloke & Perkins, 2005). Additionally, it hosts a vital rail line connecting the city of Christchurch to other major cities in the North Island of New Zealand (Coastal Pacific, 2020).

As of the 2013 Census, its population stood at 3,552 individuals, comprising of 48.48% males and 51.52% females (StatsNZ, 2013). According to the most recent census, in 2018, the population of the town increased to 3,912 people, which is a 10.1% increase in population compared with the 2013 Census figures. The unemployment rate decreased from 3.3% in 2013 to 1.2% in 2018 (StatsNZ, 2020a). Tourism and primary industries are the largest industries in Kaikōura (Stevenson et al., 2016), as these, combined with the retail sector, employ over 50% of the working population (StatsNZ, 2013).

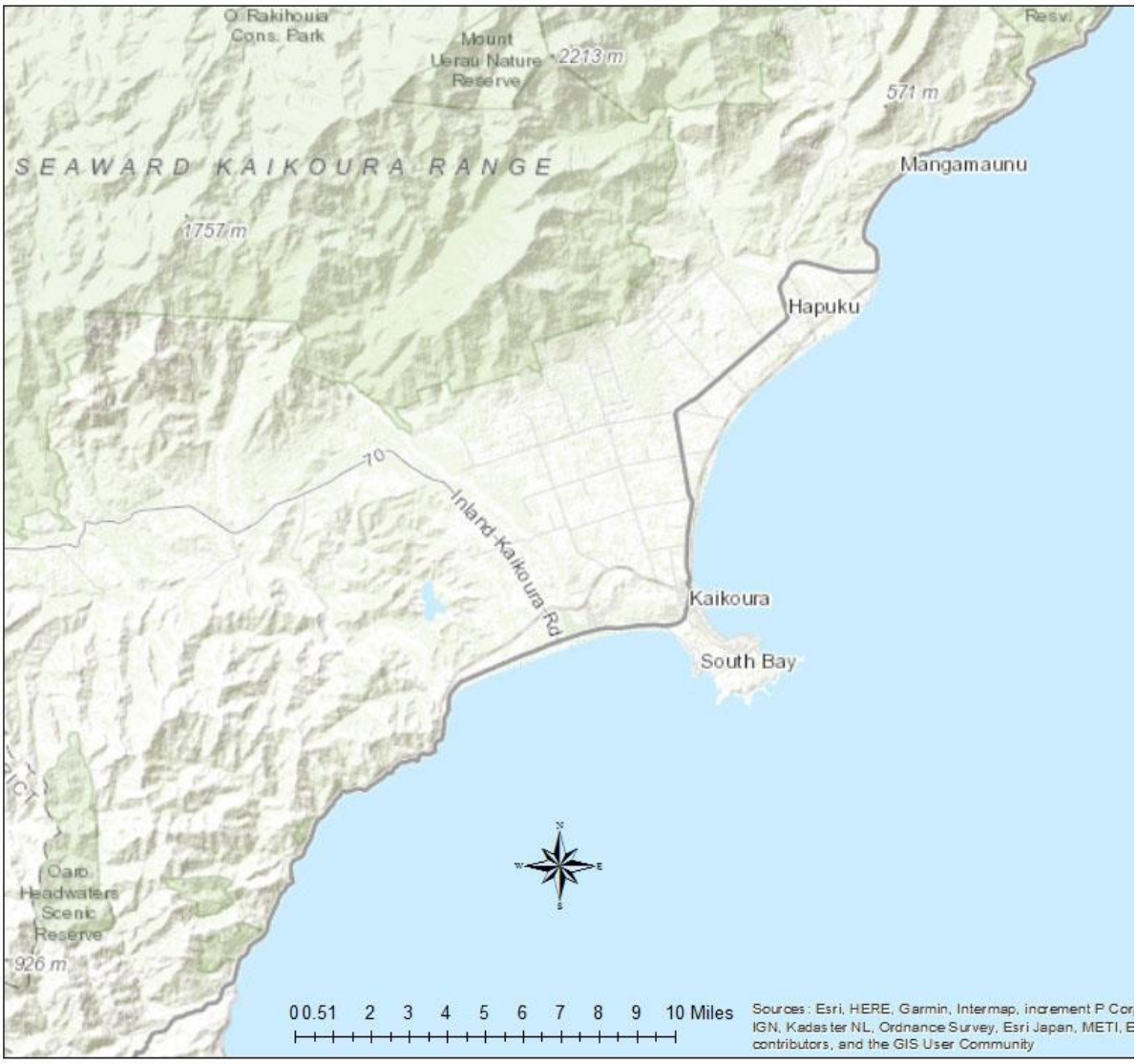


Figure 5.1 Aerial View of Kaikōura (Google, 2019)

On the 14th of November 2016 at 12:02 NZDT, the town of Kaikōura was affected by an M7.8 earthquake with an epicentre 15km north-east of Culverden (Ministry of Civil Defence & Emergency Management, 2017). The impact of the earthquake and ensuing aftershocks, as well as tsunami, destroyed transport infrastructure (road and rail), utilities (potable water and sewage, power, optic fibre), and buildings within Kaikōura (Hatton et al., 2017; Ministry of Civil Defence & Emergency Management, 2017; Woods et al., 2017). It also negatively impacted the aquatic habitat of Kaikōura (Stevenson et al., 2016). Figure 5.1 is a pictorial illustration of the 2016 Kaikōura earthquake.

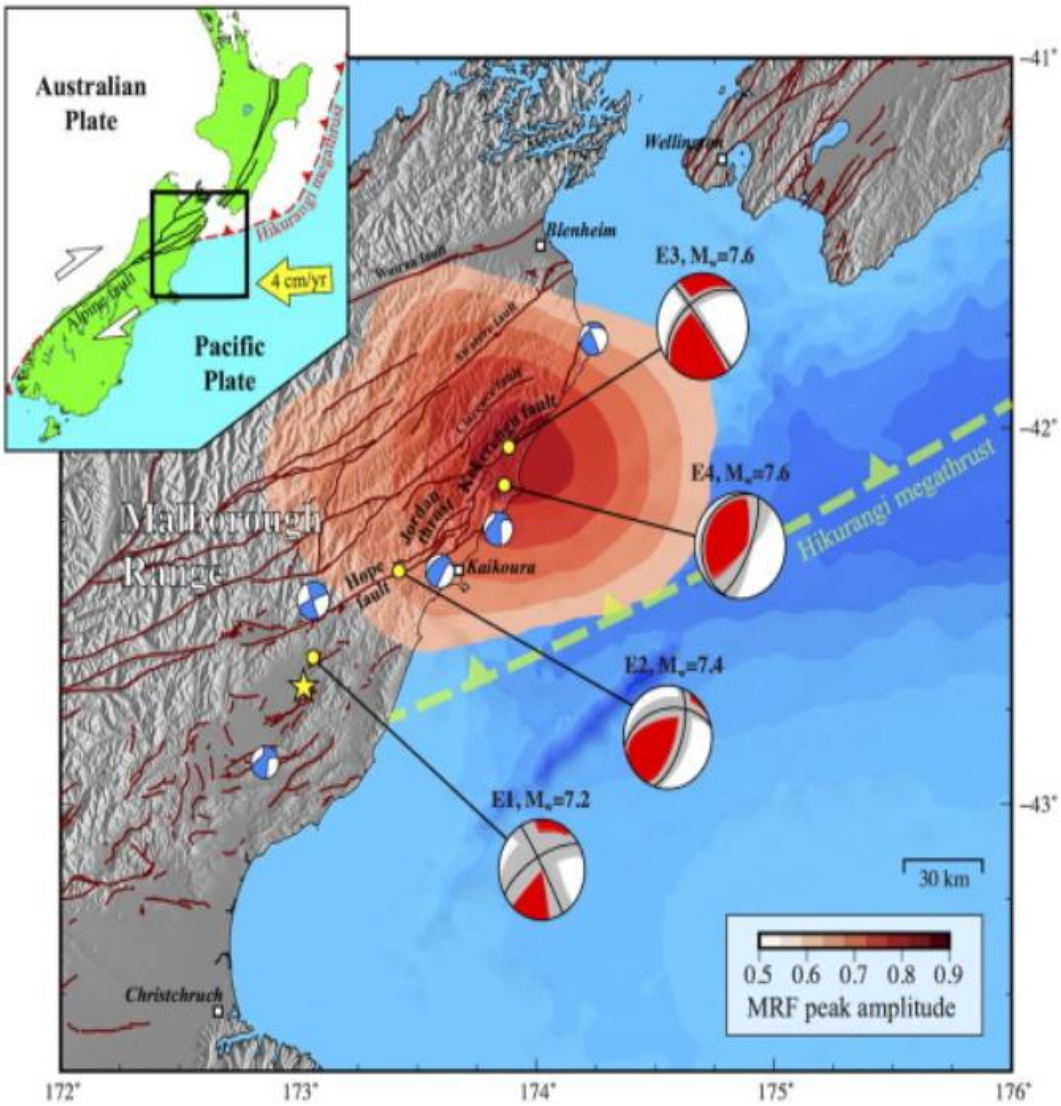


Figure 5.2 Kaikōura earthquake in 2016 (Source: Duputel and Rivera (2017))

There are at least 746 businesses in Kaikōura (StatsNZ, 2013); it will be challenging to quantify the impacts of the earthquake on job losses or organisation productivity. However, (Stevenson et al., 2016) noted that Kaikōura and environs had experienced the loss of productivity and jobs, in spite of government interventions by paying the wages of the workers for a while after the disaster. This could be attributed to several factors that affected the three main industries in Kaikōura; the chief of these is the transportation disruption. After the earthquake, Kaikōura was isolated from the rest of New Zealand by land due to uplifts, rock falls, and landslides (Woods et al., 2017). At the time of conducting this

research, transport remained a major obstacle for businesses as, each time it rained, roads leading to Kaikōura were either partially or completely closed, leaving travellers stranded.

Managers and business owners in the tourism industry saw increased cancellations on booking whenever rains were forecasted for the community, as visitors were afraid of being stranded in Kaikōura. Businesses in the retail sector highlighted an increase in freight costs as well as a disruption in their supply chain because of road works. Similarly, Stevenson et al. (2016) illustrated the impact of transportation disruption on primary industries, as businesses were unable to get their products to markets promptly. It may take some time for farmlands and aquatic habitats to recover from the level of obliteration dealt on them by the 2016 earthquake. The issue of damaged utilities (portable and wastewater facilities) would affect the well-being of residents of Kaikōura, locals, and visitors alike. Additionally, the psychological impacts of the incident on the locals may affect organisational productivity as several locals are disturbed by loud noises, which force them to re-live past horrors of the earthquake.

From the information provided by Kaikōura district council (2018), it will take a while for things to normalise (construction-wise) in Kaikōura. However, while individuals wait for this to happen, operating costs for businesses may increase and without a commensurate increase in revenue, organisations may result to laying off staff. This will ultimately affect the livelihood quality in the community. When the construction works are completed, the destruction of natural resources, as well as public image, may take longer to recover. Irrespective of disaster impacts on industries, businesses, and, potentially, livelihoods, the populace of Kaikōura highlighted a few livelihood lessons learned from the event; the chief of these was the need to diversify individual livelihoods as well as the economy of Kaikōura (2018).

Business owners and government officials interviewed collectively agreed on the need to diversify the economy of Kaikōura; however, their approaches differed slightly. Business owners are trying to diversify their operations to take advantage of the market created by the current recovery works. This will protect their businesses as well as the livelihood of their staff in the short term but may not necessarily account for the long-term changes in the economy of Kaikōura. On the other hand, the

government staff interviewed are focused on developing diversification strategies that are capable of sustaining livelihood in the short term as well as protecting and improving the economy of the town in the long term. According to city council staff, they are working to develop a vision for Kaikōura, which will assist in attracting and retaining needed talents and investments in a sustainable manner.

The 2016 earthquake also taught individuals and business owners the need to understand the terms of their insurance policy, as this led to a great deal of misunderstanding between the insurer and their clients. These misunderstandings have created a negative perception of insurance which is not good for both the insurers, as well as in mitigating the effects of future disasters in the town. Other lessons highlighted include the importance of physical and psychological preparedness for people living in disaster situations, as well as the need to develop external networks that could assist businesses and individuals in protecting their interests in the outside world in the event of a disaster.

These relationships could help them to source and send items where they are handicapped to do so by disaster disruptions. Additionally, the earthquake highlighted the importance of cash and inventory management as well as self-efficacy to sustain and protect lives and livelihoods after a disaster. Finally, the importance of technology, innovation, and flexibility to strengthen existing livelihoods options while fostering the development of new ones after a disaster was also emphasised. Table 5.1 provides a summary of livelihood lessons from the 2016 Kaikōura earthquake. Each lesson emanated from the analysis of answers provided to a set of questions in interviews or observation. These lessons will be discussed further in the discussion section.

Table 5.1 Livelihood lessons from the 2016 Kaikōura earthquake

1	Physical wellbeing and psychological preparedness are essential to livelihood preparedness
2	Understanding insurance policies, as well as accessibility of affordable insurance, are critical.
3	Government support in the form of business subsidies to pay employees living wages is essential for livelihood recovery
4	Livelihood diversification plays a significant role in livelihood preparedness
5	Societal networks external to the local community are instrumental in assisting individuals and businesses in coping with disasters
6	Cash reserve and/or capital inventory creates self-efficacy which is essential to sustain livelihood.

In all, the earthquake not only resulted in hardship and pain for the locals of Kaikōura town; it taught them valuable lessons that would enhance their livelihood preparedness for future events.

5.2 Demographic information on the questionnaire participants

From a sample size of 236 individuals who lived through and are currently recovering from the 2016 Kaikōura earthquake, 140 responses were obtained about how important different indicators are in preparing individual livelihoods for a disaster. Of the 140 responses received, 135 individuals provided 100% feedback; the rest provided less than 50% feedback. Table 5.2 highlights a breakdown of the demographic data obtained in Kaikōura:

Table 5.2 Demographic data about survey participants

Category	Items	Values
Gender	Male	36%
	Female	64%
Age group	15 – 19	1.5%
	20 – 24	11%
	25 – 34	18.3%
	35 – 49	28.7%
	50 – 64	34.6%
	64+	5.9%
Education level	Secondary	32.8%
	Level 1 – 4*	21.9%
	Level 5 – 6**	19%
	Level 7***	18.2%
	Postgrad+	3.7%
	No formal education	4.4%
Ethnicity	European	79.4%
	Māori	7.3%
	Asia	5.8%
	Africa/Middle East and Americas	2.9%
	Pacific Islands	2.9%
	Mixed	4.6%
	Couple with dependents	35%

Family type (with and without *dependents*[1])	Couple without dependents	30%
	Single parents	25%
	Single individuals without dependents	10%
Perception on Climate change	Affect Livelihood	41.6%
	Not affect livelihood	34.3%
	Unsure	24.08%
Job sector of respondents	Hospitality and tourism	31.2%
	Wholesale and retail trading	22.5%
	Healthcare workers	9.4%
	Education and training	8%
	Construction	5.8%
	Primary industry	5.1%
	Utilities	2.9%
	Housing and real estate	2.9%
	Financial services and insurance	2.9%
	Information and media telecommunication	2.9%
	Civil servant	2.9%
	Manufacturing	1.4%
	Logistics	0.7%
1: Dependents : Children (individuals below 15 StatsNZ (2016)) and/or older adults above 65 years and the disabled		
**Certificate, **Diploma, ***Degree (New Zealand Qualifications Authority, 2020)*		

With respect to gender, approximately 64% of the response were obtained from females while 36% were males. Based on the labour market participants grouping used by Statistics NZ, data was collected across six age groups: people within the ages of 50 – 64 represented 34.6% of the total response, making them the greatest contributor to the study. This was followed by those between 35 - 49 at 28.7%, 25-34 at 18.3%, 20 – 24 at 11%, 64+ at 5.9% and 15 – 19 at 1.5% of the respondents.

In terms of education, the respondents were classified into six categories. The greatest number of responses was obtained from those with a secondary school certification as their highest formal qualification. They represented 32.8% of the respondents. This was followed by individuals with levels

1 – 4 certifications at 21.9%. Individuals with levels 5 or 6 diploma represented 19% of the data, while those with level 7 qualification or a bachelor's degree made up 18.2% of the results. People without any formal qualification amounted to 4.4% of the data, while those with a postgraduate degree and above constituted 3.7% of the total response.

The Kaikōura population constitutes of people from various ethnic backgrounds, all of whom contributed to the data. People of European ancestry made up 79.4% of the respondents, while those of Māori and Asian descent constituted 7.3% and 5.8%, respectively, of obtained data. Pacific Islanders, people from the Middle East/Latin America/Africa, and other ethnic groups constituted 2.9%, respectively. It is important to note that 4.5% of the respondents highlighted multiple ethnicities; most of these individuals were either European Māoris, European Asians, or European Islanders.

In terms of family types, respondents in Kaikōura were classified into four categories based on the existence of dependents. Dependents in this context encompass children, spouses, and other family members who are incapable of earning for any reason. Individuals who are married and have dependants represented 35% of the respondents. This was closely followed by those who are married but have no dependents at 30%. Single people who have no dependents and single parents were represented by 25% and 10%, respectively.

Due to the geographical location of Kaikōura and the global trends of a changing climate, an attempt was made to assess whether individual perception on the effect of climate change on livelihoods influenced the way individuals viewed the livelihood indicators. 41.6% of respondents believed that a changing climate would affect their livelihood, while 34.3% believed climate change would have no impact on the way they earn a living. Nonetheless, 24.08% of individuals were unsure if and how climate change would affect their livelihoods.

With regards to jobs, responses were obtained for 13 different sectors in Kaikōura. Hospitality and tourism, as well as wholesale and retail trading, had the highest representation at 31.2% and 22.5%, respectively. Healthcare workers and those who classified their job sector as 'others' were represented by 9.4% and 1.4% respectively of the obtained data. Responses obtained from individuals working in

the construction sector and those whose livelihood depends on the primary industry represented 5.8% and 5.1%, respectively. Utilities, housing and real estate, information and media communication, financial and insurance services, public administration, as well as education and training individually accounted for 2.9% of the obtained data. Manufacturing, as well as logistics, were least represented at 1.4% and 0.7%, respectively.

5.3 Principle component analysis and T-test for indicators of livelihood preparedness

The analysis results delivered a Bartlett test of sphericity of 80.635 and an associated significance level of 0.000, which demonstrates that the correlation matrix is not an identical matrix. The value of the Kaiser-Mayer-Olkin measure of sampling adequacy is 0.699, which is greater than the minimum value of 0.5 proposed by Field (2009); Pallant (2011) for factor analysis. The principal component analysis generated a single component solution with an eigenvalue greater than one. This is depicted in the scree plot in Figure 5.3.

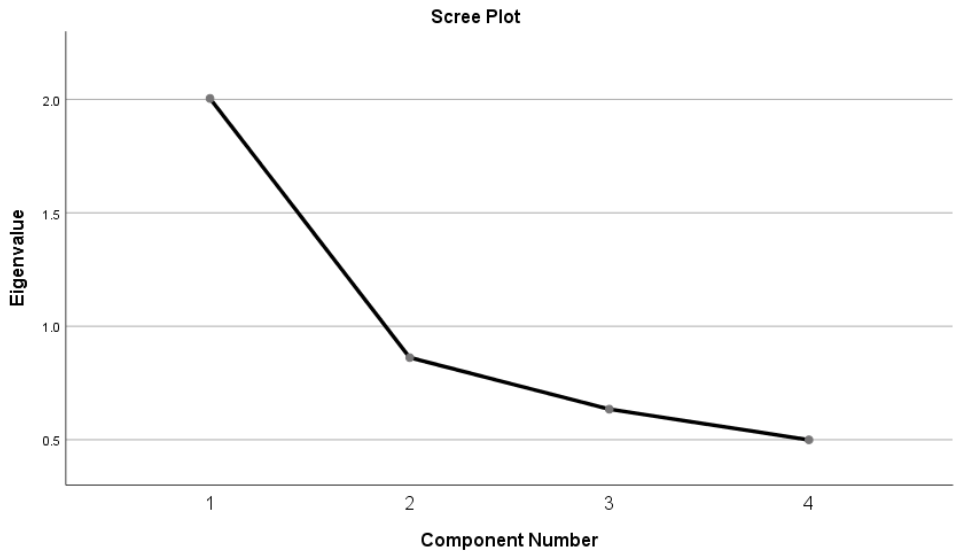


Figure 5.3 Scree plot of livelihood preparedness indicators

While component one had an eigenvalue of two components, two and four had an eigenvalue of < 1, rendering them less viable (Field, 2009; Pallant, 2011). Furthermore, Tabachnick and Fidell (2007) suggested that components on and after a change in slope on a scree plot are less important. Since only one component could be derived, the result could not be rotated using any of the rotational options on

SPSS. Nonetheless, each variable had a loading value > 0.5 on component one. Table 5.3 shows the component matrix derived from SPSS.

Table 5.3 Component matrix derived from SPSS

Component one	
Indicators	Loading factor
Resource accessibility	0.804
Livelihood diversity	0.507
Individual adaptive capacity	0.730
Effectiveness of Individual disaster risk reduction measures	0.754

Resource accessibility had the greatest loading value of 0.804 on component one, while individual livelihood diversification had the least weight on component one.

Table 5.4 illustrates the correlation among different components of livelihood preparedness in Kaikōura. Resource accessibility recorded the highest correlation value with other indicators, especially the effectiveness of individual disaster risk reduction measures, as both had a correlation value of 0.489. Similarly, the effectiveness of individual disaster risk reduction measures and individual adaptive capabilities recorded relatively higher correlation values with each other at 0.376. However, livelihood diversity had the lowest correlation value with other indicators of livelihood preparedness, with a value of 0.179 recorded between livelihood diversity and effectiveness of individual disaster risk reduction measures.

Table 5.4 Correlation matrix

Indicators and correlation values				
Indicators	Resource accessibility	Livelihood diversity	Individual adaptive capacity	Effectiveness of individual disaster risk reduction measures
Resource accessibility	1.000	0.263	0.418	0.489
Livelihood diversity	.263	1.000	0.223	0.179
Individual adaptive capabilities	.418	0.223	1.000	0.376

Effectiveness of individual disaster risk reduction measures	.489	0.179	0.376	1.000

Table 5.5 illustrates the results of the one-sample t-test as well as the mean value obtained for each indicator of livelihood preparedness. Indicators in Table 5.5 were depicted in descending order of their means, with the highest mean value of 4.37 obtained for individual adaptive capacity. The overall mean score stood at 4.05, which is higher than the values obtained for all indicators except individual adaptive capacity.

Table 5.5 One sample T-test for indicators of livelihood preparedness in Kaikōura

No	Indicators	Mean	T	P-value
1	Resource accessibility	3.96	-1.210	.228
2	Livelihood diversity	3.83	-2.686	.008
3	Individual adaptive capacity	4.37	4.559	.000
4	Effectiveness of DRR measures	4.04	-.222	.825
	Overall mean value = 4.054			

Perhaps this could be attributed to the fact that the least response obtained for individual adaptive capacity was a ranking of two. Similarly, the effectiveness of individual disaster risk reduction measures was slightly below the overall mean at 4.04 as a relatively greater number of individuals (totalling 107) rated it as at least a four on a five-point scale as important for livelihood preparedness. On the other hand, livelihood diversity recorded the lowest mean value at 3.83. In addition to two missing values, this indicator was perceived by the highest number of individuals (four individuals) as not important and somewhat important (nine individuals) to livelihood preparedness in Kaikōura

Ning et al. (2014) noted that individuals could diversify their livelihood either in the same sector (internal diversification) or into a different sector (external diversification); hence an attempt was made to ascertain people's perspective on internal and external diversification. For either option, the majority of individuals (> 70%) either were indifferent or ranked it as important. However, a slightly greater

percentage of people felt it was very important to diversify in the same sector (7.9%) as opposed to externally (7.1%).

Both individual adaptive capacity and livelihood diversity recorded statistically significant p-values $P < 0.05$. However, for this research, only individual adaptive capacity would be regarded as the critical indicator for livelihood preparedness in Kaikōura as a relatively high mean value was also obtained for it.

5.4 Principal component analysis and T-test for factors influencing indicators of livelihood preparedness

From the systematic review of literature, 17 factors were highlighted to influence the effectiveness of disaster risk reduction, while 10, 8, and 7 factors influenced resource accessibility, individual adaptive capacity, and livelihood diversity, respectively. Sequel to the preliminary studies in Kaikōura, these were streamlined to 13 factors for effective disaster risk reduction and five factors for resource accessibility and livelihood diversity, respectively. On the other hand, the number of factors influencing individual adaptive capacity increased to eight. Factors influencing all four indicators were optimised to align with the Kaikōura context.

Similarly, Figures 3.6 through to 3.9 highlighted a relatively higher representation of some factors compared to others, suggesting a wider influence of those factors relative to others influencing a particular indicator. For instance, the influence of access to resources on livelihood diversity was highlighted by 92.59% of reviewed articles. Within the Kaikōura context, the aim was to identify factors critical to livelihood preparedness rather than factors critically influencing each indicator. Additionally, factors influencing each indicator seemed to be clustered in groups as highlighted by the PCA depicted in Table 5.8.

Table 5.6 depicts the results of the one-sample T-test conducted to determine factors critical to livelihood preparedness in Kaikōura. The factors in Table 5.6 are ranked in descending order of means; items with higher mean values are ranked above others. Where the same mean value was obtained, a higher rank value was given to the factor with a lower P value, which suggests a relatively greater

statistical significance. As seen in Table 5.6, factors ranked from number 1 to 11 are considered critical factors that have influenced livelihood preparedness in Kaikōura. These 11 factors have a relatively higher mean value (> 4.09) and a statistically significant P value (P < 0.05). Factors ranked from 12 to 31 in Table 5.6 either had P values > 0.05, meaning that no statistical difference was observed for those factors (12–16), or had a mean value < 4.09 (23–31). In some cases, both the mean value and the *P*-value are outside the listed cut-off points (17–22).

Table 5.6 One-sample T-test for factors influencing livelihood preparedness in Kaikōura

Test Value = 4.09							
Ranking	**Factors**	**t**	**df**	**Sig. (2-tailed)**	**Mean**	**95% confidence interval of the difference**	
						Lower	**Upper**
1	Access to livelihood infrastructures and services (e.g. roads, power, water)	9.952	135	0.000	4.68	0.47	0.70
2	Willingness to adapt to changes and new circumstances	6.640	135	0.000	4.50	0.29	0.53
3	Access to social capital (friends, family, community support)	4.433	135	0.000	4.38	0.16	0.41
4	Knowledge about the hazards that could affect you and your family	4.448	133	0.000	4.36	0.15	0.39
5	People's willingness and own ability to take disaster risk reduction measures	3.892	132	0.000	4.35	0.13	0.40
6	Lessons learned from past disasters	3.472	134	0.001	4.34	0.11	0.39
7	Attitude and belief towards preparing for disasters	3.191	135	0.002	4.29	0.07	0.32
8	Physical and mental preparedness for a disaster event and its aftermath	2.706	134	0.008	4.29	0.05	0.34
9	Availability of early warning systems	2.689	131	0.008	4.28	0.05	0.33
10	Availability of external support (from the government agencies and/or NGOs and others)	2.532	135	0.012	4.27	0.04	0.32
11	Mutual support in a neighbourhood	2.436	135	0.016	4.26	0.03	0.32
12	Skillsets of an individual	1.788	135	0.076	4.20	-0.01	0.23
13	Undertaking preventive measures to disaster-proof houses and buildings (e.g., fastening household items and retrofitting old buildings/houses)	0.997	132	0.320	4.17	-0.07	0.22
14	Access to timely and accurate hazard/risk information	0.983	132	0.327	4.16	-0.07	0.20

15	Access to external support (from the government agencies and/or NGOs and others)	0.901	135	0.369	4.15	-0.08	0.21
16	Access to financial assets (e.g. savings, loans, banking services and insurance)	0.857	135	0.393	4.15	-0.08	0.21
17	An individual's hazard and risk perception	-0.150	135	0.881	4.08	-0.13	0.11
18	Using tools and resources in a smart way to mitigate risks and for recovery	-0.094	131	0.925	4.08	-0.15	0.13
19	Financial capability for disaster risk mitigation	-0.541	131	0.589	4.05	-0.17	0.10
20	Possession of skills and resources in market demands	-1.169	132	0.244	4.00	-0.24	0.06
21	Incorporation of local (traditional) knowledge with modern disaster risk reduction techniques	-1.535	134	0.127	3.97	-0.27	0.03
22	Utilising assets/resources in a creative/innovative manner	-1.727	131	0.087	3.96	-0.27	0.02
23	Access to various types of assets/resources	-2.222	132	0.028	3.93	-0.30	-0.02
24	Level of community participation and consultation in Council's disaster risk reduction plans	-2.115	133	0.036	3.93	-0.30	-0.01
25	People's own perception of hazards and associated risks	-4.012	132	0.000	3.80	-0.43	-0.14
26	Knowledge about alternative livelihood options in one's locality	-3.384	132	0.001	3.80	-0.45	-0.12
27	Knowledge about the local context (e.g. social norms, cultural beliefs, laws)	-3.926	134	0.000	3.77	-0.48	-0.16
28	Prior disaster experience	-3.811	134	0.000	3.74	-0.53	-0.17
29	Level of work experience	-4.863	134	0.000	3.70	-0.54	-0.23
30	Participation in training for disaster risk reduction	-6.772	131	0.000	3.59	-0.64	-0.35
31	Knowledge about government laws and policies surrounding work and income	-6.517	132	0.000	3.48	-0.79	-0.42

Kaiser–Meyer–Olkin values, as well as figures for Bartlett's test of sphericity, were obtained for factors influencing the four indicators of livelihood preparedness. These values are illustrated in Table 5.7.

Table 5.7 Dataset suitability test

For factors influencing:	Kaiser–Meyer–Olkin value	Bartlett's test of sphericity
Resource accessibility	.761	$\chi 2$ (10) = 254.346, p < .001,
Livelihood diversity	.749	$\chi 2$ (10) = 199.502, P < .001,
Individual adaptive capacity	.760	$\chi 2$ (28) = 222.34, p < .001
Effectiveness of DRR measures	.812	$\chi 2$ (78) = 519.809, p < .001

In all cases, the obtained KMO values exceeded the cut-off point of .5 recommended by Kaiser (1974) and supported by Field (2009). Likewise, the results of Bartlett's test of sphericity suggested that the correlation values between factors influencing each indicator were significant enough to permit a PCA (Field, 2009).

Even though items ranked from 12 to 31 seemed less critical for livelihood preparedness in Kaikōura, all the factors in Table 5.6 appeared to influence the four indicators of livelihood preparedness. These influences are summarised in Table 5.8, which depicts a pattern matrix obtained from the PCA.

Table 5.8 A pattern matrix of factors influencing the indicators of livelihood preparedness in Kaikōura

Indicator	Factor	Components						
		1	2	3	4	5	6	7
		Access to resources	**Resourcefulness and ability to innovate**	**Knowledge about livelihoods**	**Self-efficacy**	**Contextual knowledge and work experience**	**Disaster preparedness**	**Individual DRR measures and social cohesion**
Resource accessibility	Availability of external support (from the government agencies and/or NGOs and others)	.854						
	Access to external support (from the government agencies and/or NGOs and others)	.853						
	Access to social capital (friends, family, community support)	.769						
	Access to livelihood infrastructures and services (e.g. roads, power, water)	.716						
	Access to financial assets (e.g. savings, loans, banking services and insurance)	.597						
Livelihood diversity	Utilising assets/resources in a creative/innovative manner		.915					
	Access to various types of assets/resources		.858					
	Possession of skills and resources in market demands		.754					
	Knowledge about government laws and policies surrounding work and income			.924				
	Knowledge about alternative livelihood options in one's locality			.734				
Individual adaptive capacity	An individual's hazard and risk perception				.777			
	Attitude and belief towards preparing for disasters				.754			

	Physical and mental preparedness for a disaster event and its aftermath	.722				
	Willingness to adapt to changes and new circumstances	.675				
	Skillsets of an individual	.580				
	Level of work experience		.855			
	Lessons learned from past disasters		.652			
	Knowledge about the local context (e.g. social norms, cultural beliefs, laws)		.651			
Effectives of DRR measures	Availability of early warning systems			.830		
	People's willingness and own ability to take disaster risk reduction measures			.736		
	Financial capability for disaster risk mitigation			.702		
	Using tools and resources in a smart way to mitigate risks and for recovery			.680		
	Knowledge about the hazards that could affect you and your family			.611		
	Access to timely and accurate hazard/risk information			.522		
	Level of community participation and consultation in Council's disaster risk reduction plans				.828	
	People's own perception of hazards and associated risks				.822	
	Undertaking preventive measures to disaster-proof houses and buildings (e.g. fastening household items and retrofitting old buildings/houses)				.508	
	Mutual support in a neighbourhood				.457	

In Table 5.8, 31 factors influencing specific indicators of livelihood preparedness are depicted across seven components and arranged in descending order of their loading value on the pattern matrix of a unique indicator. With respect to resource accessibility, an initial PCA extracted a single component (Component 1) with eigenvalues > 1, which explained approximately 58.3% of the total variance. This was affirmed by a scree plot because only one single component was above or to the left of the inflexion point. Component 1 is depicted as 'Resource accessibility' in Table 5.8. For livelihood diversification, Components 2 (resourcefulness and ability to innovate) and 3 (knowledge about livelihoods) were extracted because both had eigenvalues > 1 and explained approximately 53% and 21% of the variance, respectively. This aligned with findings deduced from an inspection of the scree plot because only two components with eigenvalue > 1 were positioned on or above the first inflexion point.

For the individual adaptive capacity indicator, three groups with eigenvalues > 1, explaining that approximately 38%, 13%, and 12% of the variance respectively were extracted initially. However, an inspection of the scree plot showed multiple changes in gradient at eigenvalues > 1, which could justify the extraction of either two or three groups. Consequently, following the iterative steps listed in the methodology, the fourth component (self-efficacy) and fifth component (contextual work and work experience) with a combined variance of approximately 51% were selected.

Lastly, an initial analysis of factors influencing the effectiveness of DRR measures derived a four-component solution with eigenvalues > 1, explaining approximately 35.4%, 9.7%, 8.8%, and 8.3% of the variance, respectively. However, an inspection of the scree plot showed multiple inflexion points, which could justify the extraction of one, two, or four groups. Nonetheless, following the iterative steps outlined in the methodology, two components, Disaster preparedness (Component 6) as well as individual DRR measures and Social cohesion (Component 7), with a combined variance of 45.1%, were obtained. Although solutions that derived three and four groups respectively explained a higher percentage of the total variance, the constructs of these solutions were less optimal. In addition, the incorporation of local (traditional) knowledge with modern DRR techniques, prior disaster experience, and participation in training for DRR had loading values < .4 and hence were omitted in Table 5.8

5.5 Significance tests by demographics

A one-way MANOVA was performed to ascertain any potential variance among different demographic groups with regards to the four indicators of livelihood preparedness. Starting with gender as the independent variable, the indicators of livelihood preparedness included resource accessibility, livelihood diversity, individual adaptive capacity, and effectiveness of individual disaster risk reduction measures; there was no statistically significant differences between males and females on the combined dependent variables F (4, 132) = 1.44, P = .225; Wilks' Lambda = .96; partial eta squared = .042.

Another one-way MANOVA was carried out using age as the independent variable. |However, responses from the 15 – 19 age group were ignored as they did not satisfy the sample size assumption highlighted by Tabachnick and Fidell (2007) and affirmed by Pallant (2011). Nonetheless, there was no statistically significant difference between the age groups on the combined variables, F (16, 386) = 1.014, P = .441; Wilks' Lambda = .88; partial eta squared = .031.

Like the last two demographics, no statistically significant difference was identified between different levels of educational qualifications on the combined dependent variable, F (20, 425) = 1.15, P = .298; Wilks' Lambda = .84; Partial eta squared = .958.

With regards to ethnicity, no statistically significant difference was identified among various ethnicities in Kaikōura on the combined variables, F (20, 422) = 1.03, P = .426; Wilks' Lambda = .85; Partial eta squared = .039. Similarly, no statistically significant difference was detected among people with and without dependents in Kaikōura on the combined variables, F (12, 336) = 0.567, P = .868; Wilks' Lambda = .948, Partial Eta Squared = .971.

Regarding people's perception of the effects of climate change, like other demographic data evaluated so far, no statistically significant difference was detected irrespective of their perceptions of a changing climate. The MANOVA delivered a combined variable F (8, 262) = .776, P = 0.624; Wilks' Lambda = .954, Partial Eta Squared = .023

These sectors (manufacturing and logistics) will be exempted from the MANOVA as they do not meet the sample size condition. No statistically significant difference was detected among individuals from

different job sectors on the combined variable F (44, 457) = 1.08, P = 0.336; Wilks' Lambda = .684, Partial Eta Squared = .090

In all, the absence of statistically significant differences between those who believed climate change would affect their livelihoods and those who were unsure about climate change or thought differently was in contrast with the findings of Muringai et al. (2020) on the effects of climate change on individual livelihoods. Further research will be required to justify this finding. A similar trend also repeated among people working in different job sectors. It was expected that those working in primary industries, as well as other sectors vulnerable to climate change, might have recorded statistically significant values different from other groups. Nonetheless, the absence of statistically significant differences between people of different educational levels was expected as most people in Kaikōura had basic education. If the situation was reversed, perhaps the results would be different. The next section presents the structural equation modelling conducted for this research.

5.6 Structural equation modelling

According to Nachtigall (2003) and Kline (1999), SEM is sensitive to abnormal or incomplete datasets. Hence, incomplete data were eliminated to limit potential simulation errors, which reduced the data size to 137 responses. DSSC (2012), supported by Bentler and Chou (1987), believed 15 responses per unobserved variable was reasonable for an SEM analysis. Given that there are 4 unobserved variables and 137 responses, our current sample size should be enough to run an SEM analysis of indicators of livelihood preparedness, excluding the influencing factors. At a minimum discrepancy value (CMIN/DF) of .361 and two degrees of freedom, a Chi-square value of .722 with a *p* value of .697 was obtained.

The model delivered goodness of fit value (GFI) of .997, and a root mean square error value of approximately (RMSEA) .000. An adjusted goodness of fit index (AGFI) value of .987 was obtained with a comparative fit index (CFI) value of 1.00. A normed fit index (NFI) and Tucker Lewis index (TLI) value of .991 and 1.052 was obtained, respectively. A modification index was conducted to obtain a better fit; however, the optimum value was obtained with the current model in Figure 4. According to

DSSC (2012); Kline (2016), with the exception of the CMIN/DF figure, obtained fitness values suggesting a model fit between current dataset and the hypothesised livelihood preparedness model proposed in Figure 4.2. Figure 5.4 illustrates a structural equation model for livelihood preparedness with standardised regression estimates.

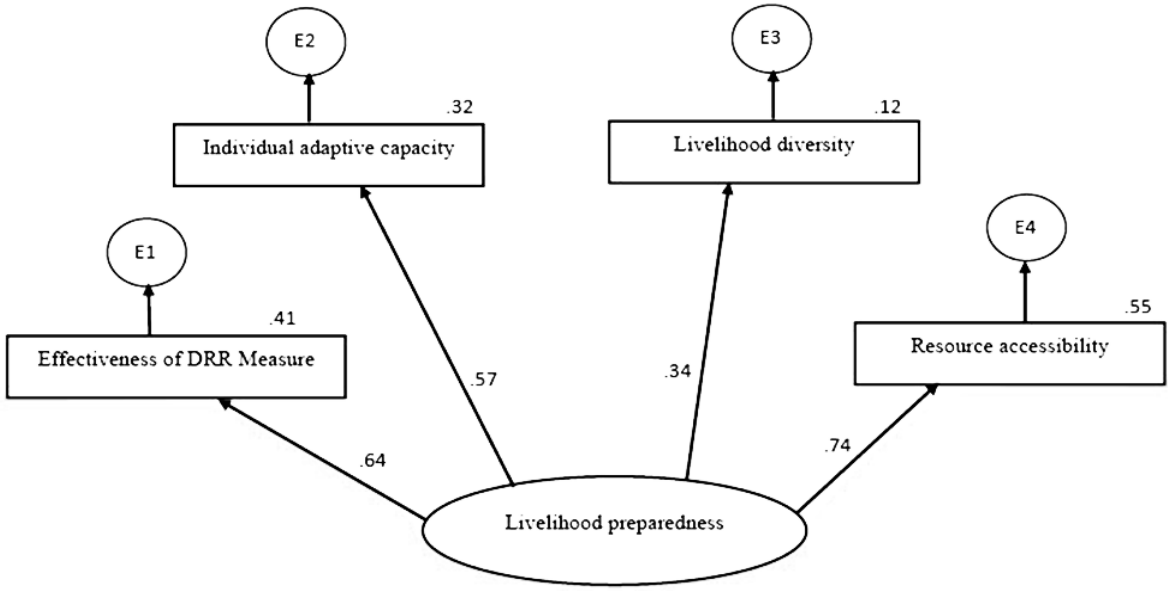


Figure 5.4 Structural equation model for livelihood preparedness indicators with standardised estimates

The highest standardised regression estimate value was obtained between livelihood preparedness and resource accessibility at .74. Resource accessibility also had a relatively higher variance at .55 compared to other indicators of livelihood preparedness. Regression estimate values of .64 and variance of .41 were obtained for Effectiveness of DRR, while individual adaptive capacity had a standardised regression value of .57 and variance of .32. Livelihood diversity obtained the least standardised regression value and variance at .34 and .12, respectively.

As an expanded version of Figure 5.4, Figure 5.5 is an attempted illustration of the SEM model of indicators and factors influencing livelihood preparedness in Kaikōura. (with standardised estimates). The GFI and other fitness measurement parameters listed above do not apply to Figure 5.5.

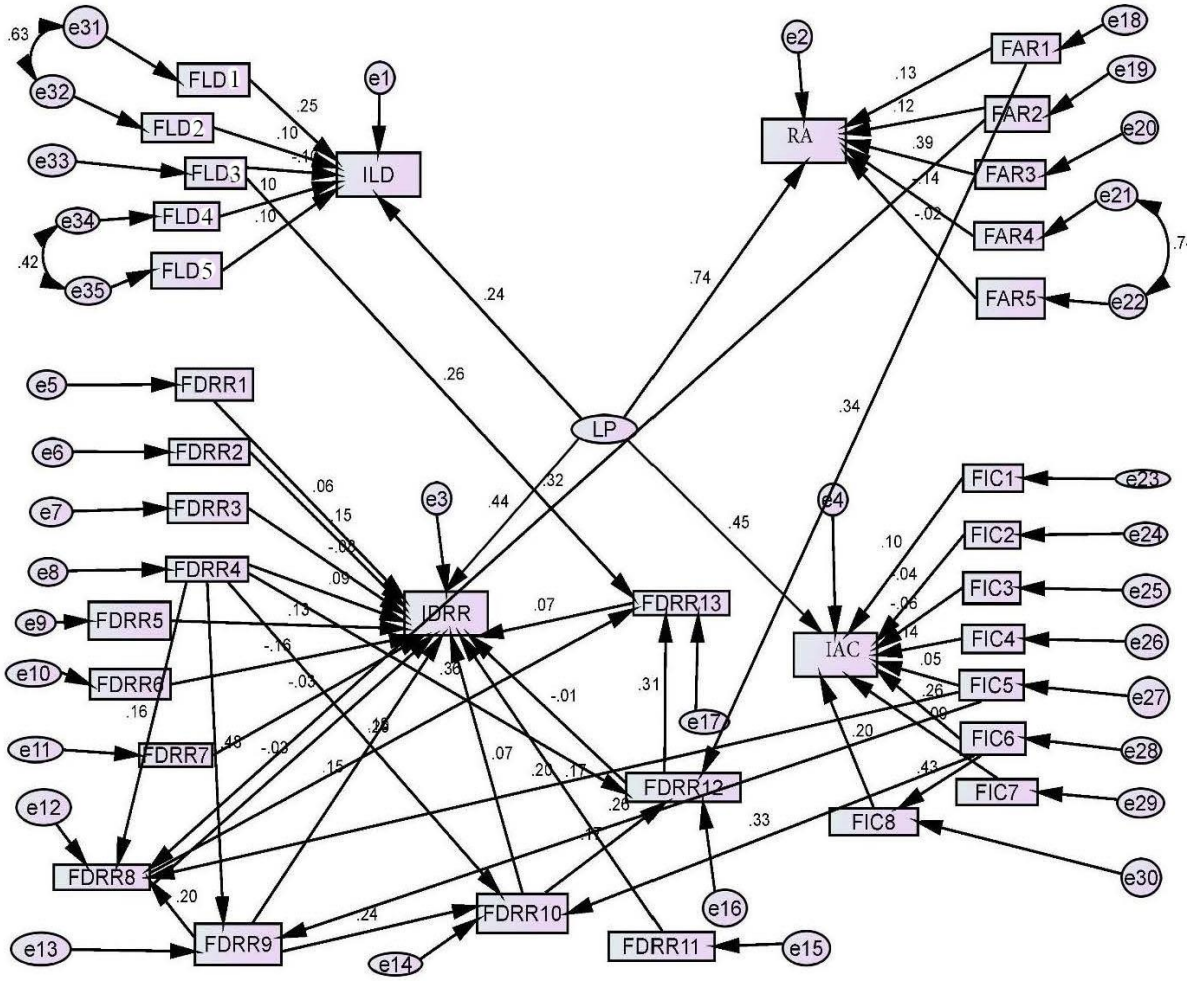


Figure 5.5 SEM model of indicators and factors influencing livelihood preparedness in Kaikōura (with standardised estimates)

Figure 5.5 is a less accurate representation of relationships between factors influencing livelihood preparedness in Kaikōura, as the model fitness criteria set out in the literature could not be met. This could be attributed to the limited sample size compared to the number of items to be analysed. Nonetheless, it highlighted a probable influence of certain factors on others, both from factors influencing the same indicators and those that affect a different indicator. This aligned with our findings at the preliminary stage of this research. These probable relationships will be discussed in subsequent sections.

5.7 A framework for livelihood preparedness in Kaikōura

The framework shown in Figure 5.6 was developed by drawing on the questionnaire and interview results. The indicators of individual livelihood preparedness, resource accessibility, livelihood diversity, individual adaptive capacity, and effectiveness of DRR measures are the pillars of the framework. Hence, the level of livelihood preparedness is assessed based on the individual performance on each indicator.

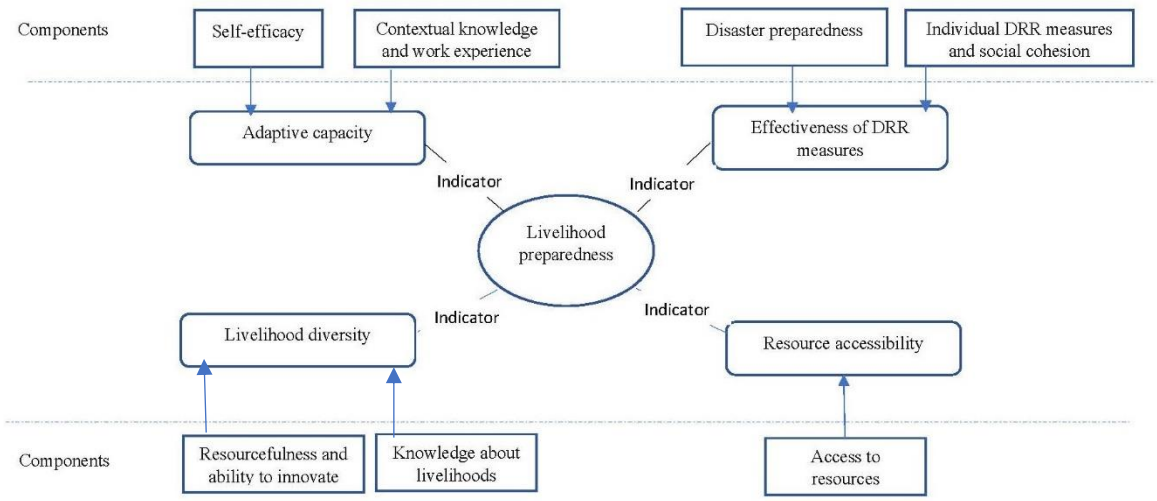


Figure 5.6 A framework for livelihood preparedness in Kaikōura

Depending on the purpose of measuring individual livelihood preparedness in Kaikōura, either an overview or an in-depth approach could be adopted. For an overview approach, values of −1 to 1 would be assigned to each component influencing different indicators of livelihood preparedness, where −1 would indicate absence or limitations in a component. A value of 1 would be assigned to components to which an individual's response is affirmative, whereas 0 would be used when it is difficult to determine the presence or absence of a component. The sum of values assigned to each component influencing an indicator would suggest an individual's performance on the indicator, and the total of values obtained from the four indicators would show how prepared people's livelihoods are for disruption. A total value of 7 would indicate a prepared livelihood, and that of −7 would signify an unprepared livelihood.

The overview approach should be adopted to create a snapshot of livelihood preparedness within families in Kaikōura. However, it would be less ideal for policy development and livelihood improvement because it might not show areas that require development. For instance, with regard to resource accessibility, assuming a value of −1 was obtained for an individual, it would be difficult to identify areas of improvement among the five factors that constitute access to resources. Secondly, the overview approach does not account for the different values attached to each factor within a component of factors. Hence, for policy formulation, an in-depth approach would be required.

In line with a relatively high model fitness obtained from SEM of livelihood preparedness indicators (Figure 5.5), the framework for measuring livelihood preparedness in Kaikōura would be the summation of the product of standardised regression values (SRV), variance (V), the response obtained from the Likert scale (LK) for different indicators (IND) and the error terms associated with each observed variable. Thus, the equation is as follows:

$$\text{Livelihood preparedness (LP)} = \sum\left((\mathrm{SRV_{IND}})(\mathrm{V_{IND}})(\mathrm{LK_{IND}})\right) + \sum E \qquad \text{Eq 1}$$

These would form the basis of an in-depth approach to measuring livelihood preparedness in Kaikōura. The standardised regression values were included because they represented the extent of deviation in livelihood preparedness for one standard deviation in the indicators. Given the absence of statistical differences between groups, it is assumed that variance values obtained for each indicator will be constant across the population in Kaikōura, hence its inclusion in Equation 1. The Likert scale value in Equation 1 is an individual's input upon which the calculation of their level of preparedness will be based. The error terms were included to account for both structural and systematic errors associated with the observed variables. Some of these errors could be linked to factors affecting each indicator of livelihood preparedness. Further research will be required to assess potential errors not accounted for by factors influencing each indicator. E_{LD}, $E_{RA,}$ E_{IDRR}, and E_{IAC} are partly represented by factors influencing livelihood diversity, resource accessibility, effectiveness of disaster risk reduction, and individual adaptive capacity, respectively.

To account for portions of the error term linked to factors influencing different indicators of livelihood preparedness, a value R of -1 is assigned for negative response to a particular factor and 1 for a positive response. Zero will be assigned to situations in which neither a positive nor negative assessment could be obtained. Factors within each component that are highlighted as critical values in Table 5.6 are also multiplied by their mean values in Table 5.6.

Hence $E = \sum F_{LV} M^* R$ where F_{LV} is the loading values of different factors and M* is the mean value for critical factors. R is obtained with respect to each factor.

All are summed up to obtain an individual's strength on each indicator. Summation of values obtained from all four indicators would indicate the livelihood preparedness level of a person. It is important to note that there might be individual preferences to different factors, which could make the multiplication of loading values and means a less valid approach to highlighting the importance of a factor for an individual's livelihood preparedness. However, given that mean and loading values were derived from the collective population in Kaikōura, the wisdom of the crowd, as explained by Surowiecki (2005), suggests that these values (mean and loading values) could be an optimal way of highlighting the importance of different factors.

Thus, substituting the regression values and variances into Equation 1, results in Equation 2:

$$\text{LP in Kaikōura} = (0.04E_{LD}LK_{LD} + 0.26E_{IDRR}LK_{IDRR} + 0.41E_{RA}LK_{RA} + 0.18E_{IAC}LK_{IAC}) \qquad \text{Eq 2}$$

Note: LD = Livelihood diversity, IDRR = Effectiveness of disaster risk reduction measure, RA = Resource accessibility, IAC = Individual adaptive capacity

On a 5-point Likert scale, the maximum obtainable value for an individual in Kaikōura would be 118, which suggests an optimally prepared livelihood. While a minimal value of -118 could be obtained from Equation 2, which would be indicative of a livelihood vulnerable to disasters. To ease comprehension, results from the scale will be expressed in percentage terms where a fully prepared livelihood (118 points) will equate to 100%, and any feedback below 100% would suggest that there is room for improvement. It is important to note that the accuracy of values obtained from Equation 2 is dependent on objective choices an individual makes on the Likert scale, as well as an accurate assessment of

different factors influencing livelihood preparedness. Equation 2 could be developed into a mobile application to ease the process of implementation. Please see Appendix B for a sample of the model.

Chapter 6 Discussion

This chapter presents a detailed discussion of obtained results and comparison to previous findings in livelihood publications as well as the implication of the current study in Kaikōura. It starts with an in-depth discussion on livelihood preparedness for resilience and sustainable living. Subsequently, lessons learned from the 2016 earthquake are discussed in detail. Lessons learned from the 2016 Kaikoura earthquake are based on interviews and observations of people who lived through the disaster. To illustrate the human context within which this study was conducted, a detailed overview of the demographics that partook in this study will be presented. This is followed by a comprehensive discussion of livelihood preparedness indicators and factors influencing them. These indicators and factors were derived from the systematic review of literature and subjected to different statistical tools. Results of these statistical tools were compared to previous literature and certain variations were explained by earlier interviews and observations of Kaikōura residents. Current chapter also provides a foundation for furthers studies of results that do not align with literature and could not be explained through interviews and observations. Finally, the outcome of the results and model validation will be discussed in this chapter.

6.1 Livelihood preparedness for resilience and sustainable living

Prior to this study, the sustainable livelihood framework has been the default tool to analyse individual livelihoods. SLA is viewed as an all-encompassing developmental tool aimed at the analysis of current livelihood conditions to guide developmental interventions (DFID, 2000). The SLA framework seemed ideal for developmental activities as it was formulated to address developmental challenges in poor countries (Morse & McNamara, 2013). However, from a livelihood perspective, it could be argued that its operationalisation was less optimal. Critics of the sustainable livelihood framework, among other things, have argued that greater attention was given to the micro-level at the expense of macro influences and power dynamics that could exist between people of different social strata (De Haan, 2012). In a few instances, developmental projects instigated by the SLA framework have always adopted a top-down approach, which may not always be beneficial to lives and livelihoods of ordinary

people (Morse & McNamara, 2013). Additionally, the SLA is unable to account for long-term transformations (Scoones, 2009; Thulstrup, 2015).

The concept of resilience was introduced in livelihood and developmental studies to complement the SLA framework to account for long-term transformations. Although effective, the ambiguous definition of resilience (folke,2000) and its ubiquitous use could limit its utility and adoption by everyday individuals preparing their livelihoods for a disaster. Heeding the call by De Haan (2012) for a meta-analysis of livelihood literature, this study analysed individual livelihoods from the perspective of individuals who have lived through disasters rather than the developmental approach that forms the bases of sustainable livelihood studies (Morse & McNamara, 2013). It also attempts to limit the ambiguity associated with defining resilience in livelihood and disaster research (Ifejika Speranza et al., 2014; Nyamwanza, 2012).

Livelihood preparedness is a state of readiness for livelihood in the face of potential disasters. In theory, a sustainable and resilient livelihood should be prepared to handle disasters. However, putting the concept of sustainability and resilience into practice could be somewhat challenging to individuals. The application of the framework depicted in Figure 5.6 could ease the operationalisation process in Kaikōura. This research started with an overarching question of whether there exists an operational alternative to the application of sustainable livelihood framework or livelihood resilience indicators in assessing individual livelihood preparedness. Within the Kaikōura context, perhaps the framework depicted in Figure 5.6 could play a complementary role. In other words, the implementation of a framework for livelihood preparedness in Kaikōura is expected to complement livelihood resilience and sustainability effort of individuals living in Kaikōura. Rather than waiting for the government or other external bodies, by applying the framework, individuals could take centre stage in readying their livelihoods to withstand disasters. In addition to reducing the recovery time, individuals taking control of the livelihood preparedness process would be beneficial for both businesses and governments.

From a business perspective, Hinson and Slade (2011) highlighted the importance of employees for business continuity. Conventional business continuity literature focuses on protecting the employees from physical harm in the event of a disaster in hopes that they will be instrumental in the recovery

process (Asgary et al., 2012). However, individuals with relatively high livelihood preparedness levels might be of even greater value as they might be able and willing to continue working even if their wages are interrupted in the short-term following a disaster. After the 2016 earthquake in Kaikōura, governments paid Kaikōura residents in the labour market between 200 to 500 NZD per week, as most businesses could not afford to pay employees. However, a handful of businesses whose owners were interviewed emphasized that they opted out of the support scheme after a week as they took measures prior to the earthquake to prepare their business and the livelihoods of their employees. In other words, individual livelihood preparedness could limit government spending post disasters.

6.2 Lessons learned from the 2016 Kaikōura earthquake

To enable individuals to prepare their livelihoods for future disruptions, starting with physical and psychological preparedness as well as the affordability and enlightenment on insurance policies, the next section will discuss the lessons learned from the 2016 earthquake, as summarised in Table 5.1 of the previous chapter.

6.2.1 Physical and Psychological preparedness as well as the affordability and enlightenment on insurance policies

At the initial stages of every interview, we sought to know how the interviewee was coping with the recovery process. Depending on the answers provided, we probed further to ascertain how they have been combining the recovery process with trying to earn a living. Finally, we asked if they had taken any steps to protect their livelihoods from future hazards. These sets of questions emphasised the relevance of psychological preparedness and physical wellbeing for livelihood preparedness in disaster situations. The responses from K13 and K5 highlighted below exemplified these findings:

"Each time I hear a loud noise, I am forced to re-live the feelings of the last earthquake" K13

"I try to exercise and eat healthy as much as possible" K5

It is important to note that this view was shared by other individuals within Kaikōura. Furthermore, the opinions shared by K13 and K5 respectively re-echoed the views of Reser and Morrissey (2009) that psychological preparedness played an essential role in emergencies as well as in coping with associated

stress while reducing post-incident distress. People living in hazard-prone areas may require constant pre-disaster counselling to prepare their minds for how to resume their livelihood endeavours after a disaster. Regarding physical wellbeing, Salmon (2001) highlighted the role of physical exercising as a tool for limiting the harmful effects of stress. In all, physical exercise, eating healthy and psychological preparedness would assist in livelihood preparedness for people living in hazardous situations.

Additionally, when asked about risk transfer mechanisms like insurance taken prior to the last earthquake to mitigate against disaster impacts, the majority of the respondents held a negative view of insurance. This included individuals who received their insurance claims in full, as K1 notes:

"*I had a full business interruption insurance, so the insurance provider came through with payment. However, had part of the store not been damaged, the insurance company might not have paid."*

In K1's situation, apart from the damages to his store building, the tsunami damaged some goods in the store as well. The earthquake also destroyed access to K1's place of business. From the interviewee's point of view, had the store building remained intact, the insurance claims might not have come through. This view was in contrast with what was portrayed in Hamish Davies and French (2015), as full business insurance should cover any restriction to business continuity caused by any unforeseen circumstance. Unfortunately, many other business owners shared similar views to K1's. A significant number of people we interacted with believed insurance companies either could not pay or were unwilling to do so. This calls for increased education of the public on insurance policies and obligations which may assist in choosing policies that suit their need while managing expectations with regards to claims after a disaster. It may also reduce the current negative perception surrounding insurance following the last earthquake.

Similarly, several individuals (notably K8, K12, and K13) stressed the high cost of insurance premiums after the disaster, thereby rendering it inaccessible to those willing to purchase a policy. To counter this challenge, Linnerooth-Bayer and Mechler (2007) proposed a public-private partnership to provide insurance for people living in hazard-prone areas. This partnership would involve private insurance companies that will manage the insuring process as well as the governments, NGOs, and other support

organisations that will contribute funds to reduce the cost of insurance premiums. To some extent, this is already employed in New Zealand through the Earthquake Commission (EQC).

The EQC is a crown establishment aimed at efficiently managing the pricing of risk and the settlement of claims while educating the public on insurance (EQC, 2018). From the insurance complaints raised in Kaikōura, perhaps there is the need to further optimise the risk-pricing mechanism to reduce or subsidise the cost of insurance premiums, especially for those recovering from disasters. On the other hand, ICNZ (2017) believes insurance costs will become more affordable when risk-reducing measures are put in place. Nonetheless, it remains to be seen how this can be applied to hazard-prone towns like Kaikōura and, more specifically, how risk reduction and transfer measures can be adapted to limit the impacts of disasters on livelihoods.

6.2.2 Relevance of government support

During our studies, we sought to ascertain how much help the people of Kaikōura received directly from the government with regards to their livelihoods; most of the respondents praised the decision of government to support businesses by paying their staff for the first few weeks after the disaster, thereby reducing the stress on livelihood caused by the disaster. A full-time staff member of businesses within Kaikōura was paid 500 NZD per week while part-time staff was paid 200 NZD per week. However, a few part-time workers noted that the payment they received was not enough for their survival. A case of note was that of K13 who lived through the 2011 Christchurch earthquake, who was just beginning to recover from the shock; the person moved to Kaikōura to start anew just before the disaster and had to take up a part-time job for the short term. When the earthquake struck, the person lost all for the second time and found that having to survive on 200 NZD was challenging.

The inadequacies of cash support are not unique to Kaikōura as this was also highlighted by Baffoe and Matsuda (2018) in which the funds provided through Livelihood Empowerment Against Poverty Programme (LEAP) was insufficient but, the Ghanaian government in this case also provided health insurance to reduce the stress on lives and livelihood. Nonetheless, some business owners (K1 and K2) opted out of the government support programme early, not because they were less affected but because both the business and the employee had preparedness measures in place that enabled them to resume

business faster. Even though the importance of cash support from the government was highlighted by Kaikōura residents, as illustrated in the systematic review, government support could come in different forms. Castellanos et al. (2013) and Wilkinson (2011) stressed the importance of government policies as these could make or break preparedness measures. A broader discussion on the effects of government policy will be highlighted later in the chapter.

In all, it is expected that through individual livelihood preparedness, government spending post disasters could be reduced but not eliminated, as government played a key role in reducing the stress on livelihood from the 2016 earthquake in Kaikōura. However, there may be cause to re-evaluate stipends paid to part-time workers, especially those who are re-entering the workforce because of conditions beyond their control.

6.2.3 Livelihood diversification for livelihood preparedness

Individuals and council officials in Kaikōura emphasised the importance of livelihood diversification as a tool for livelihood preparedness. Prior to the earthquake, some individuals had already adopted a diverse livelihood strategy which eased their recovery. This was most evident in the answer provided by K5;

".. for the first few weeks after the disaster, business in our restaurant and holiday parking was quite slow. However, on the motel side, things remained profitable. ... my husband's day job also helped. The diverse nature of our income stream aided our recovery process."

K5's sentiments were also shared by K7 and K 8, both of whom adopted a diversified livelihood strategy before the disaster. More so, K2 and K13 hoped to use the opportunities created by the 2016 earthquake to diversify their livelihood endeavours and increase their short-term cash flow while creating an alternative means of livelihood that could mitigate the livelihood effects of future disasters. In line with the views of Newport et al. (2016) on the role of technology for livelihood diversification, K12 plans to diversify her business using social media and other opportunities created by the internet. Consequently, a manager at Kaikōura City Council stressed the importance of a vision and sustainability in the efforts to diversify livelihoods and ultimately the Kaikōura Economy.

"... we must first decide if we are tourist community or a community of tourist ... then find a way to diversify our economy in a manner that protects the environment, embodies our ideals and assists us in mitigating against the impacts of future disasters".

In all, livelihood diversification is both a hedging tool (Ning et al., 2014) and a means of adaptation (Motsholapheko et al., 2011); it may not guarantee an increased income in the long term but could prepare livelihoods for an unforeseen circumstance.

6.2.4 Societal networks external to the local community are instrumental in assisting individuals and businesses in coping with disasters

In consonance with numerous literature on disaster survival and recovery, Kaikōura locals (K1-K16) echoed the importance of social relationships for survival and recovery from disasters (Aldrich & Meyer, 2015; Cradock-Henry et al., 2018). They noted that, after the 2016 earthquake, community members assisted one another in any way possible. Nonetheless, business owners and managers emphasised the significance of external networks, other businesses, or personal relationships in a different geographic location. This was depicted in the following response:

"... we also had the right networks that looked out for us after the disaster. Our networks assisted us in getting things to Kaikōura and looked out for our interest when we could not access the outside world" K6.

Response from K6 represented the opinions of other business owners we contacted during the research. Additionally, most business owners or managers emphasised that, for these relationships to deliver value immediately after a disaster, those connections need to be in place well in advance of any disruptive event. In all, external relationships are vital in disaster survival and recovery, more so for business owners and managers as external partners not affected by the disaster could protect the interests of incapacitated counterparts undergoing recovery.

6.2.5 Cash and inventory management, as well as self-efficacy, are vital to sustaining livelihood after a disaster

Businesses recovering from the 2016 earthquake stressed the importance of cash and inventory management to ensure business continuity after a disaster. This was depicted in the response obtained from K1:

"I had to properly manage my inventory and capacity to ensure that I was not cash trapped; I mostly sold my stocks and only replaced items in high demand."

While cash flow and supply chain interruption are established impacts of most disasters on businesses (Benyoucef & Forzley, 2007; Runyan, 2006), local businesses in Kaikōura re-echoed these phenomena and attempted to combat them by managing their cash and inventory accordingly. Some business owners (K11, K13, K15) re-invented their business strategy to take advantage of new opportunities created by the disaster while attempting to increase cash flow.

After the 2016 Kaikōura earthquake, our fieldwork indicated that a higher number of individuals living in Kaikōura increased efforts to implement risk-reducing measures. Actions taken ranged from re-evaluating building foundation (K13) to storing food, water, medicine, and first aid items (K3, K4, K5, K14) as well as devising and posting evacuation plans at strategic locations (K1, K2, K6, K7, K10, K16). In line with Paton et al. (2015)'s hypothesis on self-efficacy, a significant number of Kaikōura locals believed that an increased level of self-efficacy could mitigate the effects of future disasters. In contrast to the finding of Morrison and Oladujoye (2013) about CEOs, business owners, as well as government officials in Kaikōura, took self-efficacy more seriously compared to other members of the community. This may be attributed to either a potentially higher exposure to information on disasters or a greater sense of responsibility not just for themselves and their immediate family members but for their employees and clients. While an increased level of self-efficacy was recorded following the last earthquake, its true measure may lie in the future when the impacts of the last disaster have faded in people's minds.

Following the preliminary studies that focused on lessons learned from the 2016 earthquake in which the research participants were mostly business owners and/or managers, an in-depth survey of Kaikōura

residents was conducted. Demographics of the survey participants will be discussed in the next section, as this could be instrumental in understanding the research outcome.

6.3 Understanding of the survey demographic response in Kaikōura

As illustrated in our results section, more females (64%) than males (36%) responded to our survey in Kaikōura. However, 2018 census figures indicated that men and women constituted approximately 50.8% and 49.19%, respectively, of the workforce population in Kaikōura (StatsNZ, 2020a). A relatively lower rate of response from males could be linked to the random approach adopted to distribute questionnaires, as no effort was made to ensure a proportional distribution of the survey between men and women. Nonetheless, during the preliminary field trip in 2018, more women were willing to speak to us on how the earthquake affected their lives and livelihood. This could be linked to the "masculine cultures of self-reliance and independence" of men in dealing with stressful outcomes of a disaster (Whittaker et al., 2012, p. 169).

Even though the greatest number of responses was obtained from individuals between 50 – 64 years of age, the median age of our respondents stood at 38.5 years. This was slightly younger than the median age of the workforce in Kaikōura, which stood at 39.71 years (StatsNZ, 2020a). Nonetheless, people above 40 years of age in Kaikōura seemed wealthier as they mostly owned their own businesses or worked as managers in different organisations in Kaikōura. 4.4% of our respondents were part of the official 24.8% individuals (StatsNZ, 2020a) that have no formal educational qualification. Despite the lack of formal qualifications, people in this category we encountered could read and write; hence they were able to use modern technology to access information or create business opportunities when the need arose.

Although He et al. (2018) highlighted the influence of dependents on an individual's ability to adapt to disruptions, further research would be required to assess if this is the case in Kaikōura, as the current dataset contains other demographic data that could explain any potential effect. Additionally, due to the diverse background of our respondents, it was difficult to isolate potential links between factors and individuals from various demographic groups. Nevertheless, since they all lived through and are

currently recovering from the 2016 earthquake, their collective insight on factors that influenced different indicators of livelihood preparedness in Kaikōura remains valid. The next section will discuss the indicators of livelihood preparedness as it relates to Kaikōura

6.4 Livelihood preparedness indicators in Kaikōura

The first step to enhancing livelihood preparedness in Kaikōura is to measure the extent to which individuals have prepared their livelihoods for disruption. This could be assessed by the application of indicators. As suggested by Field (2009) and Pallant (2011), using the scree plot on Figure 5.3 as well as the loading factors in Table 5.3, resource accessibility, livelihood diversity, individual adaptive capacity, and effectiveness of individual disaster risk reduction measures were statistically validated as indicators of livelihood preparedness. An overall mean value of 4.05 on a five-point Likert scale affirmed their value as a measure of livelihood preparedness in Kaikōura.

Even though individual adaptive capacity was depicted as the most significant indicator by the t-test in Table 5.5, it may not be the most valued indicator of livelihood preparedness in Kaikōura. The loading value of resource accessibility in Table 5.3 and its high correlation with other indicators in Table 5.4 portrays it as the most valuable indicator of livelihood preparedness. Lack of assets would limit an individual's ability to adapt to changing conditions for livelihood preparedness (Cannon, 2006; Newport et al., 2016; Rampengan et al., 2014). Compared to other indicators, the highest correlation values were obtained between resource accessibility and effectiveness of individual disaster risk reduction measures, which is in line with the findings of Vatsa Krishna (2004) as assets are vital to mitigate against risk and associated vulnerability.

On the other hand, livelihood diversity had the least loading value in Table 5.3 and correlated poorly with other indicators in Table 4, especially the effectiveness of individual disaster risk reduction measures. These, combined with a relatively higher inclination to diversify within the same sector as their current livelihood strategy, might be indicative of a people less willing to deviate from their usual way of life. This was evident as well at the preliminary stage of the study, as most people (especially those in decision-making positions) admitted the need to diversify the economy of the community as

well as their livelihoods but were reluctant to make any changes in fears that diversification could harm the environment and their way of life.

An alternative explanation to the relatively lower loading value obtained for livelihood diversity in Table 5.3, as well as its low regression value in Figure 5.4 could be linked to the New Zealand tax policy. Given that livelihood diversity might entail an individual getting multiple jobs, from an income perspective, this could be counterproductive as the New Zealand government imposes a higher tax rate for secondary incomes. Hence, people in Kaikōura could be less inclined to diversify their livelihood if it is perceived to result in a marginal reduction of their income. In all, going by figures depicted in Figure 3.5, it could be argued that the relatively low preference for livelihood diversity in relation to livelihood preparedness is not unique to Kaikōura.

Additionally, due to the unpredictable nature of geological disasters (USGS, 2019), greater focus has been on effectiveness of individual disaster risk reduction measures to prepare individual livelihoods vulnerable to geological hazards (Suri, 2018; Wilkinson, 2011). However, a comparatively high significant level obtained for individual adaptive capacity suggests a heightened interest by individuals in Kaikōura to adapt their livelihoods. Timing of the data collection might be partly responsible for this result as data was collected at the recovery stage of the disaster. Nonetheless, greater emphasis on individual adaptive capacity, especially for geological hazards, is positive as it could fasten recovery and potentially protect individual livelihoods from future disasters (Armijos et al., 2017).

From a disaster and geographical perspective, current findings are slightly different from the outcomes of the systematic review, as highlighted in Figures 3.11 and 3.12, respectively. Effective disaster risk reduction measures followed by individual adaptive capacity were widely emphasised in geological disasters rather than resource accessibility. Similarly, livelihood diversity and individual adaptive capacity seemed more prevalent in the Australian and Pacific Island region in which New Zealand and Kaikōura are located. Among other factors that would require further research, these variations may be attributed to disaster and livelihood contexts in Kaikōura. The 2016 Kaikōura earthquake triggered a tsunami which makes it a combination of a geological and a hydrological disaster. Likewise, livelihoods in Kaikōura are mainly dependent on tourism and the primary industry, which might not be reflective

of livelihood endeavours in other parts of the Australian and Pacific Island region. Lastly, the variations may be due to limited publications on livelihood and preparedness studies focused on the Australian and Pacific Island region.

The absence of any statistically significant difference in the response obtained from various demographic groups could be explained by several factors, the first of which is our sample size (236 individuals for the survey). According to Holland (2019); Pallant (2011); Tabachnick and Fidell (2007), *p* values can be misleading because they are highly dependent on sample size. An increased sample size amplifies the likelihood of obtaining statistically significant results. Even though we had a response rate of over 50%, perhaps a larger sample size and response rate might have delivered statistically significant results.

Similarly, the lack of evidence for social inequality in Kaikōura might justify the absence of variations obtained from different genders and ethnic groups. Social inequality between men and women or among people of different ethnic origins leads to unequal distribution of assets and limited tools to prepare individual livelihoods for a disaster (Baffoe & Matsuda, 2018; Zhang et al., 2012). The probable absence of social inequality could result in men and women from different ethnic backgrounds sharing similar perspectives on indicators of livelihood preparedness.

The absence of variations in results obtained with respect to age, dependents, job sector, and climate change warrant further research as these deviate from previous studies. Since the older generation tends to be more experienced in livelihood endeavours (Mabuku et al., 2019) but less flexible to change (Barclay et al., 2015), it was expected that responses from individuals 50 years and above would differ from the rest. Similarly, a variation was also expected among single individuals and those with dependents, as indicated by (He et al., 2018). Individuals with dependents will have to take cognisance of them in taking preparedness measures, which could make their perception of the livelihood indicators different.

Lastly, although unlikely, the lack of a statistically significant difference among different demographic groups maybe because all the respondents experienced the same disaster in 2016. Other than

demographic factors, other factors influence different indicators of livelihood preparedness. Starting with resource accessibility, the next section will discuss the influence of factors on different indicators of livelihood preparedness in Kaikōura.

6.4.1 Factors influencing resource accessibility in Kaikōura

The influence of five factors on resource accessibility was examined in Kaikōura. These factors were arranged in decreasing order of importance and influence (Table 5.8). Going by the communality and loading values, these factors seem to form three clusters. The first cluster, and perhaps the most important set of factors, is the availability of external support and access to external support. Even though governments and NGOs attempted to provide support in different forms, accessibility was perceived to be easier for organisations rather than individuals. Additionally, organisations were able to leverage their external contacts beyond Kaikōura to obtain any resource needed. The relatively structured nature of organisations, as well as their potentially greater bargaining power compared to individuals, might explain this trend. Nonetheless, from the perspective of Amarasinghe and Bavinck (2011), individuals could improve their external networks and reach by forming or joining existing functional cooperatives.

The second cluster seems to be between access to social capital and access to livelihood infrastructure. These might have also contributed to the relatively higher importance indicated for availability and access to external support. Due to infrastructural damages, Kaikōura was isolated from the rest of New Zealand (Stevenson et al., 2017). Individuals were forced to leverage their social capital in the form of friends and family within the community to access resources needed for survival. This is in line with the findings of Anushka et al. (2018), which highlighted the importance of social capital in disaster preparedness and recovery. Access to financial assets (FAR3) was particularly important as it assisted individuals to purchase other resources needed to prepare individual livelihoods for a disaster. In all, it might be beneficial for individuals living in hazard-prone areas to increase their social capital within and outside their community, as it could assist them to access resources needed to prepare their livelihoods for unforeseen disruptions.

6.4.2 Factors influencing livelihood diversity in Kaikōura

As highlighted in Table 5.8, within Kaikōura, the influence of five factors on livelihood diversity was assessed. These factors were combined into two unique components based on their loading values obtained from principal component analysis. These components include resourcefulness and the ability to innovate (component 1) and knowledge about livelihoods (component 2). Loading values on the pattern matrix signify the level of importance attached to each factor (Tabachnick & Fidell, 2007). Hence, a higher value on the pattern matrix indicates greater importance or the influence of a factor on a component. With respect to component 1, the greatest importance was attached to the utilisation of assets/resources in an innovative manner. This was particularly visible in the hospitality and tourism industry of Kaikōura. Businesses in the hospitality sector promptly modified their business model to cater to the influx of construction workers. Souvenir store owners sold more items that were made from natural resources within Kaikōura. Tourism companies with expensive assets like helicopters which were used previously for whale watching, were repurposed for courier, construction, and rescue missions. Nonetheless, changes in business models and repurposing of assets may have assisted in keeping businesses afloat, thereby protecting the livelihoods of individuals in those sectors.

Access to various types of assets/resources was the second most important factor in component 2. Like the findings of Islam et al. (2018); Ng'ang'a et al. (2016); Onneshan (2008), access to cash was particularly important to people in Kaikōura. Even though the government provided relief funds for individuals after the quake, it was not in equal measure as part-time workers expressed their limited capability to pay bills and feed themselves by just relying on government support. Individuals with skills in demand after the earthquake (e.g., construction workers) found it easier to secure jobs. For component 2, knowledge about government laws and policies held greater importance than knowing about alternative livelihood options. Knowledge of government policies might be useful in guiding an individual's choice of a livelihood strategy. Nevertheless, people aware of alternative livelihood options quickly adopted new technologies (like Facebook and Airbnb) to create new income streams. Individuals with a diverse knowledge base could develop multiple skills that might be needed in times of uncertainty.

In the short term, some of the measures highlighted above to protect livelihoods seem adaptive. However, in the long term, individuals and organisations alike might look to keep these newly developed livelihood options where the market exists while continuing their core businesses, thereby providing a diversified livelihood strategy. In all, livelihood diversity might be embarked upon as an adaptive response to a disaster or a means to take advantage of an existing or developing market, using resources at one's disposal.

6.4.3 Factors affecting individual adaptive capacity

From the results of a PCA on seven factors that influenced individual adaptive capacity in Kaikōura, two components, named self-efficacy (component 1) and contextual knowledge and work experience (component 2), were derived. Loading values in Table 5.8 show that an individual's hazard and risk perception is of utmost importance for self-efficacy in Kaikōura. This was followed by an individual's attitude and belief towards preparing for disasters. Where an individual does not perceive an event as hazardous or risky, they might not take actions to adapt or prepare their lives and livelihood (Xu et al., 2018). A similar effect is obtained if they perceive themselves as helpless to the effects of a disaster (Kusumawati et al., 2019). While some people in Kaikōura felt helpless, others saw it as an opportunity to adapt their livelihood strategy. Physical and mental preparedness also weighed significantly on self-efficacy in Kaikōura. At the time of the preliminary study, while a significant portion of the labour force in Kaikōura had gone back to work, some individuals highlighted their reduced capability to concentrate on tasks as loud noises brought back memories of the quake.

Perhaps increased counselling and health checks in communities living in hazardous situations might always be required. This could assist in faster recovery of the mind and body in the event of a disaster, hence limiting the potential effects of the event on individual livelihood. An individual's willingness to adapt also weighed significantly on component 1. Although a relatively lower loading value was obtained for this factor, its effects were highlighted by most individuals we spoke to in Kaikōura. They acknowledge the need to adapt livelihood options in Kaikōura; however, individuals are less willing to do so if it would change the current lifestyle in Kaikōura. Individual skillset seemed least important to

component 1; nonetheless, this could affect the use of other livelihood assets (Baffoe & Matsuda, 2018; Fang, 2013).

With respect to contextual knowledge and work experience, level of work experience had the most influence. This was followed by lessons learned from past disasters and knowledge about the local context, respectively. Within Kaikōura, it was observed that individuals with vast experience in their livelihood endeavours got back to work sooner as their skills and experience were vital in the community recovery effort. Similarly, although to a lesser extent, few individuals who lived through the 2012 Christchurch earthquake utilised past lessons to prepare their livelihoods for disasters. Nevertheless, most people we encountered who lived in Christchurch at the time of the 2011 quakes who moved to Kaikōura afterward only to re-live the same event were significantly traumatised let alone applying the lessons from their past.

Surveyed individuals believed that knowledge about the local context in Kaikōura (e.g., social norms, cultural beliefs, and laws) was important in taking measures to adapt their livelihoods in Kaikōura. For instance, prior to the 2016 earthquake, New Zealand has always had laws in place for sustainable extraction of natural resources (New Zealand Government, 2020). It could be argued that people living in Kaikōura whose livelihoods are dependent on sectors like fishing understand that the sustainability of their livelihoods may well depend on their ability and willingness to adapt their livelihoods in line with government laws on conservation. In all, an individual's hazard and risk perception, as well as their level of work experience, seemed most important for individual adaptive capacity in Kaikōura.

6.4.4 Factors affecting effectiveness of DRR measures in Kaikōura

The influence of 13 factors on effectiveness of DRR measures for livelihood preparedness in Kaikōura was analysed using a PCA. These factors were reduced to two components, disaster preparedness (component 1) and individual DRR measures and social cohesion (component 2). The importance and correlation of each factor on either component were depicted in Table 5.8 in a pattern matrix. For component 1, going by the loading on the pattern matrix in Table 5.8, the availability of early warning systems followed by people's willingness and ability to take DRR measures seemed to be of relatively greater importance to people living in Kaikōura. Although there is an early warning system in place,

there was a brief miscommunication in the severity of the quakes and accompanying tsunami at the initial stages of the disaster (Ministry of Civil Defence & Emergency Management, 2017).

Nonetheless, some individuals followed pre-set guidelines as established by the government by moving further inland and uphill even before accurate information was received about the hazard severity. People stressed the importance of access to accurate and timely hazard information as it could buy more time to prepare. In the aftermath of the 2016 quakes, more people in Kaikōura were keen on taking increased DRR measures.

Even though the financial capacity for disaster risk reduction was highlighted as the third most important factor for component 1, it had a relatively lower correlation value with other factors that influence the effectiveness of DRR for livelihood preparedness when compared to knowledge of hazards that could affect an individual as well as their family and using tools and resources in a smart way to mitigate risks and for recovery. The knowledge of hazards that could affect an individual, as well as their family, seemed to have a significant influence on disaster preparedness (component 1) and individual DRR measures and social cohesion (component 2). Knowledge of prevailing hazards in one's location may well assist an individual to conduct a preparedness audit to ascertain where they are able to help themselves and situations that would need external intervention (Belle et al., 2017). Similarly, the innovative utilisation of resources in disaster situations could enable resource optimisation and increased utility (Kumar et al., 2013).

With regards to individual DRR measures and social cohesion (component 2), the level of community participation and consultation in council's disaster risk reduction seemed most important to people with respect to social inclusivity. This was particularly visible in infrastructural development and repairs as there seemed to be some disparity between the expectation of the people and the actions of the Kaikōura local council. Individuals we spoke to at the preliminary stage of the study believed that government prioritised the construction of earthquake-resistant transport networks into Kaikōura at the expense of other livelihood infrastructures in the community. They noted that, while the roads into Kaikōura would ease travel to Kaikōura and potentially limit the impact of rock falls on future road users, equal attention should be given to hasten the repairs of damaged road networks within the community, as this could

boost commerce internally. Although there have been numerous calls for community inclusion in government DRR endeavours (Cannon, 2006; Seddiky et al., 2020; Weichselgartner & Pigeon, 2015), an effective manner to implement it remains to be seen, possibly due to a divide between government and individual expectations.

The second highest loading value was obtained for people's perceptions about risks with respect to individual DRR measures and social cohesion. As mentioned earlier, risk perception would determine the choice of an individual to take DRR actions. Although to a lesser extent, this also correlated with other factors in component 1 (disaster preparedness). This was also the case with mutual support in a community. Even though mutual support had the least value on individual DRR measures and social cohesion for livelihood preparedness, individuals in Kaikōura stressed the importance of community during a disaster and at the recovery phase of the disaster. Additionally, it could be argued that the disaster further galvanised the community from a livelihood perspective; people knew more about their neighbours and their livelihood endeavours, potentially easing the sales and sourcing of goods and services locally. In the long term, this could create a robust network of individuals and local businesses that could fulfil each other's needs and reduce their reliance on external connections for help during future disasters.

The incorporation of local and modern knowledge, prior disaster experience, and participation in DRR training did not register significant loading values on the pattern matrix. While these factors seem less important for DRR in the Kaikōura context, they correlated significantly with other factors. The incorporation of local and modern knowledge could foster smarter usage of assets and resources for disaster risk reduction (Rai & Khawas, 2019) to protect livelihoods from disasters. Prior disaster experience combined with training in DRR could shape individual perception about risk as well as their ability and will to undertake preparedness actions.

6.4.5 Government, location, and migration

This research failed to account for the influence of government actions and policies as well as location in the principal component analysis because of the complex nature of each factor within Kaikōura. Governments are tasked with the redistribution of assets in a society, especially in disaster situations,

while providing preparedness measures that are beyond the capacity of individuals (Cannon, 2006; Kumasi et al., 2019; Newport et al., 2016). In other words, individual decisions to diversify, adapt and mitigate the effects of a disaster on livelihoods may hinge on government actions or inactions and policies. With respect to asset redistribution, government provided aid to the working people of Kaikōura; however, there was a diverse opinion on the adequacy of this aid package. From the policy perspective, both the government and people of Kaikōura agreed on the need to diversify their local economy. Nevertheless, individuals seem to be looking to the government for policy direction after in-depth consultation with stakeholders. In summary, further research will be required to measure the influence of government on different indicators of livelihood preparedness on Kaikōura.

With respect to location, Bird et al. (2011); Iwasaki (2016); Molua (2009) indicated that location influences an individual's exposure to hazards as well as their resources to protect their livelihoods in the event of a disaster. Without more data, it was difficult to link people's location to their access to resources. However, people living closer to the sea seemed more traumatised even two years after the last earthquake. Most of the people living in these locations would not even entertain a discussion about the quakes as it brought back painful memories. More research is required to measure the effects of location on different indicators of livelihood preparedness for Kaikōura.

Unlike the Laingpatehi people who migrated for livelihood and DRR purposes after a volcanic eruption (Rampengan et al., 2014), things were slightly different in Kaikōura. Migration within Kaikōura was more of a DRR measure, as immediately after the quake, individuals moved to higher ground to protect their lives and livelihood. This relocation was permanent for some residents and less so for others. Some individuals relocated their families alone while retaining the location of their livelihood source; others moved both. Further research will be required to ascertain the relationship between disasters, livelihood, and migration of people within and into Kaikōura.

6.4.6 Potential interrelationships between factors that influence different indicators of livelihood preparedness as suggested by SEM.

Following the outcome of a failed model fit in Figure 5.5, the overall SEM output model may not be a true representation of reality in Kaikōura; nonetheless, it highlighted some interesting results that

aligned with our findings at the preliminary stage of the research. These findings were suggested by the AMOS software modification output function to improve the overall model fitness. Firstly, the modification index on AMOS suggested the regression of four factors on access to timely and accurate hazard/risk information (FDRR8). These factors include knowledge of the hazards that could affect you and your family (FDRR4), Access to social capital (friends, family, community support) (FAR2), an individual's hazard and risk perception (FIAC5), people's willingness and their own ability to take disaster risk reduction measures (FDRR9). Additionally, knowledge about hazards that could affect one's family as well as risk perception also regressed on people's willingness and ability to take DRR measures.

Consequently, in the first few hours of the 2016 earthquake, timely and accurate information about the potential for a tsunami was lacking (McDonald et al., 2017; Stevenson et al., 2017). However, people living in Kaikōura seemed knowledgeable about the potential of a tsunami after an earthquake. Additionally, on most buildings (public and private), there were posters that instructed people to move further inland and uphill after an earthquake in anticipation of a tsunami and then wait for further information from the authorities. However, it is unclear how many of these posters were available prior to the earthquake. In addition, the number of individuals who perceived a threat of a tsunami after the earthquake and were willing and able to take actions to protect their lives and livelihood could not be determined. Nevertheless, people we spoke to who lived inland and on higher grounds seemed willing to accommodate other residents by providing temporal accommodation.

Secondly, with regards to financial capabilities for disaster risk reduction (FDRR10), the regression of knowledge about the hazards that could affect you and your family (FDRR4), people's willingness and own ability to take disaster risk reduction measures (FDRR9), and their willingness to adapt to changes and new circumstances (FIAC6) were suggested by modification index on Amos. More research would be required to explain or refute the regression of the first two factors. However, at the preliminary stage of our research, it was observed that people with relatively higher will to adapt to new circumstances promptly implemented changes that increased their financial standing in the aftermath of a disaster.

An example of this was a couple who managed a hospitality business which included a restaurant, rooms for short-term stays, and trailer parks. In the aftermath of the earthquake, to reduce the risk of their business collapsing, they reorganised their establishment to cater to construction workers whose hospitality needs were relatively different from that of tourists. Additionally, individuals who were willing to adapt to changes and new circumstances (FIAC6) seemed physically and mentally prepared to handle the ordeals of recovering from the earthquake. This was also highlighted in the works of Paton et al. (2015) hence the regression of willingness to adapt to changes and new circumstances (FAIC6) on physical and mental preparedness for a disaster event and its aftermath (FAIC8),

The regression of financial capabilities for disaster risk reduction (FDRR10), knowledge about the hazards that could affect you and your family (FDRR4), access to livelihood infrastructures and services such as roads, power, and water (FAR1), on the availability of early warning systems (FDRR12) will require further investigation. This is also the case for regression values that regressed on using tools and resources in a smart way to mitigate risks and for recovery (FDRR13). The correlation between different error terms would also require further research.

In all, certain factors within the SEM model seem to influence other factors that affect different indicators (e.g., access to social capital (friends, family, community support) (FAR2) and an individual's hazard and risk perception (FIC5). This could partly explain the correlation values obtained between indicators in Table 5.4. Multiple factors that influenced individual disaster risk reduction measures seem to be influenced by other factors, some of which influence the same indicators and others influence a different one (e.g. FDRR8, FDRR9, FDRR10, FDRR12, FDRR13). Only one factor from livelihood diversification (FLD5) had a probable influence on another factor in a different indicator. However, greater number of correlations was suggested between error terms for factors that influenced livelihood diversification. Further research will be required to establish or refute the relationships depicted in Figure 5.5. Hence, to measure livelihood preparedness in Kaikōura, Eq 2 will be adopted. A fitted model of Figure 5.5 could highlight additional error terms not accounted for in equation 2. A sample of an ideally prepared livelihood would be illustrated in Appendix B

6.5 Implications of the current study in Kaikōura

For individuals who lived through and are currently recovering from the 2016 earthquake in Kaikōura, access to livelihood infrastructure seems to be an essential factor for their livelihoods. This is not surprising given the extent of destruction to most of the infrastructure following the earthquake (Ministry of Civil Defence & Emergency Management, 2017; Stevenson et al., 2017). However, owing to the finite nature of resources available to carry out repairs, Kaikōura residents and political leaders may need to work together to establish a priority list of projects that are relevant for livelihood recovery in the short and long term. Similarly, significant value was placed on people's willingness to adapt to new circumstances. This could be of greater value to policymakers and leaders alike because an increased willingness by the public to adapt to new circumstances may translate to reduced resistance to changes that would improve the overall wellbeing of the residents.

Given that Kaikōura was isolated because of road and rail damage, access to social capital and mutual support within the community appears particularly important to livelihoods in Kaikōura. It is unclear whether the cooperation and coordination we observed among Kaikōura residents existed prior to the earthquake or was a result of the shared disaster experience. Nonetheless, strong connections among community members proved to be helpful for people's physical and mental recovery, thus improving their lives and livelihood. A significant value was also attached to the availability of external support because these served as a connection to the external world while the community was isolated. The importance of social networks observed in Kaikōura echoes the findings of other studies that suggested pre-disaster social networks facilitate individual adaptation in post-disaster (Kwok et al., 2019; Paton et al., 2015) and ease the dissemination of other forms of capital, thereby hastening the recovery process (Bhakta Bhandari, 2014; Bihari & Ryan, 2012). Consequently, stakeholders such as the government, business owners, and employees (all residing in Kaikōura) need to create more avenues that foster the building of communal and external relationships since this could assist in preparing livelihoods within Kaikōura and potentially limit the impact of future disruptions on individual livelihoods.

Similar to the findings of previous studies Armijos et al. (2017); Barclay et al. (2015); Suri (2018), knowledge about hazards that could affect individuals and their families was considered critical for

people living in Kaikōura. It could be argued that the knowledge base of Kaikōura residents goes beyond mere hazards and the risks they pose. During the interviews, we found that most people understood the impact mechanism of these hazards and the actions that could be taken to mitigate their effects on them. However, the interviews also revealed that some individuals considered themselves incapable of taking any meaningful actions and relied on the external agencies for DRR. People's willingness and ability to undertake DRR measures might have been shaped by their attitudes and beliefs towards preparing for a disaster (Barclay et al., 2015; Cannon, 2006; Mabuku et al., 2018).

The findings from this research also suggest that economic sector support and community groups should work together to foster a positive attitude towards better employment placement, livelihood preparedness, and DRR. This could be achieved by drawing upon the positive lessons learned from past disasters. It is also vital for the younger generations to be better educated on natural hazards and their impacts, as well as how they can better plan for future employment through training in diversified skills.

In examining hazard-related international policy settings in the New Zealand context, such as the Sendai Framework, the Paris Agreement, and the Sustainable Development Goals, Saunders et al. (2020) highlighted the absence of direct reference to vulnerability within the primary tools that govern the management of natural hazards and potential impact of a changing climate in the country. Through the assessment of factors that could affect a person's ability to prepare their livelihoods for a disaster, the framework developed in this research could be adopted to highlight areas of vulnerability while complementing the living standards framework formulated by the New Zealand Treasury (2019).

6.6 Results and model validation:

For this stage of the research, twelve industry experts were contacted. However, just four of the experts were willing to participate in the validation process. These experts are knowledgeable in livelihood and disaster research as well as in the statistical tools applied in this study. Similarly, an attempt was made to reach Kaikōura residents from previous studies who had opted to participate in future studies. However, only two residents were willing to participate in the validation process. This process was conducted on a one-on-one basis as it was difficult to choose a time that suited everyone. For both

groups (experts and Kaikōura residents), the validation process started with a presentation of the research findings from literature and statistical analysis of surveys in Kaikōura. Table 6.1 highlights the current roles of experts and Kaikōura residents.

Table 6.1 Validation participants

Expert participants
Manager at Callaghan institute
Lecturer in disaster management
Postdoc in Disaster management
Postdoc in machine learning and Artificial intelligence
Kaikōura Residents
Manager in Kaikoura council
Undergrad researcher living in Kaikoura

With respect to industry experts, following the presentation, their questions and feedback focused on the universal applications of these indicators in other locations and disaster contexts and the livelihood preparedness equations developed in this study. With regards to the universal application of livelihood preparedness indicators, the experts unanimously agreed that these indicators could be applied to measure livelihood preparedness in various locations and disaster contexts. However, they expected that the level of importance attached to each indicator would vary depending on the disaster context, location, and livelihood strategies available to individuals. Additionally, depending on location and disaster contexts, critical factors influencing livelihood preparedness are expected to vary. Given the novelty of equations 1 and 2, which underpin the livelihood preparedness tool (see appendix B), extensive community testing combined with machine learning was suggested to improve and further validate the model. The experts believe this could also enhance its application in other disaster contexts.

With respect to the two Kaikōura residents who participated in this study, it was difficult to focus on the 2016 earthquake without highlighting the livelihood impacts of the COVID-19 pandemic. While they believed the proposed framework could assist individuals to improve their livelihood, they

highlighted a significant difference between the current pandemic and the 2016 earthquake. From data obtained after the 2016 earthquake, resource accessibility was ranked as the most important indicator of livelihood preparedness in Kaikōura. However, the two residents unanimously agreed that livelihood diversity is currently the most critical indicator of livelihood preparedness in the community. Similarly, previous data highlighted access to livelihood infrastructure as the most critical factor for livelihood preparedness; however, current participants believed mental wellbeing is most important in the current pandemic setting. One of the participants justified her stance as follows:

"In 2016, people could see what the problem was, the roads leading to Kaikōura were all damaged. Today, it is very hard for people to understand what is happening. All they can see is that their lives and livelihood are withering away, and no one seems to have a proper explanation. This is driving people mad!"

The next chapter will present the recommendations derived from the current study.

Chapter 7 Research Summary

The cost of disasters on lives and livelihoods has increased many folds in the past decade. However, there are few tools available that can be used to measure the level of livelihood preparedness for disruptions caused by natural hazards. By studying the experience and perceptions of communities affected by the 2016 Kaikōura earthquake in New Zealand, this research aimed to develop an assessment tool for measuring livelihood preparedness for disastrous events. A mixed-method approach was applied, which combined a systematic review approach, a pilot study, and a survey of 140 individuals who lived through the 2016 earthquake in Kaikōura. Using t-tests, principal component analysis and structural equation modelling, the results identified the structural relationships between the four indicators of livelihood preparedness, illustrated the importance of resource accessibility, and highlighted 11 critical factors for livelihood preparedness in Kaikōura. Access to livelihood infrastructure was highlighted as the most critical factor for livelihood preparedness in Kaikōura. Additionally, through the application of principal component analysis, factors influencing livelihood preparedness in Kaikōura were reduced to seven components, all of which influence different indicators of livelihood preparedness. A combination of results and discussion from these statistical instruments was applied to develop a framework for measuring livelihood preparedness. This framework could assist disaster risk reduction policymakers, business owners, and individuals to formulate new or improve existing strategies and initiatives for people to better prepare their livelihoods for future disruptions caused by disasters.

The next section will summarise the role of individuals, businesses, governments, and non-governmental organisations in livelihood preparedness. It will also include the theoretical contributions of current research, its practical implications, shortcomings, and areas of further study.

7.1 The role of individuals in livelihood preparedness

Livelihood preparedness is the readiness of individual livelihoods in the face of disasters. Even though governments and other external entities could facilitate the preparedness process, people should be allowed to take centre stage in the preparation of their livelihoods for potential disruptions. This can be

initiated through the assessment of livelihood context and factors that affect the way people earn a living. The assessment outcome will suggest steps individuals could take to prepare their livelihood as well as areas that will require external support or a collective measure. Adequately prepared individuals may be inclined to assist their neighbours to implement preparedness measure pre-disasters and potentially help with community recovery post-disasters. These could lead to a sustainable and resilient livelihood outcome in a community, as individuals would be less reliant on external help while potentially reducing government expenditure on recovery after a disaster.

7.2 Business continuity for livelihood preparedness

From a livelihood perspective, business continuity and individual livelihood preparedness are intrinsically linked. Hence as part of a business continuity strategy, staff should be encouraged to take preparedness measures that will ensure that they remain in good health and continue to earn a living regardless of a disruption. This can be partly achieved through business and unemployment insurance. Within Kaikōura, government and insurance providers will need to work harder to restore people's faith in the insurance process. Through a public/private partnership, government and insurance providers could work to reduce the cost of insurance premium packages while enacting laws that enable disaster risk reduction strategies. Additionally, pre-disasters, government, businesses, and individuals living in Kaikōura should strive to develop both internal and external networks, as this would be vital in disaster recovery.

7.3 Role of Government and NGOs in Livelihood preparedness

In addition to facilitating a people-centred approach to livelihood preparedness, governments and NGOs should constantly monitor potential stressors that could compromise individual livelihoods in the event of a disaster. In the aftermath of the 2016 earthquake, access to livelihood infrastructure was most critical for livelihood preparedness; however, this might not be the case in future disruptions. Through machine learning and big data analysis, hidden factors that could affect livelihoods could be detected. Similarly, governments and NGOs should enable an open communication line with the community as

this could assist information dissemination while serving as a feedback mechanism with the capacity to assess the impacts of intervention projects.

7.4 Policy interventions for livelihood preparedness

After the 2016 earthquake, Kaikōura residents overwhelmingly highlighted the importance of resource accessibility for livelihood preparedness. Hence a concerted effort is required to ease the process of accessing resources both for individuals and organisations. Even though livelihood diversification is instrumental for livelihood preparedness, individuals in Kaikōura seem less keen to diversify their livelihoods. This could be resolved in part by the provision of tax incentives for people willing to take up second jobs, in areas of the economy with inelastic labour demand as well as sectors of the economy whose goods and services are profitable, but different from the rest of the economy. Additionally, the younger generation living in Kaikōura should be encouraged to acquire a diverse skillset as this could help their ability to diversify their livelihoods. People who lived through the 2016 Kaikōura earthquake stressed the importance of access to livelihood infrastructures. Because of the finite nature of resources available to carry out repairs, Kaikōura residents and political leaders may need to work together to establish a priority list of projects that are relevant for livelihood recovery in the short and long term.

Lastly, the livelihood preparedness measures and framework highlighted in this study should be adopted to complement the New Zealand living standard framework, as this could ease the process of conducting livelihood vulnerability audits for people living in Kaikōura and, potentially, other isolated locations in New Zealand. Consequently, outcomes of the vulnerability audits and lessons learnt from past disasters should be engraved in the minds of Kaikōura residents through different forms of art, as this could ensure that the preparedness process is carried on to the next generation.

7.5 Theoretical contributions

From a theoretical perspective, the concept of sustainable living and resilience have always dominated the study of individual livelihoods. This could be attributed to the developmental origins of sustainability and resilience. However, through a systematic review of literature focused on individual livelihoods and disaster preparedness, this study presented resource accessibility, livelihood diversity,

individual adaptive capacity, and effectiveness of individual disaster risk reduction measures as indicators of livelihood preparedness. It is important to note that the indicators and factors highlighted in this study were not meant to replace the sustainability framework or different livelihood resilience indicators. Nonetheless, it should be viewed as an operational alternative or complement, depending on the application context.

Rather than viewing people's livelihood from a developmental perspective to foster sustainability and resilience, this study assessed the impacts of a disaster from the standpoint of those whose livelihood has been directly impacted by a disaster. The indicators highlighted in this study, although not novel in themselves when combined as suggested in this study, could enable people to take charge of readying their livelihood for a disaster. Additionally, the livelihood preparedness tool proposed could foster an action-based approach to livelihood preparedness in Kaikōura. On a global scale, the fundamental principles applied to develop the livelihood preparedness tool could serve as a lever to reshape the perception of individual livelihood in a disaster context.

7.6 Research outcomes

Current research was guided by an overarching research question which asked if there was an operational tool to measure individual livelihood preparedness for disasters caused by natural hazards in New Zealand. The overarching research question was further broken down into three sub-questions. The first of these questions sort to identify indicators of livelihood preparedness and factors that influenced them. To address this question, two objectives (objectives 1 and 2 in chapter 1) were developed, which identified four indicators of livelihood preparedness and factors influencing them as well as the disaster context in which they were discussed.

Given that current research adopted the 2016 Kaikōura earthquake as the reference point, the second research sub-question identified the lessons learned from the 2016 Kaikōura earthquake. Three objectives were developed to answer current research question. The first objective (objective 3 in chapter 1) derived five lessons from the 2016 Kaikōura earthquake. Resource accessibility was the most critical indicator for livelihood preparedness while access to livelihood infrastructure was the most vital

factor influencing livelihood preparedness following the earthquake. These were achieved across objectives 4 and 5, respectively.

The last question focused on measuring livelihood preparedness in a disaster context. These were answered across objectives 6 and 7, which sort to develop a framework and tool to assess livelihood preparedness in Kaikōura. In all, current study formulated an operational tool that could be used to evaluate individual livelihood preparedness within Kaikōura. Future studies will be required to make it fit for purpose in other locations and disaster contexts.

7.7 Practical implications

From an individual and governmental perspective, indicators and influencing factors highlighted in this research can be applied to conduct livelihood vulnerability audits to ascertain how best to channel resources to foster livelihood preparedness. Based on the livelihood preparedness tool, the vulnerability audit process could be developed into a mobile application that allows people to independently assess their preparedness level. Results from the livelihood audits will enable people to identify areas of their livelihood that require additional work as well as potential resources that will be needed to do so effectively. In other words, the livelihood preparedness tool gives individuals the ability to take preparedness actions with limited dependence on external support where possible.

Similarly, individuals could also share their self-assessment results with their employers and policymakers. By sharing this information with employers, businesses are empowered to decide how best to assist their staff in preparing their livelihoods for potential disruptions. This could in turn potentially foster business continuity in unforeseen circumstances. For policymakers, self-assessment results when combined with other data sources using big data analysis and machine learning, can create a holistic picture of the preparedness level in the community. Consequently, Artificial intelligence can be trained to detect factors that influence livelihood preparedness indicators by analysing the social media feeds of consenting individuals. New factors highlighted in this process will be used to constantly update the current livelihood preparedness tool developed in this study, thereby ensuring that it remains

fit for purpose. Finally, a well-trained AI model could spot potential relationships between different factors that are not obvious to humans.

Within Kaikōura, lessons learned from the 2016 earthquake, combined with the livelihood preparedness index developed in this study, if adopted, could assist the community to build back better, thereby limiting the effects of future disruptions. In the long term, it could also assist the community to track the preparedness level of individuals and detect emerging threats to individual livelihoods and proffer solutions while highlighting areas that would require collective action. On a global scale, current set of indicators highlighted can be applied to assess livelihoods in different disaster contexts. However, more work will be required to detect factors unique to other locations and disaster contexts that will influence current indicators of livelihood preparedness. The resultant framework obtained from linking current indicators to location and disaster-specific factors could be adopted to complement the sustainable development goals and deliver sustainable livelihood outcomes.

7.8 Limitations of the current study

Owing to the distinct nature of hazards and livelihood endeavours across different locations, the framework and tool derived in this study might only be applicable to Kaikōura residents. Additionally, the entire framework was based on the perceptions of individuals recovering from a disaster. Hence, it is possible to obtain a different outcome if people are surveyed at a different time. Participatory observation was adopted to deduce the impact mechanism of different factors in Kaikōura. This approach may be less objective and limit the ability of the researcher to interpret the contextual manifestation of certain factors in Kaikōura. To mitigate this challenge, the observation process was conducted by three researchers who were conversant with factors highlighted in the systematic review. After the observation process, a consensus was reached about the contextual nature of each factor after comparing notes. Additionally, the preliminary drafts of the questionnaire were also shared with randomly selected residents to ensure that included factors were relevant in Kaikōura. While efforts were made to obtain responses from a larger and more diverse sample size, responses were received from less than 20% of the working population of Kaikōura as of 2016. Similarly, although not by design, some demographic groups were less represented than others. Perhaps at a larger response rate and from

a more diverse sample size, a different result could be obtained. Although survey material was designed in consultation with some residents of Kaikōura, it has not accounted for cultural biases associated with scales within questionnaires. Similarly, current research did not include correction factors that would ensure that the responses of minority demographics with a lower population and response rate are not suppressed by responses from larger groups.

7.9 Areas of further research

- Results of the systematic review of literature highlighted varying interests in the four indicators of livelihood preparedness across different locations and disaster settings. More work is required to ascertain the reason for this variation. Additional work is required to determine if livelihoods in Asia and Africa are more vulnerable to disasters when compared to other locations as a relatively higher number of literatures derived from the systematic review focused on these continents.
- Even though an attempt was made to highlight the role of governments in livelihood preparedness, further research is required to identify the influence of government on different indicators of livelihood preparedness. Similarly, additional work is required to ascertain how people located in different parts of Kaikōura prepare their livelihoods for disruptions. More work is also required to determine the influence of migration within and into Kaikōura on livelihood preparedness.
- While the current study did not highlight any significant differences among different demographics in Kaikōura, additional research with a more balanced sample size (where possible) will be required to retest this finding. Similarly, the population of Kaikōura seem to be tilted in favour of certain demographics; this could tip the results of statistical analysis in their favour or produce statistical insignificance in some instances. To address this issue, future study should focus on developing a correction factor that would ensure that the responses of minority groups with a lower population in Kaikōura are adequately accounted for.

- More importantly, the potential effects of a changing climate on different sectors in Kaikōura should be assessed as current research participants seemed unsure about its potential effects on their livelihoods.
- Current study utilised the AMOS software package which adopts the covariant approach to structural equation modelling. This could not deliver a fitted model to highlight the interrelationships between factors influencing different indicators of livelihood preparedness. Future studies with a larger sample size and a partial least-square approach to SEM could deliver a better result.
- Feedback from the field trip highlighted a community that has lost faith in the insurance sector. Given the important role of insurance in livelihood preparedness and recovery, extensive research is required to determine how to restore trust in the insurance process.
- Even though an attempt was made to validate the model developed in the current study, extensive testing of the formulated model is required within Kaikōura. More so, future studies are required to assess the validity of the formulated model in other hazard contexts within Kaikoura. Afterwards, the model could be modified for testing in locations outside Kaikōura.
- An in-depth study of social equity for livelihood preparedness will also be needed in future studies as a reduction in inequality could foster equitable distribution of resources that are needed for livelihood preparedness.
- Due to the sensitive nature of individual livelihoods, further studies are required to ascertain and resolve privacy issues that may arise from combining current livelihood preparedness tool with artificial intelligence and machine learning for policy formulation. Similarly, more work is needed to understand necessary cultural changes within a business that will encourage staff to share results of their livelihood vulnerability audits with their employer in a manner that protects both the business and employee.

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Appendix A: Factors influencing different indicators of livelihood preparedness and sources

Table 7.1 Identified factors and sources for livelihood diversity

Source	Access to asset/resources (education, skill)	Creative use of assets (innovation)	Knowledge of livelihood options available in a locality	Market conditions and demand including government policies	Experience in different livelihood options	Access to technology for productivity	Migration for livelihood purposes
(Baffoe & Matsuda, 2018)	√		√	√	√		
(Belle et al., 2017)	√						√
(Castellanos et al., 2013)	√	√	√	√	√	√	
(Fakhruddin & Rahman, 2015)	√			√			√
(Kumar et al., 2013)	√			√			√
(Le Dé et al., 2018)	√		√	√			√
(Motsholapheko et al., 2011)	√			√	√		√
(Molua, 2009)	√	√		√	√		√
(Newport et al., 2016)	√	√		√	√	√	
(Ning et al., 2014)	√		√	√	√	√	√
(Onneshan, 2008)	√	√		√		√	√
(Rampengan et al., 2014)	√	√	√	√	√		√
(Walsh & Fuentes-Nieva, 2014)	√		√		√		
(Whittaker et al., 2012)	√		√				√
(Manandhar, 2016)							√
(Daramola et al., 2016)	√						√
(Hansen et al., 2019)	√			√		√	
(Kumasi et al., 2019)	√			√		√	√
(Solh & van Ginkel, 2014)	√	√		√		√	√
(He et al., 2018)	√		√		√		√
(Mabuku et al., 2018)	√						√
(Qin et al., 2019)	√			√			√
(Deen, 2015)	√						
(Senapati & Gupta, 2015)	√					√	√
(Venugopal et al., 2019)	√		√	√		√	
(Ng'ang'a et al., 2016)	√						√
(Chapagain & Gentle, 2015)							√

Table 7.2 Identified factors and sources for adaptive capacity of individuals

Source	Local Knowledge	Individual flexibility (willingness to adapt)	Risk Perception	Physical and mental preparedness	Previous disaster experience	Individual skill	Presence of dependants
(Ademola et al., 2016)	√			√	√		√
(Anushka et al., 2018)	√	√	√	√	√	√	
(Barclay et al., 2015)	√		√	√	√	√	
(Birkmann et al., 2013)	√		√		√		
(Cannon, 2006)	√	√	√	√	√	√	
(Castellanos et al., 2013)	√		√		√		
(Chapagain & Gentle, 2015)	√			√		√	√
(Daramola et al., 2016)	√	√		√		√	
(Fakhruddin & Rahman, 2015)	√	√	√	√	√	√	
(Gebrehiwot & van der Veen, 2015)	√		√		√		
(Iwasaki, 2016)					√	√	
(Kelman & Mather, 2008)			√	√	√		√
(Le Dé et al., 2018)	√	√		√		√	
(Islam et al., 2018)	√		√	√	√	√	
(Newport et al., 2016)				√			
(Nhuan et al., 2016)	√		√	√	√	√	
(Rampengan et al., 2014)	√	√	√	√	√	√	
(Zhang et al., 2012)				√	√	√	
(Ahsan, 2017)	√		√	√			
(Bird et al., 2011)	√		√	√	√		√
(Fahad & Jing, 2018)					√		
(Jianjun et al., 2015)		√	√		√		
(Kumasi et al., 2019)	√		√			√	
(He et al., 2018)		√				√	√
(Luqman et al., 2018)			√				
(Solh & van Ginkel, 2014)		√					
(Mabuku et al., 2018)	√	√	√		√	√	√
(Mabuku et al., 2019)	√					√	√
(Qin et al., 2019)			√	√			√
(Senapati & Gupta, 2015)			√		√		
(Srinivas & Nakagawa, 2008)	√	√		√		√	√

Table 7.3 Identified factors and sources for effectiveness of disaster risk reduction measures

Source	Access to technology for DRR	level of education	Innovation	Effective hazard communication	Effective and accurate early warning system	Training to conduct DRR	Access to financial assets	perception about hazards	Willingness to take preparedness actions	Optimal structural preparedness	Infusion of local and modern knowledge in disaster risk reduction for livelihood preparedness	Mutual Support in Neighbourhood	Knowledge of hazard peculiar to a location	Inclusion of individuals in disaster risk reduction planning	Role of government and NGOs in DRR	Previous disaster experience	Migration to escape disaster impacts
(Akwango et al., 2017)	√			√	√	√	√				√	√			√	√	√
(Anushka et al., 2018)						√	√	√	√	√		√	√			√	√
(Armijos et al., 2017)				√	√	√	√		√	√		√	√	√	√	√	
(Barclay et al., 2015)			√	√	√		√	√	√		√	√	√	√	√	√	
(Belle et al., 2017)		√		√	√	√		√	√	√	√	√	√		√		√
(Birkmann et al., 2013)	√	√		√	√		√	√	√			√		√	√	√	√
(Cannon, 2006)	√		√	√		√	√		√	√	√	√	√				
(Chapagain & Gentle, 2015)	√	√			√		√								√	√	√
(Clot, 2014)	√					√	√		√	√	√	√	√	√	√		
(Garai, 2017)			√	√	√	√	√	√	√	√	√	√	√	√	√	√	
(Daramola et al., 2016)		√		√	√	√	√								√	√	√
(Gebrehiwot & van der Veen, 2015)		√		√		√			√				√	√	√		
(Mishra et al., 2010b)		√			√			√	√	√		√	√		√	√	
(Ng'ang'a et al., 2016)							√					√		√	√		
(Kelman & Mather, 2008)	√	√		√	√			√			√		√			√	
(Islam et al., 2018)	√				√		√	√			√		√				
(Iwasaki, 2016)				√	√	√	√	√				√	√	√	√	√	

(Kumar et al., 2013)			√			√	√			√	√	√	√	√	√	√	
(Suri, 2018)	√	√			√	√	√	√					√	√	√	√	
(Linnerooth-Bayer & Mechler, 2007)							√			√		√			√		
(Løvholt et al., 2014)				√	√	√	√	√	√	√	√	√	√	√	√	√	
(Practical Action Nepal, 2010)	√	√	√		√	√			√	√	√	√	√	√	√	√	√
(Newport et al., 2016)		√		√	√	√	√	√	√	√		√	√	√	√		
(Nhuan et al., 2016)	√	√		√		√	√		√	√		√	√			√	
(Okayo et al., 2015)	√	√		√	√	√	√	√	√		√	√	√		√	√	√
(Onneshan, 2008)			√		√	√	√		√		√	√	√	√	√		√
(Oxfam, 2009)		√		√	√	√	√		√	√	√	√	√	√	√		
(Paton & Johnston, 2015)			√	√					√	√	√	√	√	√		√	
(Rampengan et al., 2014)			√		√			√			√	√	√	√		√	
(Walsh & Fuentes-Nieva, 2014)	√			√	√	√			√	√	√	√	√	√	√		
(Wilkinson, 2011)	√		√	√	√	√	√		√			√	√	√	√	√	
(Manandhar, 2016)		√		√	√	√	√			√							
(Bird et al., 2011)	√			√	√			√	√	√	√	√	√	√	√	√	
(Fahad & Jing, 2018)		√					√	√	√						√	√	
(He et al., 2018)					√		√			√		√		√	√		√
(Solh & van Ginkel, 2014)	√		√											√			
(Mabuku et al., 2018)				√	√	√	√	√	√		√	√	√		√	√	
(Molua, 2009)				√	√		√								√		√
(Qin et al., 2019)		√					√	√	√			√	√	√	√		
(Rahut & Ali, 2018)		√				√	√					√				√	√
(Deen, 2015)				√	√		√		√	√		√			√		

Table 7.4 Identified factors and sources for sources for resource accessibility

Source	Government policy and action	Social inequality	Insurance	Cash	Individual skill and Knowledge	Age	Livelihood infrastructure	Formal Education (literacy)	Technology	Location
(Ahsan, 2017)	√	√		√		√	√	√		
(Anushka et al., 2018)					√					
(Akter et al., 2017)	√		√		√					
(Baffoe & Matsuda, 2018)	√	√		√	√	√	√	√		√
(Barclay et al., 2015)	√	√		√	√	√		√		
(Birkmann et al., 2013)	√	√		√	√		√			√
(Bogardi, 2004)										√
(Cannon, 2006)	√	√		√	√			√		√
(Clot, 2014)	√				√		√		√	
(Fakhruddin & Rahman, 2015)	√	√		√	√	√	√	√		√
(Fang, 2013)	√				√			√	√	√
(Garai, 2017)	√	√			√			√		
(Gebrehiwot & van der Veen, 2015)				√	√	√		√	√	√
(Iwasaki, 2016)		√					√	√		√
(Linnerooth-Bayer & Mechler, 2007)	√		√		√					
(Le Dé et al., 2018)	√				√		√			√
(Islam et al., 2018)	√				√					√
(Løvholt et al., 2014)	√				√	√	√			√
(Molua, 2009)	√	√		√	√	√	√	√		√
(Practical Action Nepal, 2010)				√	√					√
(Newport et al., 2016)	√	√		√	√		√	√		
(Nhuan et al., 2016)			√				√	√	√	√
(Onneshan, 2008)	√	√			√					
(Rampengan et al., 2014)	√			√						√
(Walsh & Fuentes-Nieva, 2014)					√					√
(Wilkinson, 2011)	√			√						√
(Zhang et al., 2012)	√	√			√		√	√	√	√
(Caudell et al., 2015)	√	√	√	√		√		√		√
(Daramola et al., 2016)			√	√	√		√	√	√	√
(Bird et al., 2011)					√			√		√
(Fahad & Jing, 2018)	√		√	√				√		√
(Kumasi et al., 2019)	√	√	√		√				√	√
(He et al., 2018)	√	√		√	√		√			√
(Luqman et al., 2018)			√		√			√		√
(Mabuku et al., 2019)	√	√	√	√	√	√		√		√
(Solh & van Ginkel, 2014)		√							√	
(Mabuku et al., 2018)	√			√	√	√		√		√
(Qin et al., 2019)	√		√	√	√		√	√		√
(Deen, 2015)	√	√	√		√		√	√	√	
(Mishra et al., 2010a)									√	
(Senapati & Gupta, 2015)	√			√	√				√	

(Venugopal et al., 2019)	√			√	√			√	√	
(Ng'ang'a et al., 2016)	√	√	√	√	√			√		
Whittaker (Whittaker et al., 2012)	√		√	√			√	√		
(Ademola et al., 2016)		√	√		√		√	√		√
(Chapagain & Gentle, 2015)	√	√	√	√	√				√	√
(Castellanos et al., 2013)	√			√	√					√
(Kumar et al., 2013)	√	√		√	√		√	√		
(Motsholapheko et al., 2011)	√		√	√	√			√		√
(Akwango et al., 2017)	√	√		√	√	√		√	√	

Appendix B: Livelihood preparedness tool

Livelihood preparedness (LP) = Σ $((SRV_{IND})(V_{IND})(LK_{IND}))$ E Eq 1

LP in Kaikōura = $(0.04E_{LD}LK_{LD} + 0.26E_{IDRR}LK_{IDRR} + 0.41E_{RA}LK_{RA} + 0.18E_{IAC}LK_{IAC})$ Eq 2

Hence E = $\sum F_{LV}M^{*}R$ where F_{LV} are the loading values of different factors and M* are mean value for critical factors. R is obtained with respect to each factor. (NB: figures in red were obtained by calculation)

Factors	Mean of critical factors	Loading value	Feedback	Indicator Error	Livelihood preparedness (LP) = Σ ((SRVIND)(VIND)(LKIND)) E				
Resource Accessibility (RA)					Calc	RA	ILD	IAC	IDRR
FAR5	4.27	0.854	1	3.64658	SEM Regression	0.74	0.34	0.57	0.64
FAR4	1	0.853	1	0.853	Variance	0.55	0.12	0.32	0.41
FAR2	4.38	0.769	1	3.36822	Product	0.41	0.04	0.18	0.26
FAR1	4.68	0.716	1	3.35088					
FAR3	1	0.597	1	0.597					
		3.789		11.81568	LP	117.57	118		
Livelihood diversity (ILD)									
FLD2	1	0.915	1	0.915					
FLD1	1	0.858	1	0.858					
FLD3	1	0.754	1	0.754					
FLD5	1	0.924	1	0.924					
FLD4	1	0.734	1	0.734					
		4.185		4.185					
Individual Adaptive capacity (IAC)									
FIC5	1	0.777	1	0.777					
FIC4	4.29	0.754	1	3.23466					
FIC8	4.29	0.722	1	3.09738					
FIC6	4.5	0.675	1	3.0375					
FIC1	1	0.58	1	0.58					
FIC2	1	0.855	1	0.855					
FIC3	4.34	0.652	1	2.82968					
FIC7	1	0.651	1	0.651					
		5.666		15.06222					
Effectiveness of disaster risk reduction (IDRR)									
FDRR12	4.28	0.83	1	3.5524					
FDRR9	1	0.736	1	0.736					
FDRR10	1	0.702	1	0.702					
FDRR13	1	0.68	1	0.68					
FDRR4	4.36	0.611	1	2.66396					
FDRR8	1	0.522	1	0.522					
FDRR9	4.35	0.828	1	3.6018					
FDRR7	1	0.822	1	0.822					
FDRR5	1	0.508	1	0.508					
FDRR1	4.26	0.457	1	1.94682					
		6.696	1	15.73498					

Appendix C: Interview Respondents and input

Interview respondents and codes	
Equipment Store owner	K1
Eatery owner	K2
Electronics store sales officer 1	K3
Electronic store sales officer 2	K4
Hospitality business owner	K5
Grocery store manager	K6
Motel owner and manager	K7
Auto Mechanic shop owner	K8
Owner of real estate firm	K9
Fish and chips store manager	K10
Sales and Marketing Manager	K11
Souvenir store owner	K12
Artist and Arts store owner	K13
Book store salesperson	K14
Art gallery store owner	K15
Manger at Kaikoura district office	K16
Respondents for other locations affected by the 2016 Kaikōura earthquake	
Motel housekeeper in Christchurch	CH1
Family Store manager	KA1
Flower store manager	KA2
Seasonal Worker	KA3

Household store manager	KA4
CEO of Enterprise North Canterbury	KA5
Store Owner	L1
Supermarket owner	L2
Gifts, crafts and clothes store owner	L3

05-12/07/18 (Kaikoura)

Interview 10 (K1 Hunting equipment store owner).

How long have you been in business?

9 years. I was in a store next door, in the process of moving to my current store on the night of the last earthquake. The store was under repair for one and a half years; at some point, we had to move our stocks to current location even before the repairs were complete.

What steps did you take to protect your business and livelihood?

I had a full business interruption insurance, so the insurance company came through with my payment. However, had part of the store not been damaged, the insurance company might not have paid up. But the truth remains that it is very difficult to prepare sufficiently for any disaster.

Where their steps taken after the disaster to protect your livelihood?

I had to properly manage my inventory and capacity to ensure that I was not cash trapped; I mostly sold my stocks and only replaced items in high demand.

What lessons did you learn from the disaster?

I became wiser, I tried to understand my insurance policy better. I am also keeping more cash at had to protect myself and business in the event of a disaster.

Did the government assist you to get back your livelihood?

Yes they did. They paid my staff till my business was able to trade again.

How about the community? Did they help to recover your livelihood?

Well the disaster brought the community closer together.

Interview 11: K2 Eatery owner:

How long have you been in Kaikoura?

My business was open for 5 days before the last quake.

What have you done differently after the disaster to protect your livelihood?

I have diversified and will continue to diversify my business strategy. Initially I focused on just breakfasts but after the disaster, I started making lunch and I am working on getting a liquor licence to be able to serve food and beverages in the evenings

How has your livelihood fared after the earthquake?

In a way, I will say that business has become better. My location has also played a role as most construction workers handling the repairs pass by the state highway. The community has also been very supportive of my business

How helpful has government been in protecting your livelihood before and after the disaster?

The government offered me business subsidy in the first week after which I rejected the subsequent offers because my business had reopened. I thought there were people in more need of it than I was.

What lessons have you learnt from the last quake?

I have learnt to take what I can get, make the best use of opportunities and resources.

Interview 12: K3 (electronics sales Store worker)

How long have you worked in the store?

I have worked here for 10 years

What have you done to protect your livelihood before and after the disaster?

Before the disaster, I had content Insurance; since my house and belongs where destroyed by the quake, the insurance company came through. After the disaster, I have learnt to be more prepared by keeping more food packs and storing water.

What was the effect of the disaster on the community?

In a way, the disaster brought the community together.

How much help did you get from the government?

I received a 500 nzd living wage for the first 2 weeks of the disaster.

Do you have any other source of income?

No.

Interview 13: K3 (Electronics Store worker 2)

How long have you had this job?

I have worked here for 7 years

In what way did you try to protect your livelihood in case of disaster? None really.

Do you have or are you planning on getting an insurance? No

What assisted you in recovering your livelihood?

I received 500 nzd from the government as well as some food from the community and NGOs

What lessons have you learnt from the disaster?

I learnt the importance of always being prepared; I now store food and water to protect myself as well as some emergency cash.

Interview 14: K5 (Motel Owner).

How long have you owned this establishment?

20 years. I and my husband first bought the restaurant by the side then we later bought the land and properties around it. We expanded the business to a motel, then a holiday parking for trailers. My husband also works in the local counsel. We would have loved to diversify further but age is not exactly on our side, so we are looking to lease out the motel business soon.

Would you say that the diversified nature of your business contributed positively in protecting your livelihood?

Yes, it did. For the first few weeks after the disaster, it was just the locals and people that were in the hotel after the disaster. Business in the restaurant and holiday parking business was quite slow. However, the motel side of things remained profitable.

How has business been after as compared to before the last earthquake?

Business has been very good after the last quake. We got business from repair workers as well as locals whose houses were damaged. As soon as the roads were opened, business was even better than before.

What steps did you take before the earthquake to protect your livelihood?

None whatsoever. We used to have insurance but at some point, we had some issue with the insurance provider, so we decided to terminate our insurance policy.

What have you done differently to protect your livelihood?

Stocked my pantry with food and water. I also keep extra cash for emergency. I have also implemented HSE procedures in our homes and businesses.

In what way has government assisted in protecting your livelihood?

Government supported us by paying our workers till we were able to get back to business. NGO provided food parcels for the guests that we had in the motel at the time of the disaster and in a way, the disaster brought the community together

Is there anything else you would like to share about the last disaster?

Kaikoura is a small town with just a single road assess; this in combination with the fact that we are also close to the sea makes us vulnerable. The quake also affected everyone differently especially the old people.

Interview 15: K6 (Store manager).

How long has this business been running?

16 years.

How were you and the business affected?

As a business, we were closed for one day as we lost all the stock in store. The entire staff pulled together the next day to clean up and restart the business to assist the community in getting better.

What would you have done differently to protect your livelihood?

Nothing really, it is very difficult to prepare for a disaster as the situation keeps evolving. However, we had an Insurance policy that was helpful. We also had the right networks that looked out for us after the disaster. Our networks assisted us in getting things to Kaikoura and looked out for our interest when we could not access the outside community. Our location on the state highway is also an important asset to our business; had the building been destroyed by the quake or Tsunami, we would be looking for a similar location. The government and community were also helpful in their own ways.

Lessons Learnt?

We are taking health and safety more seriously.

Interview 16: K7 (Motel owner and Manager):

How do you make a living?

We did not have this particular motel before the last quake, we bought it 7 months after the last quake. However, I grew up in Kaikoura and I also have six other motels in the South Island.

Are there steps you have taken to protect your livelihood?

Yes, we have insurance, stocked food, water and money that will last for a while after a disaster. We also have first aid kits and implemented HSE procedures in the motel; on the wall of each motel room, it gives exact instructions on what to do in the event of a Tsunami.

Are there lessons learnt from the quake?

In a way, the quake brought the community together and brought about infrastructural repairs that will make Kaikoura even better. The economy has also surpassed the pre-quake conditions; the quake put Kaikoura on the map. Most importantly, one can never be too prepared for a disaster.

Interview 17: K8 (Auto Mechanic shop owner):

How long have you owned this business?

30 years.

What services do you offer?

Any mechanical repair works on cars, machines and trucks. I also offer trucking and towing services. (Diversified within the sector).

Do you run any other business?

No but I also serve as the chief fire brigade officer.

How was your business affected after the quake?

Immediately after the quake, business was shut for a while because the roads were closed. But as soon as it was reopened, business started to boom.

What steps did you take to protect your livelihood?

I had and still have insurance, but it doesn't always cover everything. I have also improved technology in the workplace so that in the event of a disaster, some of my staff can work from home.

Are there any lessons learnt?

I have learnt to take life as it comes; keep at least 7 days supply of food and water, have a generator set around and learn more about my surrounding to be more prepared.

How did the community behave after the quake?

The last quake brought people together.

How much help did you get from government and NGOs?

The government paid the wages of my staff till we were able to resume business. The NGOs did a great job also as they provided us with some aid packages.

What do you think could be done better to save lives and protect livelihoods in the event of another disaster?

I think government needs to improve logistics in Kaikoura. This will help evacuation plans and assist business to get back on their feet.

Interview 18: K9 (Estate agent firm owner)

How long have you been in business in Kaikoura?

10 years

How did you plan to protect your livelihood before the earthquake?

I had business interruption insurance which was helpful after the quake.

What steps have you taken after the quake to prepare for another unforeseen event?

I keep emergency food, water and first aid kits. I also have a go bag with cash and important documents. Lastly, most of my workers have sleeping bags in the truck of their cars.

What about lessons learnt?

I have learnt to see the upside in every situation, I also appreciate the fact that I am lucky to be alive.

How about the community?

The disaster brought us together as a community.

How helpful was the government?

The government services were outstanding after the disaster. The civil defence services was wonderful.

Interview 19: K10 (Chips and Fish store manager)

How long have you worked here?

I have worked here for 2 weeks but I am also working in a restaurant for the past six months.

What steps have you taken to protect your livelihood?

For myself not much other than always having a torch handy at night. But for the business, we have implemented an evacuation procedure in the event of a crisis, we are also fully insured.

How do you see the business climate in Kaikoura?

The major challenge I see is the roads; people do not want to live in Kaikoura because each time it rains or the weather changes, the roads are blocked off. This is affecting business in Kaikoura.

Interview 20: K11 (Sales and marketing manager; she was also at the Christchurch earthquake):

How long have you worked in the industry?

I have worked in the industry for 20 years, but this business opened September 2016 two months before the last quake.

what structures did you have in place to protect your livelihood in the event of a disaster?

I and the team had knowledge, experience and skill in the industry. We also had the network to get any asset or skill we lacked. These were very helpful after the quake. The initial plan and still the plan for the business is to take tourist whale watching and alpine viewing, however after the quake, because the road was close for a while, we had to redirect our focus. We assisted in flying relief materials and personnel into Kaikoura. We also started providing commercial air travel in Kaikōura and other destinations around.

What steps are you taking to protect your livelihood in the event of another disaster?

Immediately after the quake, we got certified by Qualmark to assure our clients that we will always provide quality services. We also adhere strictly to all the rules of the aviation industry. We are taking health and safety more seriously. At the moment we are making safety videos in other languages like Spanish, German and mandarin. We also have an internal auditor that audits us every 2 weeks to make sure that we adhere to industry best practise. We also do our bit to ensure that Kaikoura is communicated in the best way possible to the world. Occasionally, we assist the construction works in conducting a fly by inspection of the construction works in the mountains to ensure that all the repairs are carried out properly.

We are also building more collaborations with local tour firms to provide combo tour package. In addition to that, we are in talks with Sudiam hotels to create a tour package as they are looking to build

a hotel in Kaikoura. We are also talking to the Cruise ships on possible collaboration. We are very flexible with our packages; we offer packages that are as short as 30 mins fly to see the quake site and even longer ones that could take up to 3 hours. We also bought over a fixed wing plane business to further diversify our portfolio in the industry. We have also increased our marketing campaign

How is the tourism industry recovering in Kaikoura?

Things were slow initially but after some months business began to boom. The reopening of the road was very beneficial to our business.

Interview 21: K12 (Souvenir Store owner in Kaikoura):

How long have you owned this business?

I bought this business 5 weeks before the quake and the quake has nearly destroyed it.

What steps did you take to protect your livelihood before the quake?

I had business interruption insurance but the insurance company was not very helpful when it was time to pay up. I will not be paying insurance anymore.

What are you doing differently to protect your current business in the event of another disaster?

Nothing; I could not afford to do anything even if I wanted to because I can't afford it. The road closure after the quake coupled with the fact that my business is seasonal hasn't made things easy. The only thing I have done so far is to attend some free courses at the chamber of commerce.

Do you have any other source of income?

Yes, I earn some money through Airbnb.

What lessons have you learnt from the past disaster?

I learnt that social media and taking my business online is imperative to my survival in the industry. I have also learnt more about the seasonal nature of our business. Lastly, I learnt that there is very little one can do in the face of natural disaster. I am also storing more food.

Do you think the government can do anything to make live better?

Yes, they can assist in the clean up exercise.

How about the community, how helpful have they been?

People in Kaikoura have been very helpful.

Interview 22: K13 Arts and Artist store owner. (She was also at the Christchurch quake)

How long have you owned this store?

Since November last year, before then, I use to work at Henry's store and painted part time.

Other than painting, how else do you make a livelihood? I am also a certified massage therapist. After the quake, I lost my employment at Henry's so I worked as a massage therapist before opening my art store. I also sell other people's articles in my store.

Are there steps you took before the quake to protect your livelihood? Not really.

What lessons have you learnt about the quake?

I now pay more attention to the foundation of the house before I rent or buy any house.

How about insurance?

After the quake, it has become very difficult to get insurance in Kaikoura so I am not looking at that for the time been.

What steps have you taken to protect your livelihood after the quake?

I try to be self-sufficient at all times; I always have a full tank of petrol, water, food and a portable cooker.

Are you a member of any society in the community?

Yes, I belong to the Arts society and the old people's home society.

How supportive was the community in Kaikoura after the quake?

Everyone was very helpful they all offered to help in their own way however, this was not my experience in the quake at Christchurch. The communities in Christchurch wanted to take or steal the once you had.

How much help did you get from the government after the quake?

Not enough, because I was working part time at Henry's, I did not get the full government support.

How much help did you get form NGOs?

None, the only NGO that helped was the Art society, they tried to assist each other after the quake.

Interview 23: K14 (Bookstore Salesperson):

How long have you worked here? Since November last year, before then, I worked at whale watchers.

How has sales been after the quake?

Very slow plus during winter, sales are quite slow in Kaikoura.

What did you do before the quake to protect your livelihood?

Nothing.

How about after the quake? Nothing as well.

Do you have any other job or skill that earns you an income? No

Did you receive any help form the government after the quake? No

How about the NGOs? They were very helpful. I was also part of the group that organised community events to help people recover after the quake.

Interview 24: K15 (Art gallery store worker)

How long have you worked here?

I just started two weeks ago, am helping the owner who is short staffed at the moment.

What do you do to earn an income?

I owned a backpacker business and a farm; I sold the backpacker and leased out part of the farm to a dairy company all before the quake.

What steps did you take to protect your livelihood before the quake?

I had an insurance which paid up after the quake. I also have a vegetable garden in my house and could get meat from my farm.

What would you have done differently before the quake to protect your livelihood?

I would have gotten more water containers because we had water in the farm after the quake but no way to distribute it. I would have also gotten more power cables and diesel for the generator.

What lessons have you learnt?

The need to have a proper evacuation plan.

How helpful was the community and the government?

The government was helpful after the quake but more needs to be done in making the road into Kaikoura better. The community shared everything after the quake and the art society also assisted its members in any way they could.

What is the prospect of arts and gift business in Kaikoura?

Recovering slowly but I believe it is still a viable sector.

What else will you like the government to do?

Improve the infrastructure in Kaikoura and construct a heated pool in Kaikoura.

Interview 26: K16 (Kaikoura Council Staff)

What is the best way to tackle livelihood preparedness?

The community must first decide or define who they are and what they value as a people. This will assist them in making livelihood choices and setting up disaster management policies and procedure. Most importantly, emergency or disaster management procedures are best put in place before a disaster

02/07/18.

Interview 1: CH1 (Motel housekeeper in Christchurch)

How do you earn a living?

I work as a housekeeper in a motel.

What steps have you taken to protect your livelihood from unexpected events?

I have taken out insurance, I keep emergency food and water in disaster resistant containers. I also keep first aid kits at home.

Where those steps in place before the last earthquake?

I had insurance before the earthquake.

Did they deliver the intended results?

NO, the insurance did not deliver results when it mattered most

What informed your decision to take those steps now and are you confident that it will protect your livelihood from future unexpected events

I took out the insurance as a stop gap, but I am not confident that it will deliver the intended results. I feel more confident in keeping emergency food supplies at home.

Interview 2: KA1 (Family Store manager) (Kapoi)

How do you earn a living?

I work as a store manager for a 147-year-old family owned business. It took us three and half years to recover from the disaster. Government was very helpful as they paid the wages of the staff till we reopened.

What steps have you taken to protect your livelihood from unexpected events?

I focused more on protecting people than any specific preparation to protect income or business. I also try to take care of my health by managing my stress level because each time I hear a rumble, I think it's the quake all over again. This causes me to re-live the event all over again. However, I have a business insurance. The earthquake also brought people together like never before. Experience was more important than education in preparing and protecting the business, its people and livelihood during a disaster.

Where those steps in place before the last earthquake?

Yes, I had an insurance before the last earthquake.

Did they deliver the intended results?

Not exactly. The insurance companies were not helpful in the last disaster. I have learnt to look at the fine print on insurance policies. I am confident that in the event of another disaster, I will be more prepared to protect my life and that of my family as I know more about health and safety, the importance of community, communication, security and ways of taking advantage of government policies to rebuild my life after a disaster.

Interview 3: KA2 (Flower store manager)

How do you earn a living?

I work as a manager in this flower store for the past 10 years.

What steps have you taken to protect your livelihood from unexpected events?

I have not done much to protect my livelihood in the event of an unforeseen event. Part of the reason for this is the lack of financial resources to do so. (Lack of finance to pay for insurance). I also do not trust insurance companies.

After the disaster, have you done anything differently?

Yes, I keep a first aid kit, emergency food and water supplies. I also keep a good torchlight close.

Looking back at the last quake, what would you have done differently?

I would have secured household items properly. The major challenge in preparing for a disaster or trying to protect livelihood was that each disaster is different; they all have unique set of challenges. In the past disasters, government and NGOs have been helpful in securing my livelihood. Community has also proven valuable in recovering after a disaster.

Interview 4: KA3 (Seasonal Worker)

How do you earn a living?

I work as a seasonal worker

What steps have you taken to protect your livelihood from unexpected events?

Before the most recent quake nothing.

Have you done anything differently to protect your livelihood after the last earthquake?

Not much because I have a natural spring water close to my property. I also have a food garden in my property. However, I keep my household items fastened properly. I am also trying to manage my stress level because I feel frightened when I hear a random rumble. I also appreciated the community spirit after the quake because it helped me back on my feet. The government also gave me 500 NZD to sustain myself after the quake. However, assistance from the government wasn't easily accessible.

Interview 5: KA4 (Household store manager)

How do you earn a living?

Before the last quake, I was working at a different household items store, I was working at Harvey Norman.

What steps have you taken to protect your livelihood from unexpected events?

To be honest, I do not believe it is possible to prepare for any disaster let alone livelihood because each disaster comes with unique set of challenges.

What lessons did you learn that could influence your livelihood preparedness?

I learnt the importance of having a positive attitude because in a way my livelihood became better after the earthquake. I got a better house through my insurance after the quake. I also began to make more money because the quake caused a surge in population within my area; more people brought about more earning opportunities. However, I still re-live the quake each time I hear a loud noise. I learnt the importance of family, income, government policy and age in disaster situations. I also keep emergency meal packs and first aid kits in my home and workplace. I also keep my car keys very close to me at all times.

Interview 6: KA5 (CEO of Enterprise North Canterbury)

How long have you worked here?

I have managed the affairs of Enterprise North Canterbury Kaiapoi for the past two and half years. We assist local businesses recover from disaster situations. Before then, I started and ran a couple of other small businesses

What factors or items do you think are important for livelihood preparedness?

Documentation of past events, training, financing, income and proper communication.

Do you have an Insurance policy to protect your livelihood?

No because most insurance policies are ambiguous at best and might not deliver when disaster strikes.

Are there other mains of protecting your livelihood in disaster situations?

I now know more about health and safety; I also keep first aid kits.

3/07/18 (Lyttleton)

Interview 7: L1 (Store Owner)

How long has your business been open for?

Since August last year. I was not here on the day of the last quake, but I nearly lost my daughter on that day; the roof of her workplace collapsed on her.

Do you have any source of income other than this business? No

How has the income from the business been since after the quake?

Things are just starting to pick up.

What lessons have you learnt from the quake? How do you intend to protect your livelihood for the next unforeseen circumstance?

Fasten items properly to the wall, keep emergency food water and first aid items.

How have people been after the quake?

The disaster brought the community together.

Would you have done anything differently? Are you doing anything differently?

Not exactly but it made some of my family members change their livelihood strategy; they were inspired to do more.

How air repair works coming on?

Slowly but steadily. Before the roads were reopened, most of my sales have been to locals and repair workers. However, as soon as the roads reopened, my sales increased; Lyttleton got more tourist after the quake than before it. As soon as the repairs are completed and done properly, I believe my business will do better.

How much help did you get from the government and NGOs?

In my opinion, the NGOs were more helpful than government. A particular government establishment that was supposed to take care of the injured forced my daughter to start work even before her injuries were healed. So I think the government was less helpful in some cases.

What else can you tell us about the disaster?

The disaster indirectly caused the deaths of a lot of people because of the stressful conditions it brought. Most people were not allowed to take items from there store until it was deemed safe, but this process took weeks to be completed. The quake also caused vulnerable infrastructure to crumble.

Interview 8: L2(Supermarket owner)

What steps have you taken before and after the last quake to protect your livelihood?

Before the last earthquake, I had insurance but after the quake insurance has become very expensive and inaccessible. I still have insurance but in addition to that, I have also made sure that the building code of my business place and residential building is up to date. I have also taken HSE more seriously.

How do you think the community is getting on after the last quake?

Things are getting back to normal; the only challenge is that most repair works have been done in a hurry and not done properly so people are spending more to do repair works.

How much help did you get from the government?

The government was very helpful. They paid my workers for the period that our business was closed.

What about the economy of Lyttleton after the quake?

Things are getting back to normal on that front too; more businesses are opening up shop in Lyttleton.

Interview 9: L3 (Gifts, crafts and clothes store owner)

How long have you been in business?

10 years.

How much damage did the last quake cost you?

My business was closed for six months and in that time, I did not have any other source of income. If not for government assistance in that period, I am not sure how I would have survived.

What effect did the quake have on your livelihood?

It made me to reconsider my livelihood strategy, I work less at the store now and employ 2 people to cover the store when I am not around. I try to enjoy life more.

What would you have done differently before the quake?

Perhaps fastening the items properly to the wall or floor.

Before the last quake, what did you do to protect your livelihood?

I had Insurance and it was very helpful after the quake.

How has things been for yourself and the community after the quake?

Immediately after the quake business was very slow but as soon as things stabilized, sales grew higher than before. In the past 3 years, business has grown by at least 20% per annum. The community has also been very supportive as they buy locally made items more. The disaster also brought everyone together.

What would you do to improve your livelihood?

Try to understand the community more, become more sustainable by using recyclable and renewable material

Appendix D: Questionnaire

Questionnaire

Livelihood preparedness for disasters

About the survey

You are invited to participate in the questionnaire survey for the research project "Livelihood preparedness for disasters", undertaken at the University of Auckland, New Zealand. The project aims to develop a framework that can assist stakeholders to measure individual livelihood preparedness. Livelihood preparedness are actions taken by individuals to promote, protect and prevent the effects of unforeseen events on their means of earning a living.

This questionnaire survey is anonymous and will take 15-20 mins of your time. The information you provide will be treated with confidentiality. The survey is approved by the University of Auckland Human Participants Ethics Committee with reference number 014782. Your input will assist us to ascertain the very factors that most concern your livelihood preparedness.

We appreciate your support and participation.

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Section A: Respondent Information

Q1 Were you born in New Zealand?

- ○ Yes
- ○ No

Q2 Which of the following ethnic group(s) best describes you? (you can choose one or more options)

- ☐ European
- ☐ Maori
- ☐ Asian
- ☐ Pacific Islander
- ☐ Middle Eastern/Latin American/African
- ☐ Other

Q3 In which age bracket do you belong?

- ○ 15-19
- ○ 20 – 24
- ○ 25 - 34
- ○ 35 – 49
- ○ 50 – 64
- ○ 65+

Q4 Which gender do you identify as

- ○ Male
- ○ Female

Q5 What is your highest level of education?

- ○ Doctoral Degree
- ○ Master's degree
- ○ Post-graduate and honours degree
- ○ Bachelor's degree and level 7
- ○ Level 5 or 6 Diploma
- ○ Level 1 – 4 certification
- ○ Secondary school qualification
- ○ No formal qualification

Q6 Which of the following best describes you?

- ○ I am married and have dependents
- ○ I am a single parent
- ○ I am married without dependents
- ○ I am single without dependents

Other, please specify _____

Q7 What did you do for living before the earthquake in 2016?

- ○ I was self-employed

- ○ I worked for an organisation full time
- ○ I worked for an organisation part-time
- ○ I was unemployed
- ○ Other (please specify) _____

Q8 What do you do now for living?

- ○ I changed my job since the quake
- ○ I stayed in the same organisation
- ○ I changed my employment status (e.g. from part time to full time, or vice versa)
- ○ I am unemployed

Q9 Which of these sectors best describes the industry you currently work in?

- ○ Primary industries (agriculture, forestry and mining)
- ○ Manufacturing
- ○ Construction
- ○ Utilities (gas, power and water)
- ○ Wholesale and retail trading
- ○ Housing and real-estate
- ○ Logistics (warehousing, postal services, transport services)
- ○ Information and media telecommunication
- ○ Financial and insurance services
- ○ Hospitality
- ○ Public administration and safety (law enforcement, government workers and public office holders)
- ○ Education and training

- ○ Healthcare and special assistance
- ○ Other, please specify

Q10 Are you happy with your current job?

- ○ Extremely happy
- ○ Happy
- ○ Neutral
- ○ Slightly unhappy
- ○ Unhappy

Q11 How do you access civil defence and emergency management (CDEM) information?

- ☐ Internet (Google, CDEM website)
- ☐ Workplace
- ☐ Yellow Pages
- ☐ Kaikōura District Council – 03 319 5026
- ☐ People you know (colleagues)
- ☐ Friend, neighbours, other extended family members
- ☐ Council Distributed Resources
- ☐ Public/social/community events
- ☐ Social Media (Facebook, Twitter, etc)

☐ Local Library

☐ TV

☐ Radio

☐ Other Please specify_____

Q12 In your opinion, do you think climate change would affect your livelihood?

○ Yes

○ No

○ Not sure

Section B: Livelihood preparedness indicators

On a scale of 1 - 5 (where 1 indicates not important and 5 indicates very important) how important are these steps to improving your ability to earn a living and meet the basic needs of you and your family, in the event of a disaster.

Q13 **Livelihood diversity**: i.e. Having multiple sources of income OR having several different ways of earning a living.

Not Important 1	Somewhat Important 2	Neutral 3	Important 4	Very Important 5

Q14 **Effectiveness of disaster risk reduction measures**: i.e. Implementation of measures to mitigate risks or reduce disaster impacts (e.g. fasten items in my house to prevent them falling on someone during an earthquake).

Not Important 1	Somewhat Important 2	Neutral 3	Important 4	Very Important 5

Q15 **Resource accessibility:** e.g. Having access to cash, loans, social capitals and other assets.

Not Important 1	Somewhat Important 2	Neutral 3	Important 4	Very Important 5

Q16 **Individual adaptive capability**: i.e. Being able to adapt to changes and/or new circumstances.

Not Important 1	Somewhat Important 2	Neutral 3	Important 4	Very Important 5

Section C: Livelihood diversity

Q17 On a scale of 1 - 5 (where 1 indicates not important and 5 indicates very important) how important do you believe the following are?

	Not Important 1	Somewhat Important 2	Neutral 3	Important 4	Very Important 5
Having multiple but **related** ways of earning a living (e.g. I am a business owner, and, in the meantime, I have a job as a business mentor) (ILD*)					
Having multiple but **unrelated** ways of earning a living (e.g. I am a farmer and teach part-time in a secondary school) (ILD**)					
Having access to various types of assets/resources **(FLD 1)**					
Utilising asset/resources in a creative/innovative manner **(FLD2)**					
Possessing skills and resources in demand **(FLD3)**					
Being able to know how to use existing digital platforms to create a business opportunity (e.g. using Airbnb to open a					

home/farm stay business **(FLD4)**					
Having knowledge about the work and income policies **(FLD5)**					

Section D: Disaster risk reduction measures

Q18 On a scale of 1 - 5 (where 1 indicates not important and 5 indicates very important), how important do you believe the following measures are to assist you in reducing the impact of a natural disaster on your employment/livelihood

	Not Important 1	Somewhat Important 2	Neutral 3	Important 4	Very Important 5
Mutual support in a neighborhood (**FDRR1)**					
Incorporation of traditional wisdom and knowledge in disaster risk reduction **(FDRR2)**					
Having prior disaster experience (**FDRR3)**					
Knowledge about the hazards that could affect you and your family **(FDRR4)**					
Undertaking preventive measures to disaster-proof houses and buildings (e.g. fastening household items and retrofit old buildings/houses) **(FDRR5)**					
Level of community participation and consultation in Council's disaster risk reduction plans **(FDRR6)**					
People's own perception of hazards and associated risks (**FDRR7)**					
Access to timely and accurate hazard/risk information **(FDRR8)**					

People's willingness and own ability to take disaster risk reduction measures **(FDRR9)**					
Financial capability for disaster risk mitigation **(FDRR10)**					
Participation in training for disaster risk reduction **(FDRR11)**					
Availability of early warning systems **(FDRR12)**					
Using tools and resources in a smart way to mitigate risks and for recovery **(FDRR13)**					

Section E: Resource Accessibility

Q19 On a scale of 1 - 5 (where 1 indicates not important and 5 indicates very important), how important do you believe access to the following assets (will or have enabled) enable you to prepare for disasters.

	Not Important 1	Somewhat Important 2	Neutral 3	Important 4	Very Important 5
Access to critical infrastructure services (e.g. roads, power, water) **(FAR1)**					
Access to social capital (friends, family, community support) **(FAR2)**					
Access to financial assets (e.g. savings, loans, banking services and insurance etc.) **(FAR3)**					
Access to external support (from the government agencies and/or NGOs) **(FAR4)**					
Availability of external support (from the government					

agencies and/or NGOs) **(FAR5)**					

Section F: Individual Adaptive Capacity

Q20 On a scale of 1 - 5 (where 1 indicates not important and 5 indicates very important), how important are these factors in influencing your ability to adapt in times of a disaster

	Not Important 1	Somewhat Important 2	Neutral 3	Important 4	Very Important 5
Skill sets of individual people **(FIC1)**					
Level of work experience **(FIC2)**					
Lessons learned from past disasters **(FIC3)**					
Attitude and belief towards preparing for disasters **(FIC4)**					
An individual's hazard and risk perception **(FIC5)**					
Willingness to adapt to changes and new circumstances **(FIC6)**					
Knowledge about the local context (e.g. social norms, cultural beliefs, laws) **(FIC7)**					
Physical and mental preparedness for a disaster event and its aftermath **(FIC8)**					

Section G: Thanks for your participation

Please leave your contact details below, if you would like to (please tick)

- ○ Provide us with more detailed information; we can arrange a 30 minutes interview by either Skype or in person at a time that would most suit you.
- ○ Receive a copy of the research report by email.

Your Name: _____

Phone number or email address: _____