Disaster Recovery in Urban Communities

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Sahar Zavareh Hofmann

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Betreuer(in): Prof. Dr. Gordon Winder
Zweitgutachter(in): Prof. Dr. Jürgen Schmude

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Abstract

Recovery after disasters is becoming a more prominent focal area of research as the geography literature on disaster management embraces a resilience approach. The damaging impacts of natural disasters on individuals are often compounded by problems and failures in managing recovery after the event. Such problems and failures in recovery take on specific dimensions when disaster events damage the well-established and well-functioning but costly infrastructure and built environments of affluent urban societies. In these circumstances, the extent and nature of property damage combines with the specific pattern of economic and institutional resources available and the disaster recovery management applied to shape the long-term recovery process. As such events become more common and costly, it is important to develop systematic knowledge of how to have a successful and organized recovery process, and, curiously, especially in the case of developed countries. There is a need for a better understanding of what constitutes a successful recovery process, what happens with this process, what long-term recovery is, and how to use the process to mitigate future disasters. The purpose of this research is therefore to compare and contrast long-term recovery planning and management following major disasters in order to identify common lessons, challenges, and ways to mitigate future losses and damages. Although recovery is not everywhere managed the same, there are important lessons that can be learned from the experiences of others. In particular, it is worth identifying the effects of local institutions on recovery and the learning processes that occur.

This research seeks to understand and assess disaster recovery in urban communities by examining the relationship between disaster resilience, housing and insurance. This dissertation addresses five research questions, which are addressed in separate chapters, each of which will be published separately:

(1) How to assess urban resilience policies supporting disaster risk reduction approaches? The 100 Resilient Cities (100RC) was launched by the Rockefeller Foundation to build worldwide resilience. An evaluation of each member city Resilient Strategies plan took place using directed and summative content analysis to determine whether or not vulnerability and risk narratives were applied in its disaster risk reduction approaches. The results reveal the differences produced among member cities due to the role of actors and power expressed in the policy design and implementation. The overall findings suggest that the 100RC program has not fundamentally addresses issues related to the Sendai Framework for Disaster Risk Reduction goals to reduce disaster risk and vulnerabilities. While many members identified many disaster risks and challenges among shocks and stresses, most were overlooked when designing and implementing key policies for urban resilience. This research was published as a journal article in a special publication focused on reviewing the five-year progress of the

Sendai Framework for Disaster Risk Reduction implementation for insight into lessons and planning (Hofmann Zavareh, 2021).

(2) How do urban-rural linkages in sustainability transitions impact disaster recovery management and recovery? Analysis of urban-rural linkages in recovery from the earthquake events in Christchurch, New Zealand reveal how desired transformations were entangled in rural, national and international linkages. Three key findings are found; (1) the elements in urban-rural linkages framework are interconnected; (2) the relationalities assumed in the framework do not always hold, and (3) emphasis on urban-rural linkages may obscure other geographies of recovery. This reveals the complexity of the task to map spatial flows, linkages and partnerships among urban, peri-urban and rural areas managing transition pathways for sustainable development. This research was published as part of a special peer-reviewed book publication focused on Rural-Urban Linkages for Sustainable Development edited by Armin Kratzer and Jutta Kister with Routledge (Winder & Hofmann Zavareh, 2020).

(3) How to analyze natural disaster damage for specific localized regions to obtain calculations of losses for communities managing recovery using economic models? Micro-level assessments of regional and local disaster impacts in tourist destinations provide the opportunity for economic geographers to assist in calculating precise damage assessments at small regional scales that in turn support the tourism sector and other inter-dependent economies facing reconstruction challenges after disasters. To calculate precise damage assessments, a micro-level assessment model is developed. The island of Dominica is chosen as an example for the model using statistical data from the tourism sector to outline and detail the consequences of a disaster specifically for communities. The results highlight the importance of damage assessments on a small-scale level needed for communities to better understand impacts for residents and the local tourism sector. Only after identifying regional impacts, it is then possible to apply adequate disaster recovery financing needed for residents and the tourism sector recovery. This research was published in the Tourism Geographies journal as part of the Tourism in Changing Natural Environments special publication (Schmude et al., 2018).

(4) How to measure long-term community housing recovery using dynamic economic resilience? The research assesses long-term housing recovery and community resilience in the case of Broadmoor, a community located in New Orleans. The community long-term housing measurement is calculated using housing recovery scenarios (dynamic economic resilience). The dynamic economic resilience scenario results provide an indication as to how significant implementation of new disaster recovery policies and procedures can be centered on a more efficient handling of applications for building permits, as well as financial claims

for rebuilding or buy-outs, and a more effective management of constrained reconstruction resources for community resilience rebuilding. These results also support recent Munich Re disaster risk modeling studies to improve flood protection in New Orleans. This case demonstrates the role of measuring long-term housing is necessary to better understand the housing recovery processes in different market types. The Broadmoor case also highlights that the speed of recovery was greatly influenced by adopting a community-based approach to managing local and regional resources. This research has been accepted for publication as a journal article in Environmental Hazards (Zavareh & Winder, 2021).

(5) What is the role of insurance in managing overall community recovery and housing resilience? The role of insurance, and government buy-outs in recovery are explored in two case study communities (Broadmoor, New Orleans and Avonside, Christchurch). Analysis of case studies using a framework based on "Build Back Better" demonstrating the role of insurance embedded in the scale of long-term housing recovery processes in different market types. Regardless of how the financing or insurance scheme was employed, the most significant factor appears to be the rate (time compression) at which households were able to successfully access and implement financial resources. These two aspects of time compression are interconnected for the success of financing recovery schemes. Successive events or extreme events as seen in both cases, placed considerable burdens on complex institutional systems (local, state, national) that are often disruptive in a nonlinear recovery process. The cases highlight the speed of recovery as the main influencer of long-term housing recovery, given that personal liability is rather manageable if able to access funding for rebuilding efforts. This suggests that a reconceptualization of what exactly community housing resilience is, is needed as it relates to the field of disaster recovery. Here resilience is the opposite of simply rebuilding, contesting the current housing recovery paradigm in "Build Back Better" and disasters research. This research is currently under review for publication.

There is still much to be learned about disaster resilience, sustainability transitions, measuring disaster damages and losses, as well as housing recovery for long-term community resilience. Future research should aim to provide more robust modeling and attempt to bridge the gaps in literature and knowledge in collaboration with community stakeholders of post-disaster recovery.

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List of Abbreviations

100RC	100 Resilient Cities
BBB	Build Back Better
BIA	Broadmoor Improvement Association
BNOB	Bring New Orleans Back Commission
BRP	Broadmoor Redevelopment Plan
CanCERN	Canterbury Communities Earthquake Recovery Network
Canterbury CDEM	Canterbury Civil Defence Emergency Management Group
CAO	Chief Administrative Officer
CBD	Central Business District
CCC	Christchurch City Council
CDBG	Community Development Block Grant
CERA	Canterbury Earthquake Recovery Authority
CER Act	Canterbury Earthquake Recovery Act
CRF	City Resilience Framework
CRI	City Resilience Index
CRO	Chief Resilience Officer
CRS	City Resilience Strategy
DER	Dynamic Economic Resilience
DRR	Disaster Risk Reduction
EQC	Earthquake Commission
FEMA	Federal Emergency Management Agency
FHA	Federal Housing Authority
GCR	Greater Christchurch Region
GDP	Gross Domestic Product
HAP	Louisiana Homeowners Assistance Program
HDI	Human Development Index
HUD	U.S. Department of Housing and Urban Development

IRMO	Infrastructure Rebuild Management Office
JBR	Jungle Bay Resort
LINZ	Land Information New Zealand
LURP	Land Use Recovery Plan
MLAM	Micro-level Assessment Model
NFIP	National Flood Insurance Program
NGO	Non-governmental Organizations
NORA	New Orleans Redevelopment Authority
ORDA	Office of Recovery Development and Administration
ORM	Office of Recovery Management
RBOs	Resilience Building Option
Roads	Road Home Buy-out Program
SBA	U.S. Small Business Administration
SCIRT	Stronger Christchurch Infrastructure Rebuild Team
SDG-11	Sustainable Development Goal – Number 11
SDGs	Sustainable Development Goals
SFDRR	Sendai Framework for Disaster Risk Reduction
SIDS	Small Island Developing States
ULI	Urban Land Institute
UNDDR	United Nations Office for Disaster Risk Reduction (formerly UNISDR)
UNISDR	United Nations International Strategy for Disaster Risk Reduction
UNOP	Unified New Orleans Plan
USDA	U.S. Department of Agriculture
USDT	U.S. Department of Treasury
WBGU	Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen

1. Introduction

Natural disaster events vary by event phenomena, impacts, damages, losses, relief efforts, and recovery processes. Victims of natural disasters are left with traumatic memories of the event as they learn to rebuild their communities (Pfister, 2011). Each event affects the lives of many individuals and their lived experiences, simultaneously reshaping social and cultural identities and impacting economic livelihoods. Natural hazards and disasters literature has extensively covered concepts of hazards, geophysical systems, vulnerabilities, risk, and policy planning for mitigation, relief efforts, and short-term recovery (Blaikie et al., 1994; Bryant, 1994; Burton et al., 1993; Coch, 1995; Lübken & Mauch, 2011; Palm, 1990; Smith, 1996, 2013; Tobin & Montz, 1997; and White et al., 2001). Natural disasters are seen not simply as 'natural' events requiring human intervention, but rather also as 'human-made' disasters (Blaikie et al., 1994; Hewitt, 2014; and Pelling, 2003). Natural hazards become disasters when human populations become exposed to vulnerabilities and risk (Uitto, 1998). Vulnerability is defined as the characteristic of those affected in terms of the ability to anticipate, cope, resist, manage and recover from the natural hazard. Disaster risk is defined as the possibility of loss, injury, death or any other consequence resulting from the natural disaster (Blaikie et al., 1994). Hazards research addresses real-world problems needing real-world solutions by developing conceptual frameworks assessing how these events change over time and space (White 1945, 1964; Platt, 1986). Quarentelli (1982) drew attention to the need to manage four separate phases of disaster: mitigation, preparedness, response, and recovery. Findings from this research have helped influence public policy changes and adaptation to hazards and risks (Blaikie et al., 1994). Natural disasters and hazards phenomena have dramatically impacted environmental and socioeconomic systems through the loss of life, environmental degradation, poverty, property damage, and social and economic disruption (Bankoff, 2007; Makoka & Kaplan, 2005; Kapucu & Özerdem, 2013). White, Kates and Burton (2001) recognized these trends in their research in the late 1970s and foresaw that as populations increased and economies grew that there would be fewer events, but those events would occur with higher costs and would be more severe. The impacts of hazards and disasters have a long history of focused thinking and research as seen in the literature. However, this recognition has grown from after the 2000's once understood that future disasters would occur in urban environments that are costly and deadly on scales not previously seen. Therefore, there is a growing attention to new concepts and frameworks as scale of urban disaster mounts.

Geographers have engaged critically with natural hazards research by addressing the vulnerabilities and marginalization of traditional institutions, development, integration of markets and economies, poverty, and the exploitation of natural resources resulting from these built environments (Robbins, 2004). How risk and vulnerability are conceptualized, measured and mitigated is vital to understand relationships between physical, social, political and economic factors (Montz & Tobin, 2013) that directly impact where people live and work. People within communities and cities are vulnerable often due to their migration patterns, access to resources and the likelihood of a natural disaster event occurring (Cutter et al., 2000). Vulnerability is both a biophysical and social response (Liverman, 1990). Increasing vulnerability now combines with declining infrastructure and increased exposure of cities and other highly populated areas to natural disasters. resulting in further uneven economic development. In the field of hazards research, cities and communities are becoming more important as they are exposed to more risk (Burton, 2015; Cross, 2001; Frazier et al., 2013; Jones & Tanner, 2015, 2017; Mitchell 1995, 1998,1999; Pelling, 2003; Sharifi, 2016).

In response to concerns to support community resilience due to the increasing frequency and severity of disasters, concepts of disaster resilience, disaster recovery, economic recovery, build back better have gained increasing prominence in science and policy sectors. As the concepts continue to evolve in support of community resilience, there has been increased effort and recognition of the importance of developing methods and frameworks needed for assessments (Cohen et al., 2016; Cutter, 2016; Perry, 2018; Sharifi, 2016). Disaster researchers find resilience is a useful concept for understanding disasters and reducing the effects of disasters through many possible mechanisms (Perry, 2018; Zakour & Gillespie, 2013). Yet, there remains many issues to be resolved for applications at the community level of analysis (Barrios, 2014), ways to measure resilience (Cutter et al., 2014), and the relationships between resilience and public policy, specifically related to disaster risk reduction (Amundsen, 2012).

1.1 Disaster Resilience

'Resilience' has emerged in cities and urban research to provide insights into complex socio-ecological systems in managing disaster issues (Batty, 2008; Folke, 2006; and Gunderson, 2010), and to shift the foci from response to mitigation and recovery, and from short term to long-term capabilities. Urban resilience is "the capacity of a city to rebound from destruction" (Vale and Campanella, p. 351, 2005) using three mechanisms; persistence (systems resisting disturbance), transition, and transformation (Chelleri et al., 2015). In discussing a community or a city's ability to withstand disasters, researchers often refer to the term 'resilience' (Harrison & Williams, 2016). Natural disaster resilience is defined as "The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" (UNISDR, 2009). Much emphasis is placed on recovery and resilience after disasters (Priest et al., 2005). Communities begin coping with the disaster immediately after the event, but just how resilient a community is in light of these natural hazards depends largely on the feasibility and success of managing all four of Quarantelli's (1982) phases of a disaster. Each of these phases has a unique set of attributes characterizing the evolution of a disaster and the resiliency of the community. The social resilience of these communities is driven by their ability to cope with the external stresses of the disaster recovery process in response to social, political and environmental changes (Adger, 2000). Recovery and resilience are specific to each city due to their unique attributes and inherent abilities to rebound as a function of political and economic factors (Campanella, 2006). Strengthened resilience is seen as the pathway to help mitigate immediate deaths, injuries, and economic losses from disasters by utilizing four methods (Tarhan et al., 2016): (1) systematic assessment and monitoring of risks associated with disasters in order to improve understandings of risks by the public and government; (2) establishment of a culture and system of incentives promoting accountability by stakeholders for planning, preparation, response and recovery of disasters; (3) the use of long-term planning through investments and use of existing measures; and (4) with international cooperation with the aid and support of research and evaluation. Assessing long-term recovery of natural disasters can contribute to urban resiliency of cities.

1.2 Disaster Recovery

Within disasters research, recovery after disasters 'represents the least understood aspect of emergency management, from the standpoint of both the research community and practitioners' (Smith & Wenger, 2007, p. 234). Smith and Wenger (2007, p. 237) define disaster recovery as 'the differential process of restoring, rebuilding, and reshaping the physical, social, economic, and natural environment through pre-event planning and post-event actions.' Haas, Kates, and Bowden (1977) completed the first comprehensive research of the recovery process to identify policy and lessons from rebuilding a city after a disaster. Rubin et al. (1985) noted that recovery was much more complicated than the model presented by Haas et al (1977), and suggested research using qualitative data should evaluate the process of recovering in order to improve upon the speed and quality of recovery. Johnson (1999) completed one of the first studies providing a long-term view of recovery from the 1989 Loma Prieta earthquake using a decade of data for small and large cities and identified four phases critical to post-disaster recovery: immediate response of those endangered and of property; restoration of utilities and short-term housing; short-term recovery to restore pre-disaster levels for functioning households and businesses; and permanent reconstruction to repair, rehabilitate and redevelop the community. Smith and Deyle (1998) emphasize there is a distinction between short-term and long-term recovery planning. Schwab et al. (1998) determined that recovery should not come at the expense of quickly attempting to restore normal activities and functions for the public.

1.3 Economic Recovery

Most disaster policies currently in practice are largely based on providing assistance immediately after the event has occurred, where reconstruction efforts have often focused on restoring communities back to pre-disaster standards without actually reducing or eliminating future vulnerabilities (Comfort et al., 1999; Hewitt, 2013a and 2013b). Social, political and institutional frameworks play vital roles in this economic recovery (Hewitt, 2013b; White et al., 2001; Wright & Storr, 2009). Recent natural disaster trends and economic losses reveal the inequities and challenges cities face. Risk is distributed from insurance companies through various feedback loops dependent upon decisions made by insurers, reinsurers, policy holders, and other interested parties all of whom have vested economic interests (Mauelshagen, 2011). The reinsurance firm Munich Re conducted analysis of world economic losses and insurance costs from natural disasters and found that while total losses were $38USD billon between 1950 and 1959, they were 14 times greater during the period 1990 to 1999 (ISDR, 2002). Furthermore, Munich Re's natural catastrophe research findings illustrate an increasing upward trend that natural disasters and hazards are threatening economic development in both developing and emerging economies. Despite these negatives, Munich Re finds opportunities for positive economic development after these natural disaster events through a better quality of life from the rebuilding and redesign of new infrastructure (Munich Re, 2013). Social, political and institutional frameworks play vital roles in this economic recovery (Wright & Storr, 2009).

Economic resilience in relation to disasters is concerned with actions taken before and after events, in order to reduce losses and overall risk (Bruneau et al., 2003; Rose, 2016 and 2017; Rose & Dormady, 2018). Economic recovery from disasters is also concerned with the repair and reconstruction of buildings and infrastructure connected to restoring the workforce, and the social and political institutions. Recovery from a disaster event and time durations, are now linked through resilience concepts (Xie et al., 2018). Rose (2004) defines two types of economic resilience applicable to disaster recovery; static economic resilience and dynamic economic resilience. Static economic resilience is the ability or capacity of a system to maintain function as well as continue functioning when experiencing a shock. Static economic resilience refers to how the remaining resources at a particular point in time, that are efficiently used and linked to how deficiencies are compensated, such as conservation, substation and relocation. Dynamic economic resilience is the ability and speed of a system to recover from a shock. Dynamic economic resilience refers to investments made for repairs and reconstruction, in order to accelerate and shorten recovery as efficiently as possible. These investments required for repairs and reconstruction are time dependent (Xie et al., 2018). This time dependent variability is linked to resilience, that either can be accelerated and shorten periods of recovery, or contribute to further economic losses having longer time-scale durations (Ayyub, 2014). Moreover, dynamic economic resilience provides a temporal perspective to housing recovery from a system rebounding from a shock (Pant et al., 2014).

1.4 Build Back Better

Following the recovery efforts of the Indian Ocean tsunami in an effort to improve reconstruction and recovery practices for communities, the notion of "Build Back Better" (BBB) was developed (Clinton, 2006; Lyons, 2009; Mannakkara & Wilkinson, 2014). BBB is seen as a holistic pathway and concept for post-disaster reconstruction, using ten guiding principles focused on the physical, social, economic and environmental dimensions of the devastated area (Clinton, 2006). Mannakkara and Wilkinson (2014) established a BBB framework using indicators (disaster risk reduction, community recovery, and monitoring and implementation) in order to assess post-disaster recovery best practices. Disaster housing and economic resilience strategies largely focus on using 'build back better' approaches to rebuild housing after disasters (World Bank, 2019). Disaster housing and economic resilience BBB strategies seeking to reduce overall vulnerabilities and risks to future disasters may involve assisting households with obtaining more affordable homes and mortgages, promoting disaster insurance policies, and investments in new building technologies. Although disaster housing and economic resilience may have similar desired outcomes for housing post-disaster reconstruction, they each have unique approaches and characteristics. Housing resilience is largely concerned with the loss of housing related to a disaster event, and the long-term impacts on communities (Ahmed, 2016). In disasters, housing resilience is linked to investments in both physical systems (e.g. infrastructure, material, labor) and social systems (e.g. governance, policies, institutions), to withstand related shocks and stresses in an effort to support overall community resilience (Hassler & Kohler, 2014). Housing resilience related to disasters is commonly addressed post-disaster by attempting to overcome underlying vulnerabilities and promote sustainability. This takes place with efforts focusing on addressing pre-disaster building and housing risks (Ahmed, 2016). Neighborhood or community housing resilience, is defined as the ability (neighborhood or community) to successfully sustain or return to its housing system, after facing shocks or stresses through demographic, social, economic or political characteristics (Wang, 2019).

1.5 Measuring Recovery

The most important factor contributing to overall post-disaster recovery success in urban communities is the process of housing recovery (Comerio, 1998). Specifically, the return of permanent housing is seen as the most critical factor (Peacock et al., 2007; Peacock et al., 2018). Housing recovery uses a typology developed by Quarantelli (1982); emergency shelter, temporary shelter, temporary housing, and permanent housing. Recent disaster research finds that long-term housing is one of the 'least studied and understood by disaster researchers' (Peacock et al., 2007). Permanent housing recovery is seen as largely dependent on financial resources for repairs or new construction (Lindell, 2013). The resettlement of housing is only successful when residents take active roles planning and reconstruction to avoid resistance by residents and the community (Oliver-Smith, 1991). Although the literature has addressed housing damage and household recovery, studies have seldom used longitudinal data to assess long-term housing recovery (Peacock et al., 2018). Although housing recovery is understood as a critical process for managing overall disaster recovery, only recently had housing become a critical focus in the disaster literature (Peacock et al., 2018).

Comerio (2014) suggests measuring recovery requires analysis at three scales of input over different timeframes: geographical scale where recovery is measured (e.g. individual, household, community, state or national); the timeframe measured (e.g. months, years, or decades); and lastly the perspective of the evaluator's assessment (e.g. family, community, government, or funder/financier stakeholder). A successful assessment or measurement of recovery would also consider evaluating different sectors using these three factors, recognizing the need to incorporate multiple assessments of the many facets of the community (Comerio, 2005). In order to create these measurements, it is suggested that the use of indicators is necessary (Chang, 2010, Johnson & Hayashi, 2012; and Comerio, 2005). Chang (2010) suggests indicators using three sets of criteria to make comparisons of disasters: a creation of a universal definition that is meaningful and consistent throughout cultures, places, and historic time periods; data should be easily accessible and readily available, and routinely collected and published in consistent time periods (e.g. annually or monthly); and have a standardized measurement that provides meaningful comparisons across space and time. Dwyer and Horney (2014) conducted an extensive literature search of potential indicators used for recovery and identified a total of 90 aggregate indicators using eight recovery support functions adopted from the US Federal Emergency Management Agency (FEMA). Of these 90 aggregate indicators, Dwyer and Horney (2014) created a definitive list of 15 proposed areas of recovery focus including infrastructure, housing, recovery funding, communication, and business or household economic recovery. Thus, the fundamental indicator of efforts to sustain social, economic and political systems for urban communities can then be seen as the repair or replacement of buildings and infrastructure utilizing insurance to aid in the recovery process in order to reduce financial liabilities, expedite repairs and rebuilding, and manage unforeseen losses of public and private resources.

At any one time, communities and households may be engaged in various recovery activities. This has contributed to the limited attempts for researchers to focus on the timescales of disaster recovery (short-term vs. long-term) as opposed to specific recovery functions needed (Lindell, 2013). Property damage resulting from disasters creates losses in asset values that can be measured by the cost of repair or replacement. Measuring disaster losses, specifically housing losses, is difficult because these losses do not reside in one place but are in fact spread around, nor are they managed by one organization (Lindell, 2013). Measuring recovery has largely been addressed through methodological approaches such as surveys, case studies and computer modelling (Chang, 2010). The two major approaches to measuring recovery either attempt to assess recovery in relation to pre-disaster conditions, or broader impacts of the economic environment with no pre-existing scenarios for comparison. The second approach often takes into account that there is a new normal instead of a pre-disaster state to return, that recovery can be indexed to track progress, and the use of geospatial technology such as GIS or remote sensing can assist with tracking recovery (Cheng et al., 2015). Housing repairs are critical, however insufficient for measuring housing recovery (Sutely et al., 2019). Most studies are often absent in modeling temporal and social aspects of housing recovery (Sutely et al., 2019). The overall use of indicators when measuring recovery assist in establishing empirical patterns in order to illustrate the disaster and its impacts, test hypotheses and make meaningful comparisons. Most research using these methods typically applies quantitative indicators, since they are effective in describing measureable changes such as changes in populations and direct economic losses. Less data is available for qualitative indicators, such as social recovery or community health and wellness. This largely is a result of resources and analysis needed to conduct in-depth studies and data collection (Chang, 2010).

1.6 The Role of Insurance in Disaster Recovery

The limited post-disaster long-term recovery research remains one of the biggest challenges for "financing large-scale urban reconstruction in developed nations" (Olshansky & Chang, p. 208, 2009). It is largely understood countries with limited financial resources face enormous financial disadvantages and rely on foreign assistance. Nevertheless, little research exists on rebuilding and financial challenges in developed nations even though this is needed for understanding how to finance the cost of recovery (Olshansky & Chang, 2009). Early work (Kunreuther, 1974) determined there are four important 'cost-bearing' methods against natural disaster losses: (1) complete governmental responsibility; (2) homeowner self-insurance; (3) compulsory insurance; and (4) implementation of land-use requirements and building codes. It also drew the lesson that the lack of adequate insurance by communities and individuals to insure themselves against potential damage from the disasters was a problem, yet it remained undecided as to whether insurance should be voluntary or compulsory (Kunreuther, 1973). Subsequent research confirms that insurance and public funding are vital in managing household recovery specifically in earthquakes and flood disaster communities (Peacock et al., 2007). The issue of post-disaster finance and economics is generally overlooked in the literature (Eadie, 1998; Ellson et al., 1984; Chang & Rose, 2012; Boisvert, 1992; and Friesema et al., 1979). The occurrence of natural disaster events has led to an increase of public financial assistance in the form of grants or subsidized loans (Lewis & Nickerson, 1989) also known as charity hazard. Charity hazard, herein is defined as individuals who do not seek traditional hazards insurance coverage, nor do they seek to mitigate their losses by engaging in any preventative measures, and solely rely on financial assistance from federal relief programs, and/or donations from individuals and institutions (Raschy & Weck-Hannemann, 2007). Coate (1995) asserted rational behavior of poor individuals would not purchase insurance coverage against losses from disasters, when one could expect charity hazard. However, there is no evidence, regardless of income class available to date maintaining individuals refuse to purchase insurance on the basis of charity hazard (Kunreuther, 1996). Browne and Hoyt (2000) provided empirical evidence that recent flood events have led to an increase in demand for flood insurance coverage.

Insurance provides three economic benefits allowing policyholders to take reasonable mitigations to reduce or minimize damage or risk, as well as enhancing social welfare. Firstly, insurance provides risk transfer from individuals to insurers. Secondly, providing risk pooling to transfer uncertainty to insurers with a claim. Thirdly, insurance manages risk allocation reflective of risk exposure (Porrini & Schwarze, 2014). Insurance reduces risk by aggregating individual risks, segregation of individual risks into separate pools, and the control of moral hazard. With the case of aggregating individual risks insurers will bundle several types of risks (fire, flood, earthquakes, etc.) into a single policy to reduce the accumulated risk of any specific policy event to the extent that risk is uncorrelated. To the extent that losses and risks are truly independent, their aggregation shifts or spreads from one individual to groups of others, reducing losses for insured individuals and risk for the entire pool. For the case of risk segregation, the spreading of the risk does not change actual risk and only works best when insurers can segregate the risk among low and high-risk policyholders, and assigning them to specifically defined risk pools. Segregation, like aggregation is able to assist in the prediction of expected losses by reducing overall pool of risks and total insurance costs because they are both similar in method and effect. Alternatively, insurance premiums may help segregate risks by reducing the level of underlying losses incurred when the premium (high rates for high risk and low rates for low risk) accurately reflects risks from the insured pool. Moral hazard requires the policyholder to change their behavior because the insurer is exposed to the risk of loss. Therefore, control of moral hazard takes place through deductibles, coinsurance and exclusion of coverage. Overall, insurance has the ability to reduce community disaster risk through private or government funded schemes (Priest, 1996).

The use of disaster insurance varies widely from private market to state-issued schemes from country to country due to penetration rates, product types, operations and design of insurance schemes. Private insurers may provide underwriting, premium payment accounting, claims management, risk assessment, education, and lobbying of political and regulatory processes. The role of government may be to manage fair competition, protect financial solvency of insurers, provide government-sponsored insurance, serve as a reinsurer, or as an underwriter. In most countries disasters insurance is voluntarily purchased, or in some cases purchased due to loan or mortgage requirements. Disaster risk can be transferred through insurance coverage using one or a combination of schemes such as property insurance, agricultural insurance, micro-insurance, business interruption insurance, reinsurance, and sovereign bonds, swaps or hedges (Surminiski, 2014). Given the nature of disasters and risk, for some insurers they can only maintain insurability or create new contracts if they are able to find innovative solutions or more novel ways to distribute risk networks for catastrophe financing (Amendola et al., 2000; Bougen, 2003). Ultimately the challenge of having insurance as an instrument for managing losses from natural disasters can place a heavy burden on recovery (Porrini & Schwarze, 2014).

Reinsurance insures insurers from disasters and are mostly unnoticed in the market by policy holders or the public due to the nature of their role as the last insurer. Traditionally, the role of insurance is as calculating risk in standard finance and economic principles. Where other tasks and responsibilities are seen to be held among other stakeholders (i.e. individual policy holders, communities, governments). In order to understand risk and uncertainty, many internal resources are allocated to due diligence and research on behalf of insurers and reinsurers. Munich Re is one such example with the development of NatCatSERVICE, a comprehensive natural catastrophe loss database and their Geo Risks Research group. Given the nature of disasters and risk, for some reinsurers they can only maintain insurability or create new contracts if they are able to find innovative solutions or more novel ways to distribute risk networks for catastrophe financing (Amendola et al., 2000; Bougen, 2003). Ultimately the challenge of having insurance as a policy for managing losses from natural disasters is placing the burden of recovery, but there is an additional challenge: how to manage cost effective loss reduction mechanisms when the insurance premiums are viable investments (Porrini & Schwarze, 2014).

Although Geographers have a long history of focused thinking and research in ways and which hazards and disasters are interconnected to the human, social and natural environment, a small amount of research exists on focusing on resilience and recovery. This in part due to the tangled net of interrelated challenges related to conceptualizing community resilience at different scales, measuring resilience, determining appropriate indicators of measurements, defining roles for different institutional systems and processes (e.g. insurance and government buy-outs, or the role of community leadership), and distinguishing short-term versus long-term disaster recovery. The purpose of this research is to address these related issues to contribute to the gaps in literature by using case studies to identify disaster resilience shocks and stresses for city resilience policies and planning, identify rural-urban linkages in disaster recovery, measure disaster recovery at community levels to assess resilience, assessing the role of insurance and government buy-outs for community resilience, and using dynamic economic resilience scenarios to measure long-term community recovery. The objectives, methods, and outline of research employed are discussed in further detail in the following sections and corresponding chapters.

1.7 Objectives

This research seeks to understand and assess disaster recovery in urban communities by examining the relationship between disaster resilience, housing and insurance. The basis of this dissertation is guided by the following research questions:

1. How to assess urban resilience policies supporting disaster risk reduction approaches?
2. How do urban-rural linkages in sustainability transitions impact disaster recovery management and recovery?
3. How to analyze natural disaster damage for specific localized regions to obtain calculations of losses for communities managing recovery using economic models?
4. How to measure long-term community housing recovery using dynamic economic resilience?
5. What is the role of insurance in managing overall community recovery and housing resilience?

Recovery after disasters has become an important a focal area of research as the geography literature on disaster management embraces a resilience approach. The damaging impacts of natural disasters on communities and individuals are often more challenging as a result of existing structural problems and failures to manage recovery. These issues related to problems and failures pre and post-disaster recovery take on specific dimensions when the disaster event damages occur in urban built environments. The shape of long-term recovery is affected in these circumstances by the extent and nature of property damage combined with the specific pattern of economic and institutional resources available and the implemented disaster recovery management systems. It is important to develop systematic knowledge of how to have a successful and organized recovery process, especially in the case of developed industrial countries and increasing natural disaster events. There is a need for a better understanding and knowledge of what it means to have a successful recovery process, what happens in these processes, what precisely is long-term recovery, and how these processes can help mitigate future disasters. The purpose of this research is therefore, to compare and contrast long-term recovery planning and management following major urban disasters in developed industrial countries to identify common lessons, challenges, and potential ways to mitigate future losses and damages. There are important lessons that can be learned from the experiences of others, despite recovery not being managed the same everywhere (Jha, 2010). It is of particular importance to identify the effects of local institutions on recovery and the learning processes that occur.

1.8 Research Aims

A total of three case studies (New Zealand, United States, and Dominica) were selected for the 'disaster recovery in urban communities' research. The recent earthquake series events in Christchurch, New Zealand, and Hurricane Katrina in New Orleans (United States) were chosen given the enormity of disaster recovery efforts undertaken and indexed as both in the top ten costliest insured catastrophic events between 1970 and 2019 by Swiss Re (Bevere, 2020). Both the New Orleans and Christchurch case studies are located in well-developed urban industrial economies that generally are understood to have well established institutional and governance systems, suitable infrastructure and disaster recovery management systems, as well as established hazards insurance markets along with adequate disaster recovery financing. Each of these urban communities have tested the capacity and expectations of developed countries to manage calamities. Firstly, each experienced subsequent natural disaster events within months that were equally as costly and deadly, or worse as in the case of Christchurch, which has had over thousands aftershocks since 2010 alone in the Canterbury region (Cowan et al., 2016). Secondly, after the initial onset of the first disaster it became evident that these well-developed countries with well-established infrastructure, systems and markets were not able to handle the initial or secondary events, or to manage disaster recovery on a local, regional, national scale and in some cases global linkages. This is further evidenced by the constant critiques centered around the lack of adequate long-term recovery in terms of insufficient permanent housing or repaired homes let alone community health and well-being. Thirdly, New Orleans and Christchurch are both member cities of the 100 Resilient Cities Rockefeller Foundation Program and pursued rigorous urban resilience and resilient recovery initiatives as part of their post-disaster recovery discourse and narratives that were largely centered on building back better and implementing new governance regimes.

The third case study, the island of Dominica was chosen as a study area specific to tourism disaster recovery due to its important role for tourist destinations encountering climate change challenges. Although Dominica is not located in a developed urban industrial country, it is an island that can be regarded as an isolated system, allowing suitable measurement of economic input and output flows for the tourism industry.

Therefore, this research aims to provide a detailed accounting from each of these case studies as to (1) how urban resilience programs, such as the 100 Resilient Cities initiative, fall short of addressing appropriate policy changes to manage climate change adaptation focused on future disasters and how to reduce overall disaster impacts, (2) how urban-rural linkages are interconnected to disaster recovery in the urban environment but also obscure geographies of recovery, (3) how to measure disaster impacts that relate to community recovery for the tourism sector and long-term housing recovery, and (4) the role of insurance in managing disaster recovery financing. Moreover, this research seeks to understand how and why such well-developed industrial urban communities, each with access to advice from well-established hazards disciplines, have not been able to adequately address disaster recovery.

1.9 Research Methods

Systematic data collection and critical analysis is needed to establish patterns and distinctions as to how well and how quickly urban communities recover from disasters. It is especially important to consider the relationship between the built environment (housing), and the sociopolitical processes (insurance and disaster recovery planning) of urban communities, in developing comprehensive disaster recovery theory. Urban disaster recovery analysis requires the use of quantitative and qualitative research methods using case studies, allowing for triangulation of data for multiple approaches to data collection at various scales using a mixed-methods case study design. Research should focus on the problem using multiple approaches (methods, different worldviews, assumptions, and theories) and by integrating data at different stages of inquiry in an illustrative manner in order to derive knowledge of the problem (Creswell & Creswell, 2017). By using a mixed-methods (qualitative and quantitative) case study approach for the research it will be possible to describe and explain the human-environment phenomena of natural disasters for each study location. Case studies are empirical inquiries investigating "a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin, 2009, p. 638). Case studies often rely upon multiple sources of evidence seeking to explain the "how" or "why" to provide a thorough account of a particular human-environment phenomenon. Using a case study methodology allows for a holistic approach of the cases in order to understand the meanings constructed within a complex socio-cultural context. Furthermore, using case studies allows for triangulation of data using many approaches of data collection (Taylor, 2016). Triangulation will include, but not be limited to, various types of methodology, data sources, assessments, perspectives and theoretical approaches. The use of these case studies will also function as longitudinal cases to allow for studying the exact case at two or more different points in time (Yin, 2009). Data collection includes primary sources from technical field observations, documentation, recordings, semi-structured interviews conducting surveys, accessing news reports, archival records, social media platforms, government and organizational documents, and expert interviews to identify the vulnerabilities, resilience, and economic housing recovery process. A total of three months each was spent in New Orleans and Christchurch to construct the housing recovery database and community recovery analysis.

1.10 Outline

This dissertation consists of five chapters. Together, they contribute to the body of knowledge on urban disaster recovery. Each chapter focuses on a new aspect of urban disaster recovery: disaster resilience (Chapter 2), disaster recovery (Chapter 3 and 4), housing recovery (Chapter 5) and the role of disaster insurance (Chapter 6). Each chapter addresses specific urban disaster research questions, cites relevant literature, uses distinct research methods, and reports economic analysis, insights and findings. The resulting chapters are also stand-alone publications (Hofmann Zavareh, 2021; Zavareh & Winder, 2021; Schmude et al., 2018; Winder & Hofmann Zavareh, 2020) and indicated with such information for reference. Moreover, these chapters and research are the result of my doctoral research project funded by my doctoral stipend, Evangelisches Studienwerk Villigst (ESV) and a German Research Foundation (DFG) research grant supervised by Prof. Dr. Gordon Winder (GW).

Chapters 2 (Hofmann Zavareh, 2021[1]) and 5 (manuscript currently under review) were each conceived as a stand-alone publication (SZH). Chapter 3 has been published as a book chapter (Winder & Hofmann Zavareh, 2020[1]) which was initially conceived by GW from a keynote address held in 2018 titled, "Rural-Urban Linkages in Sustainability Transitions: Challenges for Economic Geography," given at the "IGU Mini-Conference on Rural-Urban Linkages for Sustainable Development: An Economic Geography Perspective" held in Innsbruck, Austria The theoretical urban-rural linkages framework and case study was designed and written by SZH. The manuscript was written by GW and SZH. Chapter 4 was initially conceived by Prof. Dr. Jürgen Schmude (JS) from a presentation, "Tourism and Natural Disasters: The case of Dominica" at the 2016 Tourism Naturally Conference held in Alghero, Italy. The conference presentation was selected to be part of a special publication, Tourism in Changing Environments (Ooi et al., 2018). JS developed the MLAM model and made the necessary calculations. The theoretical research framework (adapted from Ritchie 2004) was developed by SZH. The computations were performed by JS, Katrin Schwaiger (KS), and SZH. The manuscript was written by KS and SZH with supervision from JS. All authors provided critical feedback and contributed to the final manuscript (Schmude et al., 2018[1]). Chapter 6 was conceived and designed by SZH. The research model and framework, data analysis and writing was completed by SZH with supervision from GW. GW provided critical feedback to help shape the research, analysis and manuscript, which has been accepted as a forthcoming publication in the Environmental Hazards: Human and Policy Dimensions journal (Zavareh & Winder, 2021[1]). Chapter 7 provides a conclusion to the dissertation. It addresses the five research questions, and reaches two major conclusions: (1)

disaster recovery planning and management largely overlooks the importance of focusing on long-term recovery to address community resilience, and (2) the proposed frameworks for measuring urban disaster resilience are valuable analytical tools, but are still general in nature, and need to be adopted by recovery systems in order to fully obtain all the necessary data for more specific community recovery insights.

[1]Please note that some publications refer to my legal name in the United States which is not the same in Germany, therefore some publications were issued under Zavareh or Zavareh Hofmann.

2. 100 Resilient Cities Program and the role of the Sendai Framework and disaster risk reduction for resilient cities

This chapter was conceived as a stand-alone publication (Hofmann Zavareh, 2021)

2.1 Introduction

Launched in 2013 by the Rockefeller Foundation, 100 Resilient Cities (100RC) has invested $100 million in the pursuit of urban resilience worldwide. 100RC brings together cities, experts, and public and private organizations through its Platform Partners, sponsors a Chief Resilience Officer and offers innovative financing and technology for members. The aim of the program was to create a network for best practices, share in lessons learned, and connect with other experts in an effort to assist in the scaling issue of identifying urban resilience challenges, finding solutions and implementing policies for those facing similar problems. Members participate in a resilience strategy process engaging with stakeholders and partners to identify resilience priorities, shocks and stress, and establish initiatives to create a City Resilience Strategy (CRS). It is estimated that over $1 million was allocated through training, partnerships, and other non-monetary services to each member city. The program ended in 2019, but continues to operate as a platform for members and partners to share best practices, reports, strategies, and tools under its successor, Adrienne Arsht Center for Resilience (Rockefeller, 2020).

This research seeks to answer whether the 100RC program emphasized vulnerability and risk narratives using disaster risk reduction approaches in the successive member Resilient Strategies. This is done by applying a directed and summative content analysis of plan evaluation, based on the "31 City Resilience Strategies" developed by Fitzgibbons and Mitchell (2019). This paper uses a pathways approach related to narratives of disaster vulnerability and risk. This approach analyzes resilience policies developed to support disaster risk reduction. Resilience is seen as the reactive policy response to disaster events able to resist, adapt or recover in a timely manner. Reducing vulnerability and lowering risk are seen as interconnected, resulting in enhanced livelihoods, contributing to sustainable development and strengthening communities linked to disaster risk reduction strategies. Here a resilience system refers to a 100RC resilience strategy. This paper focuses on narratives centered around community vulnerability and risk in these resilience systems. Narratives are analyzed revealing treatment of such issues: how resilience policies understand, define, and identify disaster risks, vulnerabilities, vulnerable populations or marginalized persons; determining what processes create or contribute to overall disaster risks;

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what role vulnerable stakeholders play in disaster resilience governance; whether their voices are heard and counted; whether they had a role in the development of the planning, its implementation or in future policy; whether investments are made to help them; who benefits from this collaboration; and what strategies are used for disaster recovery planning?

2.2 Resilience and disasters

The current global undertaking of disaster resilience is being pursued in the hopes of reducing disaster impacts and strengthening communities (Rockefeller, 2020; Santos & Leitmann, 2015). The United Nations led the first call in the 1990s to address international disaster risk policy with the creation of the Yokohama Strategy. The Strategy focused on international cooperation and implementation of disaster risk reduction (DRR) by providing guidelines for prevention and mitigation. This was later followed up in 2005 by the Hyogo Framework for Action, shifting focus on managing capacities and risk preparedness interventions. The Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR) was created in 2015 as an attempt to broaden and enhance responses to disasters and allow for resilience measurements (Tiernan et al., 2019). SFDRR reflects the notions of reducing disaster risk and building resilience as an integral part of the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs). These initiatives are interrelated in an effort to build overall resilience. Disasters affect a wide range of the SDGs through poverty, food insecurity, urbanization and climate change, but SDGs specifically target disaster risk resilience. SDGs link disaster resilience and DRR through issues of vulnerability, climate change, livelihoods, rebuilding, and equity (Tiernan et al., 2019). Achieving disaster resilience requires communities and households to transform in light of shocks and stresses. Hence, resilience is more than building back better, or bouncing back from a disaster: disaster resilience and DRR planning are designed to advance social equity and livelihoods. SFDRR has four priority areas: understanding disaster risk; strengthening disaster risk governance; investing in DRR for resilience; and enhancing disaster preparedness for effective response by utilizing 'Build Back Better' in recovery, rehabilitation and reconstruction. SFDRR was one of the first major agreements established from the agenda as a way to influence and complement the goals and targets by outlining seven global targets. SFDRR indicators also contribute to the measurement of SDGs (Tiernan et al., 2019). 100RC program aims to develop resilience under SFDRR, SDGs and DRR.

The UN's approach encourages pursuit of resilience policies as a prescribed remedy, incorporating notions of mitigation, preparedness, resistance and recovery in order to deal with future uncertainties (Meerow et al., 2016). Resilience has taken on several different definitions within the field of hazards and disaster research. Natural disaster resilience is defined as "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" (UNISDR, 2009). When discussing a community or a city's ability to withstand disasters, researchers often refer to the term 'resilience' (Harrison & Williams, 2016). Resilience is generally known to be a property of a range of systems that are able to remain stable when facing shocks and stresses, recover following an event, and adapt to new circumstances (Tiernan et al., 2019). Much emphasis is placed on recovery and resilience after disasters (Priest et al., 2005). One city's recovery or resilience is not the same as another's, due to its unique attributes and inherent ability to rebound based on political and economic factors (Campanella, 2006).

Resilience has emerged in urban planning and research to provide insights into managing disaster issues in complex socio-ecological systems (Batty, 2008; Folke, 2006; Gunderson, 2010). Urban resilience is "the capacity of a city to rebound from destruction" (Vale & Campanella, 2005) using three mechanisms: persistence (systems resisting disturbance), transition, and transformation (Chelleri et al., 2015). Strengthened resilience is seen as the pathway to help mitigate immediate deaths, injuries, and economic losses from disasters by utilizing four methods: (1) systematic assessment and monitoring of risks associated with disasters in order to improve understandings of risks by the public and government; (2) establishment of a culture and system of incentives promoting accountability by stakeholders for planning and preparation for response to and recovery from disasters; (3) the use of long-term planning through investments and use of existing measures; and (4) international cooperation with the aid and support of research and evaluation (Tarhan et al., 2016).

Disaster resilience strategies have gained attention among practitioners and researchers seeking to build resilient societies by focusing on urban, socioeconomic, and business resilience (Paton, 2017). Disaster resilience is a concept shared by many disciplines making it difficult for a common definition. The most frequent definition used for disaster resilience is the speed with which people, communities and societies are able to recover from hazards, shocks or stresses without compromising long-term development (Comabz, 2014; Mayunga, 2007). Disaster resilience can be described both as desired outcome(s) and a process leading to desired outcomes (Manyena, 2007). Core elements of disaster resilience include context (whose resilience is being built), disturbances (shocks and stresses), capacity to respond (ability to manage shocks/stresses), and reaction (bounce back better) (Comabz, 2014). However, under careful examination, revealed resilience after a disaster may or may not actually result in pre-disaster states. Therefore, true resilience is revealed when it is manifest as action that can be observed as a process (Bogardi & Fekete, 2018).

Disaster resilience is directly linked to disaster risk reduction (DRR) (Comabz, 2014). DRR is broadly defined as the development and application of policies, strategies and practices to reduce vulnerabilities by managing risk arising from interactions between people, environment and hazards. DRR is seen as a pathway to improved security and safety providing vital support and opportunities for households, communities, societies and governments to undertake initiatives that improve well-being, strengthen livelihoods and contribute to sustainable development. DRR is considered as a vital aspect of resilience building (Twigg, 2015). Moreover, the usage of DRR and disaster resilience can contribute to the overall urban resiliency of cities.

Disaster risk and vulnerability are closely related to resilience (Manyena, 2006). Vulnerability is defined as the characteristic of those affected in terms of the ability to anticipate, cope, resist, manage and recover from the natural hazard (Blaikie et al., 1994). Vulnerability is conceptualized and applied within DRR in multiple ways and different contexts. Vulnerability is both a phenomenon and a concept, with practical applications in DRR. Therefore, both quantitative and qualitative approaches are relevant in order to understand the entire dimensionality of vulnerability (Fuchs and Thaler, 2018). Disaster risk is defined as the possibility of loss, injury, death or any other consequence resulting from the natural disaster (Blaikie et al., 1994). How disaster risk and vulnerability are conceptualized, measured and mitigated is vital to understand relationships between physical, social, political and economic factors (Montz & Tobin, 2013), that directly impact who and what is affected by the disaster and empowered by the recovery, who is vulnerable, and who is resilient. People within communities and cities are vulnerable often due to their migration patterns, access to resources and the likelihood of a natural disaster event occurring (Cutter et al., 2000). Vulnerability is both a biophysical and social response [26]. Increasing exposure and vulnerability of urban areas to natural disasters is becoming more important to the field of hazards research since it is related to both uneven economic development and to declining infrastructure as well as a need to invest in better infrastructure to avoid rising risk (Cross, 2001; Mitchell, 1995, 1998 and 1999; Pelling, 2003). Vulnerability as a concept provides crucial insights and knowledge in understanding disaster risks for communities. Vulnerability is also an important indicator for measuring and monitoring for DRR as well as influencing urban resilience policy developments. Therefore, identifying, assessing and reducing risk and vulnerability are vital for disaster resilient societies. DRR efforts are linked to holistic and integrative vulnerability perspectives (Birkman, 2006).

It is also important to consider critiques of resilience as it relates to both the urban and disasters. Resilience in the context of urban development is focused on adaptation to disturbances, or shocks and stresses. This turns attention to managing and adapting to current shocks and stresses, rather than attempting to address existing political and economic challenges contributing to the problem formation (Leitner et al., 2018). Davoudi (2012) calls attention to how resilience has just as much influence shaping how challenges are perceived as it does in shaping how to respond to them. Resilience is dynamic, relational, and deeply political (Keck & Sakdapolrak, 2013). Critics of urban resilience argue that programs, such as the Rockefeller Foundation's 100 Resilient Cities program, should be confronted with the following questions (Leitner et al., 2018): Who determines what is desirable? Whose resilience is prioritized? Who is included/excluded from the system? Is the resilience of some prioritized over others? Does enhanced resilience reduce resilience elsewhere? To date, few studies exist that seek to provide answers to these questions (Leitner et al., 2018).

In disaster studies, Tiernan et al.'s (2019) resilience definition and usage may be appropriate, however lacks the specificity of the other approaches, and is potentially in conflict with them. Generally, resilience is often understood as a property of a system that is related to an appropriate system model. In contrast, economic geographers tend to understand this to be a potential property of a regional or sectoral economic system (Fromhold-Eisebith, 2015; Martin, 2012), while development scholars understand resilience as either a property of a social system or as a narrative (Bobar & Winder, 2018; Winder & Zavareh Hofmann, 2020). In hazards research the system is considered to be a society, and how well it deals with environmental and hazards risks (Keck & Sakdapolrak, 2013). Repositioning the concept of resilience emphasizes the growing interest in a 'pathways approach' in an effort to address governance challenges posed by dynamic and complex multi-scale systems (Leach et al., 2010). Here resilience denotes a broader approach in thinking about change and societal responses dependent on context and perspective. Leach et al. (2010) are concerned with system-framings (different ways of understanding and characterizing a system) and narratives. These narratives pertain to issues created by specific actors, networks or institutions. They can be used to justify particular kinds of actions, strategies or interventions. When these narratives are supported by institutional and political processes and by governance, they define and shape pathways in particular. In turn, such narratives can silence other narratives, so that they are never to be manifested, remaining silenced, marginalized or forgotten. Consequently, narratives are able to influence pathways through assumptions about temporality of change and styles of action (Leach et al., 2010).

Leach et al. (2010) constructs a typology of policy responses using a matrix relating two styles of actions ('control' or 'respond' to change) to temporality of change ('shock' or 'stress') to achieve four possible sustainable scenarios: stability (control action to counter shock), resilience (response to shock), durability (control action to counter stress), and robustness (response to stress). They recognize that a policy response might vary or have different impacts depending on whom is being studied, at what scale, in what space and context, as well as the varying degrees of sustainable values being considered in relation to specific goals

(Leach et al., 2010). This adds a reflexive dimension to resilience thinking by recognizing the analysis is based on specific framings with different outcomes. At the same time, it redefines resilience as a narrative of response to shock while highlighting alternative narratives. Thus, this framework can assist in the understanding of how 'resilience' is being used in the 100RC program and SFDRR: resilience is not defined as a property of a system, but rather as a narrative related to a DRR that will likely vary from city to city.

Ultimately the benefits or the burdens of urban resilience policy making and planning are rooted in power, politics and conflict (Davoudi, 2012; Torabi et al., 2021). Davoudi (2012) argues the power-laden nature of urban resilience highlights what values must be identified, choices made and identification of political pathways. Treating a city in separate parts or sectors (e.g. political, economic, social) without a holistic approach undermines resiliency and is a catalyst for long-term disaster losses and casualties (Bettencourt & West, 2010). Torabi et al. (2021) highlight the importance of examining urban resilience pathway dimensions by addressing city policies that are often rooted in power and politics. Lasa et al. (2019) stress a city's commitment to DRR should also consider an actor's (political) ability to understand risk, resilience, governance, policies, and bureaucratic processes. Potentially, scholars in urban and cities studies can contribute a theorization of policy mobility to urban resilience research. Policy mobility describes the movement of a policy from one place to another as it relates to various elements (e.g. institutions, actors, infrastructure) allowing movement. The way in which a policy moves is related to the context from which, through which, and to which it travels (Prince, 2020). Much of these works are focused on the urban and how cities are not bounded places with specific internal characteristics and processes, but function rather as nodes in relational networks linked to other nodes across various distributions of material and immaterial objects (Prince, 2020). Often the creation of a policy allows for the remaking of power relations within and between different places. Therefore, policy mobility provides an additional perspective that relations are what constitute a city and the infrastructure that enable policy mobility. This also helps us rethink cities not as singular places, but rather as urban assemblages with multiple spatialities and temporalities (Prince, 2020). Furthermore, policy mobility allows for the close study of how implementation can and has shaped why some policies get mobilized. There are important parallels here to thinking on how the manifestation of narratives occurs in a pathways approach.

2.3 Rockefeller Foundation 100 Resilient Cities

The Rockefeller Foundation launched the 100 Resilient Cities (100RC) initiative as a separate nonprofit organization in 2013 to help cities around the world build resilience to the economic, social and physical challenges they will face in the 21st century. To become a member, cities completed an application process and winners were announced in three rounds in 2013, 2014 and 2016. Cities were chosen based on the presence of mayors seeking innovation and change, a track record of establishing and maintaining partnerships, and the ability to work with diverse stakeholders. Sponsored Cities are cities whose membership is underwritten by local funders, separate from the 100RC application process. Under the 100RC initiative, member cities would receive direct funding to hire a Chief Resilience Officer (CRO) to lead the city's resilience efforts for two years. 100RC provides member cities with access to resilience building tools and services supplied by platform partners from the private, public, academic, and non-profit sectors. It is estimated that over $1 million has been allocated in funding through training, partnerships, and other non-monetary services to each member city. Platform Partners are intended to assist cities understand their needs, build new tools and improve existing ones. The program provided a unique peer support system for member cities to share and assist one another in resource development, problem-solving and networking. 100RC member cities are expected to participate in a 100 RC Resilience Strategy process. This is a roadmap designed over a 6 to 9-month process to develop resilience for the city by engaging with stakeholders, working with strategy partners in order to identify resilience priorities, shocks and stresses, and establishing a set of initiatives to move forward by creating a City Resilience Strategy (CRS) (Rockefeller, 2020).

100RC member cities utilize the City Resilience Framework (CRF) as a strategy development process and method for understanding the complexity of urban systems and the drivers contributing to a city's resilience. CRF is a framework developed by Arup, a private consulting firm, and supported by the Rockefeller Foundation. It emphasizes the 100RC strategy development process as a method for understanding urban resilience by allowing member cities to identify indicators for city resilience, support dialogue between stakeholders, and assist in the design of a city resilience strategy for implementation and oversight. The CRF recognizes that both cities and the way resilience manifests in them are unique, and aims to provide a lens to understand the complexity and nuances of city resilience (Rockefeller, 2015 and 2020).

100RC identifies seven qualities of a resilient system applicable at a city scale as well as individual systems. This formed the basis of their working principle that what was missing was a comprehensive and holistic framework combining physical aspects of cities with less tangible aspects, linked with human behavior in the context of economic, physical and social disruptions. Rather than assessing individual systems within cities to describe a resilient city, the framework is applied at the city scale. Work was further extended to both define functions critical to resilience, and test the framework in order to understand what contributes to resilience in cities, and how resilience is understood from stakeholder perspectives. This resulted in the identification of eight city functions for resilient cities: delivers basic needs; safeguards human life; protects, maintains and enhances assets; facilitates human relationships and identity; promotes knowledge; defends the rule of law, justice and equity; supports livelihoods; and stimulates economic prosperity. Additionally, 12 key themes were identified as factors for improving resiliency (Rockefeller, 2015).

2.4 Materials and Methods

The framework of this paper has been adapted from the SFDRR and the "31 City Resilience Strategies" (Fitzgibbons & Mitchell, 2019) that applies a directed and summative content analysis of plan evaluation using a formative approach to answer: Has the 100RC program emphasized vulnerability and risk narratives using DRR approaches in the successive member city Resilient Strategies? Fitzgibbons and Mitchell (2019) developed the "31 City Resilience Strategies" as an analytical framework to review all relevant resilience and specific subject areas under evaluation using directed and summative content analysis. The methodology extracts quantitative observations from strategy content and uses a list of indicators to score individual strategies based on strategy content. Qualitative content analysis assists in analyzing text data to understand the content or contextual meaning of policies. Summative content analysis allows for analysis to determine what has been said. Evaluation in planning, more commonly known as plan evaluation, helps determine how effective projects and policies are and whether they have achieved their intended goals and objectives. Conducting such evaluation increases legitimacy, improves decision making, promotes accountability, and fosters learning. Plan evaluation may take place once a policy or program has been implemented to determine intended outcomes (summative) or during the early initiative phases of development and implementation (formative) (Fitzgibbons & Mitchell, 2019; Guyadeen & Seasons, 2016; Hsieh & Shannon, 2005).

The framework supports urban resilience planning for DRR using the Sendai Framework as the unit of analysis. Two broad categories (Table 2-1) were identified for criteria: Disaster Resilience; and Open Process. Within these two categories, there are 7 sub-themes (risk and vulnerability; governance; risk reduction investments; recovery; monitoring and evaluation; and transparency and participation) and 58 criteria used for the assessment. Among the 58 criteria developed (*see Appendix A*), 49 were assigned points by a rater, indicating the degree of explicit aims to address disaster risk, vulnerability, resilience, DRR, strategy design (transparency and participation) and evaluation. Each of these 49 criteria are rated depending on how thoroughly each criterion is addressed in the resilience strategy (1 point for persuasive arguments and compelling evidence provided; 0.5 point for casual reference but no additional references; and 0 points for no evidence). Due to the lack of explicit DRR resiliency initiatives, there are multiple possible dimensions of DRR embedded within various plan design methods. Therefore, summative observations were used to capture disaster related issues tied to other initiatives or programs not explicitly meant for such issues. Therefore, the remaining nine unscored criteria were used with summative observations to assess these related DRR issues. These observations were coded and documented using

ATLAS.ti software. Atlas.ti is a computer software program that assists analysis of qualitative research data such as document analysis. Only 75 CRSs have been published in English as of March 2020 that were provided by the 100 Resilient Cities Program were used for the analysis. To ensure comparability, some cities (Barcelona, Lisbon, Puerto Rico) have been excluded from the analysis because they chose not to publish an official CRS and instead opted for other policy related publications. The analysis is discussed in the Results and Discussion section of this paper.

To validate ratings, a second external reviewer (rater) was used to rate the same criteria and methods independently of the CRS. Prior to reconciling, the overall average score was 95.57% similar between the two independent raters. Major rating discrepancies (more than 20% difference) occurred in ten CRS, and minor rating discrepancies (10-20% differences) occurred in two strategies. Summative and directed observations were reconciled among the raters, and the new overall average scores between raters were 99.33% similar. As a result, there were no major or contradictory summative data observations noted between the raters.

Table 2-1: Categories of criteria for directed content analysis

Metric	Total weighted score
Disaster Resilience	
Disaster risk and vulnerability	13
Disaster risk governance	6
Disaster risk reduction investments	7
Disaster recovery	7
Open Process	
Monitoring and evaluation	4
Transparency and participation	12
Total	**49**

Source: Hofmann Zavareh, 2021, p.4

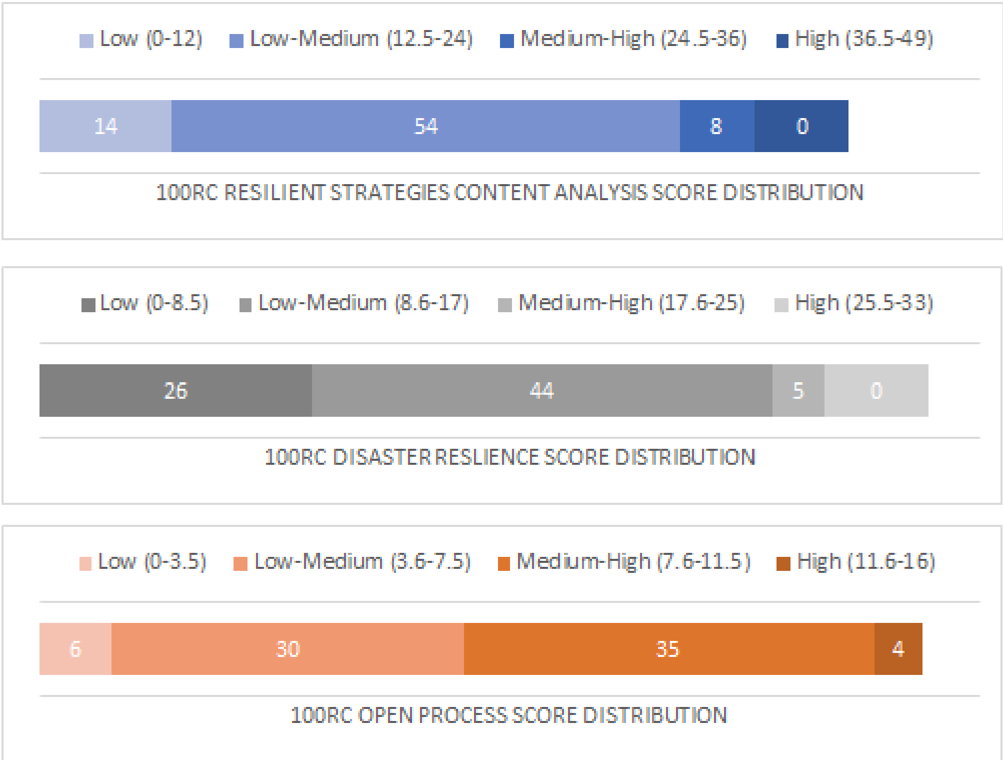
The framework provides a structure to assess only explicit DRR within a CRS. This provides an advanced analysis to quantify how cities prioritize disaster risk and resilience, allowing classification of similarities or relationships between cities, and assessment of overall transparency in the planning and monitoring of policies. However, the analysis is limited: examination of actual implementation and ongoing disaster risk and resilience policies from the strategy cannot be readily identified. The approach could be adapted and modified to assess ongoing strategies for performance using a summative plan evaluation. Additionally, the long-term disaster recovery could be used as a metric for a plan evaluation to gain insights into just how resilient a city is against DRR goals, as well as comparable climate change strategies that directly or indirectly address disaster risk, vulnerability and resilience.

2.5 Findings

The overall findings of the CRS analysis suggest that the 100RC program has not fundamentally addressed issues related to DRR's goal of achieving resilience by focusing on reducing disaster risk and vulnerability (Fig. 2-1). Many member strategies lacked specificity or clarity as to what disaster risks and vulnerabilities affected vulnerable groups, what processes would be undertaken to reduce such challenges, having collective feedback from vulnerable groups as well as engaging with them in governance and shared responsibilities, and how investments being made from partnerships or external funding sources would be managed and benefit all stakeholders. While disaster risks and challenges were identified among shocks and stresses, these tended to be overlooked when designing and implementing key policies for urban resilience. Instead, policies generally concentrated on urban infrastructure improvements, general disaster management efforts to improve early warning detection systems, improving hazard and urban growth maps, disaster education, or climate change policies. However, some member cities and strategies do report efforts focused on DRR, connected to SFDRR, SDGs or UNISDR, suggesting the decision not to prioritize vulnerability and risk may not necessarily be a result of the 100RC program.

In considering whether some cities were more likely than others to establish narratives centered around community vulnerability and risk in their CRS, the following broader categories of cities and countries are used (Table 2-1): city classification, location, climate classification, Human Development Index, Unbreakable Resilience Indicator, and Worldwide Governance Indicators. The city classification is based on the OECD-EC approach that identifies small cities between 50,000 and 100,000 inhabitants, medium between 100,00 and 250,000 inhabitants, large between 250,000 and 500,000 inhabitants, extra-large between 500,000 and 1,000,000 inhabitants, extra-extra-large between 1,000,000 and 5,000,000 inhabitants, and a global city of more than 5,000,000 inhabitants (Dijkstra & Poelman, 2012). The location of each city is determined using the Global North/South classifications (Reuveny & Thompson, 2009). The Köppen-Geiger Climate Classification system (Peel et al., 2007) applies five categories to assess whether a city is tropical (Group A), arid (Group B), temperate (Group C), cold (Group D), or polar (Group E). The World Bank and the Global Facility for Disaster Reduction and Recovery (GFDRR) has established the Online Unbreakable Resilience Indicator (URI) database as a means to move beyond traditional metrics to examine how natural disasters affect people's well-being (GFDRR, 2021). The Unbreakable report (Hallegate et al., 2016) provides a resilience percentage for each country based on drivers such as social protection (ability to access post-disaster financial and social resources), economic (providing financial inclusion), vulnerability (asset vulnerability) and exposure to disasters. The World Bank Worldwide Governance Indicators (WGI) reports aggregate and individual governance indicators using six dimensions: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption (World Bank, 2010). No data are given for Lebanon, Palestine, Singapore, South Korea, and New Zealand in the Unbreakable report, and data for Palestine is omitted from the WGI database. Therefore, the comparison analyses conducted here do not include ratings for these cities.

Figure 2-1: 100RC directed content analysis scoring



Source: Hofmann Zavareh, 2021, p.5

The policy evaluations are limited to the 75 members considered for category assessment of member cities (see Table 2-1). Although the 100RC program has intended to include a wide and diverse range of cities, there was noticeably a strong concentration of members in wealthier countries with higher human Development Index scores. Using the Human Development Index (HDI) to assess country development, notwithstanding economic growth, the analysis included a total of 51 CRS from cities in countries with very high (0.8 to 1.0), 16 with high (0.7 to 0.799), 7 with medium (0.550 to 0.699) and 2 with low (0.350 to 0.549) human development (UNDP, 2021). The sample is overwhelmingly concentrated on cities (88%) having high to very high human development in comparison to low human development cities (2%). Nevertheless, 30 of the cities were located in the Global South, compared with 45 in the Global North (Reuveny & Thompson, 2009). The majority of the cities were classified as extra-extra-large (35%) or global cities (32%) (Simplemaps, 2021). Ramallah was the only city below the small city classification and therefore received no official city population ranking (PCBS, 2018). Most cities (60%) were located in temperate climates based on the Köppen-Geiger Climate Classification system (KGCC), followed by tropical climates (21%) (Peel et al., 2007). This shows how cities located in temperate climates are less likely to suffer from climate change as those in tropical climates

Using the World Bank Worldwide Governance Indicators (WGI) to assess overall governance, the analysis included a total of 17 CRS from cities in countries with high (85 to 100), 27 with medium-high (71 to 84), 9 with medium (50 to 70), 19 with low-medium (36 to 49) and 2 with low (0 to 35) scores (World Bank, 2010). The sample is overwhelming concentrated on cities (72%) having high to medium governance in comparison to low governance cities (28%). It also appears that cities scoring well on the Unbreakable report (URI) (72% with medium and 22% with high resilience) tend to have higher resilience percentages than on the 100RC score distributions (60% with medium and 1% with high resilience). Here it is noted that cities that appear to have 'barriers' to good governance or "drivers" for resilience tended to develop resilience strategies that failed to incorporate narratives centered around community vulnerability and risk.

The broader categories of cities and countries highlight the distortions between vulnerabilities and risks associated with disasters, and capabilities to respond. Generally, whether the 100RC resilience strategies incorporated narratives around community vulnerability and risk was not consistently related to city size, climate, or other indicators such as human development, governance and resilience. These patterns of city and country categories are also important in considering the impacts and influence on policy mobility. Changing geopolitical contexts and international relations, such as the case with countries moving from low to medium human development, shape where particular cities will look to in developing disaster resilience policies. The economic context of policy making is also influenced by policy makers, which may differ depending on different relations in global capitalism, with higher human development versus lower human development. Policy mobility is also influenced by the role of stakeholders, emphasizing assumptions and knowledge claims underlying resilience policies implemented in relation to HDI scores. Those with lower scores tended to rely more heavily on 100RC program expertise and subject-matter experts provided by platform partners.

Furthermore, there appears to be a focus on disaster threat (shock) narratives that are detailed and discussed for each member city in the program. The top two shocks and stresses are connected to DRR events. Of the top five shocks and stresses (Table 2-3) identified from each member city only one is related to climate change (sea level rise). The member cities affected by the top five shocks and stresses are diverse in terms of geographic distribution from the Global North and South, population, and climate classification (e.g. tropical and dry). However, the shocks and stresses identified are not necessarily directly converted into a resilience strategy in the resulting CRS. There are 3 primary findings which form the basis of this assertion: (1) the strategies did not offer or provide vulnerable populations or marginalized residents an opportunity to self-identify their needs, priorities, or express their issues for action; (2) many strategies did not attempt to strengthen disaster risk governance by sharing DRR responsibilities between vulnerable stakeholders and government institutions, and (3) few investments were made for social protection, affordable or flexible financial services, or measures to protect assets for vulnerable residents. These findings are discussed in greater detail, followed with potential solutions supporting disaster resilience. (See Table 2-2).

Table 2-2: 100RC city and country categories

100RC Member City/Country	City Type	Location	KGCC	HDI	WGI	URI	100RC
Accra (Ghana)	XXL	Global South	Group B: Dry Climates	Medium	Medium	Medium	Medium
Amman (Jordon)	XXL	Global South	Group B: Dry Climates	High	Low-Medium	Medium-High	Low
Athens (Greece)	XL	Global North	Group C: Temperate Climates	Very high	Medium	Medium	Low-Medium
Atlanta (United States)	Global city	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Bangkok (Thailand)	Global city	Global South	Group A: Tropical Climates	High	Low-Medium	Medium	Low
Berkeley (United States)	M	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Low
Boston (United States)	XXL	Global North	Group D: Continental Climates	Very high	Medium-High	Medium	Medium
Boulder (United States)	M	Global North	Group B: Dry Climates	Very high	Medium-High	Medium	Low
Bristol (United Kingdom)	XL	Global North	Group C: Temperate Climates	Very high	High	Medium-High	Low
Buenos Aires (Argentina)	Global city	Global South	Group C: Temperate Climates	Very high	Low-Medium	Medium	Low-Medium
Byblos (Lebanon)	XL	Global South	Group C: Temperate Climates	High	Low	–	Low-Medium
Calgary (Canada)	XXL	Global North	Group D: Continental Climates	Very high	High	Medium	Low
Cali (Columbia)	XXL	Global South	Group A: Tropical Climates	High	Low-Medium	Low-Medium	Low-Medium
Can Tho (Vietnam)	XXL	Global South	Group A: Tropical Climates	Medium	Low-Medium	Medium-High	Low
Cape Town (South Africa)	L	Global South	Group C: Temperate Climates	High	Medium	Medium	Low-Medium
Chennai (India)	Global city	Global South	Group A: Tropical Climates	Medium	Low-Medium	Medium	Medium
Chicago (United States)	Global city	Global North	Group D: Continental Climates	Very high	Medium-High	Medium	Low-Medium
Christchurch (New Zealand)	L	Global North	Group C: Temperate Climates	Very high	High	–	Low-Medium
Colima (Mexico)	M	Global South	Group C: Temperate Climates	High	Low-Medium	Medium	Low-Medium
Da Nang (Vietnam)	XL	Global South	Group A: Tropical Climates	Medium	Low-Medium	Medium-High	Low
Dakar (Senegal)	XXL	Global South	Group B: Dry Climates	Low	Medium	Medium-High	Low
Dallas (United States)	Global city	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Low
Deyang (China)	XXL	Global South	Group C: Temperate Climates	High	Low-Medium	Medium	Low
Durban (South Africa)	XL	Global South	Group C: Temperate Climates	High	Medium	Medium	Low
El Paso (United States)	XL	Global North	Group B: Dry Climates	Very high	Medium-High	Medium	Medium

Table 2-2 (Continued)

Glasgow (United Kingdom)	XL	Global North	Group C: Temperate Climates	Very high	High	Medium-High	Medium
Greater Miami and the Beaches (United States)	XL	Global North	Group A: Tropical Climates	Very high	Medium-High	Medium	Medium
Honolulu (United States)	Global city	Global North	Group B: Dry Climates	Very high	Medium-High	Medium	Medium
Houston (United States)	XXL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Juarez (Mexico)	XXL	Global South	Group B: Dry Climates	High	Low-Medium	Medium	Medium
Kyoto (Japan)	Global city	Global North	Group C: Temperate Climates	Very high	High	Medium-High	Medium
Lagos (Nigeria)	Global city	Global South	Group A: Tropical Climates	Low	Low	Low-Medium	Medium
London (United Kingdom)	Global city	Global North	Group C: Temperate Climates	Very high	High	Medium-High	Low-Medium
Los Angeles (United States)	XXL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Louisville (United States)	XXL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Medellin (Columbia)	L	Global South	Group A: Tropical Climates	High	Low-Medium	Low-Medium	Medium
Melaka (Malaysia)	Global city	Global South	Group A: Tropical Climates	Very high	Medium	Medium	Low-Medium
Melbourne (Australia)	Global city	Global North	Group C: Temperate Climates	Very high	High	Medium-High	Medium
Mexico City (Mexico)	Global city	Global South	Group C: Temperate Climates	High	Low-Medium	Medium	Medium
Montevideo (Uruguay)	XXL	Global South	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Montreal (Canada)	XXL	Global North	Group D: Continental Climates	Very high	High	Medium	Medium
New Orleans (United States)	XXL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
New York City (United States)	Global city	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Norfolk (United States)	M	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Oakland (United States)	L	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Panama City (Panama)	XL	Global South	Group A: Tropical Climates	High	Medium	Low-Medium	Medium
Paris (France)	Global city	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium-High	Medium
Pittsburgh (United States)	XXL	Global North	Group D: Continental Climates	Very high	Medium-High	Medium	Medium
Pune (India)	Global city	Global South	Group A: Tropical Climates	Medium	Low-Medium	Medium	Medium
Quito (Ecuador)	XXL	Global South	Group C: Temperate Climates	High	Low-Medium	Medium	Medium
Ramallah (Palestine)	–	Global South	Group C: Temperate Climates	Medium	–	–	Medium
Rio de Janerio (Brazil)	Global city	Global South	Group A: Tropical Climates	High	Low-Medium	Medium	Medium

Table 2-2 (Continued)

Rome (Italy)	XXL	Global North	Group C: Temperate Climates	Very high	Medium	Medium	Medium
Rotterdam (The Netherlands)	XXL	Global North	Group C: Temperate Climates	Very high	High	Medium-High	Low
San Francisco (United States)	XXL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Sante Fe (Argentina)	XL	Global South	Group C: Temperate Climates	Very high	Low-Medium	Medium	Medium
Santiago De Los Caballeros (The Dominican Republic)	Global city	Global South	Group A: Tropical Climates	High	Low-Medium	Medium	Medium
Santiago Metropolitan Region (Chile)	XXL	Global South	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Seattle (United States)	XXL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Low
Semarang (Indonesia)	XXL	Global South	Group A: Tropical Climates	High	Low-Medium	Medium	Medium
Seoul (South Korea)	Global city	Global North	Group D: Continental Climates	Very high	Medium-High	–	Medium
Singapore (Singapore)	Global city	Global North	Group A: Tropical Climates	Very high	High	–	Low-Medium
St. Louis (United States)	XXL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Low
Surat (India)	Global city	Global South	Group A: Tropical Climates	Medium	Low-Medium	Medium	Low-Medium
Sydney (Australia)	Global city	Global North	Group C: Temperate Climates	Very High	High	Medium-High	Medium
Tel Aviv (Israel)	L	Global North	Group C: Temperate Climates	Very High	Medium-High	Medium	Low
The Hague (The Netherlands)	XXL	Global North	Group C: Temperate Climates	Very High	High	Medium-High	Medium
Thessaloniki (Greece)	L	Global North	Group C: Temperate Climates	Very high	Medium	Medium	Medium
Toronto (Canada)	Global city	Global North	Group D: Continental Climates	Very high	High	Medium	Medium-High
Toyama (Japan)	L	Global North	Group C: Temperate Climates	Very high	High	Medium-High	Medium
Tulsa (United States)	XL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Vancouver (Canada)	XXL	Global North	Group C: Temperate Climates	Very high	High	Medium	Medium
Vejle (Denmark)	S	Global North	Group C: Temperate Climates	Very High	High	Medium-High	Low-Medium
Washington DC (United States)	Global city	Global North	Group C: Temperate Climates	Very High	Medium-High	Medium	Medium
Wellington (New Zealand)	L	Global North	Group C: Temperate Climates	Very high	High	–	Medium

Source: Hofmann Zavareh, 2021, p. 6-7

Table 2-3: 100RC Shocks and Stresses

Shocks/Stresses	**Country (number of cities)**
Blizzard	Canada, Jordan, United States (3)
Climate Change	Canada, Chile, Denmark, Greece, Italy, Jordan, The Netherlands (2), South Africa, United Kingdom (2), United States (9)
Coastal / Tidal Flooding	Australia, Denmark, Ghana, Indonesia, Italy, Japan, Malaysia, New Zealand, Singapore, Thailand, The Netherlands, United Kingdom, United States (7), Vietnam (2)
Drought	Australia, Brazil, Canada, Chile, Ecuador, India, Indonesia, Mexico, Panama, South Africa (2), Thailand, United States (9), Vietnam (2)
Earthquake	Canada (2), Chile, China, Columbia, Ecuador, Ghana, Greece (2), India (2), Israel, Italy, Japan, Mexico (3), New Zealand, Palestine, Panama, The Dominican Republic, United States (5)
Extreme Cold	Canada (2), Italy, Mexico, The Netherlands, United States (2)
Extreme Heat	Argentina, Australia, Canada (2), France, Greece (2), Italy, Jordan, Mexico, The Netherlands, United States (12)
Fire	Chile, Columbia, Ecuador, Greece, Jordan, Panama, South Africa (2), United Kingdom, United States (5)
Hurricane / Typhoon / Cyclone	Canada, India, Lebanon, Mexico, The Dominican Republic, United States (6), Vietnam
Landslide	Brazil, Chile, Columbia, Ecuador, Italy, Japan (2), Malaysia, Mexico, Panama, South Korea, United States (2)
Liquefaction	Italy, United States
Rainfall Flooding	Argentina (2), Australia, Brazil, Canada (3), Chile, China, Columbia (2), Denmark, Ecuador, France, Ghana, Greece (2), India, Indonesia, Italy, Japan (2), Jordan, Malaysia, Mexico (2), New Zealand (2), Nigeria, Panama, Senegal, Singapore, South Africa (2), Thailand, The Dominican Republic, United Kingdom (3), United States (20), Uruguay, Vietnam (2)
Sea Level Rise / Coastal Erosion	Australia, Canada, Denmark, India, Indonesia, Italy, Japan, Malaysia, New Zealand (2), Nigeria, Senegal, Singapore, United States (10), Uruguay, Vietnam (2)
Severe Storms	Canada, Chile, Denmark, United Kingdom, United States (8)
Snowstorms	Palestine
Storm Surge	Mexico, United States (4)
Subsidence	Mexico, United States (2)
Tsunami	Lebanon, New Zealand, United States (2)
Tornado	Chile, Ecuador
Volcanic Activity	Chile, Columbia, Ecuador, Mexico, Vietnam

Source: Hofmann Zavareh, 2021, p.8

2.5.1 Vulnerable and marginalized resident engagement

Many cities collaborated with stakeholders (85%) to identify strategy goals and actions, but often collaboration was limited, especially in terms of engagement with community members, such as those most vulnerable to disaster risks. Only five cities (Atlanta, Colima, Kyoto, Panama City, Toronto) provided any evidence that vulnerable groups were afforded an opportunity to self-identify their needs and priorities. There was a tendency to detail why certain roles for managing resilience programs were to be appointed and overseen by governmental proxies, along with the need for key partnerships (with e.g. Arup, The Nature Conservancy, SwissRe, Arcadis, The Asia Foundation, Microsoft, PwC) to manage policy efforts, rather than engage directly with the community for co-creation and solutions. Conversely, many cities aimed to provide residents with opportunities for public participation for ongoing program monitoring and evaluation, but lacked specificity as to how one could do so.

Calgary recognized the traditional Indigenous territory of the Blackfoot people. Throughout their strategy development process, Indigenous people shared their thoughts, ideas and contributions to shape policies. Elders also came and gave their blessings to continue working and supporting the inclusion of Indigenous people. Toronto acknowledged their strategy was developed on the traditional territory of many nations with a long history of Indigenous people in an effort to develop a shared community vision in collaboration. This resulted in engaging over 8,000 Torontonians in face-to-face meetings, telephone conversations, social media engagement, meetings in public events and in residents' homes. They also acknowledged that residents experienced different kinds of vulnerabilities based on various factors. Here, by prioritizing vulnerable populations, resilience was seen as more of a process and investment. Specifically, Indigenous communities and leaders were involved to build further resilience and build upon Indigenous knowledge for resilience actions. This was evidenced in the Indigenous Knowledge and Climate Action Workshop that took place to address climate and environmental issues (flood and water management, green infrastructure, education, and technical and Indigenous expertise). The results from these engagements were further documented and made available publicly through the Toronto Resilience Office website. Overall, Toronto made a strong effort to focus on vulnerable and Indigenous resident engagement throughout the resilience strategy development and implementation process. Vancouver specifically addressed the role of women and other groups such as gender-diverse, two-spirit people, cis women and trans in providing a place in disaster resilience and recovery. They acknowledged the importance they play in other critical roles of social and psychological recovery following disasters and sought to elevate their role in creating a resilient city.

Cape Town had one of the more comprehensive approaches to engaging experts and vulnerable residents living in informal settlements. At the beginning of the strategy planning process over 11,000 face-to-face interviews took place with residents of informal settlements and backyard dwellings. Additional meetings and workshops were held to understand and prioritize the diverse challenges voiced among these communities. Thessaloniki involved more than 40 organizations and 2,000 citizens using online questionnaires and workshops, establishing a Resilience Day for the Municipality to engage with citizens, featuring live on-air broadcasts by the municipal television and providing printed Braille material for those visually impaired. Honolulu also engaged more than 2,200 residents over 18-months using a grassroots approach to develop the strategy. Chennai engaged over 1,800 citizens from over 500 vulnerable communities using citizen surveys. However, other strategies provided an approximate count of engaged stakeholders (e.g. Bristol 1,600; Boston 11,000), but did not specify if this included vulnerable groups, experts or other kinds of stakeholders involved in developing action items.

The majority of member city strategies fell between a medium-high range, 7.59 average score (Fig. 1) for vulnerable and marginalized resident engagement. This was most likely due to the standardization of the preliminary assessment process established by Rockefeller at the onset of the program for each member. Almost all strategies (85%) identified key external stakeholders involved for identifying policy processes. A majority also did not describe how information was disseminated to the general public. There also was very little mention as to how vulnerable residents were given opportunities to self-identify and state their needs and priorities. Any information disclosed regarding participatory workshops was used to gauge problem areas of communities typically including key stakeholders (government officials, local authorities, businesses, NGOs etc.). Still, these actors were often chosen representatives on behalf of those managing policy access and resources. Few strategies invited vulnerable community members to participate in discussions or creation of policies. Although vulnerable groups were engaged, such as with the case in Chennai, it is difficult to determine whether, beyond these interviews, any other involvement in planning and strategy implementation took place. Even fewer strategies defined vulnerability and disaster risks, identified who were vulnerable, or specific disaster risks relating to explicit vulnerable groups. Even more lacking was an understanding of how certain DRR benefits were not accessible for vulnerable groups, what impact this may have or any attempts to mitigate these effects. Strategies overall lacked a clear understanding of vulnerability beyond risk exposure.

2.5.2 DRR governance

Seventeen percent of strategies only attempted to strengthen disaster risk governance by sharing DRR responsibilities between vulnerable stakeholders and government representatives, who were seen as having responsibility and oversight. Further strategies offered no clarity on who or which entity was designated as the responsible party for disaster risk governance. This resulted in a lack of defined roles and responsibilities in 91% of strategies, so that it was not possible to share these with vulnerable persons impacted directly by disaster risk exposure. Generally, there was little consideration of local knowledge (4%) in managing on-going or future disaster risks. Strategies often excluded local knowledge and perceptions of risk. Chennai acknowledged their long history of traditional rain water harvesting methods and Indigenous knowledge from those living on the land. Yet, there was no mention as to how this knowledge would be integrated beyond traditional governance systems. In contrast, Pune focused on strengthening pathways for democratic decision-making and civic participation in local area planning. Other strategies such as those for Can Tho or Singapore, emphasized the strong use of top-down governance approaches in large part due to cultural differences. Overall, many opted only to use technical and scientific knowledge, data, and assessment methods in order to manage disaster risk exposure for vulnerable groups. This expert knowledge tended to be only held by those holding scientific or professional credentials. This further excluded vulnerable community members and those with indigenous knowledge of the land, history of the space and place in which urban geographies were shaped.

Durban took one of the more innovative approaches and pathways to developing their strategy under the guidance and feedback from vulnerable stakeholders using two 'resilience building options' (RBOs). This involved first developing an exploratory non-paper in order to explicitly define resilience and the role it would play in city development. From this two RBOs were chosen to develop the strategy focusing on collaborative informal settlement actions and integration of a dual governance system (land tenure regime and municipalities). This resulted in a unique pathways approach to manage urban resilience in effort to construct an African conceptualization for transformation. Although these are complex and interconnected challenges for Durban to address, this experience demonstrates the urgent and critical questions needing answers in understanding how one might 'do resilience' differently and in a way that addresses post-colonial urban discourses emerging among scholars.

2.5.3 Investing in DRR

Overall, 88% of the members benefited from the development of new or expanding public-private partnerships. High profile investments or partnerships were often highlighted in terms of progress and achievement in urban resilience for the city. There were no strategies that identified records of management of funds and resources would be made available for transparency and accountability among agreements. This also applied to the lack of discussion on providing financing terms for better understanding as to just how these investments would benefit or enhance economic, social, environmental, health or cultural resilience for the city. Similarly, only 5% of cities (Chennai, El Paso, Melbourne, Washington DC) offered affordable and flexible financial services such as savings and credit schemes or microfinancing for vulnerable groups affected by disaster risk. Other measures to protect community assets such as disaster insurance

(26%) were also limited for those coping with disasters (Christchurch, Honolulu, Houston, Los Angeles, Melbourne, New Orleans, New York, Toyoma, Vancouver, Washington DC, Wellington). Fewer discussed the potential use of implementing disaster related insurance products in order to fund recovery efforts (Cape Town, Chennai, Da Nang, Medellin, Miami, Quito, Ramallah, Rotterdam).

New York City secured over $3 billion in funding from FEMA to provide a comprehensive resiliency program for public housing developments, including flood-proofing and upgrading infrastructure. The city also provides a *Build it Back Better* program that also helps protect vulnerable residents from the loss of critical services during disasters. These efforts are also done in part to address neighborhoods not built to flood construction and insurance requirements in an effort to increase the number of households with flood insurance. This also includes other endeavors from the city to align zoning and building codes with the National Flood Insurance Program (NFIP) and changes to flood insurance maps. Generally, almost all members made investments for critical infrastructure and basic services to reduce vulnerability to disasters. These investments often were tied to other Rockefeller approved vendors (e.g. CDM Smith, CEMEX, Cisco, Deltares, RMS, Siemens, The Nature Conservancy, The World Bank). Overall, investments for DRR were limited mainly to critical infrastructure improvements or new systems for the city municipal services (e.g. flood control, land-use planning, mapping and risk modeling for NFIP).

2.6 Results and Discussion

The paper utilizes a pathways approach to explore policy mobility that provides a reflexive dimension in understanding how 'resilience' is being used in the 100RC program and SFDRR. This analysis is focused on observable plan content documented within the strategy, not policy implementation. These scores allow us to identify signals of potential risks, disproportionate impacts, vulnerabilities and inequities related to disasters that otherwise would not be evident. Overall, strategies received higher scores when they acknowledged criteria and attempted to mitigate vulnerabilities and risks associated with disasters, such as when they sought to develop disaster insurance, housing resettlement programs, engage vulnerable groups as stakeholders or in active participation in policy making and implementation.

100RC member cities did not all use the same format for the CRS publications, resulting in varying degrees of information and transparency on such matters as to how stakeholders were chosen, strategies were developed, accountability for programs, funding sources, partnerships or actors providing resources, and just who could participate in ongoing monitoring and evaluation. The metrics used in the framework to assess whether or not the objective of the 100RC program to design more urban resilient cities did reveal that this did occur when there was transparency, monitoring, evaluation, and participation within the design and implementation of these strategies. This assessment is only an approximation and more detailed analysis would be needed to determine equity of resilience strategy planning and implementation among member cities. There was also a considerable amount of cross marketing of other member cities and highlighting specific programs or policies throughout various strategies. The promotion of the 100RC was prominent in the structure and design of each strategy. It may have been more beneficial to have had more historical urban development, socio-economic challenges, and information related to structural problems needed to address urban and disaster resilience, rather than the promotion of the Rockefeller Foundation and its partners.

Approaches to identifying disaster risks, vulnerabilities and vulnerable groups often ignored explicitly defining these terms. Historic and structural reasons as to why such problems exist and why some DRR benefits may not be accessible to vulnerable stakeholders were seldom addressed. In some cases, risk would be defined (Melbourne, Melaka) and related to disasters but not in terms of vulnerabilities. Instead, various types of risks (e.g. cyber, biohazard, financial, crime) were discussed in numerous forms. Santiago de los Caballeros was the only city to specifically define risk in the context of disasters, and this was done in accordance with the UNISDR official definition. The city also defined vulnerability and in relation to physical, social and man-made vulnerabilities. Definitions of vulnerable groups, vulnerabilities, and vulnerability only occurred overall in four strategies (Mexico City, Miami, Santiago de los Caballeros, Quito), whereas most discussed various forms of vulnerabilities with no specific terms or definitions applied.

As previously emphasized by the 100RC program, each member city provided one or more shocks and stresses related to natural hazards and disasters. Yet, the analysis showed there were three strategies (Durban, Rotterdam, Tel Aviv) that did not identify any disaster related shocks and stresses, a finding resulting in no policies addressing disaster resilience and risk reduction. There were only four cities (Panama City, Seoul, Toyoma, Vancouver) specifically identifying and targeting DRR policies. A few strategies identified relevant SDGs and cross referenced specific SDG goals among policy actions (Athens, Bristol, Chennai, Juarez, St. Louis, Kyoto, Lagos, Pune, Melaka, Sydney). Fewer strategies identified SFDRR (e.g. Santiago Metro, Sydney), or were crossed referenced (e.g. Chennai, Toyama, Vancouver). Chennai and Colima, only made reference to SFDRR, containing no specific priority action reference from the framework, whereas Toyoma provided specific references to SFDRR priorities. Some strategies, like Buenos Aires, made initial references to the use of SDGs and UNISDR (United Nations Office for DRR), but nothing more. Few (e.g. Mexico City, Sydney) mentioned UNISDR, and intentions to address goals related to disaster management with no exact details. Most strategies either identified general disaster management policies (e.g. Atlanta, Berkley, Boulder, Chennai, Chicago, Colima, Dallas, Deyang, Honolulu, Juarez, Lagos, Medellin, Melbourne, Santiago Metro, Semarang, Sydney and

Wellington,), or instead focused on climate change initiatives (e.g. Athens, Boston, Bristol, Buenos Aires, Cape Town, Houston, Miami, Paris, Pittsburgh, Pune, St. Louis, Surat, and Toronto), despite having, and detailing significant disaster related shocks and stresses. Although Bangkok focused on climate change policies, they also applied some DRR strategies. However, there were some strategies that did not denote disaster or climate change related goals or actions (Cali, Dakar, Melaka, Norfolk, Thessaloniki), but still identified approaches to reduce disaster related risks (e.g. flooding, land-use management, storm water infrastructure, and disaster relief funds).

Chicago provided a unique action template providing a list of key implementation partners, potential key indicators to measure and track the success of actions, and equity impacts for vulnerable residents affected by the proposed actions, in order to address the interconnected nature and geographies of race, economics, hazards and vulnerabilities. However, the strategy did not provide additional information beyond these elements to gauge quantitative methods to measure and track the indicators or equity impacts. Key partners were only listed in name, and did not specify what roles were held by each stakeholder, or disclosures of financial arrangements. The use of such a template may provide further guidance for future action assessments implemented in Chicago to determine overall benefits and challenges.

Additionally, some strategies were embedded among existing policies, or incorporated into other strategies previously developed by local, regional or national governments. This made it difficult to distinguish which disaster resilience and DRR plans were the result of the 100RC program, or effected in any way by the 100RC initiative. Furthermore, the role of collaborators and partnerships, such as Arup, is difficult to discern among preexisting city resilience strategies, as well as new schemes developed from the CRS. The influence of these collaborators and partnerships designed through the 100RC program is difficult to untangle. This is not to say that a city is not able to design a resilience strategy without such resources, but the extent of their influence is indeterminable to measure in the framework. There were further ways in which stakeholder involvement was limited in the monitoring and overall program evaluation, since cities chose instead to largely work with particular stakeholders and other partners to develop such indicators of success or failures. This again often excludes vulnerable members of the community in determining the value of voices, and narratives captured and included throughout the policy design and output. Few cities disseminated policy information to non-participants using general public communication (Atlanta, Glasgow, Juarez, New York, Quito, Sante Fe, Toronto).

The 100RC has curated a list of technical and expert resources made available directly through the strategy development process and implementation. There were numerous strategies benefiting from the 100RC program and Platform Partners system, such as the use of pro-bono or consultancy services. Many cities (e.g. Buenos Aires, Can Tho, Mexico City) identified the use of

100RC Platform Partnerships, but often did not provide details of such agreements, and how much involvement took place among external stakeholders from the Rockefeller Foundation. Those that did include this information (Bristol, Boulder, Da Nang, Juarez, Norfolk, Medellin, Melbourne, Panama City, Pittsburgh, Santiago Metro) provided the names of each partner corresponding to applicable goals or policies. Lagos chose only to identify and name five relevant partners in the public and private sectors for each initiative with no other information provided. Aside from the development of the 100RC Platform Partnerships, some member cities, as with the case of Rotterdam, were able to develop an additional network in order to export services from their local private sector partners. Rotterdam reported that private sector companies such as Deltares, Arcadis and TNO were actively involved in partnerships with other cities located in Denmark, India and the USA. The program has encouraged member cities to come together in order to network share lessons, and support one another in their resilience efforts. This is evidenced by the creation of a Counter-Terrorism Preparedness and Societal Resilience as a network focused on counterterrorism and launched by London in collaboration with Barcelona, Manchester, Paris, Rotterdam, and Stockholm. Athens developed the 100RC Global Migration Network Exchange (Amman, Los Angeles, Medellin, Paris, Montreal, Ramallah, Thessaloniki) to share recent migration experiences in order to provide lessons and collaborations for others facing similar situations. Other cities benefited in other ways. In Bristol, $5 million in funding was made available for 100RC Platform Partners in the form of pro bono city tools and services for development and investment programs. Melbourne and Santiago de los Caballeros identified the use of pro-bono contributions and services provided by 100RC Platform Partners, but did not specify details as to how this would happen, or provide any additional information beyond the initial disclosure statement. 100RC ensured financing of up to $5 million for Platform Partners services in Mexico City until 2020 in an effort to support resilience efforts. This commitment culminated in a formal declaration signing by the Mayor of Mexico City at an 100RC sponsored event. There may be other cases of financial incentives provided through 100RC program in general that have not been disclosed by members. This also contributes to our understanding of how are these funds and programs monitored, evaluated and adapted to meet the most important needs of vulnerable populations. Overall, without more information it is difficult to discern the extent of financial and economic benefits gained or how these relationships were developed with other private sector companies having access to the 100RC program.

The strategy development process and the 100RC program itself are embedded within disaster resilience at multiple scales. For members, this involved the self-identification of disaster shocks and stresses, using the 100RC preliminary assessment framework and plan development in partnership with Arup. Strategy content alone was not enough to determine whether embedded actions would improve disaster resilience of vulnerable populations. Further assessment may help identify specific targets achieving certain goals managing vulnerability. This could be shown through financial analysis of budget spending in accordance with direct program outcomes (e.g.

temporary housing programs, housing improvements or new building code programs). Unexpected consequences were more likely to appear in the strategies as to how vulnerable groups were potentially marginalized further, by created programs benefiting those with existing or easier access to resources and wealth. This was most often seen with the use of digital technologies (e.g. Disaster preparedness related Apps as seen in Sydney or Vancouver), and Smart Cities initiatives designed for new infrastructure projects (e.g. Montreal). These programs tend to assume equitable access for internet or wireless connectivity, good purchasing power for digital devices, lack of mobility restrictions, accessible transportation, and proper communication or training and learning made available for such services. Examples include the development of smartphone apps, such as in Norfolk to help support vulnerable residents during emergencies and disasters. Chicago attempted to address this issue by providing more equitable public network access and basic digital literacy training. However, these actions fall short of addressing inequitable access to and with computers, laptops or mobile phones. Overall, there is little attention given to those unable to access or afford these digital technology infrastructure investments.

2.7 Conclusion

Disasters can be seen as a social process or a natural event. When disasters are seen as a social process where mitigation and recovery efforts are the responsibility of the community, a participatory approach is adapted to managing policies and resources. Alternatively, when viewed as a natural event, control of resources is often deemed necessary for policies designed by governments and institutions. These perspectives shape and influence what role urban resilience has in managing DRR. Recent initiatives such as the Sendai Framework, SDGs and 2030 Agenda highlight efforts to connect vulnerability and risk by prioritizing DRR in support of urban resilience. Yet, it remains unclear how disaster resilience planning should be undertaken. Disaster resilience is linked directly to DRR and DRR is considered a critical component of overall resilience building and practices for cities. This paper examined how cities' disaster resilience approaches varied among the 100 Resilient Cities (100RC) program. It identified whether member cities emphasized disaster resilience initiatives in their programs by assessing their efforts focused on reducing disaster risk and vulnerability. The paper applied a framework allowing careful consideration as to how DRR is utilized to manage disaster risk and disaster resilience for 100RC resilient strategies. This framework was used along with directed and summative content analysis to assess whether 75 of the Resilience Strategies developed under the 100RC program were designed to promote overall DRR. The findings suggest that efforts to address vulnerability and disaster risk across member cities have been fragmented with only superficial signs of focus detectable. Overall, this research stresses opportunities for urban disaster resilience research using the Sendai Framework. This framework involves actively identifying disaster risks and vulnerabilities, engaging with external and vulnerable stakeholders, by providing them an active role to engage in policy making and implementation, sharing in knowledge and expertise, and investing in measures to protect those unable to cope in a disaster or protection from hazards. The findings revealed very little attention was given to vulnerable communities (as participants, stakeholders, objects of inquiry, or action targets) in the 100RC member strategies, thus revealing a lack of follow-through by the 100RC program on the Sendai Framework for Disaster Risk Reduction. These results suggest real limits to policy mobility, both in the sense of the constraints on the mobility of the Sendai Framework through the 100RC program, and in terms of the lack of any core representation to the city programs developed under the 100RC program. Significantly, the analysis reported in this paper reveals that the 100RC program produces different results in each city. This is because of the specific configurations of actors and power assembled in each city around the 100RC program, and the effects they have on institutions, infrastructures and networks. Power is expressed in these structures through decisions on who participates and where participation occurs, as well as who has the authority to communicate and receive information. The analysis has shown that the disaster resilience narratives among member strategies have no consistent relation between community engagement and city characteristics, therefore policy mobility followed no consistent pattern. To achieve its policy mobility goal, the 100RC program must be flexible enough to cope with specific local power relations, but the form of mobility achieved falls short of achieving urban disaster resilience using the Sendai Framework. Crucially, if it were to achieve urban resilience under that Framework, the 100RC program must bring together not only policy makers, but also diverse stakeholders. Future research of the 100RC program, and its successor should aim to identify in what ways mobile policy addresses where urban and disaster resilient policies came from, how they were mobilized, and what happened to them along the way.

3. Rural-Urban Linkages in Sustainability Transitions: Challenges for Economic Geography and Disaster Recovery

This chapter has been published as a book chapter initially conceived by GW from a keynote address given at the "IGU Mini-Conference on Rural-Urban Linkages for Sustainable Development: An Economic Geography Perspective" held in Innsbruck, Austria. SZH contributed to the development of Srivastava's (2017) theoretical urban-rural linkages framework and contributed evidence from research for the case study. The manuscript was written by GW and SZH.

3.1 Introduction

The United Nations (UN) Habitat's SDG 11 calls for explicit consideration of rural–urban linkages when planning and researching urban futures. This suggests regional planning and economic modelling will be required along with attention to linkages and flows stretching outside the urban area. The SDG 11 thus sets new goals for geographers and requires not only urban–regional economic models but also inclusion of diverse social, environmental and economic parameters plus relation to transition pathways, resilience goals and sustainability transitions thinking. This chapter investigates the recovery process following the 2010–2011 earthquake series in Christchurch, New Zealand with the UN Habitat initiative SDG 11 declaration of the significance of rural–urban linkages within disaster research in focus. It applies Srivastava's (2017) rural–urban linkage framework identifying implications and challenges arising for economic geographers researching rural–urban linkages in disaster research with transitions and resilience in mind.

Christchurch, located in the Canterbury region of New Zealand, is the largest city on the South Island and second largest city in the country. The earthquakes during the period 2010–2011 are more commonly known as the Canterbury earthquake sequence. The most severe of these earthquakes took place on February 22, 2011, a Richter-Scale Magnitude 6.3 earthquake that killed 181 people and resulted in $40 billion NZ in total damages (Anderson, 2014), with additional insured losses of $15 billion US (Parker & Steenkamp, 2012). The earthquake sequence is the fifth largest insurance event in the world since the 1980s (Deloitte, 2015). At the time of the earthquakes, Christchurch had a population of 425,000 with approximately 7,000 living in the central city. Canterbury had strong agriculture, manufacturing, health, social and education sectors, contributing 23.2 percent of national gross domestic product. Christchurch functions as a gateway to the South Island, has one of the largest deep-water seaports in the South Island and provides interconnected road, rail and coastal sea links necessary for imports and exports. The extensive damage to Christchurch and the port was seen as a great risk and recovery was given high priority (CERA 2016a, 2016b). Over 100,000 residential houses were damaged, requiring repairs or rebuilding, of which 7,000 homes were classified as "red zoned" (requiring total demolition).

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An estimated 400,000 insurance claims were filed with the Earthquake Commission (EQC). EQC was established in 1945 to provide national disaster insurance for residential properties including contents, dwellings and land. Despite having over 93 percent of the claims settled in late 2015, many homes are left demolished or awaiting repairs, indicating that recovery is far from finished (Hall et al., 2016).

Recovery in Christchurch became focused on resilience building after a shock with stress and involved working towards a sustainability transition. Authorities planned to build a new resilient city and to transform the urban environment. This process would involve many rural–urban as well as globalized linkages, either because of the multiple effects of the earthquake series, the needs, agendas and capabilities of the rebuilders, or the recovery implications for greater New Zealand. This has proven to be a difficult recovery for a city and region of the Global North, testifying to the challenges posed by the Habitat SDG Target 11.

3.2 Disaster Recovery Design and Conceptual Tools

3.2.1 Urban Disasters

Natural disasters and hazards are a part of everyday life demanding proactive approaches to mitigate risk and damages (Cutter, 1993). It has long been recognised that cities and highly populated areas are increasingly exposed and vulnerable to natural disasters (Mitchell 1995, 1998 and 1999). Over the past decade, the UN placed much emphasis on mitigation of natural disasters in megacities (Mustow, 2002). Declining urban infrastructure has exposed cities to severe risks and vulnerabilities throughout the developed world. As risk becomes normalised and accepted in urban settings, communities in urban locations are subjected to additional risk from severe natural disaster events (Pelling, 2003). The 2011 earthquake and tsunami in Japan, the 2010 Christchurch earthquake in New Zealand and the 2005 Hurricane Katrina in New Orleans are all recent cases in developed countries that emphasise the recent challenges and gaps in hazards research (Hewitt, 2013). Rural resources can be used in disaster recovery such as in temporary shelters or housing, emergency services, facilities for displaced or disrupted business services, food banks and other critical disaster recovery services. Managing these resources and the potential ties and connections between urban and rural areas can also support the on-going recovery as well as promote a stronger process (Srivastava & Shaw, 2016).

3.2.2 Resilience in Systems

The term ‘resilience’ is often and properly understood as a property of a system, and so must be related to an appropriate system model. Within global environmental research, ‘resilience’ relates to the general persistence of ecological system functions, adaptation of humans in nature and societal resilience to ecological transformations but will take on specific meanings. In hazards research the focus is on how societies (considered as systems) deal with environmental risks and hazards (Keck & Sakdapolrak, 2013). Recently economic geographers have proposed conceptual frameworks for regional (Martin & Sunley, 2015) and sectoral (Fromhold-Eisebith, 2015) economic resilience. Martin and Sunley (2015) argue that there is no theory, agreed definition or accepted methodology for 'economic resilience', little discussion on how it should relate to uneven regional development, regional competitiveness or regional path dependence, and no consensus on what determines it. They acknowledge scepticism among their colleagues about the normative and neoliberal aspects of the use of 'resilience', competing terms from within economics and limited conceptualization of environment within economic systems. They highlight other perceived weaknesses in economic resilience thinking: a failure to relate 'resilience' to regional evolutionary paths, to regional or sectoral economic performance or, more precisely, to a regional economic system model. We add that rural-urban linkages are rarely featured in 'economic resilience' thinking. To remedy these problems, they argue that elements and indicators used in the model need to be subjected to statistical tests of the theorized drivers of resilience. Only then can 'resilience' be understood in terms of elements critical or redundant to economic system functioning. In this thinking the SDG 11 call should result in explicit consideration of rural-urban linkages in a regional economic system model.

3.2.3 Resilience in Transitions and Transition Pathways

Frameworks for thinking about 'resilience' in the context of sustainability transitions are proliferating but in them 'resilience' does not refer to a property of an ecological, economic, or social system. Instead, 'resilience' is a continuously redefined, reworked and therefore shifting target and one often understood in terms of vaguely defined transitions, themselves grafted on to existing institutions and governance structures. Here 'resilience' thinking is normative: what should be done to effect a transition. These findings are reflected in recent reviews of discussions of 'resilience' across the social sciences. Keck and Sakdapolrak (2013) observe a shift in meaning, from persistence of ecological system functions to social transformation in the face of global change. They find that "the search for new approaches to resilience-building is revealed to be not merely a technical question but a contested political one." (Keck & Sakdapolrak, 2013). Similarly, Davoudi et al. (2012) finds that 'social resilience' is conceived of as a dynamic, relational and political process and 'vulnerability' is viewed as a counterpart to 'resilience' within development studies.

In this context, the 'multi-scale framework' for analysing transformation processes based on Grin et al. (2010), and used in the Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (WBGU) (WBGU, 2011) report is a useful starting point for thinking through the narrative at work. It is assumed that by identifying desirable outcomes, it will be possible to engage governments and other actors to achieve them, often by adopting technical solutions to problems. The result will be local reactions, connected to global processes, entangled in practices, regulations and institutions. Communication problems may emerge when mobilizing for transformation within such a framework. For example, business owners respond to calls to innovate or adopt 'pro-environment practices' in diverse ways because they weigh up costs and benefits (North, 2016). Questions may arise such as what does innovation mean, when have we achieved transformation, are agencies promoting conflicting goals or are the effects of policies and projects displacing effects to other subsystems and regions (Winder & Bobar, 2018)? In effect, the multi-scale framework legitimizes action but the terms – niche niveau, system mega trends, regimes, abrupt events – as well as the interactions and relationships used are deliberately underspecified. The multi-scale framework is not specified as a model or a system with its related data, factors and tested relationships. When using such a framework, researchers must conceive of resilience as a legitimizing narrative around which actors are enrolled in a common project.

The conceptual framework of Leach et al. (2010) is prominent in the literature on transition pathways. It enables scholars to understand and represent a system while narratives shape problem identification and reactions, drawing together scientific understanding of natural processes and constructivist interpretations of the socio-political world promoted by actors, networks and institutions. It is the narratives that "justify kinds of action, strategy and intervention" (Leach et al., 2010). By relating 'tempo of change' ('stress' or 'shock') to 'response to change' ('responsive, adaptive management' or 'control-oriented management') Leach et al. (2010) define four 'styles of action 'where 'resilience' is only one style of action, and should not be thought of as a property of the system.

Their approach directs attention to the narratives, including those of 'resilience', that are being used in policy making. They establish a framework for thinking through policy making: defining governance arrangements, identifying future challenges, relating goals to assessment, classifying pathways, discussing 'shock' and 'stress', and discussing 'respond' and 'control' styles of action. They recognize that a policy response might be different or have different effects depending on which entity is being examined, at what scale, in which space and in which institutional context, and that there are versions of sustainability each valued by different groups in society or linked to specific goals (Leach et al., 2010). This framework can help to make sense of how 'resilience' is being used in the UN Habitat SDG 11 challenge: 'resilience' is not defined as a property of a system but as a narrative related to a framework related to a recovery process. In particular, this is the thinking behind a recently proposed 'framework' for researching urban-rural linkages in disaster research.

3.2.4 Urban-Rural Linkages in Disaster Research

Srivastava (2017) applies an urban-rural linkage framework to disasters in South Asia using a time-scale of pre-disaster, disaster and post-disaster phases. The urban-rural linkage and interdependency structure developed by Srivastava and Shaw (2013) identifies eight key elements and interdependencies in disasters (Table 3-1). They argue that disasters literature emphasizes economic impacts after disasters in urban areas or developed countries but should include comprehensive assessments and analysis assessing demographic and migration patterns. The negative effects on the environment, especially water, land and energy, are of great concern to stakeholders since rural incomes and urban recovery depend upon these resources.

Many markets rely on bidirectional flows between urban and rural areas of products such as raw and unprocessed materials needed for manufacturing and agriculture. After a disaster, money tends to flow from urban to rural areas in the form of remittances with short-term losses for regional economies. Investments made during recovery and rebuilding also provide unique financial gains and can aid in poverty reduction if managed properly. Waste is seen as a physical linkage between urban and rural areas because investments are often not made in waste disposal following a disaster resulting in the majority of waste being discarded into landfills located in rural landscapes. The related potential pollution and health hazards pose serious threats to rural and neighbouring areas with indirect long-term economic effects.

Table 3-1: Urban-Rural Linkage Elements and Indicators

Elements	Indicators
People	population movements and demographic patterns
Natural Resources	environmental indicators for water, land and energy
Products	flows of materials and products
Financial	flows of remittances and investments
Waste	waste disposal patterns
Information	information flows and state of connectivity
Social Interactions	cultural exchanges and trauma support
Governance	agents formally and informally responsible in community recovery

Source: Winder and Hofmann Zavareh, 2020, p. 68

The urban and rural are also linked by flows of information relating to resources, opportunities and relief efforts. Consequently, rate and flow of information and the state of connectivity, transportation or sharing of technology are all important components of recovery. Rural residents can play vital roles in recovery, for example by providing support for urban residents suffering from trauma. Governance also involves urban-rural linkages whereby formal governments, informal agents, organizations and NGOs have responsibilities in sharing and administering policies and procedures, as well as having vested interests in the community and recovery.

Srivastava (2017) expanded the urban-rural linkage disasters framework to include 'shock' and 'stress' scenarios emphasizing the need to apply the framework to urban disasters in developed countries. The framework is in fact a set of narratives about the importance of urban-rural linkages in effecting a 'resilient' recovery. Remittances can be redirected to support recovery. Investments can be managed to aid in poverty reduction. The dumping of wastes must be managed so as to avoid potential pollution and health hazards, especially in rural areas. Such narratives carry relational logics that are connected to a framework that helps make sense and meaning of the recovery process. Note that Srivastava does not expect this framework to be supported by a socio-ecological or regional economy system model, and so the interrelations remain unspecified.

3.2.5 Case Study Approach

In this research the urban-rural disaster linkage framework will be applied to a case of the Christchurch earthquake and recovery process with the aim to build understanding of urban-rural linkages in disaster recovery management lacking in developed countries. We aim to identify linkages and flows in the Christchurch recovery process, and to highlight their relevance for improving disaster recovery with a focus on resilience. Data was collected from initial recovery observations in Christchurch, interviews and secondary data analysis. However, our focus for this chapter will address only elements of governance, people, financial and waste (Table 3-2). In each case, we first identify the geographies, scales and relationalities associated with urban-rural linkages and then discuss their impact on the recovery process. We pay attention to the availability of data, issues of scale, prospects for management of and interactions among flows and linkages and politics of the transition making and responsibilisation taking place around them. We demonstrate a narrative of 'building back better' in Christchurch was entangled in both urban-rural linkages and national and global linkages. We identify challenges for economic geographers applying the urban-rural disaster linkage framework in developed countries.

3.3 Urban-Rural Linkages in Christchurch Earthquake Recovery

3.3.1 Governance

Following the earthquake of September 2010 and February 2011, Christchurch, Waimakariri, and Selwyn District Councils of Canterbury declared local states of emergency (Johnson & Olshansky, 2017). National and local government agencies fell short in managing recovery, resulting in the establishment of Canterbury Earthquake Recovery Authority (CERA), a special government agency responsible for recovery and rebuilding of the Canterbury Region. CERA operated for five years and ceased operations in April 2016. Additionally, the Canterbury Earthquake Recovery Act (CER Act) gave extraordinary powers to the Minister of Earthquake Recovery and Cabinet (Brand & Nicholson 2016).

The initial emergency response led by the Christchurch City Council (CCC) established Infrastructure Rebuild Management Office (IRMO) to begin immediate city infrastructure repairs. IRMO divided the city into four regions delegating New Zealand construction companies to manage repairs and emergency responses. After multiple earthquake events CCC developed a new procurement model, Stronger Christchurch Infrastructure Rebuild Team (SCIRT) to handle increasing workloads and demands. The SCIRT alliance was formed with national and local governments and the New Zealand Transport Agency as owner participants, and five major New Zealand construction companies as non-owner participants. SCIRT assumed responsibility for infrastructure repairs such as roads, utilities, water supply, wastewater, bridges and pump stations (Botha & Scheepbouwer, 2016). SCIRT was funded by New Zealand taxpayers, Christchurch ratepayers and a portion of insurance claims. Total rebuild projects were estimated to cost between two and three billion New Zealand dollars limited to five years and $2.1 NZ billion in spending (SCIRT, 2017).

Shortly after the February 2011 earthquake, CERA began developing a Christchurch-at-large recovery plan. CCC was asked to provide a draft recovery plan for the central city requiring approval by the Minister for Canterbury Earthquake Recovery. CCC's Share an Idea campaign took eight months resulting in a concept of radical urban planning interpreted as a community-led bottom-up practice focused on public spaces, green projects, sustainability, housing, art, culture and transportation initiatives (Brand & Nicholson, 2016).

Concerns as to how recovery would be financed and managed led to contested politics (Miles, 2012). CCC's plan was rejected by the Minister for Canterbury Earthquake Recovery, Gerry Brownlee deeming it too ambitious for implementation. The Minister directed CERA to rework the plan within 100 days. The result, the Christchurch Recovery Plan, more commonly known as the 'Blueprint', was seen as a top-down structure and plan focused on national government priorities involving reconstruction of critical public and economic infrastructure with a dramatic reduction in the central city core area (Brand & Nicholson, 2016).

CERA claimed the earthquakes resulted in an 'unprecedented opportunity' to remake Christchurch into an international city with a unique investment environment open for innovation, enterprise and diversity. 'Red tape' would be cut granting CERA special powers to fast track recovery, revise building codes, allow cutting-edge construction technologies and a five-day approval process for central city resource consent applications. The Blueprint featured 17 anchor projects (Table 3-2) designed to catalyse investments across the city centre using investment and funding models (CERA, 2016a).

Table 3-2: Christchurch Central: Anchor Projects and Precincts

Name	Functions
The Frame	urban design feature for green city core
Convention Centre Precinct	facility for domestic and international conventions
Stadium	35,000-seat facility to accommodate sports, concerts and events
Metro Sports Facility	recreation centre
Bus Interchange	public transport exchange
Te Papa Ōtākaro/Avon River Precinct	urban river park renewal project
Te Puna Ahurea Cultural Centre	centre to celebrate Ngāi Tahu and Māori culture
The Square	green area
Performing Arts Precinct	creative and cultural hub for city centre
Health Precinct	hospital site with education, innovation, and research facility
Cricket Oval	cricket venue for domestic and international tests
Residential Demonstration Project	medium-density housing for inner city living
Central Library	knowledge hub for city centre
Innovation Precinct	technology-based industry and research project
Retail Precinct	retail shopping destination
The Earthquake Memorial	honour and reflect those affected by the earthquakes
Justice and Emergency Services Precinct	justice, police, civil defence and emergency services

Source: Winder and Hofmann Zavareh, 2020 p.72

Outcomes of the anchor projects were largely viewed as the benchmarks for success or failure of CERA's legacy. Five years into the recovery many projects were either still under construction, in planning or development stages or left vacant and undeveloped due to expensive demolitions. Only three Blueprint projects were completed at the end of CERA's programme with only one, the Bus Interchange, completed near the target timeframe whereas ten projects should have been finished. Despite announcement of expansive rebuild projects, funding and initiatives, many media reports cited slow recovery. Effective April 2016, CERA was disbanded and dissolved into Regenerate Christchurch Ōtākaro Ltd., and the Greater Christchurch Group (Wright, 2016).

A further feature of recovery governance was the re-zoning of land containing approximately 7,000 homes unsuitable for repairs as 'red zone' subject to national government/CERA purchases. The dispute settlement process implemented resulted in some property owners losing equity or being unable to afford to purchase a similar property elsewhere resulting in a group of 'socio-economically disenfranchised individuals' who are unable or unwilling to participate in the rebuild (Miles, 2012). Thus the red zone, which cut across the idea of urban-rural linkages and divides, imposed penalties on some would-be rebuilders, constraining options and capacities and forcing some to migrate. For many residents, the housing rebuilding process was often a traumatic experience due to the complications of EQC governance.

Governance of the region's natural environment remained intact while recovery transformed governance of the city's built environment. CERA helped plan a regional scale initiative coordinated by existing governance structures along with Māori involvement insuring future natural environment services. In addition, both CERA's and CCC's efforts to open rural and edge city land for urban development stalled. No common vision has emerged for the urban-rural boundary in the greater Christchurch region (GCR). Further, the resilience-oriented recovery has interacted with other transition narratives, furthering planning for regional ecosystem services while sidelining an eco-mobility transition.

3.3.2 People

A national census survey was underway when the February 2011 earthquake struck. Much of the census data reporting for 2011 was cancelled resulting in no data being available for 2006-2013. Results of the 2018 census have not yet been released (Stats NZ, 2019). Media reports often cited that between 26,000 and 70,000 people, or perhaps 20 percent of the Christchurch population permanently left the city as a result of the earthquakes and damage in 2011 (Sachdeva & Levy, 2011; Binning 2011). However, these figures appear to be invalid. Studies of population movements reveal no more than a two percent change in permanent migration patterns leaving or entering either Christchurch or the GCR (Stevenson et al., 2011; Love, 2011). Nevertheless, the GCR experienced significant population changes resulting from the earthquake events. CCC (2018) reports GCR population in June 2011 at 454,600. The city's population loss was 14,000 in 2010 and 2011, and additional 7,200 between 2011 and 2012, or 6% of the city's pre-earthquake population. The city's population rebounded once the housing supply increased along with new employment opportunities, on average 1.5% growth per annum or 5,600 people per year. GCR population exceeded pre-earthquake populations reaching 500,100 in June 2017 and 511,300 in June 2018. GCR population is expected to continue to increase but growth scenarios suggest considerable uncertainty. Migration was the largest contributor to population growth in 2012 to 2013 due to the demand for skilled workers and labourers. These figures support immediate post-event population transfer from urban to rural areas as urban residents sought available housing, temporary or permanent work places and access to other critical services.

Māori populations (indigenous New Zealanders) largely reside in low socio-economic areas severely impacted by the earthquakes, and were disproportionally affected in managing access to resources. This resulted in a Māori tribal disaster response and recovery network (Māori Recovery Network or MRN) based on Māori culture, values, and practices and led by the Ngāi Tahu tribal council to ensure a coordinated response with other agencies (local and national). Māori residents received direct support from Christchurch-based marae (Māori community centres) such as Rēhua and Ngā Hau E Wha, which provided resources to rural areas as needed. Tribes based in the North Island also provided hubs to support earthquake support centres for their people in Canterbury (Kenney & Phibbs, 2014).

The New Zealand Budget for 2012 issued a $442 million package designed to cope with the anticipated shortfall of skilled workers, especially in engineering, construction and management professions. This resulted in increasing numbers of workers migrating from the United Kingdom, Ireland, United States, Philippines and China (Pickles, 2016; Stevenson et al., 2014). This inflow of largely male trade workers was interpreted as a demographic rupture by some residents who additionally cited unfair labour practices (Pickles, 2016).

3.3.3 Financial

The earthquakes resulted in sudden disruptions to many economic sectors including tourism, hospitality, retail, manufacturing, telecommunications and healthcare but did not severely impact overall economic activity (Chang et al., 2014; Parker & Steenkamp 2012; Orchiston et al., 2012; Stevenson et al., 2011; Stevenson et al., 2012). Economic recovery was slower than predicted for the Canterbury region in part due to a weak global economy and a high level of uncertainty surrounding rebuilding. Businesses were largely seen as resilient to the economic impacts (Parker & Steenkamp, 2012).

Firms faced reduced capacity, increased demand, higher administrative costs because of the need to manage insurance claims, relocations and tax deferments while employees simultaneously dealt with damaged or lost homes and helping family members or loved ones while managing the shock and trauma of experiencing the earthquakes. In these circumstances, workforce support was one of the most important types of help provided for businesses and organizations. Employee wage losses were offset with the Earthquake Support Subsidy provided by the national government for the 2010/2011 earthquakes allowing employers to continue paying wages during loss of business (Stevenson et al., 2012). Retail, accommodation and food sectors had the largest unemployment (in that order). Female workers had the most job losses and construction had the largest gain of employment (Parker & Steenkamp, 2012). Overall Canterbury had a 17 percent gain in employment with a 23 percent increase in job placement for the period between September 2012 and September 2017. By 2017 retail trade and accommodation added 17,500 more workers, up 46 percent from 2011. Median incomes also rose 26 percent from 2010, nearly 5 percent higher than the national average (18 percent) in New Zealand (Stats NZ, 2018).

Businesses and industries assisted one another to bridge ties to other networks and network actors to maintain operations. For example, pharmacies temporarily shared premises or made orders through another pharmacy supplier. They assisted one another with deliveries, and used storage and warehouse facilities in Wellington. Within Canterbury, local economies impacted by the earthquakes obtained 70 percent of this assistance from organizations located in Canterbury (so a high level of rural support), 24 percent from elsewhere in New Zealand, and 4 percent internationally. However, 40 percent of the financial resources used to manage recovery were obtained outside of Canterbury due to the spatial distribution of monetary resources, discounts and credits used by businesses (Stevenson et al., 2012).

Christchurch's Central Business District (CBD) experienced severe damage resulting in cordons implemented by local government and CERA restricting access. Over 700 of the total of 1,000 commercial buildings initially designated for demolition were demolished. In the short-term, CBD businesses were not allowed to operate and had to be temporarily relocated resulting in a 31 percent permanent business closure. Suburban commercial space charged higher rents with multi-year leases. Business interruption insurance was available for some firms but often faced claim challenges, such as denial-of-access terms to allow businesses denied access to their building to be still be eligible for insurance pay-outs. The CBD's long-term outlook was uncertain because of firm relocations, concerns over insurance pay-outs, total demolitions, total buildings being reconstructed, policies on building standards and treatment of heritage buildings (Chang et al., 2014).

Global-local geographies of financial flows and linkages occurred due to bankruptcies of local insurance companies, liabilities for reinsurance companies and the reorganization of EQC finances. The New Zealand property insurance market has been reregulated resulting in dramatic increases of insurance premiums for all New Zealand property owners as well as reassessment of risks as evidenced by heritage buildings deemed too expensive to insure or outright uninsurable (Gibson, 2013a, 2013b and 2013c). Massive sums of money changed hands but these were not flows from rural to urban areas. Rather inter-corporate and global transfers occurred facilitating or constraining local rebuilding capacities. Neither local geographies, linkages or flows produced are necessarily marked by a rural-urban divide. In addition, there were flow-on effects well beyond Canterbury, including the reprioritisation and delay of infrastructure projects elsewhere due to either government funding or lack of capacity to manage reconstruction recovery. Thus, the disaster continues to have financial effects, not necessarily in rural Canterbury, but throughout New Zealand.

3.3.4 Waste

Waste management policies were not considered part of the Christchurch planning process so were managed by local and national government agencies and contractors. CERA adopted a "quick pick and go" method to direct waste to its end-use market (Domingo & Luo, 2017). CBD building demolitions created a significant amount of debris and issues for waste management. This resulted in investment in processing facilities at landfills to manage possible reuse of materials and avoid potential drinking water contamination. Since the CBD was cordoned off, a controlled construction zone for pre-sorting and concrete-crushing was possible and allowed building owners to sell salvaged materials (Chang et al., 2014). However, recent findings indicate treatment of waste at debris sites was either mishandled or ignored (Brown et al., 2011; Domingo & Luo, 2017).

Approximately 4.25 million tonnes of demolition waste were processed at the Burwood Resource Recovery Park. Land reclamation was used to dispose of 'clean' waste but most waste was sent to landfills due to the inadequate separation of waste during removal resulting in more waste. Surcharges were applied at the landfills to cover the handling of asbestos waste from demolitions. However, levies usually assessed on waste disposal in order to reduce waste transferred to landfills were eliminated to encourage recovery (Domingo & Luo, 2017).

Despite numerous damage reports, the potable water system proved to be much more resilient than expected and services were quickly restored. Māori Wardens and community volunteers assisted the New Zealand Armed Forces in distributing chemical toilets and often responded to issues with sanitation services (Kenney & Phibbs, 2014). Approximately 780 port-a-loos were distributed around the Christchurch region with an additional 250 in transit from other regions in New Zealand and 963 from the United States as well as another 30,000 requested by CCC (Potangaroa et al., 2011).

3.4 Discussion

This investigation of the centralized approach to the Christchurch earthquake recovery programmes and economic impacts of the disaster reveals the recovery process as an example of an abrupt event with unexpected consequences despite extensive planning and potential risk reduction. Government responded to 'shocks' with 'responsive action' as a 'resilience' style under

Leach et al. (2010) framework. Fundamental, long-term and wide-ranging socio-economic system transformations were planned. For example, part of the city will never be rebuilt: it was located in the wrong place due to environmental and geotechnical factors. Significant funds were available for recovery since nearly all property and infrastructure was fully insured. New governance shaped geographies of recovery stories inside the Canterbury region but these do not adhere to urban-rural divides, linkages and flows.

The 'drawn-out' rebuilding of the city centre contrasts with both the quick resumption of business as usual in many rural and suburban areas and the long-term paralysis associated with red zone property futures. Miles (2012) contends CERA's role became politicized seen as a vehicle for the top-down decisions, obstructing opportunities for the affected community to be active in the creation of the recovery plan while emphasising residents' roles as taxpayers, ratepayers and consumers of services rather than as citizens. New governance relations reclassified some property rights. This perception is not shared by all commentators, but certainly the chosen leadership and governance styles influenced by planners, engineers, designers, disaster specialists, NGOs, and the local and national government were all, one way or another, shocks to the community. More importantly, they were shocks to the adaptive capacities of residents across the region, favouring some and penalising others. Yet, the new political climate did not clearly divide the region on urban versus rural lines. Rather, the new governance relations involved the temporary dissolution of local governance and the promotion of experts and corporations from outside the region.

New mobility patterns, including migration to rural areas, occurred as a result of the February earthquake events as residents resorted to their extended support networks. The flows proved difficult to discern because of the multiple earthquake series and disruption of normal data gathering, but movements went well beyond migration to adjacent rural areas to include migration to greater New Zealand and emigration. For residents, such as many Māori, who were unwilling or unable to move, national and regional support began to be delivered through Christchurch-based service providers, and notably the city's maraes also supported affected rural communities. Further, these responses were soon overridden by a wave of in-migration of construction workers from overseas. Thus, the framework's narrative of mobilising rural support for urban recovery is less relevant in the Christchurch recovery than the use of global, national and regional resources, many of which could be brought to Christchurch.

The earthquakes disrupted Christchurch CBD businesses forcing relocation of operations and acceptance of assistance from the national government or other Canterbury firms or networks to stay in business. Rural to urban support did occur, but the precise geography of these flows of finance and assistance varied by business networks and access. In addition, the earthquake recovery induced massive financial flows from the global insurance industry into New Zealand. While these flows were delayed in reaching Christchurch, they had profound effects including facilitating strategic investments in the Canterbury economy that would not otherwise have occurred and channelling construction capabilities away from other New Zealand regions to Christchurch. Operations at Christchurch's vital South Island transport infrastructure, the port and airport, were only partially disrupted by the earthquake events, but recovery has enabled large scale reinvestment in transport and tourism related infrastructure facilitating increased agricultural export and tourism activity. Such flows were not expected in existing regional economic models whose parameters and trends have been transformed by the earthquakes and recovery.

3.5 Conclusion

The analysis and discussion makes evident that: (1) the elements in the urban-rural linkages framework are interconnected; (2) the relationalities assumed in Srivastava and Shaw's (2013, 2016) framework do not always hold, and (3) emphasis on urban-rural linkages may obscure other geographies of the recovery. This recovery involves rural transformation where rural infrastructure is repaired, semi-periphery housing is needed, and agricultural intensification is planned. Simultaneously, it requires urban transformation: a new, smaller CBD is built and the red zone is demolished to allow restoration of vital ecosystem services. It also involves global flows and linkages: insurance funds and construction workers flow in from overseas; there is some outmigration to other regions and countries as well as the urban periphery; international insurance companies suffer losses; New Zealand earthquake risks are reset; there are flow-on effects to other New Zealand regions. Ultimately, "the long series of physical aftershocks carries on and the local, national and global implications of Canterbury's loss continue to reverberate." (Pickles, 2016, p. 6).

The disaster and recovery involved tele-coupling between regions, and between physical systems (atmosphere, land and ocean), but also among economic and social systems and at all scales: the global, national, inter-regional, urban, peri-urban and rural are entangled. With such surprise events as these the idea that economic geographers can be prepared to deploy their carefully researched models of (socio-ecological or regional economic) systems at the right regional scale to advise on building back better is a highly questionable endeavour. Such an abrupt event transforms research questions, governance structures, ideas about resilience and framings of economic systems that do refer to the environment. Instead, economic geographers can understand 'resilience' as a narrative of recovery within a transition framework and therefore as a specific and shifting politics of recovery with contested terms of reference. The challenge for economic geographers is to come to terms with 'resilience' as a narrative within a transition framework.

4. Micro-Level Assessment of Regional and Local Disaster Impacts in Tourist Destinations

Chapter 4 was initially conceived by Prof. Dr. Jürgen Schmude (JS) for a presentation, "Tourism and Natural Disasters: The case of Dominica" at the 2016 Tourism Naturally Conference (Alghero, Italy). The conference presentation was selected as part of a special publication, Tourism in Changing Environments (Ooi et al., 2018). JS developed the MLAM model and made the necessary calculations. The theoretical research framework (adapted from Ritchie 2004) was developed by SZH. The computations were performed by JS, Katrin Schwaiger (KS), and SZH. The manuscript was written by KS and SZH with supervision from JS. All authors provided critical feedback and contributed to the final manuscript (Schmude et al., 2018).

4.1 Introduction

Natural disasters range from volcanism, earthquakes, hurricanes and tropical storms bringing destruction and severe consequences such as flooding, landslides, or built infrastructure destroyed to the impacted region. The severity of disaster impacts largely depends on a country's wealth, the state of its economic development and diversification (Hallegatte & Ghil, 2008; Heger et al., 2008; Kahn, 2005; Neumayer et al., 2014; Toya & Skidmore, 2005). Impacts of natural disasters can be assessed as four types of damages: direct damages referring to impacts on housing or roads; indirect damages such as job losses or health deterioration; quantitative damage (tangible effects) related to the absolute monetary losses caused by destruction of buildings; and qualitative damage (intangible effects) signifying insecurity or social disruption (ECLAC, 2003; Hallegatte & Przyluski, 2010; Merz et al., 2004). Countries with greater economic development and diversity at the time of a disaster tend to experience lower disaster losses, whereas countries largely dependent on tourism alone are more likely to be impacted by disaster events (Kim & Marcouiller, 2015; Noy, 2009). Moreover, natural disasters are likely to increase due to the challenges brought about by climate change resulting from changes in air temperatures, precipitation rates, sea level rise, an increased frequency of heat waves, hurricanes, tropical storms, and higher tropical cyclone-related rainfall rates (IPCC, 2014; Knutson et al., 2010; Trenberth, 2011).

Small island developing states ('SIDS') are especially vulnerable to hurricane and tropical storm hazards (Briguglio, 2003; Collymore, 2011; Forbes et al., 2013; IPCC, 2007; Meheux et al., 2007; Mimura & Nurse, 2017). The likelihood of natural disasters in small islands is attributed to their limited resources, size, their location surrounded by ocean waters, and rising sea levels (Ferdinand et al., 2014; Mimura et al., 2007; Pelling & Uitto, 2001). SIDS are some of the most disadvantaged places affected by global warming (IPCC, 2007), and viewed as one of Earth's barometers of climate change (Kelman & West, 2009). Furthermore, climate change is an important factor leading to increased hazard exposure in the tourism sector for island destinations (Becken et al., 2014; Tsao & Ni, 2016). Many SIDS are dependent on tourism and are susceptible to the consequences of climate change due to increased damages to tourism infrastructures (Becken & Hay, 2007; Ibarrarán et al., 2009).

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This is referred to as ‘endangered future’ for tourist destinations because tourists are less likely to choose destinations where they perceive increased hurricane risk (Forster et al., 2012). This further illustrates the high influence disasters have on the tourism industry and the reputation of a destination (Durocher, 1994; Méheux & Parker, 2006).

Most research on disaster impact assessment is from a macroeconomic perspective only addressing consequences and impact analysis, yet tourism-based communities are rarely discussed independently in dealing with natural disasters (Kim & Marcouiller, 2015; Tsai & Chen, 2011). Studies largely focus on entire countries without providing more detail on specific damages for smaller regional scales while omitting regional particularities of a countrywide disaster. Misleading conclusions about the gravity of the disaster are likely if damages are solely assessed at a national level or do not consider the scale of impacts. These kinds of analysis do not provide the disparity of damages created from the disaster where some areas are more affected than others, thus making it more difficult to distribute governmental and financial assistance, or other available subsidies to residents. Financial assistance must not only be given to the entire country, but should be distributed accordingly to those areas with the worst impact in a time-efficient manner to avoid additional disaster aid barriers created by long negotiations with donors (Pelling et al., 2002). While dealing with the aftermath of disasters requires structured and accurate governance, sub-national distribution of economic support is necessary (Scolobig et al., 2014; Strobl, 2012).

To date, developing models estimating damages at local scales has not taken place within tourism research. We address this challenge by developing a micro-level assessment model (MLAM) to determine precise damage assessments. Dominica was chosen as study area due to the significance of the tourism sector for the island, the increased likelihood of hurricanes and tropical storms, as well as the additional dangers faced from climate change (e.g. sea level rise). Pre-disaster adaptation measures generally are preferable, such as improved hurricane warnings may decrease damages from disasters (Sadowski & Sutter, 2005), or the use of pre-disaster risk estimations to manage post-disaster losses (Tsai & Chen, 2011; Tsao & Ni, 2016). Implementing such measures is costly and requires the consideration of more than one hazard exposure (Anderson, 1995). We highlight the importance of regionally differentiated impact analysis using possible forced adaptation measures as described by Tervo-Kankare, Kajan, and Saarinen (2016), because they can be viewed as ‘benefits’ for future disasters. While MLAM is a tool that primarily aids in post-disaster damage evaluation, it may be relevant for governments and institutions supporting appropriate disaster recovery processes for communities to decrease future vulnerabilities. The model is described in greater detail first by providing a literature review of disaster impact assessments, second a discussion of the study area and disaster implications, and third by identifying the methodology used to determine the financial consequences for the tourism sector to draw conclusions from the disaster and recovery process.

4.2 Literature review

Islands are known for their vulnerabilities to natural hazards creating substantial risks for tourism industry economies (Becken et al., 2014). Although there are myriad forms of natural disaster impact assessments in the literature, the tourism sector has often not been a focal point of research in the context of natural disasters (Kim & Marcouiller, 2015; Tsai & Chen, 2011). Current analysis is conducted from a macroeconomic perspective estimating general impacts on local economies in terms of costs and consequences of individual disasters on a wide range of scales (Baade et al., 2007; Horwich, 2000; Selcuk & Yeldan, 2001; Vigdor, 2008), including entire countries or even continents (Cavallo et al., 2010; Jovel, 1989). The most common variables used for economic damage assessments are the number of people killed or number of persons affected (Jovel, 1989, Kim & Marcouiller, 2015; Noy, 2009; Vigdor, 2008), the rise in external transfer payments and grants (West & Lenze, 1994), monetary damages (Baade et al., 2007; Cavallo et al., 2010; Jovel, 1989; Kim & Marcouiller, 2015; West & Lenze, 1994), production losses (Hallegatte & Przylusky, 2010), macroeconomic growth rates or general changes in the GDP (Albala-Bertrand, 1993; Benson & Clay, 2004; Horwich, 2000; Strobl, 2012), and employment changes (Coffman & Noy, 2011; Ellson et al., 1984; Ewing & Kruse, 2005).

There is a need for disaster phenomena research specifically related to tourism (Faulkner, 2001; Faulkner & Vikulov 2001; Ritchie, 2004). Lee and Chi (2013) provide examples as to how to analyze disaster impacts on tourism by measuring the change of annual visitors in Taiwan at scenic spots after the 1999 earthquake. Tsai, Wu, Wall, and Linliu (2016) conducted qualitative interviews with local communities in Taiwan measuring perceptions of tourism impacts on communities, thereby demonstrating that the impact of disasters on the tourism sector is critical to understanding tourism disaster recovery.

Apart from assessments of social components such as visitors or impacted community residents after a disaster, it is common in literature to use economic indicators for disaster impact analysis. Irrespective of a disaster impact, standard assessments of economic impacts (e.g. by the tourism industry) for a region are conducted with input–output (IO) or computable general equilibrium models (CGE) (Dwyer et al., 2004; Kumar & Hussain, 2014). Advantages and disadvantages of both approaches for disaster impact analysis have been assessed, and IO models in general are considered insufficient for estimating potential substitution effects for impacted regions (Koks et al., 2016). Although the two common models of economic impact analysis are valuable methods to estimate economic impacts after natural disasters, micro-level assessments on a small regional level are omitted from these calculations.

Specific damage assessments in the Caribbean demonstrate further ways of estimating social and economic effects of natural disasters (volcanoes, hurricanes, and earthquakes) calculated on the macro-level (Cross, 2007; Jovel, 1989). Countrywide assessments of financial damage of hurricanes David in 1979 and Hugo in 1989 were conducted by Benson, Clay, Michael, and Robertson (2001), and Benson and Clay (2004). Rasmussen (2004) evaluated the long-term macroeconomic effects of disasters from a country-level perspective highlighting the effects of fiscal balances, as well as the necessity of pre-disaster risk reduction plans essential for recovery. Aspects of recovery are visible in media portrayals of disasters suggesting damage to the entire country (Faulkner, 2001; Huang & Min, 2002), or portrayals of large financial losses by emphasizing additional negative economic impacts (Albala-Bertrand, 1993). How well the tourism sector manages to convince the public that everything has returned to normal business is seen as the short-term basis for disaster recovery (Rowe, 1996). However, natural disasters are seen often as a national problem experienced at local levels with varying impacts on the supply and demand side of the economy (Cole, 1995). This is likely to result in a weakened economic development for a region or country despite having an adaptable tourism industry (Faulkner, 2001). Although the disaster may trigger new economic growth through the stimulus of reconstruction activities, there should be adequate financing, local personnel, and materials made available (Skidmore & Toya, 2002). Hallegatte and Przyluski (2010) collected data on the global effects from the 2010 earthquake in Port-au-Prince and Hurricane Katrina 2005 to calculate direct and indirect losses, changes in housing prices, length of reconstruction phases, and the stimulus effect of a disaster that is triggered by reconstruction activities. Pelling et al. (2002) further recognized the necessity of integrating disaster vulnerability into pre-disaster development planning in assessing direct financial and indirect damages by applying a holistic accounting of macroeconomic impacts with multiple disaster case studies.

Sector-specific research and micro-level analyses of financial disaster effects are not the main focus in natural disaster assessments. Instead, much of the analysis and focus addressed the problems of landslides (DeGraff et al., 2010; DeGraff et al., 2012; Maharaj, 1993). The current focus on macro-economic damage assessment in research should include examinations of individual economic sectors that were impacted by a disaster. Large differences among geographic regions and the shortage of available data at the micro-level are key reasons why existing research on natural disaster impacts seldom addresses damages and consequences at such small scales. Analyses lack a micro-level perspective for post-disaster impact analysis in these studies to provide a more in-depth critique of disaster recovery and impacts on financial aspects, particularly in the tourism industry. This implies real danger of distorting and misunderstanding disaster impacts.

Disaster impact analysis can be incorporated in various disaster assessment frameworks currently in the literature with small-scale disaster assessment in mind (Faulkner, 2001; Hystad & Keller, 2008; Lindell et al., 2006). This should be simultaneously examined as part of sustainable disaster recovery planning, especially at the community- level given that there are significant vulnerability variations impacting potential disaster recovery (Lindell, 2013). Disaster recovery processes involve different aspects of physical, social, economic, and environmental elements for communities through pre and post-event (Smith & Wenger, 2007). Pre-event and post-event planning both are an integral part of Faulkner's (2001) tourism disaster management framework and Hystad and Keller's (2008) disaster management framework. Lindell et al. (2006) developed a disaster impact model emphasizing three emergency management interventions for the predisaster phase (hazard mitigation, emergency preparedness, and recovery preparedness) and a post-disaster phase (mitigation of physical and social impacts). The role of individual stakeholders is particularly emphasized by Hystad and Keller (2008). They show when stakeholders are involved in the post-disaster resolution phase then they are more likely to be better prepared for future disasters. Pre- and post-disaster recovery planning are important elements of disaster recovery theory for sustainable communities (Smith & Wenger, 2007). Often the tourism industry tends to be ill prepared for disasters regardless of having knowledge of existing vulnerabilities (Becken & Hughey, 2013). Therefore, we focus on a post-disaster impact assessment at the local-scale to support sustainable disaster recovery in order to reduce vulnerabilities for the tourism sector.

4.3 Methodology

4.3.1 Study Area

We selected the island of Dominica as study area specific to tourism disaster recovery for three reasons. First, tourism plays an important role for island destinations resulting in economic dependency where tourist destinations are particularly susceptible to the consequences of climate change (Becken & Hay, 2007). Second, the SIDS Dominica and according tourism sector will continue to face severe challenges and consequences due to climate change since it poses the most threat for island communities (Forbes et al., 2013). Third, islands can be regarded as isolated systems, allowing measuring all economic input and output flows including the tourism industry.

Dominica is located within the Lesser Antilles in the Caribbean. Dominica is characterized by a mountainous interior covered in tropical rainforest, and a variegated coastline. Formerly reliant on the single export commodity bananas (Payne, 2008), the island is transitioning towards a promising tourism development. Dominica's Tourism Master Plan sees tourism as the main income generator of the future, drawing attention to the importance of sustainable development (Commonwealth of Dominica, 2013). Accordingly, the island is advertised as the 'nature island' boasting 'sustainable tourism' (DDA, 2013); a claim made plausible by the absence of mass tourism due to the island's geography (Timms & Conway, 2012).

Dominica's disaster vulnerability results from extensive zones of weakened rock, over steepened slopes, large rainfall amounts and occasional seismic activity that facilitate landslides (Teeuw et al., 2009), and one of the highest concentrations of potentially active volcanoes in the world (Lindsay et al., 2005). Due to its location in the tropical hurricane belt, each year hurricanes and tropical storms pass over the entire region, each one affecting different islands and to various extents. From 1872 to 2015, Dominica was hit by 22 hurricanes and 32 tropical storms (Hurricane City, 2016).

4.3.2 Tropical Storm Erika

On 27 August 2015, tropical storm Erika passed over Dominica bringing extraordinary rainfall resulting in rapid flooding and landslides throughout the island, particularly affecting the south and southeast parts of the island (Commonwealth of Dominica, 2015). Tropical storm Erika reached peak wind speeds of 50 mph, within the wind speed range of tropical storms according to the Saffir Simpson scale (39–73 mph; National Hurricane Center, 2016). Each location of Dominica's climate stations recorded more than 200 mm of precipitation within four hours, while some areas reached a maximum of 400 mm in the same period. The rainfall peak occurred between 4 AM and 10 AM while most residents were still in their homes when the series of flashfloods and landslides began. The situation was further aggravated by surface runoff from steep interior parts of the mountainous island reaching the coastal areas within just a few hours. The island's steep water catchments faced quick and intense runoff, exacerbating the effects of the rainfall and together resulting in severe impacts for just a few areas.

Officials claimed Dominica had been set back 20 years in tourism development as a result of tropical storm Erika with nine communities declared 'special disaster areas' by Prime Minister Roosevelt Skerrit (Commonwealth of Dominica, 2015). The storm resulted in the death of twelve people, 20 injured, 22 persons were listed as missing, 574 as homeless, 713 had been evacuated, and 7229 were living in a disaster area (IFRC, 2015). Storm Erika generated total financial damages of US$ 482.84 million, corresponding to 90% of Dominica's GDP in 2015 (GFDRR, 2015). The tourism sector was the fourth highest affected sector with total financial damages of US$ 31.18 million (Table 4-1), resulting in severe damage to the national economy due to its dependency on tourism. Furthermore, indirect costs for tourism were caused by impacts to roads and bridges, further aggravating the island's tourism sector since it is highly dependent on a functioning infrastructure to access individual tourist areas.

Among the island's 95 hotels, 31 suffered direct losses, including 11 hotels that ceased operations, and two hotels were completely destroyed. The hotel losses alone add up to a financial damages of US$ 15 million for Dominica (GFDRR, 2015). As a consequence, the number of overnight arrivals decreased from 7097 in May 2015 to 5645 in May 2016, corresponding to a net loss of 20.5% (Statistical Office Dominica, 2016). Over-night visitors comparing May 2015 and May 2016, decreased for all types of accommodation within a range of 30% to 60% (Table 4-2).

Table 4-1: Storm Erika damages and losses by sector

Sector	Damage (US$ millions)	Loss (US$ millions)	Total (US$ millions)
Roads & Bridges	239.45	48.28	287.53
Housing	44.53	9.61	54.15
Agriculture, Fisheries, Forestry	42.46	4.87	47.33
Tourism	**19.48**	**11.70**	**31.18**
Water & Sanitation	17.14	2.38	19.52
Others	16.38	2.08	18.36
Air and Sea Ports	14.90	0.08	14.98
Industry & Commerce	9.13	0.56	9.69
Total	**403.28**	**79.56**	**482.84**

Source: Schmude et al., 2018, p. 7

Table 4-2: Dominica change in over-night arrivals by accommodation type, May 2015 and May 2016

Accommodation type	Over-night arrivals May 2015	Over-night arrivals May 2016	Change May 2015 vs. May 2016
Bed & Breakfast	79	32	-59.5%
Guest House	406	231	-43.1%
Hotel	1,730	1,057	-38.9%
Apartment/Cottages	655	438	-33.1%
Dive/Eco Lodge	174	194	11.5%

Source: Schmude et al., 2018, p.7

Table 4-3: Dominica quarterly over-night arrivals, 2013, 2014 and 2015

Quarterly Arrivals	2015	2014	2013	Change 2015 vs. 2014
(1) Quarter	20,695	20,470	20,334	1.1%
(2) Quarter	18,211	18,614	16,622	-2.2%
(3) Quarter	20,690	21,372	20,407	-3.2%
(4) Quarter	14,878	21,055	20,914	-29.3%
-October	4,611	8,584	8,982	-46.3%
Total	74,474	81,511	78,277	-8.6%

Source: Schmude et al., 2018, p. 7

Apart from direct effects, one example of secondary effects of the storm was the cancellation of the Creole Music Festival in October 2015, which added to the additional loss of revenue for the tourism sector. This can be illustrated by the number of over-night arrivals in the fourth quarter of the years 2013–2015 (Table 4-3). In 2015, the fourth quarter saw a decrease in over-night arrivals by 29.3% in comparison to 2014. For the festival month of October, there was a 46.3% decrease between the same years. Influence of the Creole Music Festival on tourism arrivals is also illustrated by a monthly comparison of stop-over arrivals. In October 2014, the number of overnight arrivals was 8584, exceeding the arrivals during the season in January and February (6422 and 7400 arrivals, respectively). Consequently, the drastic decrease in overnight arrivals in the fourth quarter in 2015 compared to 2014 can be attributed to the cancellation of the festival, yet it cannot be determined whether arrivals statistics have recovered or will recover in the long-term.

Furthermore, the decrease of arrivals can partly be attributed to the destruction of several accommodation facilities. The Jungle Bay Resort ('JBR') was one facility located within the community of Petite Savanne, and provided a substantial source of income for several communities in Dominica (Figure 4-1). This is in large part due to the accessibility of JBR from the northern parts of the island, which do not allow for employees to have long-distance commutes outside the community. As the fourth largest hotel in Dominica by room numbers, JBR displayed higher personnel expenditure than other hotels of comparable or larger size due to the focus on sustainable tourism as a luxury resort. JBR will be used as case example to illustrate the disaster impact assessment model which can be used to estimate direct and indirect economic effects of natural hazards on tourism and regional development.

Historically, the area in which JBR was located has been devoid of landslides and severe hurricane activity. Unpredictable landslides following intense rainfall caused complete destruction of the resort facilities and major flooding carrying debris cut-off the main road connecting the southwestern and southeastern parts of Dominica. To date, this break in the main road is irreparable. The communities most severely impacted (e.g. Petite Savanne, Delices, and Boetica) were unprepared for a tropical storm with such devastating destruction. Ultimately, JBR's destruction led to severe economic consequences for areas with a large share of employees or suppliers because JBR cannot be rebuilt in the same area due to its status location classified as a permanent disaster area. JBR was the only large employer in this area, and facilitated a detailed assessment of communities' job markets without being influenced by many other economic factors.

4.4 Research model and data

The tourism disaster management framework proposed by Faulkner (2001) is used as the theoretical background. The relevance and application of Faulkner's (2001) framework for this study is due to the specific focus on destinations' tourism sector based on the literature review of relevant frameworks. Faulkner (2001) emphasizes the importance of scale, specifically community scale in describing disaster stages regarding disaster response. Community scale analysis is needed because of how disaster impacts and recovery differ among tourism regions and stakeholders (Faulkner, 2001). Ritchie (2004) expands on this framework, stressing disaster recovery is a crucial aspect within the tourism industry, but there is also a need for local level approaches to test and verify models utilized in the tourism disaster management.

The framework addresses six phases of a disaster requiring different types of tourism disaster strategies:

(1) Pre-event: strategies to mitigate or prevent disaster effects.

(2) Prodromal: strategies needed when a disaster is imminent.

3) Emergency: action needed during the effect of a disaster.

(4) Intermediate: short-term measures.

(5) Long-term (recovery): continuation of phase (4).

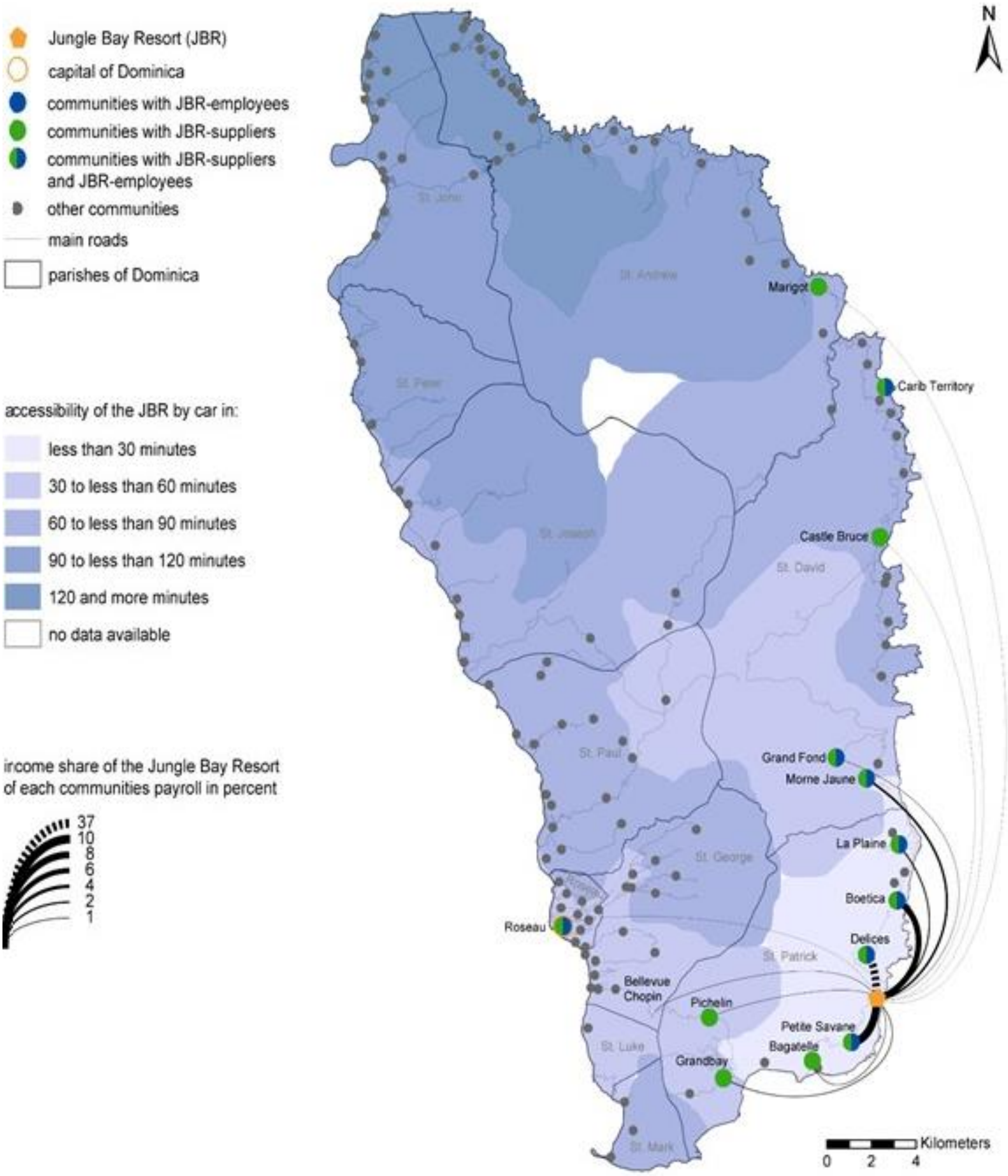
(6) Resolution: restoring routine.

Mair, Ritchie, and Walters (2014) note that there have been few cases where Faulkner's (2001) tourism disaster framework has been tested and suggest that there is a need for detailed models at each phase of the crisis or disaster lifecycle (e.g. reduction, readiness, response, and recovery). Due to this necessity of micro-level post-disaster damage assessment in the tourism sector, we focus on the precise handling of phases (4) and (5) to facilitate a successful and time-efficient phase 6 of resolution for Faulkner's (2001) framework.

Generally, disaster impacts can be investigated focusing on aspects such as material destruction causing direct economic loss (e.g. houses, infrastructure), disruptions of social structures (e.g. family linkages) or indirect economic consequences (e.g. loss in income). This model focuses on the economic consequences of the material destruction of touristic infrastructure accompanied by a loss in income in a community. Ritchie (2004) stresses the importance of the tourism sector and disaster management needing to understand the interdependence and impacts on economies and livelihoods. This aspect is particularly relevant since this can be an important indicator of livelihoods or adequate standards of living when estimating disaster impacts due to the loss of income affecting a community (e.g. indirect impacts due to the decline in revenue in the community or migration forced by the loss of employment). However, financial compensations are generally paid based on the material destructions, which do not cover the actual economic impacts of a disaster on a community. These indirect economic consequences so far have not been investigated on a small spatial level since data on the loss of jobs in most cases is only available on a regional or national level. Therefore, such information would be crucial for the development of adequate disaster recovery strategies. Calculations of monetary damages alone, even if regionally differentiated do not provide adequate information about the economic disaster aftermath for local or national recovery programs for residents. It is necessary to measure micro-level impacts on local economic situations for disaster areas in order to allocate appropriate financial programs and implement adequate recovery programs supported by local and national governments as suggested by Pelling et al. (2002) and Skidmore and Toya (2002). Areas where large parts of the job market and income sources for residents have been terminated or reduced from disasters require more financial assistance than areas with limited economic impact relying on the reconstruction of tourism infrastructure or the tourism economy.

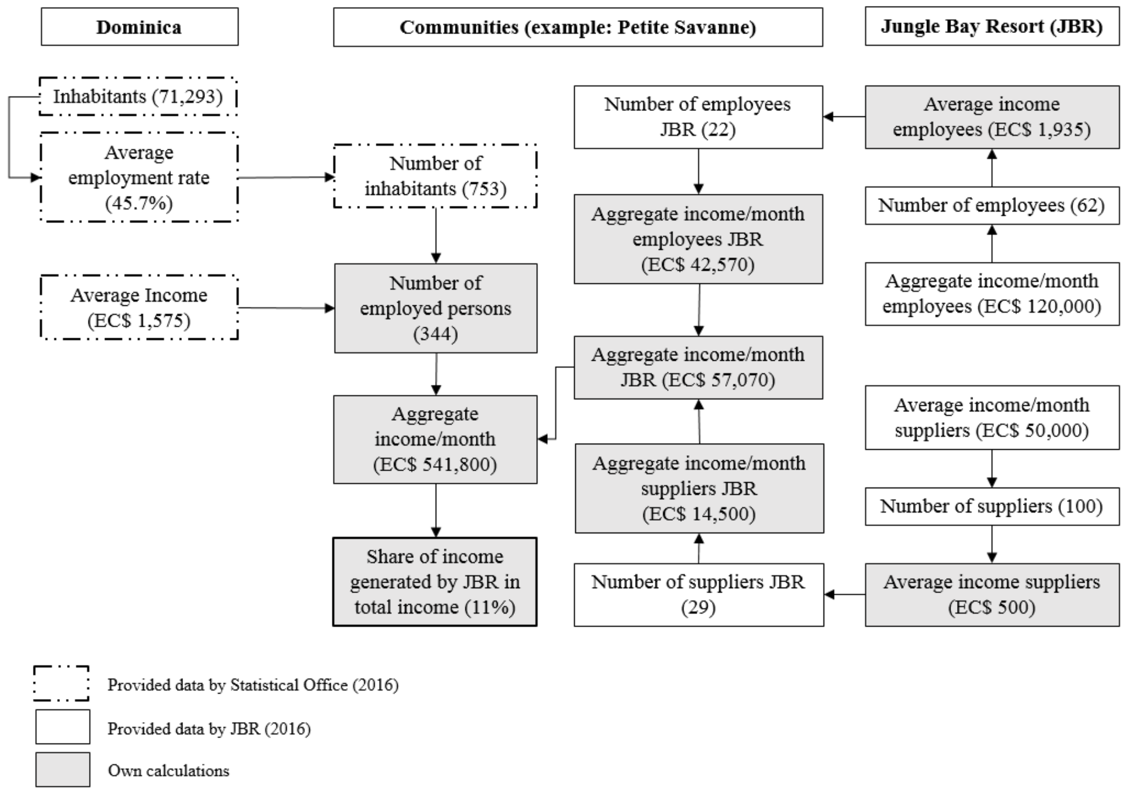
For these reasons we developed an economic calculation model capable of analyzing natural disaster damage in a specific localized region to obtain calculations of losses for communities managing recovery. The calculation of economic impacts in this research model is based on three spatial levels (local, regional and national) in relation to the pre-disaster touristic infrastructure incorporating data such as employment rates on countrywide and community-based levels, as well as community-by-community aggregated income. Detailed data about the precise income structures of one major tourism employer which has been destroyed during the disaster is used to calculate direct financial consequences for the corresponding dependent communities. The pre-destruction share of income of employees in specific areas provides a better understanding of the impact to the regions' job market and economic state for the residents.

Figure 4-1: Research area - JBR effects on the regional labor market.



Source: Schmude et al., 2018, p. 9

Figure 4-2: Micro-level analysis model (MLAM): calculation of JBR income share in total income for a sample community.



Source: Schmude et al., 2018, p. 11

4.5 Micro-level impact assessment

MLAM is calculated on the basis of data on the countrywide (Dominica), community-based and at a specific local-level (case study JBR) from the year 2015 (Figure 4-2) to estimate financial consequences for community residents formerly employed at JBR. The calculation of financial losses from JBR's destruction utilizes average numbers for Dominica's employment rate and the monthly income. Average values are used for the income of JBR employees and suppliers (e.g. room service, reservation manager, and housekeeper) and for the general level of income in Dominica, as it is not possible to determine regionally differentiated values in terms of urban versus rural areas, and job type (e.g. agricultural versus tourism sector employee), even within JBR. Petite Savanne serves as an example to illustrate the steps undertaken to calculate the share of income generated by JBR for the total income of the community. Analogously, economic impacts of employment were calculated for all communities (Table 4-4).

To estimate the number of employed persons in each community, Dominica's average employment rate (45.7%) was applied to the number of community residents. In 2015, 344 people were employed in Petite Savanne, 22 whom were employees of the JBR. Average incomes were calculated both countrywide and JBR-specific using average monthly wages at countrywide and local levels to determine the differences in average wage structures. The average income of EC$

1575/month and the number of employed persons in communities were used to calculate community-wide monthly revenues of EC$ 541,800 in Petite Savanne. Dominican average monthly income (EC$ 1575/month) is below the average income for employees of JBR (EC$ 1935/month), emphasizing the significance of JBR as an employer for the region and impact on the affected communities. The average income of a JBR supplier is EC$ 500/month, resulting in aggregate incomes of JBR employees and suppliers yielding approximately EC$ 120,000/month for JBR employees and EC$ 50,000 for JBR suppliers. In the case of Petite Savanne, the aggregate income per month generated by JBR is EC$ 57,070 (employees and suppliers included). This results in the share of income generated by JBR to the total income of communities (11% for Petite Savanne) (Table 4-4). The share of income refers to the share of income generated by suppliers and employees in the overall income of specific communities. This calculation was possible due to the availability of community-wide monthly revenues using aggregate income/month related to JBR and the aggregate income/per month for the entire community.

Table 4-4: JBR community share of employees and income, 2015

Community	JBR Employees	Share of JBR employees	Suppliers of JBR	Share of JBR income
Delices	20	21.1%	33	37.0%
Petite Savanne	22	6.4%	29	10.5%
Boetica	4	5.9%	2	8.2%
La Plaine	6	1.2%	5	1.7%
Roseau	4	0.1%	13	0.1%
Others	6	0.1%	18	0.1%
Dominica	62	0.2%	100	0.3%

Source: Schmude et al., 2018, p. 12

The resort's destruction by tropical storm Erika left 62 direct employees unemployed and immediately ceased arrangements with 100 suppliers. In 2015, 6.4% of employed people in Petite Savanne (suppliers not included) were employed by JBR. Overall income of 11% in the community was generated by employees' and suppliers' income. The highest losses of community income (employees and suppliers) are found in Delices, where 37% of income has been terminated. On a countrywide level, only 0.3% of revenue was terminated, highlighting the differences among regional losses further supporting the need to conduct analyses on a small regional scale rather than at a countrywide scale. While this share of revenue appears to be minor, the largest income shares of the JBR in community wage bills are Delices, Petite Savanne and Boetica (Figure 4-1). These communities were all in close proximity to JBR.

4.6 Discussion and conclusion

Financial damages of tropical storm Erika are illustrated on a countrywide level and examined as well on a smaller regional level. Commonly assessed country-level consequences of natural disasters help raise awareness of the destruction faced after a disaster. We affirm the importance of Benson et al. (2001) and Benson and Clay (2004) calling for attention to the country-level damages of disasters. Yet, we take a further step by analyzing damages at a small-scale level in order to estimate region-specific impacts as seen with of the community income loss between 2% and 37% resulting from the destruction of a significant employer. Such stark differences highlight the need for disaster funding and resources to be allocated on a community-by-community basis. The applied case study emphasizes the impacts of natural disasters are not equally shared across the island where some areas were declared disaster zones, and other areas only suffered minor damage. Therefore, a regional differentiation of financial disaster impacts is imperative for the development of effective relief measures and an adequate distribution of governmental subsidies. Calculations of impacts using MLAM can be used to identify communities with severe impacts needing immediate assistance. MLAM is a practical and innovative tool to support disaster recovery as it facilitates time-efficient assessment of direct financial disaster impacts specific to communities or local regions. The model is transferrable to other regions, can be adapted to different geographic scales (e.g. local or countrywide), and can be applied to any economic sector (e.g. manufacturing or agriculture), disaster type (e.g. earthquakes or volcanic eruptions), or any kind of industry (e.g. gastronomy or manufacturing).

Furthermore, MLAM can be replicated and adapted to pre-disaster phases, corresponding to Faulkner's (2001) phases 1 (pre-event) and 2 (prodromal) of the disaster management framework. We reaffirm the importance of the development of pre-disaster risk assessment measures for the tourism industry as outlined by Faulkner (2001), Faulkner and Vikulov (2001), Ritchie (2004) and Tsai and Chen (2011). Specifically, our micro-level assessment focuses on the facilitation of phases 4 (intermediate), 5 (long-term recovery), and 6 (resolution phase) in Faulkner's (2001) framework emphasizing the importance of post-disaster recovery. The disaster framework phases are inter-connected where postdisaster strategies are likely to impact or influence pre-disaster planning phases. Therefore, MLAM is useful in post-disaster assessment by providing valuable incentives for predisaster planning such as mitigation efforts, development of hypothetical disaster risk modeling, or management and distribution of financial resources for emergency services.

Despite the practical application and benefits of MLAM there are some inherent limitations of the model that must be addressed for future application or development. The model requires specific data from the labor and economic market such as income levels, employer data, supplier data, and number of employed persons to apply the model. This often presents a challenge in data acquisition due to the difficulty developing and maintaining the data where it is frequently expensive to do so for small-scale communities. In our case (JBR) we used income data calculated as averaged values on a community level as well as on an individual level. The model outcomes would have been more precise using individual income data allowing for a more in-depth small-scale impact analysis compared to other communities when assessing overall disaster losses. Additionally, having total income figures for several communities would have also provided more accurate information pertaining to loss of income. Another example would be to have the detailed supplier data for all available economic sectors (e.g. hotels, restaurants, tour operators, and shops or small business owners) in a community and not just one in our case of JBR. By capturing all representative suppliers for MLAM the result would yield a more accurate depiction of total disaster damages and losses that directly and indirectly impact the tourism sector. Lastly, MLAM presently only measures financial damages and losses at the impact of the disaster that is not necessarily a representation of real-time losses to reveal a larger time scale of losses. However, this may be resolved by performing the calculation on a regular time scale (e.g. monthly or annually).

All social impacts as well as infrastructure destruction from a disaster should be analyzed with other tools for a more comprehensive understanding and assessment of the disaster as well contributing to future research of disaster recovery. Residents of affected communities had to be relocated, and it is not known whether social structures can be transferred to the new places being created for the residents. Presently it is unclear what kind of jobs are available for former employees in the future, and how they can be reintegrated into the tourism sector, or find alternative jobs. Communities in Dominica traditionally were dependent on agriculture or partly subsistent agriculture and is now largely dependent on the tourism sector as local business owners or employees. In this new economic landscape, it is worth assessing the dangers of having a high dependency on one employer or one sector, and if tourism is the best pathway for community development. Should the tourism sector be the future pathway and leading source of GDP revenue, there needs to be more research of stakeholder's disaster recovery responses, adding on to the research of Ritchie (2004), McCool (2012), and Scolobig et al. (2014) with specific focus on the hospitality industry.

It is not enough to discuss overall economic damage alone in measuring disaster impacts. Many sectors were impacted by the disaster that incurred monetary damages. The worst sectors affected were housing, agriculture, roads, and tourism (GFDRR, 2015). Tourism is further aggravated due to the labor intensive hospitality market and dependency on other sectors such as roads and housing. Infrastructure is a critical aspect for tourism in large part due to the number of roads needed for transportation and distribution of hospitality resources. The housing sector is also important due to the availability of employee housing, but also for available accommodation units for tourists such as bed and breakfast facilities. Since the island is becoming more reliant on the tourism sector, the impact is particularly devastating for communities unable to recover after disasters. The destruction of the Jungle Bay Resort as tourism employer had far-reaching consequences for local residents, communities, and economies beyond the tourism industry. While acknowledging the work of Pelling et al. (2002), we emphasize the greater importance of assessing sectors and geographic attributes individually when natural disasters strike.

The estimation of monetary losses and localized disaster impacts by sector can serve as a foundation for focusing on long-term effects and strategies of disaster recovery for pre-disaster and post-disaster mitigation planning. A key benefit of a disaster like Tropical storm Erika is the awakening effect regarding the necessity of zoning maps and pre-disaster risk reduction plans. Awareness has been raised not only within the affected population, but also within the political and institutional systems. The phenomenon of forced adaptation should be addressed in contrast to voluntary adaptation well in advance of a disaster to assist in tourism disaster recovery to the greatest extent possible (Tervo-Kankare et al., 2016). Likewise, in the face of changing environments resulting from climate change, the focus of tourism disaster management will likely shift to use of tourism disaster management frameworks, such as Faulkner's (2001) framework utilizing different phases in the disaster process to address issues such as zoning maps, warning systems, improved communication systems and education of industry stakeholders. MLAM is a tool that we consider not confined to post-disaster assessment and recovery phases of the tourism disaster management framework. Therefore, further research should include the integration of models such as MLAM into pre-disaster planning phases, especially in the face of environmental changes such as increased hurricane frequencies or more intensive rainfall. MLAM can provide an investigative tool for pre-disaster management planning or can concentrate on other phases of Faulkner's (2001) framework to identify vulnerable communities' dependent on the tourism sector needing adequate disaster recovery planning for economic viability.

5. Build Back Better and Post-Disaster Long-term Housing Recovery: Assessing community housing resilience and the role of insurance

This chapter was conceived as a stand-alone publication. It has been submitted to International Journal of Disaster Risk Reduction and, at the date of publication of this Dissertation, is under revision.

5.1 Introduction

The notion of "Build Back Better" (BBB) was developed following the Indian Ocean tsunami recovery. BBB is seen as a holistic concept and pathway for post-disaster reconstruction, and involves guiding principles focused on the physical, social and economic environment (Clinton, 2006). Long-term housing recovery has been identified as the most important factor contributing to overall community recovery post-disaster (Comerio, 1998; Peacock et al., 2007). Smith and Deyle (1998) emphasize a distinction between short-term (repairs and rebuilding no longer than 2-3 years) and long-term (large-scale projects lasting more than 10 years) disaster recovery planning. Traditionally, the recovery process is seen as a series of sequential phases (response, early recovery or restoration, reconstruction and recovery) building upon one another, but is the exact opposite of how recovery functions (Blackman et al., 2017; Lalleamnt, 2013; Olshansky et al., 2012). The disaster literature also assumes that short-term to long-term recovery progression is linear, disregarding post-disaster processes (Blackman et al., 2017). Managing long-term housing recovery is largely dependent on financial resources needed for repairs or new construction (Lindell, 2013). It is commonly believed that the uptake of disaster insurance provides a reliable means for assisting and funding recovery. However, there is a need to better quantify the relationship between insurance, disaster recovery and housing resilience (Cambridge, 2020).

Presently, we know little about how disasters impact communities and in which way communities respond to their effects (Parés et al., 2018; Pares et al., 2014; Van Zandt et al., 2012). Therefore, this paper devises a conceptual "Build Back Better" (BBB) framework to assess long-term housing recovery and reconstruction approaches and the role of insurance for community resilience. The paper focuses on how two different communities managed long-term disaster housing recovery and reconstruction. The first community, Broadmoor (New Orleans) dealt with the aftermath of Hurricane Katrina. The second community, Avonside (New Zealand) experienced the 2010/2011 earthquake series. In each community, local responses, housing recovery, and disaster insurance processes are different, reflecting specific community resilience approaches. This paper seeks to understand how these two communities, each having housing insurance, managed long-term housing recovery. The paper specifically analyzes BBB approaches and effects on housing rebuilding and recovery.

5.2 Build Back Better, housing resilience and insurance

BBB comprises approaches for disaster recovery, rehabilitation and reconstruction processes that are meant to improve resilience by integrating disaster risk reduction measures, restoring physical infrastructure and societal systems, and revitalizing livelihoods, economies and the environment (UNISDR, 2015). BBB has no clear definition for housing recovery and lacks a people-centered housing recovery approach (Maly, 2018). Vahanvati and Rafliana (2019), further highlighting how BBB largely ignores the lack of choices, opportunities or capabilities amid housing reconstruction processes. BBB frameworks attempt to simplify the understanding and meaning of the BBB concept (Dube, 2020). The two most prevalent are the Sendai Framework (UNISDR, 2015) and the BBB Framework (Mannakkara & Wilkinson, 2013) (Dube, 2020; Fernandez & Ahmed, 2019). The Sendai Framework is largely recognized for its international application, for its understanding and prioritizing of disaster risk, strengthening disaster risk governance, investments for disaster risk reduction (DRR) initiatives, and integrating BBB principles (UNISDR, 2015). The BBB framework was developed to provide a set of indicators for DRR, community recovery and effective implementation and in response to the confusion of best practices and guidelines (Mannakkara & Wilkinson, 2013). However, existing BBB frameworks and approaches for rebuilding lack an understanding of a community's needs and priorities, resulting in more post-disaster vulnerabilities (Su & Le Dé, 2020).

Disaster housing and resilience strategies largely focus on using BBB approaches for housing rebuilding (World Bank, 2019). BBB disaster housing and resilience strategies may involve assisting households to obtain more affordable homes and mortgages, promoting disaster insurance policies, investing in new building technologies, and seeking to reduce overall vulnerabilities and risks to future disasters. Although disaster housing and resilience may have similar desired outcomes, they each have unique approaches and characteristics. Housing resilience is largely concerned with housing losses and long-term impacts on communities (Ahmed, 2016). In disasters, housing resilience is linked to investments in both physical systems (e.g. infrastructure, material, labor) and social systems (e.g. governance, policies, institutions) needed to withstand related shocks and stresses for overall community resilience (Hassler & Kohler, 2014). Post-disaster housing resilience attempts to overcome underlying vulnerabilities and promote sustainability by addressing pre-disaster building and housing risks (Ahmed, 2016). Neighborhood or community housing resilience, is defined as the ability of a neighborhood or community to successfully re-establish its housing system (Wang, 2019).

Long-term housing recovery is one of the least studied and understood aspects of disaster management (Peacock et al., 2014). Managing long-term recovery involves the combined forces of activities within a particular place (built environment) and specified periods of time (short- to long-term), known as time compression. The effects of time compression on recovery vary in relation to systems of recovery and wide-ranging time scales. Housing production is one example due to the time-compressed scale of capital depletion and capital replacement (Olshansky et al., 2012). This may be due to a range of housing issues from assessing housing damage, arranging demolitions, ordering rebuild and repairs, accessing funding sources (private, public or insurance), finding temporary housing during repairs, managing legal disputes or land buyouts, permitting for repairs or occupancy, or having to purchase a new home. In managing long-term housing recovery, the issue of post-disaster finance and economics is generally overlooked in the literature (Chang & Rose, 2012; Eadie, 1998; Ellson et al., 1984; Friesema et al., 1979; Olshansky & Chang, 2009). Insurance and public funding are vital in managing household recovery, specifically in earthquake and flood disaster communities (Peacock et al., 2007). Thus, the tension between speed and deliberation becomes one of the focal points in managing long-term housing recovery, and disaster insurance is uniquely situated to facilitate (or impede) long-term housing recovery.

Nonetheless, insurers have encountered numerous challenges and setbacks with recent major disasters. These events highlighted the problems related to unprecedented losses, underwriting risks, lack of available capital for writing new insurance or reinsurance policies, claims management processes, and insurance and reinsurance insolvencies (Douglas, 2014). The scale of disaster insurance coverage appears to be one of the biggest challenges for markets with existing and well-established disasters insurance policies. This may in large part be due to policyholder's expectations that their insurance cover should allow them to finance housing recovery (OECD, 2015). Existing disaster insurance paradigms are no longer adequate, as they are confronted as to how, and in what ways to transform, in an effort to integrate disaster resilience (Douglas, 2014). This is further supported with recent report findings promoting financial resilience for disasters insurance (Carpenter et al., 2020; Levin, 2014; Lloyds, 2018; OECD, 2015; Smith et. al, 2013; Weingärtner et al., 2017).

Almost no research exists demonstrating empirical relationships between disaster insurance and recovery (Kousky, 2019). Almost no studies exist on the role of insurance and claims in recovery, in large part due to data limitations and insurers unwilling to provide information for policy comparisons, and recovery between insured and uninsured homeowners (Kousky, 2019). Reviews of finance and investments in disaster housing recovery highlight that housing resilience (built environment) to disasters is more than a function of total investments made to properties. Total resilient housing is interconnected to factors such as overall design, property site selection, other reconstruction efforts along with total financial investments (insurance and public-private partnerships) needed for total resilient housing (Adeniyi et al., 2015). Managing post-disaster long-term housing recovery and resilience calls upon the need to reframe risk and the role of insurance, by defining acceptable risk levels, managing uncontrolled risks, and addressing structural vulnerability housing issues.

5.3 Methodology

The purpose of this research is to better understand the role of insurance in long-term housing recovery and reconstruction using Build Back Better approaches. This paper seeks to address two key questions: (1) What is the role of insurance in managing overall community recovery and housing resilience; and (2) What is the time compression (the built environment and periods of recovery) for community housing recovery? Two different case studies are used to answer these questions. This paper uses a multiple-case study approach (Yin, 2017) to allow for an in-depth investigation of the role of insurance on community long term housing recovery from the 2005 Hurricane Katrina in New Orleans and the 2010/11 Christchurch Earthquake Series. These natural disaster case studies were chosen to include major events in recent decades with affluent economies, well established insurance markets, different types of insurance markets, and varying disaster recovery policies and management. The focus is on documenting and evidencing the housing rebuilding as a measure for community recovery, BBB discourses of the recovery process to understand the overall impacts and interdependencies, timelines of recovery to assess time compression, the managing and financing of recovery to gauge the role of insurance in the recovery process, and the eventual housing resilience outcomes.

A long-term housing recovery conceptual framework is designed to analyze two events with different housing buy-outs and insurance strategies as thresholds for community housing resilience. The framework is informed by the Sendai Framework for Disaster Risk Reduction (SFDRR) (UNISDR, 2015) and the BBB Framework (Mannakkara & Wilkinson, 2013). The SFDRR and the BBB Framework have helped evolve and simplify BBB, however they both lack ways to measure or assess disaster impacts and recovery for housing resilience (Dube, 2020; Fernandez & Ahmed, 2019; Maly, 2018; Moatty, 2020; Su & Le Dé, 2020). The framework presented here derives meaning from its community centered focus and approach to housing recovery. It takes into account community participation, stakeholder equity, transparency, risk reduction and future sustainability. These principles are supported and aligned with the SFDRR and the BBB Framework. The framework uses five indicators to assess long term recovery and impacts of disaster impacts, insurance and recovery efforts:

1. Governance is required to carry out and oversee the disaster housing recovery process but involves roles for diverse stakeholders, and local, regional and national entities in implementation processes. This is an important factor as it affects how and how fast recovery can take place.

2. Community resources available for recovery are evaluated since an effort to improve both social and economic housing conditions and to support livelihoods and regenerate local economies interconnected to overall long-term community sustainability and resilience will necessarily focus on community resources.

3. Risk reduction assesses the processes in place to improve a community's overall physical housing resilience to natural hazards. This is done by reviewing structural and land-use planning of the disaster housing recovery process.

4. Housing rebuilding funding identifies all possible and potential private and public financing sources. This also includes the set of policies and processes overseeing the use of funds, such as insurance claims management and payouts.

5. Time compression affects flows of information and financing needed for housing recovery. Different funding sources (e.g. insurance, government relief, grants, private financing, loans) flow and move at different rates on separate time paths, affecting individual household recovery and reconstruction. Processes that involve different governance levels further complicate these time path dependencies, and slow or accelerate overall housing resilience and disaster recovery. The tension between speed (rebuilding as quickly as possible) and deliberation (slowing down to redevelop new housing resilient plans) becomes the focus and objective for understanding time compression impacts. For time compression, three scenarios are considered and applied: (1) only the most urgent housing disaster recovery efforts are initiated, followed up with action items requiring more deliberate and focused attention; (2) more attention is given to governance and increased planning capacity to facilitate the housing disaster recovery process; and (3) a decentralization approach creates multiple opportunities for simultaneous recovery planning and decision making.

The case studies data were collected using multiple data sources including interviews, news reports, official government policy documents, city assessor records, property records, physical property assessments for each community case study, community internal records and documents, news and media reports, and government disaster property damage assessments. The lead author conducted a total of 227 semi-structured interviews with stakeholders in New Orleans over a 3-year period (2015 – 2018) and 138 interviews in Christchurch (2016 – 2019). The interviews were with representatives of diverse organizations and interests including but not limited to residents, indigenous members of Tribal Nations, local and national government officials, religious leaders, news and media officials, academics, historians, non-profit agencies, health and wellness representatives, environmental planning specialists, members of the tourism, economic and construction sectors, experts tasked with recovery efforts, local planning, government buy-out programs, disaster mitigation policy planning, insurance policy planning, or urban planning, as well as resilience specialists. Initial interviews included stakeholders on the basis of their expertise or direct contact with community residents. This was followed by interviews with secondary stakeholders as well as recommendations made by the first round of interviewees. Interviewees were asked to discuss the disaster housing recovery process, their reflections on long-term recovery, and the role of insurance.

5.4 Findings and Results

The indicators investigate the five key dimensions of community long-term housing resilience using data collected from the primary and secondary data sources, interviews, the housing and insurance database data collected and analyzed for each case study. Note that while each of these indicators is based on a unique set of resources and processes, they are often interdependent. For example, total available private-public funding sources for housing repairs may require a new set of policies and governance structures to be in place, accounting for new risk reduction measures (e.g. building codes, geotechnical assessments, new technology adaptation).

Indicator 1: Governance

Broadmoor flooded between five and eight feet from Hurricane Katrina and over 90% of homes were damaged (BIA, 2006). After Hurricane Katrina there was much confusion and uncertainty regarding overall recovery due to the conflicting statements about funding sources, roles and responsibilities made by local, state and national government officials (Storr & Haeffele-Balch, 2012). This was clearly evident three years after Hurricane Katrina, at which point the city of New Orleans had already participated in five different recovery plans, and had not chosen a single plan to move forward (Olshansky et al., 2008). In the controversial Bring Back New Orleans recovery plan, Broadmoor was identified as one of six districts in which residents would need to prove their ability to bring back their neighborhood or face relocation (Donze & Russell, 2006).

The Broadmoor Improvement Association (BIA), a community-based initiative, played a leading role in managing the recovery process in Broadmoor. The BIA sought to address the needs of the residents by building consensus by creating the Broadmoor Redevelopment Plan (BRP) that was a long-term (10-years) community vision plan to identify housing programs and mechanisms assisting under and uninsured homeowners (BIA, 2006). This approach was in direct contestation with city, state and federal government recovery efforts. Broadmoor's BRP planning approach aimed to self-manage their overall disaster and housing recovery efforts. BIA connected and linked to local, state and federal government processes to assist homeowners and households with direct rebuilding and relocation efforts. Frequent and regular internal assessments (surveys, interviews, and community meetings) within the first three years of the aftermath provided direct feedback of the most critical resources needing attention, such as access to utilities, property access from the city government, and assistance filing relevant funding claims paperwork. Field observations, including attendance at BIA board meetings, and interactions with residents participating in events or programs (2015 – 2018) confirmed that much of this process continued well after the 10-year anniversary of Katrina, and was seen as an effort to address overall community resilience. However, the general disaster and housing recovery process for New Orleans was largely confusing, unorganized or unstructured with competing institutions and policies overlapping, or undermining one another. Additionally, the lack of a transparent and accountable insurance claims process for both NFIP and private insurance policyholders, provided further delays to the rebuilding process.

There were no disaster recovery strategies in place prior to the Christchurch earthquakes (Gjerde & de Sylva, 2018). A special government agency, Canterbury Earthquake Recovery Authority

(CERA), was established to manage recovery and rebuilding overseeing the Christchurch Recovery plan ("Blueprint") as a five-year ad hoc and short-term organization (Blundell, 2014). The Blueprint was seen as a top-down plan for Christchurch's central city that focused on national government priorities, involving reconstruction of critical public and economic infrastructure (Brand & Nelson, 2016). Effective April 2016, CERA was dissolved and reformed ("Regenerate Christchurch") to manage on-going recovery and rebuilding efforts (Wright, 2016).

Avonside had approximately 3,200 residents in 1,320 dwellings with 36 percent homeownership, 60 percent rentals, and 4 percent in trust. In 2013, Avonside reported a 43% decrease in population and a 55% loss of occupied dwellings (726) with no available social housing (CCC, 2014). There was a top-down governance process with little autonomy given to the local city council, communities or households beyond managing insurance claims directly with the Earthquake Commission (EQC) (New Zealand natural disaster insurance). Specifically, Māori community members were not part of the disaster housing rebuilding plans designed by CERA, and often were some of the most vulnerable residents. This event, much like Hurricane Katrina tested the general capacity of the financial and insurance institutions in place for housing rebuilding. It is difficult to untangle the complicated claims management process due to multiple reoccurring events, which may have resulted in multiple claims filings. It is apparent and evidenced by EQC and other governance stakeholders, that the systems and processes were not capable of handling such a large disaster event. This was in part due to the lack of available physical resources (e.g. claims adjustors, rebuilding labor and materials), and weak internal systems in place for general disaster management (Bennett et al., 2014). Unlike Broadmoor, Avonside did not take up activist approaches to navigate the housing governance rebuilding process. Greater Christchurch residents did challenge EQC claims management settlements, and Crown settlements for red zone properties (requiring government buy-out and total demolition) through lawsuits and appeals. Governance is inextricably linked to other systems and processes of long-term housing rebuilding and resilience, namely accessing funding, identifying and utilizing available resources for rebuilding, reducing risk and vulnerabilities from the disaster and aftermath, and, most importantly, influences the entire time compression direction and movement.

Indicator 2: Community resources

In both cases we find a relatively low priority given to the role communities should take in the initial or long-term recovery planning and management processes. In the case of Broadmoor, BIA took an active role, initially resisting and challenging the recovery planning process, and then became a model for engaging community stakeholders for housing rebuilding. This then became the most effective conduit for community residents to self-organize, communicate, and make key decisions that would determine the future of rebuilding, as well as the fate of their neighborhood. BIA benefited from numerous public-private partnerships (e.g. religious organizations, non-profits, FEMA, city agencies, grants, foundations) assisting in various housing and rebuilding recovery efforts. BIA was able to effectively function as a central organization hub, allowing them to identify residents needing the most critical resources, and then connecting them with appropriate resources. This continues to be the model BIA works under to address ongoing long-term recovery efforts to enable residents to return home.

In comparison to Avonside, no central neighborhood organization existed before or after the earthquakes. Most households instead worked directly with EQC and insurers to resolve existing claims, as well as managing formal disputes made against Crown red zone settlements. Interviewed residents pointed to the establishment of CERA and the City Council's consequent lack of authority, as a main reason for little community activism in the rebuilding processes. Residents also questioned the lack of long-term housing recovery planning by CERA as well the short-sighted decision to only have CERA function for five-years given the enormity of the actual recovery process. Canterbury Communities Earthquake Recovery Network (CanCERN) was one agency born out of necessity for residents to find alternative ways to mediate insurance claims between EQC, insurers, reinsurers and residents. CanCERN originally intended to be represent earthquake-affected Christchurch community groups, but, under the leadership of Leanne Curtis (founder), quickly evolved into an organization to assist homeowners and insurers resolve insurance claims. Interviews with Curtis (April 2016, December 2018) revealed how the organization was established, CanCERN challenges, housing rebuilding governance processes, and future disaster housing rebuilding. Curtis discussed the importance of CanCERN simply acting and functioning as an intermediary between both parties seeking to find acceptable resolutions, so that homeowners could complete housing renovations and reconstruction. Curtis highlighted the unique position of CanCERN: its informal role in managing insurance claim settlements and disputes, and its navigation of uncharted territory in the overall disaster recovery process and CERA management. She observed a constant tension among stakeholders due to the lack of recognition by institutions, such as EQC, CERA, and insurers that organizations, such as CanCERN, were vital in managing general housing recovery and resilience planning needed by the central government. CanCERN was formed to serve as a short-term community resource for residents, and formally ceased operations in 2015.

Indicator 3: Risk reduction

Generally, land-use planning and regulations in New Orleans consisted of higher standards for homes elevated above ground levels, and potential flood zones to reduce general flood risks. Some mitigation funding was tied to incentives to make flood prone housing modifications (e.g. to heights, setbacks, shape or building forms), which resulted in some homeowners receiving buy-outs or additional retrofitting funds. Critical repairs were deemed necessary for adequate levee protection and defense against future disasters. One of the more notable negative aspects of Hurricane Katrina recovery planning and management processes was the excessive planning fatigue experienced by residents. Comprehensive zoning plans developed from the Master Plan, were not accepted for review prior to 2010 (five years after the disaster event) and not approved until 2015, taking a total of ten years. This slow pacing of comprehensive zoning highlighted the on-going conflicts and issues between homeowners and various stakeholders impacted by such changes (Collins, 2015).

The majority of Avonside housing losses were the result of historic poor land-use decisions (Adeniyi et al., 2015). In contrast, Christchurch experienced huge areas of land affected by liquefaction. Most rebuilding data noted the limited availability of scientific and technical earthquake analysis due to the lack of geotechnical information and high costs associated with on-going liquefaction property assessments. Therefore, most rebuilding is seen as problematic for reducing vulnerabilities, and inadequate for strengthening housing resilience to disasters given the high levels of risk and uncertainty of future earthquake events. Yet, many housing plans were not developed concurrently with the Blueprint or other policy planning. This was in large part because these policies focused directly on Christchurch central city short-term rebuilding efforts and economic development and not suburban housing (Winder & Hofmann, 2020). The re-zoning of approximately 7,000 residential homes unsuitable for repairs and classified as "red zone" for government/CERA buy-outs is another hallmark of the earthquake recovery governance, risk reduction and housing rebuilding finance measures undertaken. Many residents disputed the CERA settlement red zone process due to many losing equity or the lack of available affordable housing elsewhere. This resulted in some homeowners becoming 'socio-economically disenfranchised' because they were unable or unwilling to participate in the rebuilding process (Miles, 2012). Thus, the red zone imposed penalties for many homeowners wanting to rebuild, constrained available resources and capacities to rebuild or find alternative housing, and forced many to migrate (Winder & Hofmann, 2020).

Indicator 4: Housing rebuilding funding

Broadmoor homeowners were able to access flood insurance through the National Flood Insurance Program (NFIP) providing coverage up to $US 250,000 for the building, and up to $US 100,000 for contents. Private flood insurance is available as excess coverage, over and above basic policies for homeowners, but is not allowed for NFIP policyholders (Kunreuther, 2006). It is estimated that as little as 30% of homes in Louisiana had flood insurance at the time of the disaster (King, 2005). The average NFIP homeowner received $US 100,000 per claim (Michel-Kerjan & Taglioni, 2017). Hurricane Katrina created numerous logistical and coverage challenges for insurers due to the lack of response plans for extensive flooding, the number of claims, lawsuits and demands by disaster victims (Eaton & Treaster, 2007). The aftermath exposed large financial debts for NFIP and private insurers unable to cope with repetitive flood losses and payouts, forcing some into insolvency less than a year later (Linnerooth-Bayer & Mechler, 2009). The claims process also revealed disconnects between coverages leaving many homeowners uninsured for claims or limited coverage due to policy term inconsistencies and exclusions (GAO, 2006a; Linnerooth-Bayer & Mechler, 2009). NFIP reported that over 95% of claims were closed within nine months with few complaints. Yet, the claims settlement process did not allow for appeals or disputes, resulting in new NFIP policy and claims management reforms (GAO, 2006b; Linnerooth-Bayer & Mechler, 2009; OECD, 2015). The Louisiana Homeowners Assistance Program (HAP) received funding from the U.S. Congress in December 2005 to develop the Road Home Program (Road) providing assistance with repairs or buy-outs (LCD, 2019). The program was decommissioned in 2018 (RHP, 2018) and was largely criticized for its lack of long-term effective disaster recovery by residents in interviews.

The Christchurch Earthquake series is the fifth largest insurance event in the world (Deloitte, 2015). Over 100,000 residential houses were damaged, requiring repairs or rebuilding, of which 7,000 homes were classified as "red zoned" (requiring government buy-out and total demolition) (Winder & Hofmann, 2020). New Zealanders have long expected this scheme to provide insurance for full coverage of repair or replacement (Cowan et al., 2016). Anyone having private insurance has automatic coverage with EQC up to $NZ 100,000 plus GST (tax) for a home and the land immediately surrounding it, and $NZ 20,000 plus GST for contents. Any claims exceeding these amounts (known as overcap claims) would be transferred to the homeowner's private insurer (ICNZ, 2019). In 2016, despite having most EQC claims settled by late 2015, many homes had been demolished or were awaiting repairs, indicating recovery was far from complete (Hall et al., 2016) as conceived by CERA's five-year recovery plan. As of 2018, private insurers received an average of 2 overcap claims from earthquake damages per day from EQC (ICNZ, 2019). In total, there were 14 events that generated EQC claim filings for homeowners (over 100,000 homes) resulting in numerous delays and disputes in the claims settlement process (Cowan et al., 2016; ICNZ, 2019). Given the limited robustness of the disaster insurance program directed by EQC, no additional public funding aside from the red zone buy-out program was made available. Many legal issues arose relating to such red zone properties regarding insurance contracts, court case rulings, policy compensation, and appropriate relocation and rebuilding compensation (ICNZ, 2019).

The Crown-sponsored red-zone government buy-out program may be one of the more effective measures against long-term disaster risk and vulnerabilities communities face when determining acceptable housing resilience standards. Theoretically, households were able to use settlements to find more suitable housing under the premise of a buy-out. Yet, most homeowners did not receive acceptable compensation in a relatively quick payout time, and so were unable to make repairs or relocate, and were left with large levels of home equity losses (Miles, 2012). This resulted in many households unable to cope with the total financial disparities, and disaster housing inequalities in finding alternative or substitute housing.

Table 5-1: Broadmoor community housing insurance assessment

Number of Total Properties	2,026
Property Classification	
Exempt	29
Residential	1,972
Commercial	32
Median home price (2005 pre-disaster value)	$US 193,176
Average price per square foot	$US 95
Average number of insurance claims filed (residential housing)	406
Total residential housing maximum losses	$US 150,704,388
Total residential housing maximum insured losses	$US 30,140,868
Average household flood losses	$US 74,239
Average household NFIP insurance claim settlement	$US 92,549
Total uninsured housing losses	$US 120,563,470
Estimated total net losses per property without NFIP coverage	$US 55,325
Total HAP housing settlements	36
Total HAP housing settlements payments	$US 3,990,258
Average HAP housing settlement payment	$US 110,841

Source: Author formulas and calculations using data from City of New Orleans Post-Katrina Assessments (data.nola.gov), Orleans Parish Assessor Records (qpublic.net), FEMA (2016), BIA proprietary housing database and author data

The initial Broadmoor housing database contained 2,335 properties comprised of single or multi-dwellings, and commercial buildings. This was adjusted to reflect properties designated by official City Broadmoor boundaries (Table 5-1). The Road program states that 873 properties received compensation totaling $US 86,302,735 in Broadmoor. These figures are then compared to land records data obtained from the City of New Orleans and BIA housing database applicable to Option 2 and 3. Data was not available to cross reference properties under Option 1. A total of 36 properties (less than 2% of all properties) were identified to have received a Road buyout (Option 2 or 3) averaging $US 110,841 per household, totaling $US 3,990,258 between the periods from 2007 to 2015. It is difficult to assess the Road settlements against published figures provided by Road without having more property details. Instead, the numbers provide insight into how long the application process took for those known (36) properties where a majority of the settlements occurred in 2007 (10) and 2008 (16). Interviews with residents discussed the cumbersome process of having any sort of knowledge or understanding of the application process let alone being approved.

Table 5-2: Avonside community housing insurance assessment

Number of total properties	1,361
Number of commercial properties	8
Number of Council Social Housing	151
Property Classification	
Red Zone	661
Urban Nonresidential	113
Green Zone TC2	344
Green Zone TC3	243
Median home price (2007 Capital Value)	$NZ 292,310
Average number of insurance claims filed	2
Total potential residential housing maximum losses	$NZ 341,417,800
Total EQC insurance claims payout – Event 1	$NZ 43,775,472
Total EQC insurance claims payout – Event 3	$NZ 261,304,100
Total residential housing maximum insured losses – Event 3	$NZ 93,347,200
Total red zone Crown settlement – Event 3	$NZ 193,670,600
EQC overcap maximum totals – Event 3	$NZ 54,400,000
Average total losses per household – Event 1	$NZ 58,462
Average total losses per household – Event 2	$NZ 146,155
Average insurance claim per household – Event 1	$NZ 37,479
Average insurance claim per household – Event 2	$NZ 223,719
Average Crown red zone property settlement	$NZ 292,996
Estimated total net losses per property – Event 1	$NZ 19,983

Source: Author formulas and calculations using data from CCC (ccc.govt.nz), EQC claims data (eqc.govt.nz), Muir-Wood (2012), CERA (2015)

For the insurance claims dataset for Avonside, it is assumed, based on the events having the most significant damage, that there was an average of two filing claims made among the five earthquakes (04/09/2010, 26/12/2010, 22/02/2011, 13/06/2011, and 23/12/2011) associated with EQC claims filings (Muir-Wood, 2012). Therefore, each red zone household is assumed to have had one EQC claim settlement from the first event, a Crown settlement resulting from the third event, and no additional claims (Muir-Wood, 2012). Red zone properties are considered to be fully insured for the third event or Crown settlement due to the CERA ruling compensating homeowners regardless of having insurance (CERA, 2015).

The following assumptions were used to calculate the projected total EQC insurance claims payout for the expected average two claims per property (Table 5-2). The first claim supposes all residential homes received the median EQC payment ($NZ 37,479) noting this payment excludes overcap claims (Deloitte, 2015). Among EQC claims filed, it is estimated that the median damage per insured dwelling is between $NZ 10,000 to 100,000 for Green Zone TC2 properties and 50% of the Capital Value 2007 rate for Green Zone TC3 properties because damages exceeded $NZ

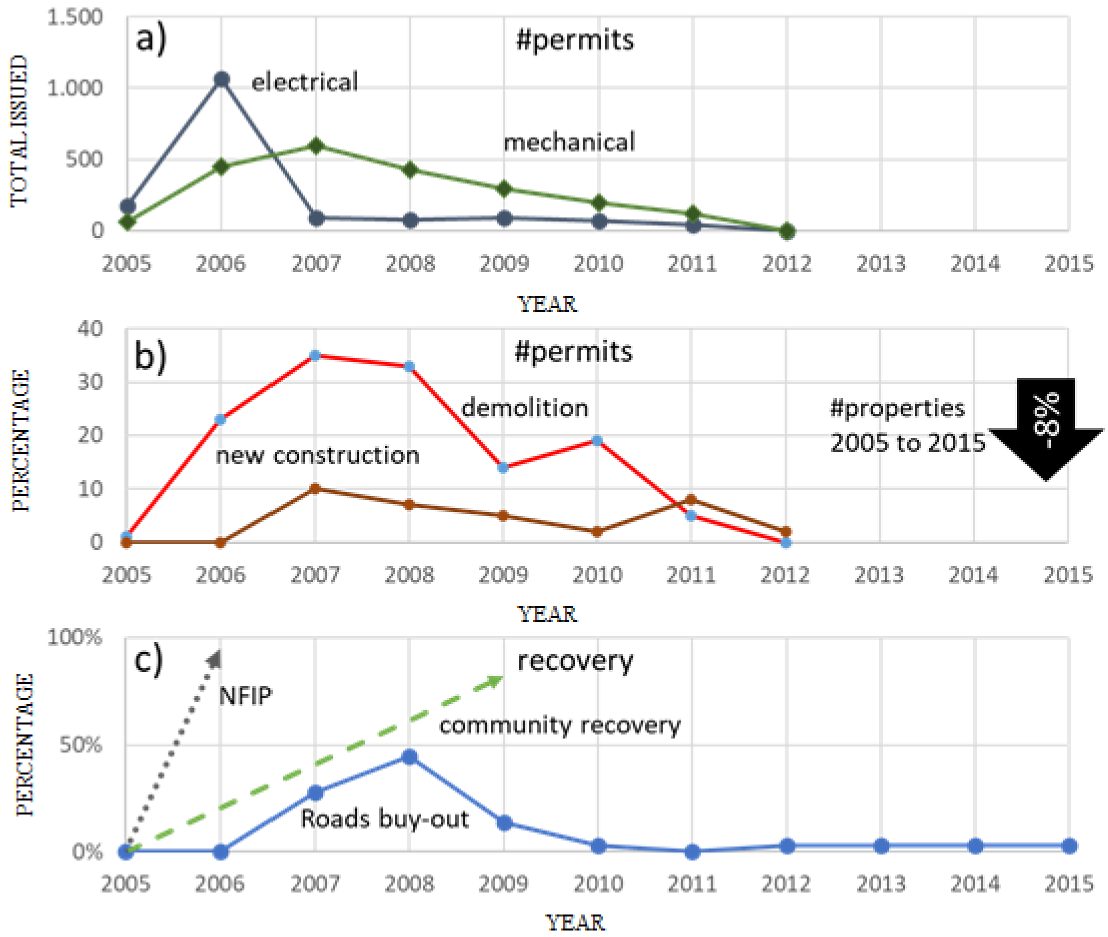
100,000. Therefore, the second claim assumes all TC2 properties are projected to have received $NZ 100,000 and TC3 received 50% of the Capital Value 2007 rate for the analysis. The second claim is tied to the third event where those classified as red zone received the Crown settlement and the remaining properties received the median EQC payment (excluding overcap claims). It is also assumed claim deductibles are satisfied and not combined with the total accounting for insured calculations. Social Housing properties (151) are excluded from the assessment since they are owned by CCC. Most residents communicated in interviews an expectation that EQC claims and payouts should not leave homeowners inundated with large financial losses. EQC average claims payouts contrasts starkly with those of Broadmoor residents who sought what appears to be minimal flood damage compensations allowable under the insurance market terms in the US (Indicator 4).

Indicator 5: Time compression

The time compression findings describe the various phenomena and activities during periods of recovery times. These results are a culmination of all previous indicators and are also interdependent. Broadmoor time compression (Fig. 5-1) was visualized using multiple data sources. Electrical permits related to Hurricane damages were resolved on a short-term basis (1-2 years), while mechanical repairs carried on for many more years (Fig. 5-1(a)). Although electrical service is an essential service to make a home livable, the need for a fully mechanically sound construction is less critical as long as basic safety levels are obtained. This shows that total recovery consists of various individual time scales leading to different levels of recovery progression. Figure 5-1(b) presents the number of permits for demolitions and new construction over the 10-year time frame. As expected, there is a shift between the onset of demolition and new construction of about one year. Interestingly, a much larger number of houses were demolished and never rebuilt. From our own inventory, from the 1,972 residential properties in 2005, only 1,816 were renovated or being repaired in 2015, resulting in a total loss of about 8% of properties. Finally, Figure 5-1(c) provides an overview of various recovery pathways. For the few NFIP-covered properties, 95% of claims were closed within 9-months. Whereas with the Roads buy-out program a delay of around 1-2 years took place and was spread over an extended period of time. It is important to stress that both only mark the first step towards recovery, as permitting, reconstruction and inspection are yet to follow. Projected timelines from payouts to rebuilding then can be interpreted with estimated insured and housing losses to assess overall community housing recovery. In contrast, community recovery shows a slower but more steady pathway, resulting in 82.2% of properties rebuilt or under construction in 2009 (Storr & Haeffele-Balch, 2012).

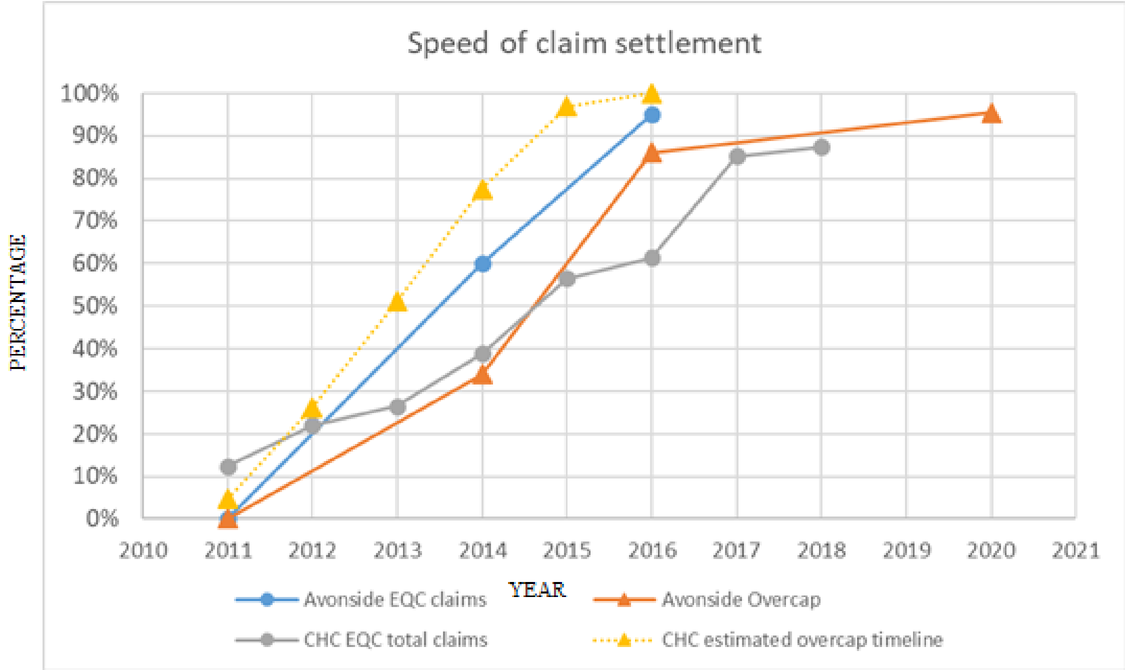
EQC established a claims handling process split up into a number of sequential steps for Avonside. These processes (e.g. filing of a claim, followed by housing assessments and claims settlements) were spread out over a period of time ranging from days or months to years. Initial delays were caused due to incomplete or delayed filing of claims. These delays may result in up to an additional 6-month processing time. Several general observations can be made concerning the development of housing recovery based on EQC published claims data (Fig. 5-2). In the first three years of recovery, the number of settlements are low and increase slowly. This is due to delays in filing claims, the discovery of additional previously undiscovered damages, and the ramp-up time needed for the insurance management systems. This period is followed by three years of significant reduction of claims at a high pace. Lastly, there are years when low remaining number of claims diminish at a much slower rate, likely due to litigations and complexities.

Figure 5-1: Broadmoor time compression



Source: Adapted from City of New Orleans Post-Katrina Assessments (data.nola.gov), and Orleans Parish Assessor Records (qpublic.net), BIA proprietary housing database and author data

Figure 5-2: Christchurch and Avonside insurance speed of claim settlements



Source: Adapted from EQC claims data (eqc.govt.nz) and author formulas and calculations using data from CCC (ccc.govt.nz), EQC claims data (eqc.govt.nz), Muir-Wood (2012), CERA (2015)

5.5 Discussion

This research sought to address (1) What is the role of insurance in managing overall community recovery and housing resilience; and (2) What is the time compression (the built environment and periods of recovery) for community housing recovery? using a Build Back Better framework applied to two case studies. Broadmoor residents sought to rebuild their community by challenging the traditional disaster recovery governance process through collaboration focused on BBB approaches. While this approach was quite successful, it remained a local effort that was not aligned with other recovery processes throughout New Orleans. In contrast, resolute consequences for risk reduction were put into place in Christchurch for areas prone to substantial future damages. The implementation of these red zones, resulted in a considerably high displacement of Avonside residents. While this further delayed housing recovery as a whole, it most likely will result in fewer future disaster damages that meet long-term BBB principles and overall long-term housing recovery.

Time compression varies amongst complex recovery processes. The onset of recovery and BBB initiatives are highly dependent on governance and the insurance claims processes. This is due to both requiring procedural systems and guidelines, as well as when resources are available (e.g. insurance settlements) to commence repairs or relocate. From the data collected and examined, insurance claims processing takes at least one year and in most cases between 2-5 years for total payouts. Therefore, in most cases, short-term recovery is already inhibited initially when accessing funding for necessary repairs. Specifically, low-income housing residents may not be able to sustain their livelihoods and out-of-pocket costs for repairs or disaster risk improvements simultaneously. An early insurance payout is therefore a necessary prerequisite to enable long-term recovery. From the community housing recovery efforts led by BIA, it can be assumed that having access to recovery funding earlier would have initiated housing rebuilding earlier with the potential to reduce overall recovery times for residents.

The results suggest that insurance plays a crucial role in overall community recovery, as it (along with other factors) critically influences the possible onset of repairs in the early years of recovery. The question of long-term recovery is directly linked to individual households having to make significant BBB decisions (rebuild, relocate or buy-out) shortly after a disaster. Examining the extent of individual household costs among the case studies provided estimates of individual household losses for each case study and therefore personal liability in the absence of a quick insurance settlement process. The greatest losses were experienced in Broadmoor. Christchurch appears to have the slowest funding speed of recovery in a market that is considered fully insured. EQC claims settlement process took, overall, seven years to be completed with a few remaining settlements still being managed presently. However, the speed of recovery and personal liability do not necessarily correlate to a factor of completed new construction or housing repairs. The data only goes as far to tell us how long the initial reconstruction phase would have been delayed, assuming large amounts of funding sources were needed to be acquired prior to any major repairs being undertaken. This supports the views of residents who stated that most major repairs, as well as investments for disaster risk improvements against future disasters could not be facilitated without some major investment from a bank, insurance, government program, or private fund.

Governance is one of the most important factors for housing resilience while insurance claims typically come only with a small set of requirements (e.g. improving resilience through flood reduction measures). Time compression for community housing therefore needs to take into account the various speed of claims processes, after which permitting, construction and inspection processes become dominant. With each having their own time line and being dependent on each other, significant delays can occur due to the limited nature of factors such as labor, building materials, etc. The tension between disaster insurance and housing recovery continues to highlight the importance of having financial resilience for BBB approaches. The lack of effective disaster recovery policies, and insurance claims management contributes to community long-term housing risks and vulnerabilities, undermining community resilience. Despite the BBB intentions of reducing risk and vulnerabilities to improve resilience, these results support the findings that housing recovery and resilience are more than a function of total investments. Instead, community housing resilience is interconnected to the overall design, property site selection and other reconstruction efforts together with total financial investments (private-public investments and insurance).

5.6 Conclusion

This paper examined two case studies in order to better understand the role of insurance in long-term housing recovery and rebuilding. The conceptual framework applied BBB approaches using five indicators that support and assess overall community housing resilience. Two key questions were addressed: the role of insurance and housing resilience, and the time compression (built environment and periods of recovery time) for community housing recovery. Public and private insurance schemes along with other available funding sources were examined to understand the dynamics between the role of insurance and housing resilience. Each case demonstrated that traditional disaster governance systems were not designed or capable to address long-term housing rebuilding and recovery, and largely relied on the assumption that disaster insurance was capable of handling overall recovery. In both cases the insurance process was hindered by challenging claims processes and government sponsored buy-out programs. The time compression is a temporal representation of all the combined BBB framework indicators (governance, community resources, risk reduction and housing rebuilding funding). In both cases, successive events or extreme events placed considerable burdens on complex (local, state, national) institutional systems that are often disruptive in a nonlinear recovery process. Many residents rely on the use of insurance to reduce risks to build back better. However, even with insurance such disasters are a major challenge for communities to rebuild or make repairs focused on Build Back Better approaches. The temporal analysis reveals disconnect between the insurance and buy-out claims management systems, and the governance systems implemented, the latter being largely focused on short-term housing recovery measures. Regardless of how the financing or insurance scheme was employed, the most significant factor appears to be the rate (time compression) at which households were able to successfully access and implement financial resources that is focused on long-term (beyond 5 years) housing solutions for long-term housing recovery. Moreover, this research contributes to the lack of ways to assess disaster impacts and recovery housing within Build Back Better literature.

6. Dynamic economic resilience scenarios for measuring long-term community housing recovery

Chapter 6 was conceived and designed by Sahar Zavareh Hofmann (SZH). The research model and framework, data analysis and writing was completed by SZH with supervision from Gordon Winder (GW). GW provided critical feedback to help shape the research, analysis and manuscript, which has been accepted as a forthcoming publication in the journal Environmental Hazards: Human and Policy Dimensions (Zavareh & Winder, 2021).

6.1 Introduction

Housing recovery has been identified as one of the most important factors contributing to overall post-disaster recovery success due to its influence on community economic and business recovery (Comerio, 1998; Peacock et al., 2018; Tierney et al., 2002, 2007). Specifically, the return of permanent housing is seen as the most critical factor (Peacock et al., 2007 and 2018). Quarantelli (1982) developed a housing recovery typology – emergency shelter, temporary shelter, temporary housing, and permanent housing – to characterize the recovery process. The most common process for household resettlement after disasters consists of those forced to relocate seeking new permanent housing or temporary housing until they are able to return to the original site (Iuchi, 2014). Smith and Deyle (1998) emphasize there is a distinction between short-term and long-term recovery planning. Research also finds long-term housing is little studied and understood by researchers (Peacock et al., 2007). Although literature has addressed housing damage and household recovery, studies seldom use longitudinal data to assess long-term housing recovery (Peacock et al., 2014). The question remains how to measure recovery of a place from a disaster when disaster recovery measures are not well theorized (Chang, 2010; Cheng et al., 2015; Peacock et al., 2018; Rose, 2004; Smith & Wenger, 2007). Most local, state or federal government officials when tasked with the post-disaster recovery process have no existing guidance on how to measure recovery (Cheng et al., 2015).

This paper addresses these challenges by using dynamic economic resilience scenarios to measure long-term community housing recovery. The community of Broadmoor impacted by Hurricane Katrina has been chosen due to the significance of housing losses, the number of households managing housing rebuilds, the increased likelihood of future disasters, as well as the additional risks faced from climate change (e.g. sea level rise). The scenarios assist in post-disaster damage evaluations, but may also be relevant for communities seeking to reduce future vulnerabilities and support resiliency initiatives. The dynamic economic resilience approach is described in detail first by reviewing the disasters literature on measuring recovery (housing), second discussing the study area and housing recovery process, third by identifying the methodology used to measure long-term housing recovery and application to the case of Broadmoor, and lastly demonstrating how

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dynamic economic resilience scenarios can contribute to disaster recovery research and gaps in the literature.

6.2 Disaster Recovery and Resilience

Haas, Kates, and Bowden (1977) offered the first comprehensive research into the recovery process, identifying policy and lessons from rebuilding. Subsequent work (Rubin et al., 1985) noted that recovery was more complicated than the model presented by Haas et al (1977) and suggested researchers should use qualitative data to evaluate the process of recovering in order to improve upon the speed and quality of recovery. Using a decade of data for small and large cities, Johnson (1999) completed one of the first studies providing a long-term view of recovery from the 1989 Loma Prieta earthquake. The study identified four phases critical to post-disaster recovery: immediate response of those endangered and of property; restoration of utilities and short-term housing; short-term recovery to restore pre-disaster levels for functioning households and businesses; and permanent reconstruction to repair, rehabilitate and redevelop the community. Smith and Deyle (1998) emphasize that short- and long-term recovery planning must be different. Schwab et al. (1998) determined that recovery should not come at the expense of quickly attempting to restore normal activities and functions for the public. More recently, this tension is expressed as a source of conflict between the aim to rebuild as quickly as possible and the aim to deliberately recover and rebuild to ensure a better result (Olshansky & Chang, 2009). The notion of "Build Back Better" (BBB) was developed in an effort to improve reconstruction and recovery practices for communities. A BBB approach is centered in disaster recovery and reconstruction processes that improves resilience (Fernandez & Ahmed, 2019). However, BBB has no clear definition for housing recovery, and more importantly, lacks a people-centered housing recovery approach (Maly, 2018). BBB largely ignores the lack of choices, opportunities or capabilities among housing reconstruction processes (Vahanvati & Rafliana, 2019).

At any one time, communities and households may be engaged in various recovery activities. This has contributed to the limited attempts by researchers to focus on the timescales of disaster recovery (short-term vs. long-term) as opposed to specific recovery functions needed (Lindell, 2013). Housing issues are some of the most complex aspects of disaster recovery (Sapat & Esnard, 2016). Property damage resulting from disasters creates losses in asset values that can be measured by the cost of repair or replacement. Disaster losses are difficult to determine because they do not reside in one place, nor are they managed by one organization (Lindell, 2013). Comerio (2014) suggests measuring recovery requires analysis at different scales over different timescales. It is suggested that this measurement should occur over three scales of input over different timeframes: geographical scale where recovery is measured (e.g. individual, household, community, state or national), the timeframe measured (e.g. months, years, or decades), and lastly the perspective of the evaluator's assessment (e.g. family, community, government, or funder/financier stakeholder).

Measuring recovery has largely been addressed through methodological approaches such as surveys, case studies and computer modelling (Chang, 2010). The two major approaches to measuring recovery either attempt to assess recovery in relation to either pre-disaster conditions or broader impacts of the economic environment with no pre-existing scenarios for comparison. The second approach often takes into account that there is a new normal instead of a pre-disaster state to return to, that recovery can be indexed to track progress, and the use of geospatial technology such as GIS or remote sensing can assist with tracking recovery (Cheng et al., 2015). Housing repairs are critical, however are viewed as insufficient for measuring housing recovery (Sutley et al., 2019). Few studies model temporal and social aspects of housing recovery (Sutley et al., 2019).

Researchers often refer to the term 'resilience,' when discussing a community or a city's ability to withstand disasters (Harrison & Williams, 2016). Resilience is generally understood to be a property of a range of systems, that are able to remain stable when facing shocks and stresses, recover following an event, and adapt to new circumstances (Tiernan et al., 2019). Disaster resilience is defined simply as the capacity to rebound from future disasters (Cutter et al., 2008). Resilience builds upon three pillars: resistance, recovery and adaptive capacity (Thieken et al., 2014), each employing a different set of strategies. Resistance focuses on limiting disaster impacts. Recovery is concerned with the timescales to return to pre-disaster states. Adaptive capacity emphasizes preparation and mitigation of future events (Slavíková et al., 2021). However, it is important to distinguish between resilience and resilient recovery, or also known as resilience of recovery. Resilient recovery focuses on recovery efforts to manage reconstruction to pre-disaster levels, as well as addressing risks and vulnerabilities in an effort to build back better (Slavíková et al., 2021). BBB frameworks have attempted to evolve and simplify the BBB concept, however they lack ways to measure disaster impacts and recovery for resilient recovery (Fernandez & Ahmed, 2019; Maly, 2018). Resilient recovery seeks to advance housing rebuilding by focusing on financing recovery schemes. The role of resilience in disaster recovery financial schemes is largely neglected (Slavíková et al., 2021). Most recovery funding is focused on early restoration efforts (Thomalla et al., 2018), rather than supporting disaster resilience for recovery processes (Sandink et al., 2016; Slavíková et al., 2020). Resilient recovery highlights three paradoxes related to financial schemes: policy, compensation and social equity (Slavíková et al., 2021). The policy paradox seeks to rebuild as quickly as possible, which may or may not reduce disaster risks and vulnerabilities. Recovery funding schemes do not always support resilient recovery. The speed and bureaucratic compensation policies impact resilience forming the second pillar of compensation in financial schemes. Lastly, social equity ensures that each person has equitable access to recovery schemes (Slavíková et al., 2021). Resilience requires more than just coping or rebuilding from a disaster. Therefore, this requires the advancement of recovery schemes in order to achieve resilience recovery (Fekete et al., 2020).

In relation to disaster recovery, economic disaster resilience research concentrates on the actions taken before and after events to reduce losses and overall risk (Bruneau et al., 2003; Rose, 2016; Rose, 2017; Rose & Dormady, 2018). Economic disaster recovery research focuses on repairs and reconstruction of building and infrastructure as well as efforts needed to restore the workforce, but also to reestablish social and political institutions. Economic recovery timescales from a disaster event are related to resilience concepts (Xie et al., 2018). Two types of economic resilience are applicable to disaster recovery: static economic resilience and dynamic economic resilience (Rose, 2004). Static economic resilience is concerned with the ability or capacity of a system to maintain function when experiencing a shock. Measures of static economic resilience then focus on whether resources are efficiently used to maintain function or to compensate for deficiencies, such as through conservation, substitution or relocation. Dynamic economic resilience is seen as the ability and speed of a system to recover from a shock, by managing investments (which are time dependent) made for repairs and reconstruction as efficiently as possible (Xie et al., 2018). The time dependent variability of investment is linked to resilience: by accelerating recovery and shortening the recovery period; or by slowing and lengthening the recovery and therefore contributing further economic losses (Ayyub, 2014). Thus, dynamic economic resilience provides a temporal perspective to housing recovery from a system rebounding from a shock (Pant et al., 2014). Therefore, this paper addresses community long-term housing recovery by applying dynamic economic resilience scenario modeling.

6.3 Methodology

The purpose of this research is to measure long-term disaster housing recovery to assess overall long-term community recovery by applying the concept of dynamic economic resilience. This is done by using housing recovery scenarios (baseline, reference recovery and dynamic economic resilience) to analyze the differences among the levels of rebuilding in each of these scenarios, such as the use of housing buy-outs and insurance as thresholds for community housing resilient recovery. In addition, a future dynamic economic resilience recovery scenario is modeled, taking in account the benefit of dynamic housing reconstruction improvements to assist with future disaster recovery policy planning.

A case study examining the community housing recovery from Hurricane Katrina is used to measure and answer what is the long-term housing community recovery. This natural disaster case study was chosen because it was a major event in recent decades inside an affluent economy, in a well-established insurance market, which was also subject to a governance system with a clear implementation process for disaster recovery policies and management. The focus is on documenting and evidencing the housing reconstruction progression in the context of the rebuilding strategies at work throughout the recovery process. The aim is to understand the impacts, timelines of recovery, how the recovery was managed and financed, what decisions were made and when, and the eventual housing resilience outcomes in terms of speed and quality of recovery. The analysis attempts to move beyond the traditional assessment of taking a physical accounting of housing stock pre and post-disaster to compare and contrast housing recovery. This is done by applying resilience scenarios that are dynamic, and reflect the recovery systems, in an attempt to better understand the role of community leadership in developing post-disaster housing recovery policies, quick and efficient use of financial reconstruction funding, and the practice of building permits used for rebuilding efforts. Multiple data sources including interviews, field research, news reports, official government policy documents, city assessor records, property records, physical property assessments for each community case study, community propriety internal housing records and documents, news and media reports, and government disaster property damage assessments were used to develop the case study and community housing database. A total of 227 semi-structured interviews with stakeholders took place in New Orleans over a 3-year period representing a diverse set of organizations and interests including but not limited to residents, city council members, news and media officials, academic institutions, historians, non-profit agencies, private planning consultants, health and wellness representatives, environmentalists and environmental planning specialists, tourism officials, commerce and economic policy planning officials, architects, engineers, builders, construction companies, teachers, local red cross organizations, churches and religious leaders, insurance experts, reinsurance experts, government officials and offices tasked with recovery efforts, local planning, Road Home Program, disaster mitigation policy planning, insurance policy planning, urban planning, and resilience specialists. We began the first interviews in April 2015 that provided stakeholder insight leading up to the 10-year anniversary festivities. The next round of interviews then took place between August and September 2015 in New Orleans. Initial interviews included stakeholders on the basis of their expertise and direct contact with community residents. This was followed by interviews with secondary stakeholders as well as recommendations made by the first round of interviewees, totaling 227 semi-structured interviews. Interviewees were asked to discuss the disaster housing recovery process, their long-term recovery reflections, and the role of insurance or home buy-outs. Additionally, a physical inventory of each property in Broadmoor was conducted to document the long-term housing recovery process. Follow-up interviews took place with residents in April and May 2018 to discuss the Broadmoor housing recovery inventory and calculation used to create the dynamic economic resilience scenarios, post-reflection of the 10-year anniversary event weekend, as well as the changing local political landscape and its impact on Broadmoor (during this time the former Broadmoor Improvement Association President, LaToya Cantrell had been elected as the first female Mayor of New Orleans). Note that only official FEMA reported funding and payments are used in this research paper. We are grateful for the cooperation of those interviewed. Their responses offered many insights into long-term housing recovery processes and outcomes.

The results from the research demonstrate how dynamic economic resilience can be applied to measure long-term community housing recovery. We see this as an initial step towards a better measurement of long-term disaster recovery and supporting overall community resilient recovery. This step supports an alternative community housing resilience perspective. The results challenge the common belief that disaster financing alone is able to effectively manage long-term housing rebuilding and recovery.

6.3.1 Research Model and Framework

This research involves the development of a dynamic economic resilience framework providing an analysis for the necessary physical and labor resources necessary for housing rebuilding. This includes the insurance and claims process, sponsored buy-out housing programs, and financial investments needed by homeowners for reconstruction (e.g. permits, claim deductibles, etc.). The dynamic economic resilience assessment (adapted from Xie et al., 2018) is estimated from a housing inventory damage calculation. The housing inventory damage is calculated using a baseline scenario (non-disaster scenario), reference recovery scenario (damaged housing inventory and actual post-disaster reconstruction scenarios), and a dynamic resilience scenario (scenarios with additional insurance coverage, and/or government buy-outs, increased reconstruction funding, and new technology investments). These measurements provide ways in which to describe and evaluate the overall long-term community housing recovery profile by using a case study. In what follows, details related to the framework assessment used in the case study, such as the general long-term disaster recovery and housing rebuilding governance processes, housing insurance, stakeholders, risk reduction through structural and land-use planning efforts, social recovery, and economic recovery, as well as data sources are provided.

6.3.1.1 2005 Hurricane Katrina Case Study

Hurricane Katrina struck the US Gulf Coast On August 29, 2005. It is estimated that there were more than 1,200 deaths, an estimated $US 125 billion in damages, $US 60 billion in insurance losses, and more than 1.7 million claims across six states (Allianz, 2015; Dolfman et al., 2007; III, 2010). The Federal Emergency Management Agency (FEMA) made a federal disaster declaration, totaling more than $110 billion in federal funding. Louisiana established the Louisiana Disaster Recovery Fund for state recovery initiatives. The Bring New Orleans Back Commission (BNOB) was established by the city in an effort to rebuild the city (Johnson & Olshansky, 2017). The Office of Recovery Management (ORM) merged into the Office of Recovery Development and Administration (ORDA) in 2008, focusing on city and local government recovery (Johnson & Olshansky, 2017). FEMA and ORDA partnered together for ongoing federal recovery projects to provide funding and assistance specifically for redeveloping blighted and abandoned properties. The City Council established the New Orleans Redevelopment Authority (NORA) to expropriate abandoned or blighted properties. The city enhanced codes and permits in 2008 to reduce and mange existing blighted properties by using fines, or seizing properties for demolitions or resale (Johnson & Olshansky, 2017). New regulations included higher standards for elevating homes above ground levels, and potential flood zones to reduce general flood risks. Mitigation funding was then tied to housing modifications (e.g. heights, setbacks, shape or building forms). However, many residents faced fatigue from what they regarded as excessive planning. Planning was continuous and undecided as with the case of the Master Plan for building and permit issuance. that took ten-years post disaster for final approval (Collins, 2015).

For years, confusion and uncertainty surrounded Hurricane Katrina recovery. This resulted from the activities of multiple funding sources, as well as numerous conflicting statements concerning roles and responsibilities made by local, state and national government officials (Storr & Haeffele-Balch, 2012). The private and public sectors made disaster recovery funding available to homeowners through insurance, direct aid, disbursements, tax breaks, tax credits, and subsidies (Kunreuther, 2006). National Flood Insurance Program (NFIP) provides flood insurance for residents and businesses (Kunreuther & Dinan, 2017). It is estimated that no more than 30% of residents had flood insurance in Louisiana (King, 2005), with the average NFIP homeowner receiving $US 100,000 per claim (Michel-Kerjan & Taglioni, 2017). Hurricane Katrina created numerous logistical and coverage challenges for insurers (Eaton & Treaster, 2007; Towers Watson, 2013), and exposed NFIP and private insurer financial debts, forcing many to declare insolvency (Linnerooth-Bayer & Mechler, 2009). NFIP processed over 95% of claims within nine months, yet many were unable to challenge or dispute claims settlements. Hurricane Katrina resulted in many new NFIP policy and claims management reforms (GAO, 2006; Linnerooth-Bayer & Mechler, 2009; OECD, 2015).

Additionally, in December 2005 the U.S. Congress appropriated $US 19.8 billion for the Community Development Block Grant Program (CDBG) to address the lack of flood insurance and housing recovery, with $US 13.4 billion allocated to Louisiana. The funding initiative established the Louisiana Homeowners Assistance Program (HAP) and the controversial Road Home Program (Road), as a conduit to provide assistance with homeowner repairs or buy-outs. Road grants were limited to $US 150,000 per application with three options: compensation for rebuilding and repairs, sell property and relocate within the state, or sell the property becoming a renter or move out of state (LCD, 2019).

6.3.1.2 Broadmoor

The community of Broadmoor located in New Orleans is examined as part of this case study because it was identified as one of the six districts in the controversial BNOB recovery plan facing forced relocation (Donze & Russell, 2006). Broadmoor flooded between five and eight feet from Hurricane Katrina with more than 90% of homes damaged from flooding. Broadmoor consists of 365 acres made up of mainly single and two family residential homes, and 12 acres of commercial land. In 2000, Broadmoor had approximately 2,915 occupied housing units with less than 10% vacancy (BIA, 2006). Established in 1930, the Broadmoor Improvement Association (BIA) is the neighborhood's association. Aided by BIA, Broadmoor residents challenged BNOB and built partnerships to transform their community (Amdal, 2012; BIA, 2006). In July 2006, BIA together with residents created the Broadmoor Redevelopment Plan (BRP). BRP addressed perceived housing recovery injustices by challenging the opposing redevelopment plans and by seeking ways to directly manage community recovery for residents by acting as an intermediary for government recovery systems (BIA, 2006). Harvard University has cited their efforts and initiatives as a model for post-disaster reconstruction planning (Ahlers, 2013).

At the time of the disaster, property tax assessments were organized among seven different districts and assessors, which was not based on a standardized system, nor did they reflect current market values. A 2006 ruling that was implemented in 2010, created one assessor in order to establish a uniform calculation amongst all districts using data from recent sales and current market values. This poses significant challenges in determining pre-disaster and post-disaster market values in Broadmoor. In this research, the Broadmoor residential market inventory calculation uses a sales comparison approach to determine the median housing price and housing index for insured and uninsured losses. Consequently, the dataset assumes the median home value solely for Broadmoor in 2005 to be $US 193,176 (cf. $US 228,620 for greater New Orleans), and the 2005 market value rate per square foot to be $US 95 (cf. $US 114 for greater New Orleans). It is assumed 80% of Broadmoor homeowners did not have any type of flood or disaster insurance for these calculations. Flood damage estimates available per property are calculated from the City of New Orleans Katrina damage assessment reports. Flood damages ranged from 4% to 100% of homes in Broadmoor, with the weighted average of 39% of current (2005) home values.

The initial Broadmoor housing database contained 2,335 properties comprised of single or multi-dwellings, and commercial buildings. This was adjusted to reflect properties designated in the Broadmoor boundaries as set forth by the City Planning Commission and Assessor of New Orleans Broadmoor boundaries. The Road Program states that 873 properties received compensation totaling $US 86,302,735 in Broadmoor. These figures were then compared to land records data obtained from the City of New Orleans and the BIA housing database applicable to Option 2 and 3. Data was not available to cross reference properties under Option 1. Between 2007 and 2015, a total of 36 properties (less than 2% of all properties) were identified as having received a Road buyout (Option 2 or 3) averaging $US 110,841 per household, and totaling $US 3,990,258. It is difficult to assess the Road settlements against published figures provided by Road without having more property details. Instead, the numbers provide insight into how long the application process took for those known (36) properties where a majority of the settlements occurred in 2007 (10) and 2008 (16). In interviews, residents discussed the cumbersome process of understanding the application and approval process. Estimated average household flood losses are $US 74,239 and average household NFIP insurance claims settlements were $US 92,549 for Broadmoor residents. Residents receiving Road home buy-outs in most cases had fewer overall net losses compared with those with NFIP insurance or uninsured losses.

6.4 Findings and Results

The community long-term housing measurement is calculated using housing recovery scenarios (dynamic economic resilience) for the case study. Here detailed findings are provided for each scenario for Broadmoor.

Baseline scenarios

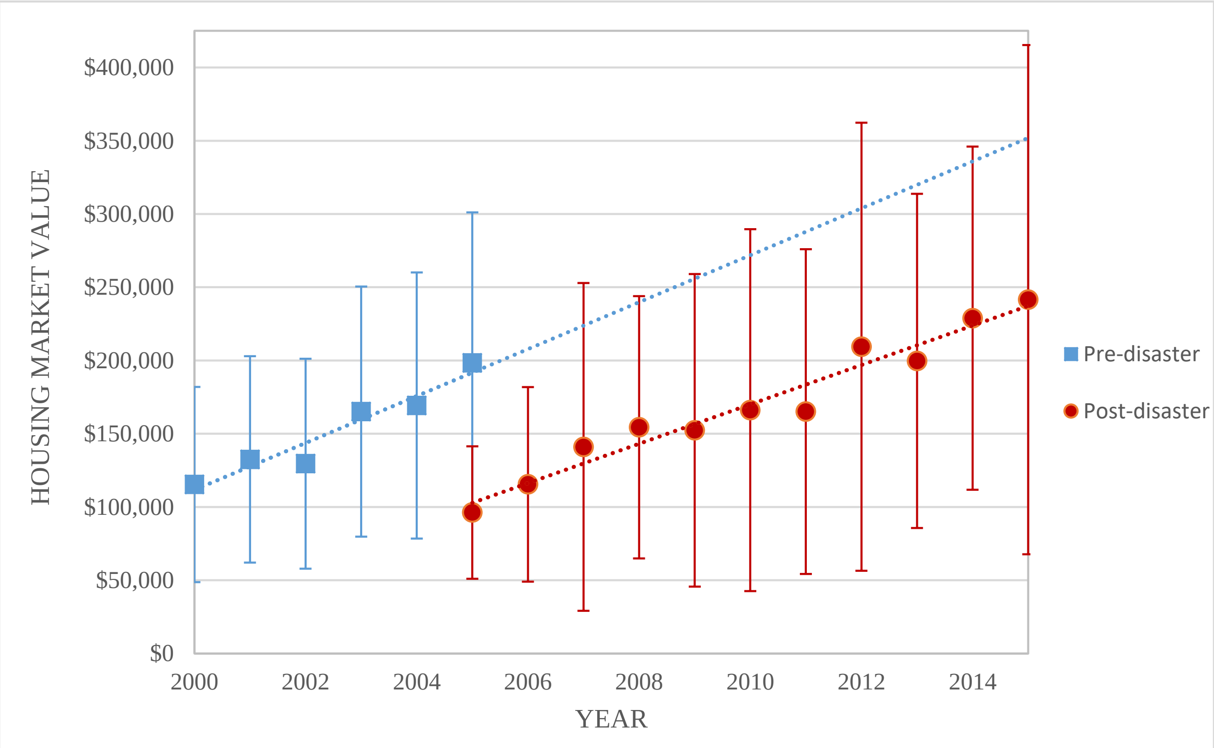
Two baseline scenarios are calculated. A non-disaster scenario with no reduced housing stock (2,026) assumes a normal housing market growth average (12% yearly average increase) using market values from the previous five years (Table 6-1), and then projects what the future market values would have been without having a disaster. The post-disaster market values are plotted from time of the event to the 10-year anniversary and reflect an average of two percent loss (10% yearly average increase) with at no time market prices reaching pre-disaster levels before the ten-year review (Fig. 6-1). The scenario demonstrates how the slope (growth rate) of the post-disaster curve is lower than the non-disaster curve. For this scenario sales prices are not a valid indicator for measurement of recovery.

Table 6-1: Scenario Data Sources

Scenario	Types of Data and Sources
Baseline	Broadmoor Improvement Association housing database
	City of New Orleans Assessor
Reference recovery	Broadmoor Improvement Association housing database
	City of New Orleans Assessor
	City of New Orleans Hurricane Katrina damage assessment reports
	City of New Orleans permits
	Interviews with Broadmoor residents and those involved with the Hurricane Katrina recovery management in New Orleans
Dynamic economic resilience	Broadmoor Improvement Association housing database
	City of New Orleans Assessor
	City of New Orleans Hurricane Katrina damage assessment reports
	Road Home Program
	US Census Bureau building statistics
	FEMA Hurricane Katrina reconstruction/payouts reports
	Interviews with Broadmoor residents and those involved with the Hurricane Katrina recovery management in New Orleans

Source: Zavareh and Winder, 2021, p. 9

Figure 6-1: Broadmoor baseline scenario estimation of residential housing market values

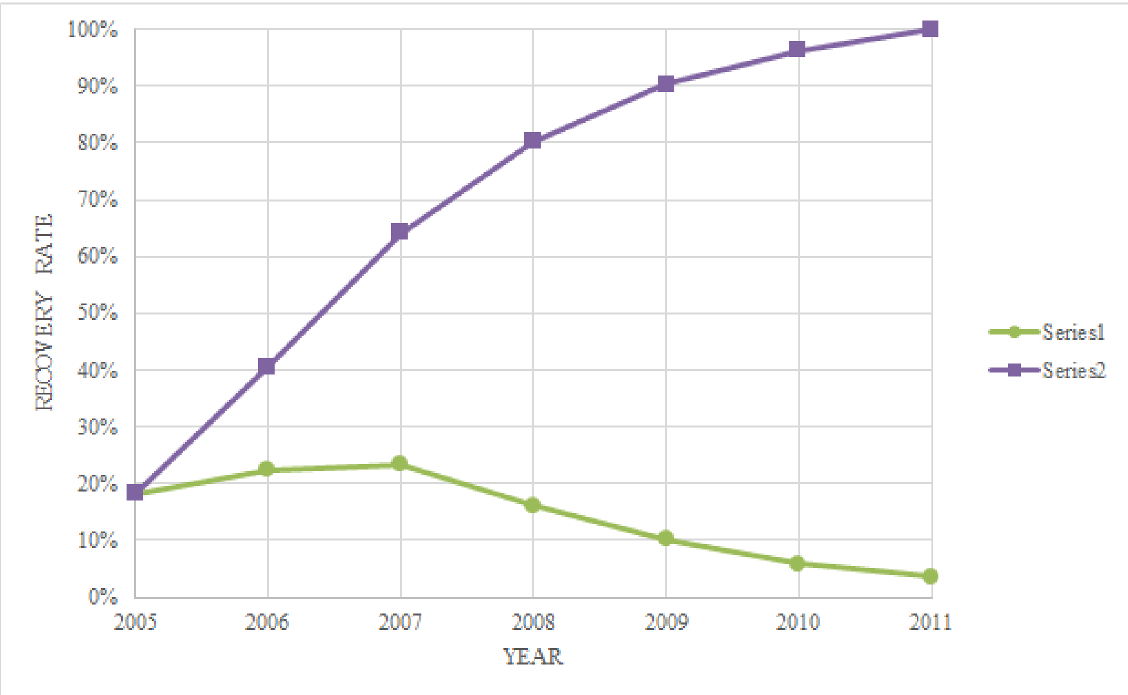


Source: Zavareh and Winder, 2021, p. 10

Reference recovery scenario

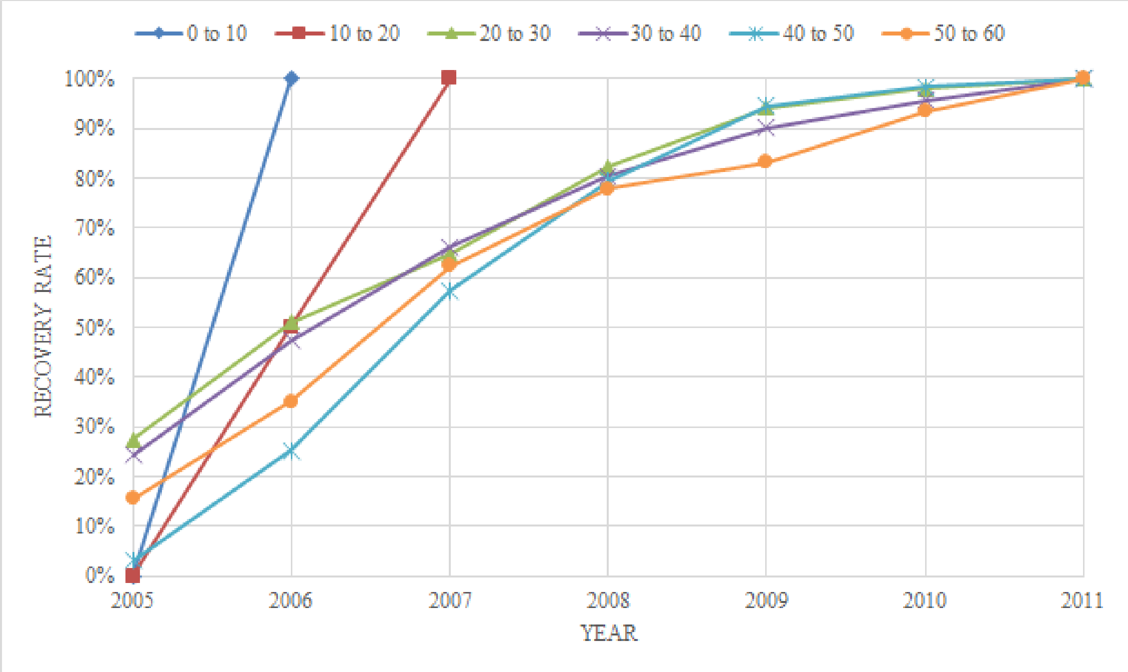
The *reference recovery scenario* (Figures 6-2 and 6-3) provides a snapshot of reduced community housing with actual post-disaster reconstruction values. To create these scenarios, actual permits issued by the City of New Orleans and official City damage assessment reports (Table 6-1) were used to construct the repair rates. The City permit analysis was filtered to include only those issued for repair damages directly caused by hurricane or flood damages. Permit types included electrical repair, emergency permits, general mechanical, new construction, structural and non-structural renovation and repair. Permits for demolitions and "simple" work for reconnection of power were not considered for this analysis. In Figure 6-2, the cumulative ratio of the sum of these permits is plotted, versus time of issuance. Due to the lack of data reporting, the actual work completion dates of the permits remain unknown. However, it is reasonable to assume that repairs would have taken anywhere from several months to years for new construction. Hence, the real repair rate values would be slightly shifted to the right on the graph. Permit data was only available from the City through 2011, a time at which supported Broadmoor community recovery was reporting recovery rates of 84.5% (Wilke, 2010). It is evident from the individual yearly repair rates, that the years from 2005 to 2007, had the highest repair rates, followed by years of steady decline in repair rates.

Figure 6-2: Broadmoor reference recovery scenario – repair rate based on number of permits issued for hurricane damage repairs



Source: Zavareh and Winder, 2021, p. 10

Figure 6-3: Broadmoor reference recovery scenarios – repair rate using city damage assessment correlated with housing rebuilding permits issued

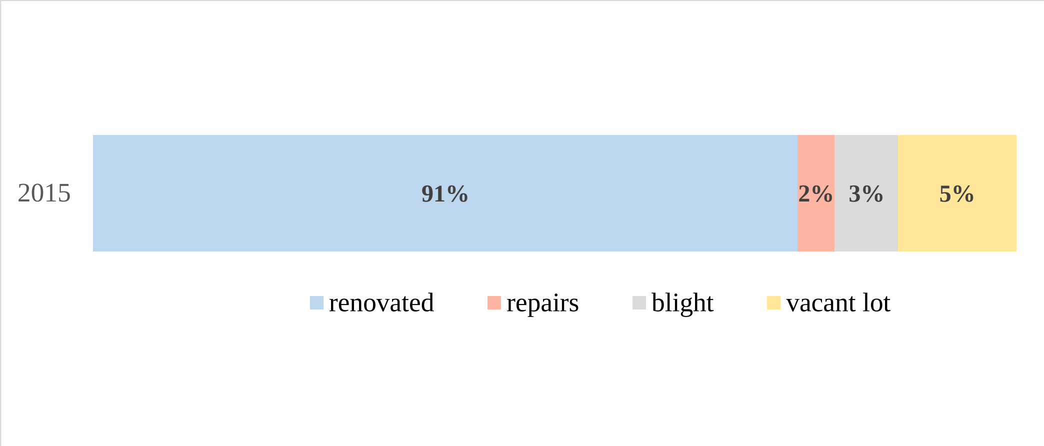


Source: Zavareh and Winder, 2021, p. 11

The data was additionally cross-referenced with City Hurricane Katrina damage assessment reports, and sorted into total percent damages for each property and then sorted by categories with intervals of 10% to provide a cumulative repair rate assessment by damage category (Fig 6-3). The results also feature the differences between those damages ranging from 0 to 10%, and those between 10 to 20% occurring in different time-scales compared with those damages ranging between 20 to 60 percent. In the latter case, the speed and level of repairs rate is far more spread out. The variations in slope indicate that especially in the early years of recovery, houses with damages between 40-60% have a lower rate of repair, in comparison to houses with lower amounts of damages. However, it is interesting to note that the long-term repair rate for damages between 20-60%, does not differ as much as one would expect. Here, factors other than the actual damage appears to be more decisive in influencing the recovery.

The assumed community housing repairs and reconstruction timeline pathway has a replacement value of 10% for damaged properties in Year 1, mainly due to the city and community recovery governance process. All remaining years are then aggregated against property damage loss values with the assumption that a majority of repairs are reached by 2009, and complete repairs (95% or more) are reached in 2010. These values help distinguish between normal and reconstruction investments. A physical housing assessment (Fig. 6-4) was conducted at the ten-year anniversary to compare and contrast these results with Figures 6-2 and 6-3. Here we see that housing rebuilding was slightly above 90% but still contained a larger amount of vacant properties with no foreseeable new construction.

Figure 6-4: Broadmoor 2015 housing recovery assessment



Source: Zavareh and Winder, 2021, p. 12

Broadmoor's governance process was largely managed through a grass-roots community-based approach, which gained momentum as residents mobilized to challenge and resist the initial city disaster housing recovery policies and planning. By taking this approach, Broadmoor was able to link directly to local, state and federal government processes, such filing paperwork for Road buy-out applications or getting permit approvals for demolitions, to assist households with direct rebuilding and relocation efforts. Frequent and regular internal assessments (surveys, interviews, and community meetings) within the first three years of the disaster aftermath provided immediate feedback where the most critical resources were needed, such as access to utilities, acquisition of entry to properties from the city government, and assistance filing relevant funding claims paperwork. Broadmoor continues to operate using this resident feedback system well after the 10-year anniversary in an effort to address overall community resilient recovery. The general New Orleans disaster and housing recovery process was largely confusing, unorganized or unstructured with competing institutions and policies overlapping, or undermining one another. This was further complicated by the lack of a transparent and accountable insurance claims process, adding further delays to the rebuilding process noted during interviews.

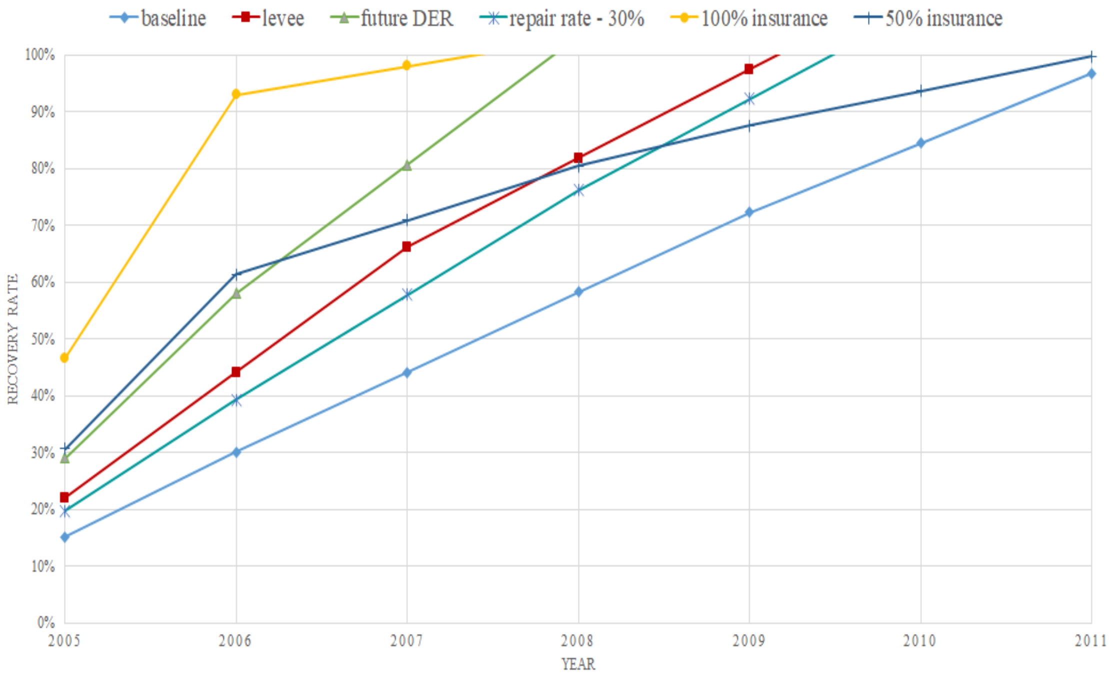
It took residents an average of three to four years to receive a Road buy-out. Insurance settlements amongst residents were not common, and often received less than what a Road buy-out provided for resettlement. Broadmoor residents expressed in interviews an overwhelming sentiment that there was a lack of trust and confidence in the disaster recovery processes (insurance, state or government funded schemes and recovery systems) to actually work. There was general disbelief over fair compensation whether it be with Road or insurance working in a corrupt system. This perspective echoed discussions held with Allianz Global Corporate & Specialty SE headquarters in Munich, where interview partners expressed similar frustrations which, it was said, contributed to the final decision to no longer have a carrier in the US providing homeowners with insurance products. This was mainly due to the mismanagement and mishandling of Katrina claims.

Aiming to rebuild their homes, Broadmoor residents sought alternative pathways, an action that can be seen as a sign of dynamic economic resilience. Once residents' realized that, due to BNOP, there would not be support from the local and federal governments to help rebuild their community, the community itself recognized they had a diverse set of skills and expertise that could come together and create their own community vision plan for rebuilding. This community vision plan was based on aligning themselves with partnerships, with what they could realistically accomplish, residents taking leadership roles and a process that reflected their true needs. Latoya Cantrell was the BIA President at the time of the initial post-disaster recovery and now serves as the City Mayor. Cantrell expressed how important it was to step up into strong leadership roles within the community of Broadmoor, otherwise they would have been left behind, ignored or worse lose their homes to city redevelopment plans. There were many battles residents had to face Cantrell reflected at the 10-year anniversary. Yet, these struggles seemed rather invisible in light of their success ten years later. This included the tedious and political process of getting access permits to re-enter and rebuild homes, filing documents if you had insurance or finding access to funding sources, reconnecting with loved ones, the political debates over how to re-establish the public school systems, and the health and well-being issues related to the disaster trauma, that once again resurfaced at the ten-year city anniversary celebrations in the form of post-traumatic stress disorders. Then there was the problem of not knowing if Broadmoor would rise above and succeed in their campaign of building a more resilient Broadmoor.

Dynamic economic resilience scenario

Since we are dealing with an observable historical event, the dynamic economic resilience scenario (Figure 6-5) uses a combination of data (e.g. damage assessments and building permits) provided from the recovery aftermath, and a conceptualized approach to presume levels of housing investments (insurance and buy-outs) to calculate a *sustainability threshold.* The results of the Roads assessment verify that 37 properties, each with more than 60% damage according to the City damage assessment report, each received a buy-out. No new properties are included for the buy-out, but it is assumed residents received funding for Option 1 (funding for repairs or rebuilding) when their properties (approximately 1,900 properties) sustained 30% or more in total damages. The additional reconstruction investment funding provided by Roads, in addition to having faster insurance claims payments (on approximately 600 properties), along with the expansion of the demolition and building permit process are all factored in when determining a new sustainable housing reconstruction. Typical new construction is considered to take anywhere from six to twelve months based on building statistics from the US Census Bureau (US Census, 2020). The scenario assumes the rate of rebuilding fluctuates between a six-month construction time period for those with 30% or less housing damages, and twelve months if greater than 30%. These assumptions are used to determine the total housing reconstruction time pathway.

Figure 6-5: Broadmoor dynamic economic resilience scenario



Source: Zavareh and Winder, 2021, p. 13

The *repair rate scenario* (repair rate - 30%) assumes that no changes were made to financial reconstruction investments, but rather that the time-path or rate at which existing compensation was provided occurred 30% faster than evidenced from the reference recovery scenarios (Fig. 6-2 and 6-3). Over time this reduces the length of the rebuilding process. Under the repair rate scenario, the reference recovery scenario long-term recovery housing threshold (84.5%) is reached two years earlier.

In consideration of additional or improved *financial reconstruction investments* (50% insurance), an increase in the total number of insured homes is considered and estimated at a 50% market penetration. This scenario models reflects prompt and efficient claims management processes for households to begin immediate repairs. This scenario demonstrates possible effects of having adequate systems in place to allow residents to begin the process of rebuilding, despite having possible building reconstruction resource constraints. It is assumed that with more rapid compensation, those with less than 30% in housing damages are able to have full repair within one year, and the remaining houses are repaired using an aggregate based on normal investment times and reconstruction in relation to total damages. The results show that the long-term recovery housing threshold is reached approximately in 2008.

The effects of having a fully insured community (based on the fact flood insurance being available in the market) is then considered (100% insurance scenario). In the *fully insured scenario*, the assumption is made of having the entire community insured with an efficient claims management system. This then indirectly influences the total repair rates aggregated amongst normal investment and reconstruction timelines. This scenario provides the fastest long-term housing recovery for Broadmoor of one year simply based on the fact that rapid investments would account for adequate distribution of resources. In order to demonstrate the benefits of applying dynamic economic resilience scenarios into future planning and policy making, additional future dynamic economic resilience scenarios are presented. The *levee scenario* (Fig. 6-5) applies a significant overhaul and investment into addressing the levee infrastructure for the City of New Orleans. This assumption is based on the recent findings from Munich Re on Hurricane Katrina disaster risk modeling (Kron, 2015). It was determined that the single most important contribution to hurricane and storm damage risk reduction measures after constructing 76 different kinds of hypothetical event simulations, was connected to city flood infrastructure improvements: higher and more resistant dykes and flood protection walls, along with efficient emergency pumps to drain water, thereby significantly reducing overall flood damages and risks to residents. These results provided a direct 90% reduction of total flood loses to residents for another 100-year flood event or 75% reduction of losses for a 500-year flood event (Kron, 2015). In addition to the infrastructure improvements, increases in Roads applications for Option 1 are assumed to be given for homeowners with more than 30% in total housing damages. By applying the levee and pump adaptations along with increased Road funding, the *future dynamic economic resilience scenario* (future DER) supports the reduced housing losses and overall reduction of risk for New Orleans as proposed by Munich Re. This scenario is also contrasted with the existing Baseline scenario to draw attention to the overall community housing resilience for Broadmoor. A *future dynamic economic resilience scenario* (future DER) estimates a hypothetical levee improvement investment, and a modified repair rate factor (similar to repair rate – 30%). Here we find substantial developments in identifying a new sustainability threshold for housing within a three-year recovery time frame.

The results from considering the *dynamic economic resilience scenario* provide an indication of how significant implementation of new policies and procedures, centered on a more efficient handling of applications for building permits, as well as financial claims for rebuilding or buy-outs, and a more effective management of constrained reconstruction resources for community rebuilding might be. This is especially important in the case of Broadmoor considering the role of BIA, and the Broadmoor Development Corporation (BDC), established by BIA, which provided technical and community resources to NORA and the Road program. Through this unique partnership, BDC was able to take receivership of homes and redevelop them to reinvest in the community, by providing new or rebuilt homes at affordable market values for homeowners. It is arguably one the single most important decisions made by the community and by the leadership of BIA. Actions under this framework contributed more than 80% of the community long-term housing recovery.

However, due to limited access to funding for BDC they were not able to work faster to obtain more housing inventory, or manage a higher rebuilding rate to meet the actual long-term housing needs of the community as desired in interviews with BIA leadership. Broadmoor residents voiced the view that long-term housing recovery occurred at much slower time scales than expected from their knowledge of recovery policy and planning, or imagined by themselves. This led to recognition of a false sense of security and truth as they experienced their own personal reality of recovery resulting in new kinds of trauma for individual recovery1. When examining a future dynamic economic resilience scenario for Broadmoor, it was assumed that investments were being made to upgrade and maintain the levees to sustain a 100 or 500-year flood loss event. Additional corrections were also made to reconstruction investment funds to help identify that the *sustainable long-term recovery threshold* was approximately three years after the event. These results also supported the Munich Re disaster risk modeling studies to improve flood protection.

6.5 Discussion and Conclusion

The case study examined the long-term community housing recovery of Broadmoor, highlighting the problems of disaster recovery governance and the challenging rebuilding process. Hurricane Katrina and its aftermath demonstrated the community's exposure to a complex set of interacting and interdependent factors unique to New Orleans. Hurricane Katrina's overall recovery efforts resulted in numerous reforms amongst federal, state and local government agencies in response to the immense media and political pressure which stimulated demands for better responses to natural disasters. The housing recovery scenarios allow us to place the housing rebuilding time-path into perspective. They help to reveal how rebuilding was influenced by governance systems, land-use regulations, and adaptation measures contributed from the physical attributes of disaster recovery management. The community systems embedded in the recovery process largely relate to the social systems and local resources adapted to define their implementation of local resilience measures. The dynamic economic resilience scenario allows us to assess differences between the dynamically resilient time-path, and the baseline and reference scenarios. In order to estimate the dynamic resilient time-path, additional housing funding (insurance payments or buy-outs), rapid financial compensation and investments in new technology (levee repairs and upgrades) are considered and assessed. This conceptualized approach allows us to compare the time-paths, and the contribution of dynamic economic resilience to accelerating initial stages of housing recovery, and shortening the overall housing rebuilding time-compression. Therefore, dynamic economic resilience depends on effective investments, not measured by the level of investment, but rather by the length and time-path recovery, or reductions in housing losses. This is especially important given that the majority of Broadmoor residents specified their housing damages were related to flood losses from the pump failures and physical breakdown of the city levees, and not the actual hurricane event itself.

This case demonstrates the role of measuring long-term housing is necessary to better understand the housing recovery processes in different market types combined with stakeholder perception data. The resilient recovery of a community, such as Broadmoor, cannot simply be read from the number of total houses repaired or rebuilt in a community: such figures do not accurately depict the community's ability to cope with the stresses in response to social, political and environmental changes. The data used in this analysis only goes as far to tell us how long the initial reconstruction phase would have been delayed or lasted, assuming funding and reconstruction sources needed for any major repairs being undertaken. The analysis reveals delays beyond what might be expected, and so supports the views, revealed in interviews, of residents, who, when asked about their own personal rebuilding experiences in Broadmoor, stated the actual post-disaster recovery process and undertaking of most major repairs was a long and tedious process, one that could not be facilitated without the support of the community coming together, and together with some major investment from a bank, insurance, government program, or private fund1. Regardless of how the recovery financing was employed, the most significant factors appear to be the rate at which households were able to successfully apply for building permits combined with rapid access to adequate financial resources. These two aspects of access to rebuilding and financial resources are interconnected for the success of long-term community housing resilient recovery. Successive events or extreme events, such as the arrival of Hurricane Rita in New Orleans one month after Hurricane Katrina, place considerable additional burdens on complex institutional systems (local, state, national) that are often disruptive in a nonlinear recovery process. The Broadmoor case also highlights that the speed of recovery was greatly influenced by adopting a community-based approach to managing local and regional resources. Given the lack of adequate financial resources available to reduce housing damage liabilities across households, the action of residents to manage resources collectively was the main factor influencing the apparent success of long-term housing recovery in the district. Hence, the use of *dynamic economic resilience scenario* analysis in this case study indicates that having (1) a local community agency providing assistance, (2) quick and efficient access to financial reconstruction funds, either from insurance, government funded buy-outs or rebuilding grants, and (3) appropriate and timely access to building permits for reconstruction, in combination, could facilitate more effective and resourceful management of disaster recovery and rebuilding in the future.

Endnotes

[1]Personal communication with Broadmoor residents, August – September 2015 and April – May 2018; New Orleans, United States

7. Conclusion

Geographers have long been engaged critically with urban resilience and disasters. Examining disaster risks, vulnerabilities have been important to understanding the relationships between the social and physical environments. This dissertation contributes to the strong human and economic geography understanding of how communities interact concerning resilience, housing and insurance to manage long-term recovery. It does so by asking the following research questions:

1. How to assess urban resilience policies supporting disaster risk reduction approaches?
2. How do urban-rural linkages in sustainability transitions impact disaster recovery management and recovery?
3. How to analyze natural disaster damage using economic models for specific localized regions to obtain calculations of losses for communities managing recovery?
4. How to measure long-term community housing recovery using dynamic economic resilience?
5. What is the role of insurance in managing overall community recovery and housing resilience?

Chapter 2 assessed the 100 Resilient Cities (100RC) program, launched in 2013 by the Rockefeller Foundation to build worldwide urban resilience. The 100RC program aims to implement urban resilience under the Sustainable Development Goals of the UN 2030 Agenda for Sustainable Development and the Sendai Framework for Disaster Risk Reduction 2015-2030. These frameworks link disaster resilience and disaster risk reduction to issues of vulnerability, climate change, livelihoods, rebuilding, and equity. Achieving disaster resilience and risk reduction requires more than building back better, or bouncing back from disaster: social equity, participation and livelihoods must also be advanced. Using a pathways approach related to narratives of disaster vulnerability and risk, this chapter analyzes the resilience policies developed to support disaster risk reduction under the program. Evaluating member city Resilient Strategies plans using directed and summative content analysis, this research assesses whether the 100RC program emphasized vulnerability and risk narratives in its disaster risk reduction approaches. Our results reveal the differences produced among member cities – and from expectations of advancing social equity, livelihoods and participation – due to the role of actors and power expressed in the policy design and implementation. The chapter concludes with recommendations to support urban disaster resilience using the Sendai Framework. Such recommendations include, members providing more information tied to historical urban development and socio-economic related to structural problems needed in order to address urban and disaster resilience, rather than more promotion material provided to promote the Rockefeller Foundation and Arup. Additional information is also needed to discern financial and economic relationships between private sector and platform partners established through the 100RC program. Further assessments are also needed to measure whether targets achieve goals managing vulnerability. Financial analysis of policy outcomes in relation to budget allocation and program spending is also important to consider for future research. This future research could contribute the understanding and knowledge as to how the program is able to address targets to improve housing, new building codes, establishing temporary housing programs, or other assets (e.g. insurance and microfinance) provided for social protection.

Chapter 3 addressed processes of disaster recovery as they related to urban-rural linkages in sustainability transitions. In Chapter 3, consideration was given to economic geography challenges posed by UN-Habitat's Sustainable Development Goal 11. This is done by prioritizing transition pathways and projects rather than regions, and by focusing on rural–urban linkages and flows in its policy and project initiatives. This chapter identifies the scope of these challenges by reporting research on the re-planning and rebuilding of Christchurch, New Zealand following the devastating earthquakes of 2010–2011. Management of the rebuilding of the city using sustainability and resilience principles ran into resistance, tele-connected with globalization processes, and became entangled in a net of practices, regulations and institutions set in place to facilitate other projects and agendas. This resulted in politically charged tensions as well as challenges for experts. As economic geographers advise on and assess transition pathways for sustainable development, as in this case of rebuilding after disaster, they will need to demonstrate how the desired transformations are entangled in complicated and dynamic economic spaces. Among other things, this will involve: Mapping spatial flows, linkages and partnerships among urban, peri-urban and rural areas; identifying globalization processes that assist or cut across the desired actions; relating transitions to policy practices and constraints; and conceptualizing new terms like "resilience" within economic geography.

Using micro-level assessments of regional and local disaster impacts in tourist destinations, chapter 4 discussed the challenges the tourism sector faces, due to the economic impacts from changing natural environments as seen with the increased frequency of natural disasters. Therefore, analyses of disaster impacts models are necessary for managing successful tourism recovery. Typically, disaster assessments are conducted on a countrywide level, which can lead to imbalanced recovery processes, and a distorted distribution of recovery financing or subsidies. We address the challenges of recovery using the tourism disaster management framework by Faulkner. To calculate precise damage assessments, we develop a micro-level assessment model to analyze and understand disaster impacts at the micro-level supporting tourism recovery in an affected destination. We examine economic consequences of a disaster at a small regional scale arguing recovery from a natural disaster is more difficult in individual areas because of differences in geographic location or infrastructure development. The island of Dominica is chosen as an example for the model using statistical data from the tourism sector to outline and detail the consequences of a disaster specifically for communities. The results highlight the importance of damage assessments on a small-scale level, such as communities in order to distinguish between individual regions facing severe changes for resident livelihoods and the local tourism sector. We argue that only after identifying regional impacts is it possible to apply adequate governmental subsidies and development strategies for a country's tourism sector and residents in a continuously changing environment in the hopes of mitigating future financial losses and future climate change impacts.

To answer question four, Chapter 5 used Broadmoor as a case study to measure long-term community housing recovery using dynamic economic resilience scenarios. The housing recovery scenarios (baseline, reference recovery and dynamic economic resilience) analyzed the differences among the levels of rebuilding, such as the use of housing buy-outs and insurance as thresholds for neighborhood housing resilience. A future dynamic economic resilience recovery scenario was modeled to take into account the benefits of dynamic housing reconstruction improvements, and assist with future disaster recovery policy planning. The scenarios are able to assist in post-disaster damage evaluations, but have the potential to be even more relevant for communities seeking to reduce future vulnerabilities and support resiliency initiatives. Two key research questions were addressed in Broadmoor relating to community dynamics of housing recovery and resilience: (1) What is the long-term community housing recovery; and (2) What is the role of disaster housing recovery policies in managing overall community recovery and housing resilience? The results identify an ideal sustainable long-term recovery threshold of three years after the disaster event. That long-term recovery took much longer than this indicates how significant problems in recovery were. Further, the research reveals that implementation of new disaster housing recovery policies and procedures need to be centered on adopting community leadership, designing more efficient systems for recovery financing and implementing more efficient building permits for community rebuilding. These three critical findings support the results of other flood modeling conducted by Munich Re to improve flood protection in New Orleans.

Chapter 6 examined the role of insurance in managing overall community recovery and housing resilience. The notion of "Build Back Better" (BBB) is seen as a holistic pathway for post-disaster reconstruction, which can be extended to assess post-disaster recovery best practices. Overall, housing recovery has been identified as the most important factor contributing to community post-disaster recovery success. An important lesson to be learned from BBB is the role of insurance, government buy-outs and housing recovery for community resilience from disasters. This research applies a conceptual framework analyzing two disaster events with different strategies of housing buy-outs and insurance as thresholds for neighborhood housing resilience. Specifically, three key questions are addressed concerning the dynamics of community housing recovery and resilience, and the role of insurance for recovery outcomes: what are the similarities and differences in recovery dynamics between the case studies, what is the role of insurance in managing overall community recovery and housing resilience, and what is the time compression for community housing recovery? The framework is applied to two different communities managing long-term housing recovery and reconstruction (Hurricane Katrina and Christchurch Earthquakes) to better understand the role of insurance. Each community's local responses, housing recovery practice, and disasters insurance process is geographically diverse, reflecting different resilience approaches. Here resilience is the opposite of simply rebuilding, contesting the current housing recovery paradigm in BBB and disasters research. This reconceptualization supports an alternative neighborhood housing resilience perspective and challenges the common belief that housing rebuilding and recovery are able to manage long term housing recovery effectively.

This research provided a set of case studies to compare and contrast long-term recovery planning and management following major disasters, in an effort to identify common lessons, challenges and ways to mitigate future losses and damages. First, the case studies provide a general approach of mapping linkages in disaster recovery, and at multiple scales and time scales, to identify additional problems overlooked and not well researched in recovery. In order to do so, detailed data sets related to small communities are constructed and then analyzed using frameworks and indicators for assessment and evaluation. Together, the papers identify multiple issues within disaster recovery related to the design of disaster policy and management for housing rebuilding and mitigation of future disaster losses. These issues include problems with the role of insurance in supporting housing recovery, insufficient disaster recovery financing, problems implementing existing financial schemes, failure to measure long-term housing recovery or to calculate actual community scale damages connected to economic and housing losses, and inattention to linkages beyond those connecting between the urban and rural environments that also shape geographies of recovery. These issues demonstrate the overall lack of attention given to addressing how to manage long-term recovery in well-developed industrial urban economies. These problems are largely the result of governance systems that are incapable of addressing post-disaster recovery planning and resilient recovery financing that are not designed to handle the increasing natural disaster events related to climate change and urbanization.

The research consistently embeds investment and insurance in the varied governance of disaster recovery, using specific cases and data sets. Several of the papers demonstrate weaknesses with previous analysis based on interpretation of conventional indicators such as total investment sums, the extent of insurance coverage and the amount of insurance pay outs. A strong case is made for policy changes to implement financing and permitting of housing construction in order to reduce housing recovery times. The measurement of financial and housing losses also presents a challenge for disaster recovery planning given the lack of available community small scale data. The case studies provide ways to make precise calculations and measurements to better understand the actual time scales and resources needed to support long-term recovery. The case studies offer measurements that can be applied to other sectors (e.g. economic such as tourism and housing) or scales such as micro (community), meso (regional or economic sectors) or macro (entire markets or fiscal and monetary policies) for analysis.

The case study research findings reveal that prioritizing long-term housing recovery as an anchor project in the governance process never took place and largely was seen as an afterthought in overall recovery planning despite its significance. The focus was rather on the immediate aftermath of disaster, and the provision of emergency shelters and temporary housing, not on urban resilient recovery planning. The lack of long-term housing recovery emphasis shifted the attention and responsibility of the governance and institutional systems to the communities in raising awareness and requiring additional, ad-hoc policies to address the lack of long-term housing planning. Analysis of long-term housing recovery consistently highlights the importance of community mobilization in disaster recovery, and reveals uneven effects of recovery on residents and communities that result from governance and insurance management problems.

Analysis of plans generated under the 100 Resilient Cities rubric reveals a scheme that largely circulates expertise in support of expert decision making, with far less attention to community resilience or participation than called for in either the Sendai or Build Back Better frameworks, each of which aims to reduce disaster vulnerabilities and risk. Researching the roles of urban-rural linkages in disaster recovery reveals that many urban resilience indicators (natural resources, flows of materials and products, investment flows, demographic patters, waste disposal, information flows, governance and social interactions) are interconnected and entangled at all scales (global, national, inter-regional, urban, peri-urban and rural) making build back better more challenging and, perhaps, even a questionable endeavor. For economic geographers the challenge then becomes how to understand resilience as a narrative of recovery within resilience or build back better frameworks.

As a result of this cumulative research, a call is made for further research into the newly circulating disaster resilience policies, which may themselves produce new vulnerabilities. The papers work to promote new indicators for assessing performance in disaster management governance. The papers use Economic Geography approaches to make a substantial contribution to disaster recovery literature. The research results offer important lessons that can be shared and that can be used to assist with recovery and learning processes for urban communities coping and adapting to disasters and future climate change challenges.

It is worth noting for future research that there is much still to be learned about the recent disaster resilience policies being implemented in cities and urban landscapes. 100RC platform partners are designing and implementing resilience strategies and assessments of disaster risk reduction measures, but their long-term effects deserve attention. Urban-rural linkages are expected to play an important role in newly designed resilience and post-disaster recovery strategies, but the case examined here highlights the importance of linkages at other scales. More work is needed that identifies the linkages in sustainability transitions post disaster. The research presented here also indicates the need to design models to assess community losses, housing losses and what roles insurance or other financial reconstruction funding sources play in managing long-term recovery. There is a lack of long-term community resilience monitoring and measurement for post-disaster recovery that addresses natural disaster losses for the tourism and housing sectors. Future research should attempt to design, in collaboration with community stakeholders, more robust modeling to remedy this shortfall.

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Appendix A: 100 Resilient Cities Evaluation Framework

Sendai Framework for Disaster Risk Reduction		
	Understanding disaster risk	
1	Is disaster risk explicitly defined and explained?	1
2	Is vulnerability explicitly defined and explained?	1
3	Are specific populations of interest (e.g. vulnerable groups) identified in the strategy?	1
4	- If yes, is their vulnerability explored in-depth? (e.g. historic or structural reasons for their vulnerability described)	1
5	Are disaster risks intentionally directed at specific groups?	1
6	- Why or why not? (unscored)	-
7	Are there disaster risk scenarios or natural hazards identified and described (shocks and stresses)	1
8	Could any of the proposed actions in the strategy directly or indirectly negatively affect a vulnerable group? (e.g. through displacement)	-
9	- Does the strategy acknowledge this potential impact?	1
10	- Do any proposed actions attempt to mitigate this impact?	1
11	Are there some DRR benefits (e.g. social, economic, legal, health, structural, cultural, educational, environmental, technological, political) that may not be accessible to vulnerable stakeholders?	-
12	- Why or why not? (unscored)	-
13	- Is this acknowledged in the Strategy?	1
14	- Is there evidence that the Strategy attempts to mitigate this or improve access?	1
15	Does the strategy's understanding of vulnerability include socioeconomic/sociocultural characteristics? (e.g. more than just risk exposure)	1
16	Does the strategy feature a map that describes disaster risk, socioeconomic vulnerability or human development?	1
17	Does the strategy acknowledge how municipal systems or processes might exacerbate disaster risk and vulnerabilities?	1
18	Is the strategy available in the predominant local language and/or minority languages? (unscored)	-
	TOTAL POSSIBLE POINTS	*13*
	Strengthening disaster risk governance to manage disaster risk	
19	Does the strategy propose any actions to correct previous disaster risk exposures?	1
20	Does the strategy define roles and responsibilities for those managing DRR initiatives	1
21	Who is assigned responsibility or accountability for uneven vulnerability?	-
22	Are there some DRR responsibilities shared between vulnerable groups or specific stakeholders impacted by disaster risk exposure?	1
23	Does the strategy combine local knowledge and perceptions of risk with technical and scientific knowledge, data and assessment methods?	1
24	Are DRR/recovery knowledge and capacities being passed on to children formally through local schools and informally via oral tradition from one generation to the next?	1
25	Are the root causes of disaster risk and vulnerability addressed in the actions, or do actions attempt to "treat" rather than prevent disaster risk and vulnerability?	-
26	Are there clear, agreed and stable partnerships between the community and other actors (local authorities, NGOs, businesses, etc.) that provide resources for DRR and recovery?	1
	TOTAL POSSIBLE POINTS	*6*

	Investing in disaster risk reduction for resilience	
27	Are there public or private investments made for DRR prevention to enhance economic, social, environmental, health and cultural resilience?	1
28	Are there clear financial partnerships or other arrangements provided for DRR and recovery?	1
29	Will the records of management of funds and resources be made available?	1
30	Are there affordable and flexible financial services (savings and credit schemes, micro-finance), whether formal or informal made available for vulnerable groups?	1
31	- Are these services organised by the community or are they provided by external actors, or both?	-
32	Are there measures taken to protect assets (e.g. insurance policies, physical protection measures) to be able to cope in a disaster?	1
33	Are assets accessible for social protection (public and private initiatives that provide income or consumption transfers to the poor, protect the vulnerable against livelihood risks, and enhance the social status and rights of the marginalized, with the overall objective of reducing their economic and social vulnerability) to support DRR and recovery discussed?	1
34	Are investments being made for critical infrastructure and basic services to reduce vulnerability to disasters and provide adequate protection from hazards?	1
	TOTAL POSSIBLE POINTS	*7*
	Effective disaster response and Build Back Better approaches	
35	Does the strategy describe measures to implement DRR and recovery focused training and education for local leadership, economic sectors, and vulnerable populations impacted by disasters?	1
36	Are the recovery sectors well-defined with appropriate recovery strategies?	1
37	Does the strategy address the housing structures (e.g. codes, building standards) vulnerable to disasters with adequate protection?	1
38	Does decision-making regarding land use and management take disaster risk into account?	1
39	Are hazard maps and disaster risk studies incorporated into resilience planning (e.g. land use, urban growth)?	1
40	Does the strategy address quality versus speed of disaster reconstruction?	1
41	Does the BBB method include women and persons with disabilities leading responses and reconstruction approaches?	1
	TOTAL POSSIBLE POINTS	*7*
	Monitoring and Evaluation	
42	Does the strategy describe a framework for evaluating whether or not its actions have been successful?	1
43	Does it mention that equity considerations will feature as an indicator of success/failure?	1
44	Does the strategy mention that monitoring and evaluation protocol will be collaboratively designed?	1
45	Is there an opportunity for public participation in conducting monitoring and evaluation?	1
	TOTAL POSSIBLE POINTS	4
	Transparency and Participation	
46	Is the stakeholder engagement process described?	1
47	- Does the strategy describe during which phases participation took place?	1
48	- Does the strategy describe what media or techniques were used for consultation?	1
49	- Does the strategy describe how many people were consulted?	1
50	- Does the strategy describe engaging external stakeholders in early problem definition?	1
51	- Does the strategy describe engaging external stakeholders in co-creation and solution generation?	1
52	- Does the strategy describe how information was disseminated to the non-participant public? (e.g. general public communications)	1
53	Which stakeholders are identified and targeted for consultation?	-

54	- Is there evidence that vulnerable groups were afforded an opportunity to self-identify their needs and priorities?	1
55	- Is there mention of vulnerable residents being engaged as stakeholders or participants?	1
56	- Were specific partnerships or arrangements achieved with key external stakeholders? (e.g. civil society, associations, industry)	1
57	Does the strategy describe what rationale was used to identify and recruit stakeholders? (e.g. why some actors were included while others were not)	1
58	Are there plans for ongoing participation, or is the strategy portrayed as "finished"?	1
	TOTAL POSSIBLE POINTS	*12*
	TOTAL POSSIBLE POINTS	*49*

Appendix B: Published Publications

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Contents lists available at ScienceDirect

Progress in Disaster Science

journal homepage: www.elsevier.com/locate/pdisas

100 Resilient Cities program and the role of the Sendai framework and disaster risk reduction for resilient cities

Sahar Zavareh Hofmann

LMU Ludwig-Maximilians-Universität München, Department Geographie, Luisenstraße 37, 80333 München, Germany

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ABSTRACT

The Rockefeller Foundation launched 100 Resilient Cities (100RC) in 2013 to build worldwide urban resilience. The 100RC program aims to implement urban resilience under the Sustainable Development Goals of the UN 2030 Agenda for Sustainable Development and the Sendai Framework for Disaster Risk Reduction 2015–2030. These frameworks link disaster resilience and disaster risk reduction to issues of vulnerability, climate change, livelihoods, rebuilding, and equity. Achieving disaster resilience and risk reduction requires more than building back better, or bouncing back from disaster: social equity, participation and livelihoods must also be advanced. Using a pathways approach related to narratives of disaster vulnerability and risk, this paper analyzes the resilience policies developed to support disaster risk reduction under the program. Evaluating member city Resilient Strategies plans using directed and summative content analysis, this research assesses whether the 100RC program emphasized vulnerability and risk narratives in its disaster risk reduction approaches. These results reveal the differences produced among member cities – and from expectations of advancing social equity, livelihoods and participation – due to the role of actors and power expressed in the policy design and implementation. The paper concludes with recommendations to support urban disaster resilience using the Sendai Framework.

1. Introduction

Launched in 2013 by the Rockefeller Foundation, 100 Resilient Cities (100RC) has invested $100 million in the pursuit of urban resilience worldwide. 100RC brings together cities, experts, and public and private organizations through its Platform Partners, sponsors a Chief Resilience Officer and offers innovative financing and technology for members. The aim of the program was to create a network for best practices, share in lessons learned, and connect with other experts in an effort to assist in the scaling issue of identifying urban resilience challenges, finding solutions and implementing policies for those facing similar problems. Members participate in a resilience strategy process engaging with stakeholders and partners to identify resilience priorities, shocks and stress, and establish initiatives to create a City Resilience Strategy (CRS). It is estimated that over $1 million was allocated through training, partnerships, and other non-monetary services to each member city. The program ended in 2019, but continues to operate as a platform for members and partners to share best practices, reports, strategies, and tools under its successor, Adrienne Arsht Center for Resilience [1].

This research seeks to answer whether the 100RC program emphasized vulnerability and risk narratives using disaster risk reduction approaches in the successive member Resilient Strategies. This is done by applying a directed and summative content analysis of plan evaluation, based on the "31 City Resilience Strategies" developed by Fitzgibbons and Mitchell [2]. This paper uses a pathways approach related to narratives of disaster vulnerability and risk. This approach analyzes resilience policies developed to support disaster risk reduction. Resilience is seen as the reactive policy response to disaster events able to resist, adapt or recover in a timely manner. Reducing vulnerability and lowering risk are seen as interconnected, resulting in enhanced livelihoods, contributing to sustainable development and strengthening communities linked to disaster risk reduction strategies. Here a resilience system refers to a 100RC resilience strategy. This paper focuses on narratives centered around community vulnerability and risk in these resilience systems. Narratives are analyzed revealing treatment of such issues: how resilience policies understand, define, and identify disaster risks, vulnerabilities, vulnerable populations or marginalized persons; determining what processes create or contribute to overall disaster risks; what role vulnerable stakeholders play in disaster resilience governance; whether their voices are heard and counted; whether they had a role in the development of the planning, its implementation or in future policy; whether investments are made to help them; who benefits from this collaboration; and what strategies are used for disaster recovery planning?

E-mail address: sahar.zavareh@geographie.uni-muenchen.de.

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2. Resilience and disasters

The current global undertaking of disaster resilience is being pursued in the hopes of reducing disaster impacts and strengthening communities [1,3]. The United Nations led the first call in the 1990s to address international disaster risk policy with the creation of the Yokohama Strategy. The Strategy focused on international cooperation and implementation of disaster risk reduction (DRR) by providing guidelines for prevention and mitigation. This was later followed up in 2005 by the Hyogo Framework for Action, shifting focus on managing capacities and risk preparedness interventions. The Sendai Framework for Disaster Risk Reduction 2015–2030 (SFDRR) was created in 2015 as an attempt to broaden and enhance responses to disasters and allow for resilience measurements [4]. SFDRR reflects the notions of reducing disaster risk and building resilience as an integral part of the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs). These initiatives are interrelated in an effort to build overall resilience. Disasters affect a wide range of the SDGs through poverty, food insecurity, urbanization and climate change, but SDGs specifically target disaster risk resilience. SDGs link disaster resilience and DRR through issues of vulnerability, climate change, livelihoods, rebuilding, and equity [4]. Achieving disaster resilience requires communities and households to transform in light of shocks and stresses. Hence, resilience is more than building back better, or bouncing back from a disaster: disaster resilience and DRR planning are designed to advance social equity and livelihoods. SFDRR has four priority areas: understanding disaster risk; strengthening disaster risk governance; investing in DRR for resilience; and enhancing disaster preparedness for effective response by utilizing 'Build Back Better' in recovery, rehabilitation and reconstruction. SFDRR was one of the first major agreements established from the agenda as a way to influence and complement the goals and targets by outlining seven global targets. SFDRR indicators also contribute to the measurement of SDGs [4]. 100RC program aims to develop resilience under SFDRR, SDGs and DRR.

The UN's approach encourages pursuit of resilience policies as a prescribed remedy, incorporating notions of mitigation, preparedness, resistance and recovery in order to deal with future uncertainties [5]. Resilience has taken on several different definitions within the field of hazards and disaster research. Natural disaster resilience is defined as "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" [6]. When discussing a community or a city's ability to withstand disasters, researchers often refer to the term 'resilience' [7]. Resilience is generally known to be a property of a range of systems that are able to remain stable when facing shocks and stresses, recover following an event, and adapt to new circumstances [4]. Much emphasis is placed on recovery and resilience after disasters [8]. One city's recovery or resilience is not the same as another's, due to its unique attributes and inherent ability to rebound based on political and economic factors [9].

Resilience has emerged in urban planning and research to provide insights into managing disaster issues in complex socio-ecological systems [10–12]. Urban resilience is "the capacity of a city to rebound from destruction" [13] using three mechanisms: persistence (systems resisting disturbance), transition, and transformation [14]. Strengthened resilience is seen as the pathway to help mitigate immediate deaths, injuries, and economic losses from disasters by utilizing four methods: (1) systematic assessment and monitoring of risks associated with disasters in order to improve understandings of risks by the public and government; (2) establishment of a culture and system of incentives promoting accountability by stakeholders for planning and preparation for response to and recovery from disasters; (3) the use of long-term planning through investments and use of existing measures; and (4) international cooperation with the aid and support of research and evaluation [15].

Disaster resilience strategies have gained attention among practitioners and researchers seeking to build resilient societies by focusing on urban, socioeconomic, and business resilience [16]. Disaster resilience is a concept shared by many disciplines making it difficult for a common definition. The most frequent definition used for disaster resilience is the speed with which people, communities and societies are able to recover from hazards, shocks or stresses without compromising long-term development [17,18]. Disaster resilience can be described both as desired outcome(s) and a process leading to desired outcomes [19]. Core elements of disaster resilience include context (whose resilience is being built), disturbances (shocks and stresses), capacity to respond (ability to manage shocks/stresses), and reaction (bounce back better) [17]. However, under careful examination, revealed resilience after a disaster may or may not actually result in pre-disaster states. Therefore, true resilience is revealed when it is manifest as action that can be observed as a process [20].

Disaster resilience is directly linked to disaster risk reduction (DRR) [17]. DRR is broadly defined as the development and application of policies, strategies and practices to reduce vulnerabilities by managing risk arising from interactions between people, environment and hazards. DRR is seen as a pathway to improved security and safety providing vital support and opportunities for households, communities, societies and governments to undertake initiatives that improve well-being, strengthen livelihoods and contribute to sustainable development. DRR is considered as a vital aspect of resilience building [21]. Moreover, the usage of DRR and disaster resilience can contribute to the overall urban resiliency of cities.

Disaster risk and vulnerability are closely related to resilience [19]. Vulnerability is defined as the characteristic of those affected in terms of the ability to anticipate, cope, resist, manage and recover from the natural hazard [22]. Vulnerability is conceptualized and applied within DRR in multiple ways and different contexts. Vulnerability is both a phenomenon and a concept, with practical applications in DRR. Therefore, both quantitative and qualitative approaches are relevant in order to understand the entire dimensionality of vulnerability [23]. Disaster risk is defined as the possibility of loss, injury, death or any other consequence resulting from the natural disaster [22]. How disaster risk and vulnerability are conceptualized, measured and mitigated is vital to understand relationships between physical, social, political and economic factors [24], that directly impact who and what is affected by the disaster and empowered by the recovery, who is vulnerable, and who is resilient. People within communities and cities are vulnerable often due to their migration patterns, access to resources and the likelihood of a natural disaster event occurring [25]. Vulnerability is both a biophysical and social response [26]. Increasing exposure and vulnerability of urban areas to natural disasters is becoming more important to the field of hazards research since it is related to both uneven economic development and to declining infrastructure as well as a need to invest in better infrastructure to avoid rising risk [27–31]. Vulnerability as a concept provides crucial insights and knowledge in understanding disaster risks for communities. Vulnerability is also an important indicator for measuring and monitoring for DRR as well as influencing urban resilience policy developments. Therefore, identifying, assessing and reducing risk and vulnerability are vital for disaster resilient societies. DRR efforts are linked to holistic and integrative vulnerability perspectives [32].

It is also important to consider critiques of resilience as it relates to both the urban and disasters. Resilience in the context of urban development is focused on adaptation to disturbances, or shocks and stresses. This turns attention to managing and adapting to current shocks and stresses, rather than attempting to address existing political and economic challenges contributing to the problem formation [33]. Davoudi [34] calls attention to how resilience has just as much influence shaping how challenges are perceived as it does in shaping how to respond to them. Resilience is dynamic, relational, and deeply political [35]. Critics of urban resilience argue that programs, such as the Rockefeller Foundation's 100 Resilient Cities program, should be confronted with the following questions [33]: Who determines what is desirable? Whose resilience is prioritized? Who is included/excluded from the system? Is the resilience of some prioritized over others? Does enhanced resilience reduce resilience elsewhere? To date, few studies exist that seek to provide answers to these questions [33].

In disaster studies, Tiernan et al.'s [4] resilience definition and usage may be appropriate, however lacks the specificity of the other approaches, and is potentially in conflict with them. Generally, resilience is often understood as a property of a system that is related to an appropriate system model. In contrast, economic geographers tend to understand this to be a potential property of a regional or sectoral economic system [36,37], while development scholars understand resilience as either a property of a social system or as a narrative [38,39]. In hazards research the system is considered to be a society, and how well it deals with environmental and hazards risks [35]. Repositioning the concept of resilience emphasizes the growing interest in a 'pathways approach' in an effort to address governance challenges posed by dynamic and complex multi-scale systems [40]. Here resilience denotes a broader approach in thinking about change and societal responses dependent on context and perspective. Leach et al. [40] are concerned with system-framings (different ways of understanding and characterizing a system) and narratives. These narratives pertain to issues created by specific actors, networks or institutions. They can be used to justify particular kinds of actions, strategies or interventions. When these narratives are supported by institutional and political processes and by governance, they define and shape pathways in particular. In turn, such narratives can silence other narratives, so that they are never to be manifested, remaining silenced, marginalized or forgotten. Consequently, narratives are able to influence pathways through assumptions about temporality of change and styles of action [40].

Leach et al. [40] constructs a typology of policy responses using a matrix relating two styles of actions ('control' or 'respond' to change) to temporality of change ('shock' or 'stress') to achieve four possible sustainable scenarios: stability (control action to counter shock), resilience (response to shock), durability (control action to counter stress), and robustness (response to stress). They recognize that a policy response might vary or have different impacts depending on whom is being studied, at what scale, in what space and context, as well as the varying degrees of sustainable values being considered in relation to specific goals [40]. This adds a reflexive dimension to resilience thinking by recognizing the analysis is based on specific framings with different outcomes. At the same time, it redefines resilience as a narrative of response to shock while highlighting alternative narratives. Thus, this framework can assist in the understanding of how 'resilience' is being used in the 100RC program and SFDRR: resilience is not defined as a property of a system, but rather as a narrative related to a DRR that will likely vary from city to city.

Ultimately the benefits or the burdens of urban resilience policy making and planning are rooted in power, politics and conflict [34,41]. Davoudi [34] argues the power-laden nature of urban resilience highlights what values must be identified, choices made and identification of political pathways. Treating a city in separate parts or sectors (e.g. political, economic, social) without a holistic approach undermines resiliency and is a catalyst for long-term disaster losses and casualties [42]. Torabi et al. [41] highlight the importance of examining urban resilience pathway dimensions by addressing city policies that are often rooted in power and politics. Lasa et al. [43] stress a city's commitment to DRR should also consider an actor's (political) ability to understand risk, resilience, governance, policies, and bureaucratic processes. Potentially, scholars in urban and cities studies can contribute a theorization of policy mobility to urban resilience research. Policy mobility describes the movement of a policy from one place to another as it relates to various elements (e.g. institutions, actors, infrastructure) allowing movement. The way in which a policy moves is related to the context from which, through which, and to which it travels [44]. Much of these works are focused on the urban and how cities are not bounded places with specific internal characteristics and processes, but function rather as nodes in relational networks linked to other nodes across various distributions of material and immaterial objects [44]. Often the creation of a policy allows for the remaking of power relations within and between different places. Therefore, policy mobility provides an additional perspective that relations are what constitute a city and the infrastructure that enable policy mobility. This also helps us rethink cities not as singular places, but rather as urban assemblages with multiple spatialities and temporalities [44]. Furthermore, policy mobility allows for the close study of how implementation can and has shaped why some policies get mobilized. There are important parallels here to thinking on how the manifestation of narratives occurs in a pathways approach.

2.1. Rockefeller Foundation 100 Resilient Cities

The Rockefeller Foundation launched the 100 Resilient Cities (100RC) initiative as a separate nonprofit organization in 2013 to help cities around the world build resilience to the economic, social and physical challenges they will face in the 21st century. To become a member, cities completed an application process and winners were announced in three rounds in 2013, 2014 and 2016. Cities were chosen based on the presence of mayors seeking innovation and change, a track record of establishing and maintaining partnerships, and the ability to work with diverse stakeholders. Sponsored Cities are cities whose membership is underwritten by local funders, separate from the 100RC application process. Under the 100RC initiative, member cities would receive direct funding to hire a Chief Resilience Officer (CRO) to lead the city's resilience efforts for two years. 100RC provides member cities with access to resilience building tools and services supplied by platform partners from the private, public, academic, and nonprofit sectors. It is estimated that over $1 million has been allocated in funding through training, partnerships, and other non-monetary services to each member city. Platform Partners are intended to assist cities understand their needs, build new tools and improve existing ones. The program provided a unique peer support system for member cities to share and assist one another in resource development, problem-solving and networking. 100RC member cities are expected to participate in a 100 RC Resilience Strategy process. This is a roadmap designed over a 6 to 9-month process to develop resilience for the city by engaging with stakeholders, working with strategy partners in order to identify resilience priorities, shocks and stresses, and establishing a set of initiatives to move forward by creating a City Resilience Strategy (CRS) [1].

100RC member cities utilize the City Resilience Framework (CRF) as a strategy development process and method for understanding the complexity of urban systems and the drivers contributing to a city's resilience. CRF is a framework developed by Arup, a private consulting firm, and supported by the Rockefeller Foundation. It emphasizes the 100RC strategy development process as a method for understanding urban resilience by allowing member cities to identify indicators for city resilience, support dialogue between stakeholders, and assist in the design of a city resilience strategy for implementation and oversight. The CRF recognizes that both cities and the way resilience manifests in them are unique, and aims to provide a lens to understand the complexity and nuances of city resilience [1,56].

100RC identifies seven qualities of a resilient system applicable at a city scale as well as individual systems. This formed the basis of their working principle that what was missing was a comprehensive and holistic framework combining physical aspects of cities with less tangible aspects, linked with human behavior in the context of economic, physical and social disruptions. Rather than assessing individual systems within cities to describe a resilient city, the framework is applied at the city scale. Work was further extended to both define functions critical to resilience, and test the framework in order to understand what contributes to resilience in cities, and how resilience is understood from stakeholder perspectives. This resulted in the identification of eight city functions for resilient cities: delivers basic needs; safeguards human life; protects, maintains and enhances assets; facilitates human relationships and identity; promotes knowledge; defends the rule of law, justice and equity; supports livelihoods; and stimulates economic prosperity. Additionally, 12 key themes were identified as factors for improving resiliency [56].

3. Materials and methods

The framework of this paper has been adapted from the SFDRR and the "31 City Resilience Strategies" [2] that applies a directed and summative content analysis of plan evaluation using a formative approach to answer:

Has the 100RC program emphasized vulnerability and risk narratives using DRR approaches in the successive member city Resilient Strategies? Fitzgibbons and Mitchell [2] developed the "31 City Resilience Strategies" as an analytical framework to review all relevant resilience and specific subject areas under evaluation using directed and summative content analysis. The methodology extracts quantitative observations from strategy content and uses a list of indicators to score individual strategies based on strategy content. Qualitative content analysis assists in analyzing text data to understand the content or contextual meaning of policies. Summative content analysis allows for analysis to determine what has been said. Evaluation in planning, more commonly known as plan evaluation, helps determine how effective projects and policies are and whether they have achieved their intended goals and objectives. Conducting such evaluation increases legitimacy, improves decision making, promotes accountability, and fosters learning. Plan evaluation may take place once a policy or program has been implemented to determine intended outcomes (summative) or during the early initiative phases of development and implementation (formative) [2,45,46].

The framework supports urban resilience planning for DRR using the Sendai Framework as the unit of analysis. Two broad categories (Table 1) were identified for criteria: Disaster Resilience; and Open Process. Within these two categories, there are 7 sub-themes (risk and vulnerability; governance; risk reduction investments; recovery; monitoring and evaluation; and transparency and participation) and 58 criteria used for the assessment. Among the 58 criteria developed, 49 were assigned points by a rater, indicating the degree of explicit aims to address disaster risk, vulnerability, resilience, DRR, strategy design (transparency and participation) and evaluation. Each of these 49 criteria are rated depending on how thoroughly each criterion is addressed in the resilience strategy (1 point for persuasive arguments and compelling evidence provided; 0.5 point for casual reference but no additional references; and 0 points for no evidence). Due to the lack of explicit DRR resiliency initiatives, there are multiple possible dimensions of DRR embedded within various plan design methods. Therefore, summative observations were used to capture disaster related issues tied to other initiatives or programs not explicitly meant for such issues. Therefore, the remaining nine unscored criteria were used with summative observations to assess these related DRR issues. These observations were coded and documented using ATLAS.ti software. Atlas.ti is a computer software program that assists analysis of qualitative research data such as document analysis. Only 75 CRSs have been published in English as of March 2020 that were provided by the 100 Resilient Cities Program were used for the analysis. To ensure comparability, some cities (Barcelona, Lisbon, Puerto Rico) have been excluded from the analysis because they chose not to publish an official CRS and instead opted for other policy related publications. The analysis is discussed in the Results and Discussion section of this paper.

To validate ratings, a second external reviewer (rater) was used to rate the same criteria and methods independently of the CRS. Prior to reconciling, the overall average score was 95.57% similar between the two independent raters. Major rating discrepancies (more than 20% difference) occurred in ten CRS, and minor rating discrepancies (10–20% differences) occurred in two strategies. Summative and directed observations were reconciled among the raters, and the new overall average scores between raters were 99.33% similar. As a result, there were no major or contradictory summative data observations noted between the raters.

The framework provides a structure to assess only explicit DRR within a CRS. This provides an advanced analysis to quantify how cities prioritize disaster risk and resilience, allowing classification of similarities or relationships between cities, and assessment of overall transparency in the planning and monitoring of policies. However, the analysis is limited: examination of actual implementation and ongoing disaster risk and resilience policies from the strategy cannot be readily identified. The approach could be adapted and modified to assess ongoing strategies for performance using a summative plan evaluation. Additionally, the long-term disaster recovery could be used as a metric for a plan evaluation to gain insights into just how resilient a city is against DRR goals, as well as comparable climate change strategies that directly or indirectly address disaster risk, vulnerability and resilience.

Table 1
Categories of criteria for directed content analysis.

Metric	Total weighted score
Disaster Resilience	
Disaster risk and vulnerability	13
Disaster risk governance	6
Disaster risk reduction investments	7
Disaster recovery	7
Open Process	
Monitoring and evaluation	4
Transparency and participation	12
Total	**49**

4. Findings

The overall findings of the CRS analysis suggest that the 100RC program has not fundamentally addressed issues related to DRR's goal of achieving resilience by focusing on reducing disaster risk and vulnerability (Fig. 1). Many member strategies lacked specificity or clarity as to what disaster risks and vulnerabilities affected vulnerable groups, what processes would be undertaken to reduce such challenges, having collective feedback from vulnerable groups as well as engaging with them in governance and shared responsibilities, and how investments being made from partnerships or external funding sources would be managed and benefit all stakeholders. While disaster risks and challenges were identified among shocks and stresses, these tended to be overlooked when designing and implementing key policies for urban resilience. Instead, policies generally concentrated on urban infrastructure improvements, general disaster management efforts to improve early warning detection systems, improving hazard and urban growth maps, disaster education, or climate change policies. However, some member cities and strategies do report efforts focused on DRR, connected to SFDRR, SDGs or UNISDR, suggesting the decision not to prioritize vulnerability and risk may not necessarily be a result of the 100RC program.

In considering whether some cities were more likely than others to establish narratives centered around community vulnerability and risk in their CRS, the following broader categories of cities and countries are used (Table 2): city classification, location, climate classification, Human Development Index, Unbreakable Resilience Indicator, and Worldwide Governance Indicators. The city classification is based on the OECD-EC approach that identifies small cities between 50,000 and 100,000 inhabitants, medium between 100,00 and 250,000 inhabitants, large between 250,000 and 500,000 inhabitants, extra-large between 500,000 and 1,000,000 inhabitants, extra-extra-large between 1,000,000 and 5,000,000 inhabitants, and a global city of more than 5,000,000 inhabitants [47]. The location of each city is determined using the Global North/South classifications [48]. The Köppen-Geiger Climate Classification system [49] applies five categories to assess whether a city is tropical (Group A), arid (Group B), temperate (Group C), cold (Group D), or polar (Group E). The World Bank and the Global Facility for Disaster Reduction and Recovery (GFDRR) has established the Online Unbreakable Resilience Indicator (URI) database as a means to move beyond traditional metrics to examine how natural disasters affect people's well-being [50]. The Unbreakable report [51] provides a resilience percentage for each country based on drivers such as social protection (ability to access post-disaster financial and social resources), economic (providing financial inclusion), vulnerability (asset vulnerability) and exposure to disasters. The World Bank Worldwide Governance Indicators (WGI) reports aggregate and individual governance indicators using six dimensions: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption [52]. No data are given for Lebanon, Palestine, Singapore, South Korea, and New Zealand in the Unbreakable report, and data for Palestine is omitted from the WGI database. Therefore,

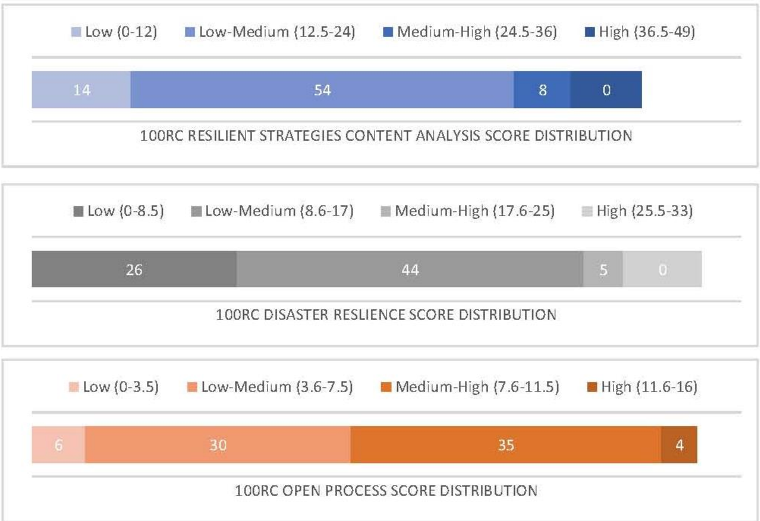

Fig. 1. 100RC directed content analysis scoring.

the comparison analyses conducted here do not include ratings for these cities.

The policy evaluations are limited to the 75 members considered for category assessment of member cities (see Table 2). Although the 100RC program has intended to include a wide and diverse range of cities, there was noticeably a strong concentration of members in wealthier countries with higher human Development Index scores. Using the Human Development Index (HDI) to assess country development, notwithstanding economic growth, the analysis included a total of 51 CRS from cities in countries with very high (0.8 to 1.0), 16 with high (0.7 to 0.799), 7 with medium (0.550 to 0.699) and 2 with low (0.350 to 0.549) human development [53]. The sample is overwhelmingly concentrated on cities (88%) having high to very high human development in comparison to low human development cities (2%). Nevertheless, 30 of the cities were located in the Global South, compared with 45 in the Global North [48]. The majority of the cities were classified as extra-extra-large (35%) or global cities (32%) [54]. Ramallah was the only city below the small city classification and therefore received no official city population ranking [55]. Most cities (60%) were located in temperate climates based on the Köppen-Geiger Climate Classification system (KGCC), followed by tropical climates (21%) [49]. This shows how cities located in temperate climates are less likely to suffer from climate change as those in tropical climates.

Using the World Bank Worldwide Governance Indicators (WGI) to assess overall governance, the analysis included a total of 17 CRS from cities in countries with high (85 to 100), 27 with medium-high (71 to 84), 9 with medium (50 to 70), 19 with low-medium (36 to 49) and 2 with low (0 to 35) scores [52]. The sample is overwhelming concentrated on cities (72%) having high to medium governance in comparison to low governance cities (28%). It also appears that cities scoring well on the Unbreakable report (URI) (72% with medium and 22% with high resilience) tend to have higher resilience percentages than on the 100RC score distributions (60% with medium and 1% with high resilience). Here it is noted that cities that appear to have 'barriers' to good governance or "drivers" for resilience tended to develop resilience strategies that failed to incorporate narratives centered around community vulnerability and risk.

The broader categories of cities and countries highlight the distortions between vulnerabilities and risks associated with disasters, and capabilities to respond. Generally, whether the 100RC resilience strategies incorporated narratives around community vulnerability and risk was not consistently related to city size, climate, or other indicators such as human development, governance and resilience. These patterns of city and country categories are also important in considering the impacts and influence on policy mobility. Changing geopolitical contexts and international relations, such as the case with countries moving from low to medium human development, shape where particular cities will look to in developing disaster resilience policies. The economic context of policy making is also influenced by policy makers, which may differ depending on different relations in global capitalism, with higher human development versus lower human development. Policy mobility is also influenced by the role of stakeholders, emphasizing assumptions and knowledge claims underlying resilience policies implemented in relation to HDI scores. Those with lower scores tended to rely more heavily on 100RC program expertise and subject-matter experts provided by Platform Partners.

Furthermore, there appears to be a focus on disaster threat (shock) narratives that are detailed and discussed for each member city in the program. The top two shocks and stresses are connected to DRR events. Of the top five shocks and stresses (Table 3) identified from each member city only one is related to climate change (sea level rise). The member cities affected by the top five shocks and stresses are diverse in terms of geographic distribution from the Global North and South, population, and climate classification (e.g. tropical and dry). However, the shocks and stresses identified are not necessarily directly converted into a resilience strategy in the resulting CRS. There are 3 primary findings which form the basis of this assertion: (1) the strategies did not offer or provide vulnerable populations or marginalized residents an opportunity to self-identify their needs, priorities, or express their issues for action; (2) many strategies did not attempt to strengthen disaster risk governance by sharing DRR responsibilities between vulnerable stakeholders and government institutions, and (3) few investments were made for social protection, affordable or flexible financial services, or measures to protect assets for vulnerable residents. These findings are discussed in greater detail, followed with potential solutions supporting disaster resilience. (See Table 2).

Table 2
100RC city and country categories.

100RC Member City/Country	City Type	Location	KGCC	HDI	WGI	URI	100RC
Accra (Ghana)	XXL	Global South	Group B: Dry Climates	Medium	Medium	Medium	Medium
Amman (Jordon)	XXL	Global South	Group B: Dry Climates	High	Low-Medium	Medium-High	Low
Athens (Greece)	XL	Global North	Group C: Temperate Climates	Very high	Medium	Medium	Low-Medium
Atlanta (United States)	Global city	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Bangkok (Thailand)	Global city	Global South	Group A: Tropical Climates	High	Low-Medium	Medium	Low
Berkeley (United States)	M	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Low
Boston (United States)	XXL	Global North	Group D: Continental Climates	Very high	Medium-High	Medium	Medium
Boulder (United States)	M	Global North	Group B: Dry Climates	Very high	Medium-High	Medium	Low
Bristol (United Kingdom)	XL	Global North	Group C: Temperate Climates	Very high	High	Medium-High	Low
Buenos Aires (Argentina)	Global city	Global South	Group C: Temperate Climates	Very high	Low-Medium	Medium	Low-Medium
Byblos (Lebanon)	XL	Global South	Group C: Temperate Climates	High	Low		Low-Medium
Calgary (Canada)	XXL	Global North	Group D: Continental Climates	Very high	High	Medium	Low
Cali (Columbia)	XXL	Global South	Group A: Tropical Climates	High	Low-Medium	Low-Medium	Low-Medium
Can Tho (Vietnam)	XXL	Global South	Group A: Tropical Climates	Medium	Low-Medium	Medium-High	Low
Cape Town (South Africa)	L	Global South	Group C: Temperate Climates	High	Medium	Medium	Low-Medium
Chennai (India)	Global city	Global South	Group A: Tropical Climates	Medium	Low-Medium	Medium	Medium
Chicago (United States)	Global city	Global North	Group D: Continental Climates	Very high	Medium-High	Medium	Low-Medium
Christchurch (New Zealand)	L	Global North	Group C: Temperate Climates	Very high	High		Low-Medium
Colima (Mexico)	M	Global South	Group C: Temperate Climates	High	Low-Medium	Medium	Low-Medium
Da Nang (Vietnam)	XL	Global South	Group A: Tropical Climates	Medium	Low-Medium	Medium-High	Low
Dakar (Senegal)	XXL	Global South	Group B: Dry Climates	Low	Medium	Medium-High	Low
Dallas (United States)	Global city	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Low
Deyang (China)	XXL	Global South	Group C: Temperate Climates	High	Low-Medium	Medium	Low
Durban (South Africa)	XL	Global South	Group C: Temperate Climates	High	Medium	Medium	Low
El Paso (United States)	XL	Global North	Group B: Dry Climates	Very high	Medium-High	Medium	Medium
Glasgow (United Kingdom)	XL	Global North	Group C: Temperate Climates	Very high	High	Medium-High	Medium
Greater Miami and the Beaches (United States)	XL	Global North	Group A: Tropical Climates	Very high	Medium-High	Medium	Medium
Honolulu (United States)	Global city	Global North	Group B: Dry Climates	Very high	Medium-High	Medium	Medium
Houston (United States)	XXL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Juarez (Mexico)	XXL	Global South	Group B: Dry Climates	High	Low-Medium	Medium	Medium
Kyoto (Japan)	Global city	Global North	Group C: Temperate Climates	Very high	High	Medium-High	Medium
Lagos (Nigeria)	Global city	Global South	Group A: Tropical Climates	Low	Low	Low-Medium	Medium
London (United Kingdom)	Global city	Global North	Group C: Temperate Climates	Very high	High	Medium-High	Low-Medium
Los Angeles (United States)	XXL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Louisville (United States)	XXL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Medellin (Columbia)	L	Global South	Group A: Tropical Climates	High	Low-Medium	Low-Medium	Medium
Melaka (Malaysia)	Global city	Global South	Group A: Tropical Climates	Very high	Medium	Medium	Low-Medium
Melbourne (Australia)	Global city	Global North	Group C: Temperate Climates	Very high	High	Medium-High	Medium
Mexico City (Mexico)	Global city	Global South	Group C: Temperate Climates	High	Low-Medium	Medium	Medium
Montevideo (Uruguay)	XXL	Global South	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Montreal (Canada)	XXL	Global North	Group D: Continental Climates	Very high	High	Medium	Medium
New Orleans (United States)	XXL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
New York City (United States)	Global city	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Norfolk (United States)	M	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Oakland (United States)	L	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Panama City (Panama)	XL	Global South	Group A: Tropical Climates	High	Medium	Low-Medium	Medium
Paris (France)	Global city	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium-High	Medium
Pittsburgh (United States)	XXL	Global North	Group D: Continental Climates	Very high	Medium-High	Medium	Medium
Pune (India)	Global city	Global South	Group A: Tropical Climates	Medium	Low-Medium	Medium	Medium
Quito (Ecuador)	XXL	Global South	Group C: Temperate Climates	High	Low-Medium	Medium	Medium
Ramallah (Palestine)		Global South	Group C: Temperate Climates	Medium			Medium
Rio de Janerio (Brazil)	Global city	Global South	Group A: Tropical Climates	High	Low-Medium	Medium	Medium
Rome (Italy)	XXL	Global North	Group C: Temperate Climates	Very high	Medium	Medium	Medium
Rotterdam (The Netherlands)	XXL	Global North	Group C: Temperate Climates	Very high	High	Medium-High	Low
San Francisco (United States)	XXL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Sante Fe (Argentina)	XL	Global South	Group C: Temperate Climates	Very high	Low-Medium	Medium	Medium

Santiago De Los Caballeros (The Dominican Republic)	Global city	Global South	Group A: Tropical Climates	High	Low-Medium	Medium	Medium
Santiago Metropolitan Region (Chile)	XXL	Global South	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Seattle (United States)	XXL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Low
Semarang (Indonesia)	XXL	Global South	Group A: Tropical Climates	High	Low-Medium	Medium	Medium
Seoul (South Korea)	Global city	Global North	Group D: Continental Climates	Very high	Medium-High		Medium
Singapore (Singapore)	Global city	Global North	Group A: Tropical Climates	Very high	High		Low-Medium
St. Louis (United States)	XXL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Low
Surat (India)	Global city	Global South	Group A: Tropical Climates	Medium	Low-Medium	Medium	Low-Medium
Sydney (Australia)	Global city	Global North	Group C: Temperate Climates	Very High	High	Medium-High	Medium
Tel Aviv (Israel)	L	Global North	Group C: Temperate Climates	Very High	Medium-High	Medium	Low
The Hague (The Netherlands)	XXL	Global North	Group C: Temperate Climates	Very High	High	Medium-High	Medium
Thessaloniki (Greece)	L	Global North	Group C: Temperate Climates	Very high	Medium	Medium	Medium
Toronto (Canada)	Global city	Global North	Group D: Continental Climates	Very high	High	Medium	Medium-High
Toyama (Japan)	L	Global North	Group C: Temperate Climates	Very high	High	Medium-High	Medium
Tulsa (United States)	XL	Global North	Group C: Temperate Climates	Very high	Medium-High	Medium	Medium
Vancouver (Canada)	XXL	Global North	Group C: Temperate Climates	Very high	High	Medium	Medium
Vejle (Denmark)	S	Global North	Group C: Temperate Climates	Very High	High	Medium-High	Low-Medium
Washington DC (United States)	Global city	Global North	Group C: Temperate Climates	Very High	Medium-High	Medium	Medium
Wellington (New Zealand)	L	Global North	Group C: Temperate Climates	Very high	High		Medium

4.1. Vulnerable and marginalized resident engagement

Many cities collaborated with stakeholders (85%) to identify strategy goals and actions, but often collaboration was limited, especially in terms of engagement with community members, such as those most vulnerable to disaster risks. Only five cities (Atlanta, Colima, Kyoto, Panama City, Toronto) provided any evidence that vulnerable groups were afforded an opportunity to self-identify their needs and priorities. There was a tendency to detail why certain roles for managing resilience programs were to be appointed and overseen by governmental proxies, along with the need for key partnerships (with e.g. Arup, The Nature Conservancy, SwissRe, Arcadis, The Asia Foundation, Microsoft, PwC) to manage policy efforts, rather than engage directly with the community for co-creation and solutions. Conversely, many cities aimed to provide residents with opportunities for public participation for ongoing program monitoring and evaluation, but lacked specificity as to how one could do so.

Calgary recognized the traditional Indigenous territory of the Blackfoot people. Throughout their strategy development process, Indigenous people shared their thoughts, ideas and contributions to shape policies. Elders also came and gave their blessings to continue working and supporting the inclusion of Indigenous people. Toronto acknowledged their strategy was developed on the traditional territory of many nations with a long history of Indigenous people in an effort to develop a shared community vision in collaboration. This resulted in engaging over 8000 Torontonians in face-to-face meetings, telephone conversations, social media engagement, meetings in public events and in residents' homes. They also acknowledged that residents experienced different kinds of vulnerabilities based on various factors. Here, by prioritizing vulnerable populations, resilience was seen as more of a process and investment. Specifically, Indigenous communities and leaders were involved to build further resilience and build upon Indigenous knowledge for resilience actions. This was evidenced in the Indigenous Knowledge and Climate Action Workshop that took place to address climate and environmental issues (flood and water management, green infrastructure, education, and technical and Indigenous expertise). The results from these engagements were further documented and made available publicly through the Toronto Resilience Office website. Overall, Toronto made a strong effort to focus on vulnerable and Indigenous resident engagement throughout the resilience strategy development and implementation process. Vancouver specifically addressed the role of women and other groups such as gender-diverse, two-spirit people, cis women and trans in providing a place in disaster resilience and recovery. They acknowledged the importance they play in other critical roles of social and psychological recovery following disasters and sought to elevate their role in creating a resilient city.

Cape Town had one of the more comprehensive approaches to engaging experts and vulnerable residents living in informal settlements. At the beginning of the strategy planning process over 11,000 face-to-face interviews took place with residents of informal settlements and backyard dwellings. Additional meetings and workshops were held to understand and prioritize the diverse challenges voiced among these communities. Thessaloniki involved more than 40 organizations and 2000 citizens using online questionnaires and workshops, establishing a Resilience Day for the Municipality to engage with citizens, featuring live on-air broadcasts by the municipal television and providing printed Braille material for those visually impaired. Honolulu also engaged more than 2200 residents over 18-months using a grassroots approach to develop the strategy. Chennai engaged over 1800 citizens from over 500 vulnerable communities using citizen surveys. However, other strategies provided an approximate count of engaged stakeholders (e.g. Bristol 1600; Boston 11,000), but did not specify if this included vulnerable groups, experts or other kinds of stakeholders involved in developing action items.

The majority of member city strategies fell between a medium-high range, 7.59 average score (Fig. 1) for vulnerable and marginalized resident engagement. This was most likely due to the standardization of the preliminary assessment process established by Rockefeller at the onset of the program for each member. Almost all strategies (85%) identified key external

Table 3
100RC shocks and stresses.

Shocks/Stresses	Country (number of cities)
Blizzard	Canada, Jordan, United States (3)
Climate Change	Canada, Chile, Denmark, Greece, Italy, Jordan, The Netherlands (2), South Africa, United Kingdom (2), United States (9)
Coastal/Tidal Flooding	Australia, Denmark, Ghana, Indonesia, Italy, Japan, Malaysia, New Zealand, Singapore, Thailand, The Netherlands, United Kingdom, United States (7), Vietnam (2)
Drought	Australia, Brazil, Canada, Chile, Ecuador, India, Indonesia, Mexico, Panama, South Africa (2), Thailand, United States (9), Vietnam (2)
Earthquake	Canada (2), Chile, China, Columbia, Ecuador, Ghana, Greece (2), India (2), Israel, Italy, Japan, Mexico (3), New Zealand, Palestine, Panama, The Dominican Republic, United States (5)
Extreme Cold	Canada (2), Italy, Mexico, The Netherlands, United States (2)
Extreme Heat	Argentina, Australia, Canada (2), France, Greece (2), Italy, Jordan, Mexico, The Netherlands, United States (12)
Fire	Chile, Columbia, Ecuador, Greece, Jordan, Panama, South Africa (2), United Kingdom, United States (5)
Hurricane/Typhoon/Cyclone	Canada, India, Lebanon, Mexico, The Dominican Republic, United States (6), Vietnam
Landslide	Brazil, Chile, Columbia, Ecuador, Italy, Japan (2), Malaysia, Mexico, Panama, South Korea, United States (2)
Liquefaction	Italy, United States
Rainfall Flooding	Argentina (2), Australia, Brazil, Canada (3), Chile, China, Columbia (2), Denmark, Ecuador, France, Ghana, Greece (2), India, Indonesia, Italy, Japan (2), Jordan, Malaysia, Mexico (2), New Zealand (2), Nigeria, Panama, Senegal, Singapore, South Africa (2), Thailand, The Dominican Republic, United Kingdom (3), United States (20), Uruguay, Vietnam (2)
Sea Level Rise/Coastal Erosion	Australia, Canada, Denmark, India, Indonesia, Italy, Japan, Malaysia, New Zealand (2), Nigeria, Senegal, Singapore, United States (10), Uruguay, Vietnam (2)
Severe Storms	Canada, Chile, Denmark, United Kingdom, United States (8)
Snowstorms	Palestine
Storm Surge	Mexico, United States (4)
Subsidence	Mexico, United States (2)
Tsunami	Lebanon, New Zealand, United States (2)
Tornado	Chile, Ecuador
Volcanic Activity	Chile, Columbia, Ecuador, Mexico, Vietnam

stakeholders involved for identifying policy processes. A majority also did not describe how information was disseminated to the general public. There also was very little mention as to how vulnerable residents were given opportunities to self-identify and state their needs and priorities. Any information disclosed regarding participatory workshops was used to gauge problem areas of communities typically including key stakeholders (government officials, local authorities, businesses, NGOs etc.). Still, these actors were often chosen representatives on behalf of those managing policy access and resources. Few strategies invited vulnerable community members to participate in discussions or creation of policies. Although vulnerable groups were engaged, such as with the case in Chennai, it is difficult to determine whether, beyond these interviews, any other involvement in planning and strategy implementation took place. Even fewer strategies defined vulnerability and disaster risks, identified who were vulnerable, or specific disaster risks relating to explicit vulnerable groups. Even more lacking was an understanding of how certain DRR benefits were not accessible for vulnerable groups, what impact this may have or any attempts to mitigate these effects. Strategies overall lacked a clear understanding of vulnerability beyond risk exposure.

4.2. DRR governance

Seventeen percent of strategies only attempted to strengthen disaster risk governance by sharing DRR responsibilities between vulnerable stakeholders and government representatives, who were seen as having responsibility and oversight. Further strategies offered no clarity on who or which entity was designated as the responsible party for disaster risk governance. This resulted in a lack of defined roles and responsibilities in 91% of strategies, so that it was not possible to share these with vulnerable persons impacted directly by disaster risk exposure. Generally, there was little consideration of local knowledge (4%) in managing on-going or future disaster risks. Strategies often excluded local knowledge and perceptions of risk. Chennai acknowledged their long history of traditional rain water harvesting methods and Indigenous knowledge from those living on the land. Yet, there was no mention as to how this knowledge would be integrated beyond traditional governance systems. In contrast, Pune focused on strengthening pathways for democratic decision-making and civic participation in local area planning. Other strategies such as those for Can Tho or Singapore, emphasized the strong use of top-down governance approaches in large part due to cultural differences. Overall, many opted only to use technical and scientific knowledge, data, and assessment methods in order to manage disaster risk exposure for vulnerable groups. This expert knowledge tended to be only held by those holding scientific or professional credentials. This further excluded vulnerable community members and those with indigenous knowledge of the land, history of the space and place in which urban geographies were shaped.

Durban took one of the more innovative approaches and pathways to developing their strategy under the guidance and feedback from vulnerable stakeholders using two ‘resilience building options’ (RBOs). This involved first developing an exploratory non-paper in order to explicitly define resilience and the role it would play in city development. From this two RBOs were chosen to develop the strategy focusing on collaborative informal settlement actions and integration of a dual governance system (land tenure regime and municipalities). This resulted in a unique pathways approach to manage urban resilience in effort to construct an African conceptualization for transformation. Although these are complex and interconnected challenges for Durban to address, this experience demonstrates the urgent and critical questions needing answers in understanding how one might ‘do resilience’ differently and in a way that addresses post-colonial urban discourses emerging among scholars.

4.3. Investing in DRR

Overall, 88% of the members benefited from the development of new or expanding public-private partnerships. High profile investments or partnerships were often highlighted in terms of progress and achievement in urban resilience for the city. There were no strategies that identified records of management of funds and resources would be made available for transparency and accountability among agreements. This also applied to the lack of discussion on providing financing terms for better understanding as to just how these investments would benefit or enhance economic, social, environmental, health or cultural resilience for the city. Similarly, only 5% of cities (Chennai, El Paso, Melbourne, Washington DC) offered affordable and flexible financial services such as savings and credit schemes or microfinancing for vulnerable groups affected by disaster risk. Other measures to protect community assets such as disaster insurance (26%) were also limited for those coping with disasters (Christchurch, Honolulu, Houston, Los Angeles, Melbourne, New Orleans, New York, Toyoma, Vancouver, Washington DC, Wellington). Fewer discussed the potential use of implementing disaster related insurance products in order to fund recovery efforts (Cape Town, Chennai, Da Nang, Medellin, Miami, Quito, Ramallah, Rotterdam).

New York City secured over $3 billion in funding from FEMA to provide a comprehensive resiliency program for public housing developments, including flood-proofing and upgrading infrastructure. The city also provides a *Build it Back Better* program that also helps protect vulnerable residents from the loss of critical services during disasters. These efforts are also done in part to address neighborhoods not built to flood construction and insurance requirements in an effort to increase the number of households with flood insurance. This also includes other endeavors from the city to align zoning and building codes with the National Flood Insurance Program (NFIP) and changes to flood insurance maps. Generally, almost all members made investments for critical infrastructure and basic services to reduce vulnerability to disasters. These investments often were tied to other Rockefeller approved vendors (e.g. CDM Smith, CEMEX, Cisco, Deltares, RMS, Siemens, The Nature Conservancy, The World Bank). Overall, investments for DRR were limited mainly to critical infrastructure improvements or new systems for the city municipal services (e.g. flood control, land-use planning, mapping and risk modeling for NFIP).

5. Results and discussion

The paper utilizes a pathways approach to explore policy mobility that provides a reflexive dimension in understanding how 'resilience' is being used in the 100RC program and SFDRR. This analysis is focused on observable plan content documented within the strategy, not policy implementation. These scores allow us to identify signals of potential risks, disproportionate impacts, vulnerabilities and inequities related to disasters that otherwise would not be evident. Overall, strategies received higher scores when they acknowledged criteria and attempted to mitigate vulnerabilities and risks associated with disasters, such as when they sought to develop disaster insurance, housing resettlement programs, engage vulnerable groups as stakeholders or in active participation in policy making and implementation.

100RC member cities did not all use the same format for the CRS publications, resulting in varying degrees of information and transparency on such matters as to how stakeholders were chosen, strategies were developed, accountability for programs, funding sources, partnerships or actors providing resources, and just who could participate in ongoing monitoring and evaluation. The metrics used in the framework to assess whether or not the objective of the 100RC program to design more urban resilient cities did reveal that this did occur when there was transparency, monitoring, evaluation, and participation within the design and implementation of these strategies. This assessment is only an approximation and more detailed analysis would be needed to determine equity of resilience strategy planning and implementation among member cities. There was also a considerable amount of cross marketing of other member cities and highlighting specific programs or policies throughout various strategies. The promotion of the 100RC was prominent in the structure and design of each strategy. It may have been more beneficial to have had more historical urban development, socio-economic challenges, and information related to structural problems needed to address urban and disaster resilience, rather than the promotion of the Rockefeller Foundation and its partners.

Approaches to identifying disaster risks, vulnerabilities and vulnerable groups often ignored explicitly defining these terms. Historic and structural reasons as to why such problems exist and why some DRR benefits may not be accessible to vulnerable stakeholders were seldom addressed. In some cases, risk would be defined (Melbourne, Melaka) and related to disasters but not in terms of vulnerabilities. Instead, various types of risks (e.g. cyber, biohazard, financial, crime) were discussed in numerous forms. Santiago de los Caballeros was the only city to specifically define risk in the context of disasters, and this was done in accordance with the UNISDR official definition. The city also defined vulnerability and in relation to physical, social and man-made vulnerabilities. Definitions of vulnerable groups, vulnerabilities, and vulnerability only occurred overall in four strategies (Mexico City, Miami, Santiago de los Caballeros, Quito), whereas most discussed various forms of vulnerabilities with no specific terms or definitions applied.

As previously emphasized by the 100RC program, each member city provided one or more shocks and stresses related to natural hazards and disasters. Yet, the analysis showed there were three strategies (Durban, Rotterdam, Tel Aviv) that did not identify any disaster related shocks and stresses, a finding resulting in no policies addressing disaster resilience and risk reduction. There were only four cities (Panama City, Seoul, Toyoma, Vancouver) specifically identifying and targeting DRR policies. A few strategies identified relevant SDGs and cross referenced specific SDG goals among policy actions (Athens, Bristol, Chennai, Juarez, St. Louis, Kyoto, Lagos, Pune, Melaka, Sydney). Fewer strategies identified SFDRR (e.g. Santiago Metro, Sydney), or were crossed referenced (e.g. Chennai, Toyama, Vancouver). Chennai and Colima, only made reference to SFDRR, containing no specific priority action reference from the framework, whereas Toyoma provided specific references to SFDRR priorities. Some strategies, like Buenos Aires, made initial references to the use of SDGs and UNISDR (United Nations Office for DRR), but nothing more. Few (e.g. Mexico City, Sydney) mentioned UNISDR, and intentions to address goals related to disaster management with no exact details. Most strategies either identified general disaster management policies (e.g. Atlanta, Berkley, Boulder, Chennai, Chicago, Colima, Dallas, Deyang, Honolulu, Juarez, Lagos, Medellin, Melbourne, Santiago Metro, Semarang, Sydney and Wellington,), or instead focused on climate change initiatives (e.g. Athens, Boston, Bristol, Buenos Aires, Cape Town, Houston, Miami, Paris, Pittsburgh, Pune, St. Louis, Surat, and Toronto), despite having, and detailing significant disaster related shocks and stresses. Although Bangkok focused on climate change policies, they also applied some DRR strategies. However, there were some strategies that did not denote disaster or climate change related goals or actions (Cali, Dakar, Melaka, Norfolk, Thessaloniki), but still identified approaches to reduce disaster related risks (e.g. flooding, land-use management, storm water infrastructure, and disaster relief funds).

Chicago provided a unique action template providing a list of key implementation partners, potential key indicators to measure and track the success of actions, and equity impacts for vulnerable residents affected by the proposed actions, in order to address the interconnected nature and geographies of race, economics, hazards and vulnerabilities. However, the strategy did not provide additional information beyond these elements to gauge quantitative methods to measure and track the indicators or equity impacts. Key partners were only listed in name, and did not specify what roles were held by each stakeholder, or disclosures of financial arrangements. The use of such a template may provide further guidance for future action assessments implemented in Chicago to determine overall benefits and challenges.

Additionally, some strategies were embedded among existing policies, or incorporated into other strategies previously developed by local, regional or national governments. This made it difficult to distinguish which disaster resilience and DRR plans were the result of the 100RC program, or effected in any way by the 100RC initiative. Furthermore, the role of collaborators and partnerships, such as Arup, is difficult to discern among preexisting city resilience strategies, as well as new schemes developed from the CRS. The influence of these collaborators and partnerships designed through the 100RC program is difficult to untangle. This is not to say that a city is not able to design a resilience strategy without such resources, but the extent of their influence is indeterminable to measure in the framework. There were further ways in which stakeholder involvement was limited in the monitoring and overall program evaluation, since cities chose instead to largely work with particular stakeholders and other partners to develop such indicators of success or failures. This again often excludes vulnerable members of the community in determining the value of voices, and narratives captured and included throughout the policy design and output. Few cities disseminated policy information to non-participants using general public communication (Atlanta, Glasgow, Juarez, New York, Quito, Sante Fe, Toronto).

The 100RC has curated a list of technical and expert resources made available directly through the strategy development process and implementation.

There were numerous strategies benefiting from the 100RC program and Platform Partners system, such as the use of pro-bono or consultancy services. Many cities (e.g. Buenos Aires, Can Tho, Mexico City) identified the use of 100RC Platform Partnerships, but often did not provide details of such agreements, and how much involvement took place among external stakeholders from the Rockefeller Foundation. Those that did include this information (Bristol, Boulder, Da Nang, Juarez, Norfolk, Medellin, Melbourne, Panama City, Pittsburgh, Santiago Metro) provided the names of each partner corresponding to applicable goals or policies. Lagos chose only to identify and name five relevant partners in the public and private sectors for each initiative with no other information provided. Aside from the development of the 100RC Platform Partnerships, some member cities, as with the case of Rotterdam, were able to develop an additional network in order to export services from their local private sector partners. Rotterdam reported that private sector companies such as Deltares, Arcadis and TNO were actively involved in partnerships with other cities located in Denmark, India and the USA. The program has encouraged member cities to come together in order to network share lessons, and support one another in their resilience efforts. This is evidenced by the creation of a Counter-Terrorism Preparedness and Societal Resilience as a network focused on counterterrorism and launched by London in collaboration with Barcelona, Manchester, Paris, Rotterdam, and Stockholm. Athens developed the 100RC Global Migration Network Exchange (Amman, Los Angeles, Medellin, Paris, Montreal, Ramallah, Thessaloniki) to share recent migration experiences in order to provide lessons and collaborations for others facing similar situations. Other cities benefited in other ways. In Bristol, $5 million in funding was made available for 100RC Platform Partners in the form of pro bono city tools and services for development and investment programs. Melbourne and Santiago de los Caballeros identified the use of pro-bono contributions and services provided by 100RC Platform Partners, but did not specify details as to how this would happen, or provide any additional information beyond the initial disclosure statement. 100RC ensured financing of up to $5 million for Platform Partners services in Mexico City until 2020 in an effort to support resilience efforts. This commitment culminated in a formal declaration signing by the Mayor of Mexico City at an 100RC sponsored event. There may be other cases of financial incentives provided through 100RC program in general that have not been disclosed by members. This also contributes to our understanding of how are these funds and programs monitored, evaluated and adapted to meet the most important needs of vulnerable populations. Overall, without more information it is difficult to discern the extent of financial and economic benefits gained or how these relationships were developed with other private sector companies having access to the 100RC program.

The strategy development process and the 100RC program itself are embedded within disaster resilience at multiple scales. For members, this involved the self-identification of disaster shocks and stresses, using the 100RC preliminary assessment framework and plan development in partnership with Arup. Strategy content alone was not enough to determine whether embedded actions would improve disaster resilience of vulnerable populations. Further assessment may help identify specific targets achieving certain goals managing vulnerability. This could be shown through financial analysis of budget spending in accordance with direct program outcomes (e.g. temporary housing programs, housing improvements or new building code programs). Unexpected consequences were more likely to appear in the strategies as to how vulnerable groups were potentially marginalized further, by created programs benefiting those with existing or easier access to resources and wealth. This was most often seen with the use of digital technologies (e.g. Disaster preparedness related Apps as seen in Sydney or Vancouver), and Smart Cities initiatives designed for new infrastructure projects (e.g. Montreal). These programs tend to assume equitable access for internet or wireless connectivity, good purchasing power for digital devices, lack of mobility restrictions, accessible transportation, and proper communication or training and learning made available for such services. Examples include the development of smartphone apps, such as in Norfolk to help support vulnerable residents during emergencies and disasters. Chicago attempted to address this issue by providing more equitable public network access and basic digital literacy training. However, these actions fall short of addressing inequitable access to and with computers, laptops or mobile phones. Overall, there is little attention given to those unable to access or afford these digital technology infrastructure investments.

6. Conclusions

Disasters can be seen as a social process or a natural event. When disasters are seen as a social process where mitigation and recovery efforts are the responsibility of the community, a participatory approach is adapted to managing policies and resources. Alternatively, when viewed as a natural event, control of resources is often deemed necessary for policies designed by governments and institutions. These perspectives shape and influence what role urban resilience has in managing DRR. Recent initiatives such as the Sendai Framework, SDGs and 2030 Agenda highlight efforts to connect vulnerability and risk by prioritizing DRR in support of urban resilience. Yet, it remains unclear how disaster resilience planning should be undertaken. Disaster resilience is linked directly to DRR and DRR is considered a critical component of overall resilience building and practices for cities. This paper examined how cities' disaster resilience approaches varied among the 100 Resilient Cities (100RC) program. It identified whether member cities emphasized disaster resilience initiatives in their programs by assessing their efforts focused on reducing disaster risk and vulnerability. The paper applied a framework allowing careful consideration as to how DRR is utilized to manage disaster risk and disaster resilience for 100RC resilient strategies. This framework was used along with directed and summative content analysis to assess whether 75 of the Resilience Strategies developed under the 100RC program were designed to promote overall DRR. The findings suggest that efforts to address vulnerability and disaster risk across member cities have been fragmented with only superficial signs of focus detectable.

Overall, this research stresses opportunities for urban disaster resilience research using the Sendai Framework. This framework involves actively identifying disaster risks and vulnerabilities, engaging with external and vulnerable stakeholders, by providing them an active role to engage in policy making and implementation, sharing in knowledge and expertise, and investing in measures to protect those unable to cope in a disaster or protection from hazards. The findings revealed very little attention was given to vulnerable communities (as participants, stakeholders, objects of inquiry, or action targets) in the 100RC member strategies, thus revealing a lack of follow-through by the 100RC program on the Sendai Framework for Disaster Risk Reduction. These results suggest real limits to policy mobility, both in the sense of the constraints on the mobility of the Sendai Framework through the 100RC program, and in terms of the lack of any core representation to the city programs developed under the 100RC program. Significantly, the analysis reported in this paper reveals that the 100RC program produces different results in each city. This is because of the specific configurations of actors and power assembled in each city around the 100RC program, and the effects they have on institutions, infrastructures and networks. Power is expressed in these structures through decisions on who participates and where participation occurs, as well as who has the authority to communicate and receive information. The analysis has shown that the disaster resilience narratives among member strategies have no consistent relation between community engagement and city characteristics, therefore policy mobility followed no consistent pattern. To achieve its policy mobility goal, the 100RC program must be flexible enough to cope with specific local power relations, but the form of mobility achieved falls short of achieving urban disaster resilience using the Sendai Framework. Crucially, if it were to achieve urban resilience under that Framework, the 100RC program must bring together not only policy makers, but also diverse stakeholders. Future research of the 100RC program, and its successor should aim to identify in what ways mobile policy addresses where urban and disaster resilient policies came from, how they were mobilized, and what happened to them along the way.

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Declaration of Competing Interest

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

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4 Rural–urban linkages in sustainability transitions

Challenges for economic geography and disaster recovery

Gordon M. Winder and Sahar Zavareh Hofmann

1 Introduction

The United Nations (UN) Habitat's SDG 11 calls for explicit consideration of rural–urban linkages when planning and researching urban futures. This suggests regional planning and economic modelling will be required along with attention to linkages and flows stretching outside the urban area. The SDG 11 thus sets new goals for geographers and requires not only urban–regional economic models but also inclusion of diverse social, environmental and economic parameters plus relation to transition pathways, resilience goals and sustainability transitions thinking. This chapter investigates the recovery process following the 2010–2011 earthquake series in Christchurch, New Zealand with the UN Habitat initiative SDG 11 declaration of the significance of rural–urban linkages within disaster research in focus. It applies Srivastava's (2017) rural–urban linkage framework identifying implications and challenges arising for economic geographers researching rural–urban linkages in disaster research with transitions and resilience in mind.

Christchurch, located in the Canterbury region of New Zealand, is the largest city on the South Island and second largest city in the country. The earthquakes during the period 2010–2011 are more commonly known as the Canterbury earthquake sequence. The most severe of these earthquakes took place on February 22, 2011, a Richter-Scale Magnitude 6.3 earthquake that killed 181 people and resulted in $40 billion NZ in total damages (Anderson 2014), with additional insured losses of $15 billion US (Parker & Steenkamp 2012). The earthquake sequence is the fifth largest insurance event in the world since the 1980s (Deloitte 2015). At the time of the earthquakes, Christchurch had a population of 425,000 with approximately 7,000 living in the central city. Canterbury had strong agriculture, manufacturing, health, social and education sectors, contributing 23.2 percent of national gross domestic product. Christchurch functions as a gateway to the South Island, has one of the largest deep-water seaports in the South Island and provides interconnected road, rail and coastal sea links necessary for imports and exports. The extensive damage to Christchurch and the port was seen as a great risk and recovery was given high priority (CERA 2016a, 2016b). Over 100,000 residential houses were damaged, requiring repairs or rebuilding, of which 7,000 homes were classified as "red zoned" (requiring total demolition). An estimated 400,000 insurance claims were filed with the Earthquake Commission (EQC). EQC was established in 1945 to provide national disaster insurance for residential properties including contents, dwellings and land. Despite having over 93 percent of the claims settled in late 2015, many homes are left demolished or awaiting repairs, indicating that recovery is far from finished (Hall et al. 2016).

Recovery in Christchurch became focused on resilience building after a shock with stress and involved working towards a sustainability transition. Authorities planned to build a new resilient city and to transform the urban environment. This process would involve many rural–urban as well as globalized linkages, either because of the multiple effects of the earthquake series, the needs, agendas and capabilities of the rebuilders, or the recovery implications for greater New Zealand. This has proven to be a difficult recovery for a city and region of the Global North, testifying to the challenges posed by the Habitat SDG Target 11.

2 Disaster recovery design and conceptual tools

2.1 Urban disasters

Natural disasters and hazards are a part of everyday life, demanding proactive approaches to mitigate risk and damages (Cutter 1993). It has long been recognized that cities and highly populated areas are increasingly exposed and vulnerable to natural disasters (Mitchell 1995, 1998, 1999). Over the past decade, the UN placed much emphasis on mitigation of natural disasters in megacities (Mustow 1994). Declining urban infrastructure has exposed cities to severe risks and vulnerabilities throughout the developed world. As risk becomes normalized and accepted in urban settings, communities in urban locations are subjected to additional risk from severe natural disaster events (Pelling 2012). The 2011 earthquake and tsunami in Japan, the 2010 Christchurch earthquake in New Zealand and the 2005 Hurricane Katrina in New Orleans are all recent cases in developed countries that emphasize the recent challenges and gaps in hazards research (Hewitt 2013). Rural resources can be used in disaster recovery such as in temporary shelters or housing, emergency services, facilities for displaced or disrupted business services, food banks and other critical disaster recovery services. Managing these resources and the potential ties and connections between urban and rural areas can also support the on-going recovery as well as promote a stronger process (Srivastava & Shaw 2016).

3 Resilience in systems

The term "resilience" is often and properly understood as a property of a system, and so must be related to an appropriate system model. Within global environmental research, "resilience" relates to the general persistence of ecological system functions, adaptation of humans in nature and societal resilience to ecological transformations but will take on specific meanings. In hazards research the focus is on how societies (considered as systems) deal with environmental risks and hazards (Keck & Sakdapolrak 2013). Recently, economic geographers have proposed conceptual frameworks for regional (Martin & Sunley 2015) and sectoral (Fromhold-Eisebith 2015) economic resilience. Martin and Sunley (2015) argue that there is no theory, agreed definition or accepted methodology for "economic resilience", little discussion on how it should relate to uneven regional development, regional competitiveness or regional path dependence, and no consensus on what determines it. They acknowledge scepticism among their colleagues about the normative and neoliberal aspects of the use of "resilience", competing terms from within economics and limited conceptualization of environment within economic systems. They highlight other perceived weaknesses in economic resilience thinking: A failure to relate "resilience" to regional evolutionary paths, to regional or sectoral economic performance or, more precisely, to a regional economic system model. We add that rural–urban linkages are rarely featured in "economic resilience" thinking. To remedy these problems, they argue that elements and indicators used in the model need to be subjected to statistical tests of the theorized drivers of resilience. Only then can "resilience" be understood in terms of elements critical or redundant to economic system functioning. In this thinking the SDG 11 call should result in explicit consideration of rural–urban linkages in a regional economic system model.

4 Resilience in transitions and transition pathways

Frameworks for thinking about "resilience" in the context of sustainability transitions are proliferating, but in them "resilience" does not refer to a property of an ecological, economic or social system. Instead, "resilience" is a continuously redefined, reworked and therefore shifting target and one often understood in terms of vaguely defined transitions, themselves grafted on to existing institutions and governance structures. Here "resilience" thinking is normative: What should be done to effect a transition. These findings are reflected in recent reviews of discussions of "resilience" across the social sciences. Keck and Sakdapolrak (2013) observe a shift in meaning, from persistence of ecological system functions to social transformation in the face of global change. They find that "the search for new approaches to resilience-building is revealed to be not merely a technical question but a contested political one" (Keck & Sakdapolrak 2013, p. 14). Similarly, Davoudi et al. (2012) finds that "social resilience" is conceived of as a dynamic, relational and political process and "vulnerability" is viewed as a counterpart to "resilience" within development studies.

In this context, the "multi-scale framework" for analysing transformation processes based on Grin et al. (2010), and used in the Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen report (WBGU 2011) is a useful starting point for thinking through the narrative at work. It is assumed that by identifying desirable outcomes, it will be possible to engage governments and other actors to achieve them, often by adopting technical solutions to problems. The result will be local reactions, connected to global processes, entangled in practices, regulations and institutions. Communication problems may emerge when mobilizing for transformation within such a framework. For example, business owners respond to calls to innovate or adopt "pro-environment practices" in diverse ways because they weigh up costs and benefits (North 2016). Questions may arise, such as what does innovation mean, when have we achieved transformation, are agencies promoting conflicting goals or are the effects of policies and projects displacing effects to other subsystems and regions (Winder & Bobar 2018)? In effect, the multi-scale framework legitimizes action but the terms – niche niveau, system mega trends, regimes, abrupt events – as well as the interactions and relationships used are deliberately underspecified. The multi-scale framework is not specified as a model or a system with its related data, factors and tested relationships. When using such a framework, researchers must conceive of resilience as a legitimizing narrative around which actors are enrolled in a common project.

The conceptual framework of Leach et al. (2010) is prominent in the literature on transition pathways. It enables scholars to understand and represent a system while narratives shape problem identification and reactions, drawing together scientific understanding of natural processes and constructivist interpretations of the socio-political world promoted by actors, networks and institutions. It is the narratives that "justify kinds of action, strategy and intervention" (Leach et al. 2010, p. 374). By relating "tempo of change" ("stress" or "shock") to "response to change" ("responsive, adaptive management" or "control-oriented management"), Leach et al. (2010) define four "styles of action" where "resilience" is only one style of action, and should not be thought of as a property of the system.

Their approach directs attention to the narratives, including those of "resilience", that are being used in policy making. They establish a framework for thinking through policy making: Defining governance arrangements, identifying future challenges, relating goals to assessment, classifying pathways, discussing "shock" and "stress", and discussing "respond" and "control" styles of action. They recognize that a policy response might be different or have different effects depending on which entity is being examined, at what scale, in which space and in which institutional context, and that there are versions of sustainability each valued by different groups in society or linked to specific goals (Leach et al. 2010). This framework can help to make sense of how "resilience" is being used in the UN Habitat SDG 11 challenge: "resilience" is not defined as a property of a system but as a narrative related to a framework related to a recovery process. In particular, this is the thinking behind a recently proposed "framework" for researching rural–urban linkages in disaster research.

5 Rural–urban linkages in disaster research

Srivastava (2017) applies an rural–urban linkage framework to disasters in South Asia using a time-scale of pre-disaster, disaster and post-disaster phases. The rural–urban linkage and interdependency structure developed by Srivastava and Shaw (2013) identifies eight key elements and interdependencies in disasters (Table 4.1). They argue that disasters literature emphasizes economic impacts after disasters in urban areas or developed countries but should include comprehensive assessments and analysis assessing demographic and migration patterns. The negative effects on the environment, especially water, land and energy, are of great concern to stakeholders since rural incomes and urban recovery depend upon these resources.

Many markets rely on bidirectional flows between urban and rural areas of products such as raw and unprocessed materials needed for manufacturing and agriculture. After a disaster, money tends to flow from urban to rural areas in the form of remittances with short-term losses for regional economies. Investments made during recovery and rebuilding also provide unique financial gains and can aid in poverty reduction if managed properly. Waste is seen as a physical linkage between urban and rural areas because investments are not often made in waste disposal following a disaster, resulting in the majority of waste being discarded into landfills located in rural landscapes.

Table 4.1 Rural–urban linkage elements and indicators

Elements	*Indicators*
People	Population movements and demographic patterns
Natural Resources	Environmental indicators for water, land and energy
Products	Flows of materials and products
Financial	Flows of remittances and investments
Waste	Waste disposal patterns
Information	Information flows and state of connectivity
Social Interactions	Cultural exchanges and trauma support
Governance	Agents formally and informally responsible in community recovery

Source: Srivastava (2017).

The related potential pollution and health hazards pose serious threats to rural and neighbouring areas with indirect long-term economic effects.

The urban and rural are also linked by flows of information relating to resources, opportunities and relief efforts. Consequently, rate and flow of information and the state of connectivity, transportation or sharing of technology are all important components of recovery. Rural residents can play vital roles in recovery, for example by providing support for urban residents suffering from trauma. Governance also involves rural–urban linkages whereby formal governments, informal agents, organizations and NGOs have responsibilities in sharing and administering policies and procedures, as well as having vested interests in the community and recovery.

Srivastava (2017) expanded the rural–urban linkage disasters framework to include "shock" and "stress" scenarios emphasizing the need to apply the framework to urban disasters in developed countries. The framework is in fact a set of narratives about the importance of rural–urban linkages in effecting a "resilient" recovery. Remittances can be redirected to support recovery. Investments can be managed to aid in poverty reduction. The dumping of wastes must be managed so as to avoid potential pollution and health hazards, especially in rural areas. Such narratives carry relational logics that are connected to a framework that helps make sense and meaning of the recovery process. Note that Srivastava does not expect this framework to be supported by a socio-ecological or regional economy system model, and so the interrelations remain unspecified.

6 Case study approach

In this research the rural–urban disaster linkage framework will be applied to a case of the Christchurch earthquake and recovery process with the aim to build understanding of rural–urban linkages in disaster recovery management lacking in developed countries. We aim to identify linkages and flows in the Christchurch recovery process, and to highlight their relevance for improving disaster recovery with a focus on resilience. Data was collected from initial recovery observations in Christchurch, interviews and secondary data analysis. However, our focus for this chapter will address only elements of governance, people, financial and waste (Table 4.2). In each case, we first identify the geographies, scales and relationalities associated with rural–urban linkages and then discuss their impact on the recovery process. We pay attention to the availability of data, issues of scale, prospects for management of and interactions among flows and linkages and politics of the transition making and responsibilization taking place around them. We demonstrate a narrative of "building back better" in Christchurch was entangled in both rural–urban linkages and national and global linkages. We identify challenges for economic geographers applying the rural–urban disaster linkage framework in developed countries.

7 Rural–urban linkages in Christchurch earthquake recovery

7.1 Governance

Following the earthquakes of September 2010 and February 2011, Christchurch, Waimakariri, and Selwyn District Councils of Canterbury declared local states of emergency (Johnson & Olshansky 2017). National and local government agencies fell short in managing recovery, resulting in the establishment of Canterbury Earthquake Recovery Authority (CERA), a special government agency responsible for recovery and rebuilding of the Canterbury Region. CERA operated for five years and ceased operations in April 2016. Additionally, the Canterbury Earthquake Recovery Act (CER Act) gave extraordinary powers to the Minister of Earthquake Recovery and Cabinet (Brand & Nicholson 2016).

The initial emergency response led by the Christchurch City Council (CCC) established the Infrastructure Rebuild Management Office (IRMO) to begin immediate city infrastructure repairs. IRMO divided the city into four regions, delegating New Zealand construction companies to manage repairs and emergency responses. After multiple earthquake events, CCC developed a new procurement model, the Stronger Christchurch Infrastructure Rebuild Team (SCIRT) to handle increasing workloads and demands. The SCIRT alliance was formed with national and local governments and the New Zealand Transport Agency as owner participants, and five major New Zealand construction companies as non-owner participants. SCIRT assumed responsibility for infrastructure repairs such as roads, utilities, water supply, wastewater, bridges and pump stations (Botha & Scheepbouwer 2016). SCIRT was funded by New Zealand taxpayers, Christchurch ratepayers and a portion of insurance claims. Total rebuild projects were estimated to cost between two and three billion New Zealand dollars limited to five years and $2.1 NZ billion in spending (SCIRT 2017).

Shortly after the February 2011 earthquake, CERA began developing a Christchurch-at-large recovery plan. CCC was asked to provide a draft recovery plan for the central city requiring approval by the Minister for Canterbury Earthquake Recovery. CCC's Share an Idea campaign took eight months, resulting in a concept of radical urban planning interpreted as a community-led bottom-up practice focused on public spaces, green projects, sustainability, housing, art, culture and transportation initiatives (Brand & Nicholson 2016).

Concerns as to how recovery would be financed and managed led to contested politics (Miles 2012). CCC's plan was rejected by the Minister for Canterbury Earthquake Recovery, Gerry Brownlee, who deemed it too ambitious for implementation. The Minister directed CERA to rework the plan within 100 days. The result, the Christchurch Recovery Plan, more commonly known as the "Blueprint", was seen as a top-down structure and plan focused on national government priorities involving reconstruction of critical public and economic infrastructure with a dramatic reduction in the central city core area (Brand & Nicholson 2016).

CERA claimed that the earthquakes resulted in an "unprecedented opportunity" to remake Christchurch into an international city with a unique investment environment open for innovation, enterprise and diversity. "Red tape" would be cut, granting CERA special powers to fast-track recovery, revise building codes and allow cutting-edge construction technologies and a five-day approval process for central city resource consent applications. The Blueprint featured 17 anchor projects (Table 4.2) designed to catalyse investments across the city centre using investment and funding models (CERA 2016a).

Outcomes of the anchor projects were largely viewed as the benchmarks for success or failure of CERA's legacy. Five years into the recovery many projects were either still under construction, in planning or development stages or left vacant and undeveloped due to expensive demolitions. Only three Blueprint projects were completed at the end of CERA's programme with only one, the Bus Interchange, completed near the target timeframe, whereas ten projects should have been finished. Despite announcement of expansive rebuild projects, funding and initiatives, many media reports cited slow recovery. Effective April 2016, CERA was disbanded and dissolved into Regenerate Christchurch Ōtākaro Ltd., and the Greater Christchurch Group (Wright 2016).

A further feature of recovery governance was the rezoning of land containing approximately 7,000 homes unsuitable for repairs as the "red zone", subject to national government/CERA purchases. The dispute settlement process implemented resulted in some property owners losing equity or being unable to afford to purchase a similar property elsewhere, resulting in a group of "socio-economically disenfranchised individuals" who are unable or unwilling to participate in the rebuild (Miles 2012). Thus the red zone, which cut across the idea of rural–urban linkages and divides, imposed penalties on some would-be rebuilders, constraining options and capacities and forcing some to migrate. For many residents, the housing rebuilding process was often a traumatic experience due to the complications of EQC governance.

Governance of the region's natural environment remained intact, while recovery transformed governance of the city's built environment. CERA helped plan a regional-scale initiative coordinated by existing governance structures along with Māori involvement, insuring future natural environment services. In addition, both CERA's and CCC's efforts to open rural and edge city land for urban development stalled. No common vision has emerged for the rural–urban boundary in the greater Christchurch region (GCR). Further, the resilience-oriented recovery has interacted with other transition narratives, furthering planning for regional ecosystem services while sidelining an eco-mobility transition.

Table 4.2 Christchurch Central: Anchor projects and precincts

Name	*Functions*
The Frame	Urban design feature for green city core
Convention Centre Precinct	Facility for domestic and international conventions
Stadium	35,000-seat facility to accommodate sports, concerts and events
Metro Sports Facility	Recreation centre
Bus Interchange	Public transport exchange
Te Papa Ōtākaro/Avon River Precinct	Urban river park renewal project
Te Puna Ahurea Cultural Centre	Centre to celebrate Ngāi Tahu and Māori culture
The Square	Green area
Performing Arts Precinct	Creative and cultural hub for city centre
Health Precinct	Hospital site with education, innovation, and research facility
Cricket Oval	Cricket venue for domestic and international tests
Residential Demonstration Project	Medium-density housing for inner city living
Central Library	Knowledge hub for city centre
Innovation Precinct	Technology-based industry and research project
Retail Precinct	Retail shopping destination
The Earthquake Memorial	To honour and reflect on those affected by the earthquakes
Justice and Emergency Services Precinct	Justice, police, civil defence and emergency services

Source: CERA 2016a

7.2 People

A national census survey was underway when the February 2011 earthquake struck. Much of the census data reporting for 2011 was cancelled, resulting in no data being available for 2006–2013. Results of the 2018 census have not yet been released (Stats NZ 2019). Media reports often cited that between 26,000 and 70,000 people, or perhaps 20 percent of the Christchurch population permanently left the city as a result of the earthquakes and damage in 2011 (Sachdeva & Levy 2011; Binning 2011). However, these figures appear to be invalid. Studies of population movements reveal no more than a 2 percent change in permanent migration patterns leaving or entering either Christchurch or the GCR (Stevenson et al. 2011; Love 2011). Nevertheless, the GCR experienced significant population changes resulting from the earthquake events. CCC (2018) reports GCR population in June 2011 at 454,600. The city's population loss was 14,000 in 2010 and 2011, and additional 7,200 between 2011 and 2012, or 6 percent of the city's pre-earthquake population. The city's population rebounded once the housing supply increased along with new employment opportunities, on average 1.5 percent growth per annum or 5,600 people per year. The GCR population exceeded pre-earthquake populations, reaching 500,100 in June 2017 and 511,300 in June 2018. The GCR population is expected to continue to increase, but growth scenarios suggest considerable uncertainty. Migration was the largest contributor to population growth in 2012–2013 due to the demand for skilled workers and labourers. These figures support immediate post-event population transfer from urban to rural areas as urban residents sought available housing, temporary or permanent work places and access to other critical services.

Māori populations (indigenous New Zealanders) largely reside in low socio-economic areas severely impacted by the earthquakes, and were disproportionally affected in managing access to resources. This resulted in a Māori tribal disaster response and recovery network (Māori Recovery Network or MRN) based on Māori culture, values and practices and led by the Ngāi Tahu tribal council to ensure a coordinated response with other agencies (local and national). Māori residents received direct support from Christchurch-based marae (Māori community centres) such as Rēhua and Ngā Hau E Wha, which provided resources to rural areas as needed. Tribes based in the North Island also provided hubs to support earthquake support centres for their people in Canterbury (Kenney & Phibbs 2014).

The New Zealand Budget for 2012 issued a $442 million package designed to cope with the anticipated shortfall of skilled workers, especially in engineering, construction and management professions. This resulted in increasing numbers of workers migrating from the United Kingdom, Ireland, United States, Philippines and China (Pickles 2016; Stevenson et al. 2012). This inflow of largely male trade workers was interpreted as a demographic rupture by some residents who additionally cited unfair labour practices (Pickles 2016).

7.3 Financial

The earthquakes resulted in sudden disruptions to many economic sectors including tourism, hospitality, retail, manufacturing, telecommunications and healthcare but did not severely impact overall economic activity (Chang et al. 2014; Parker & Steenkamp 2012; Orchiston et al. 2012; Stevenson et al. 2011, 2012). Economic recovery was slower than predicted for the Canterbury region in part due to a weak global economy and a high level of uncertainty surrounding rebuilding. Businesses were largely seen as resilient to the economic impacts (Parker & Steenkamp 2012).

Firms faced reduced capacity, increased demand, higher administrative costs because of the need to manage insurance claims, relocations and tax deferments, while employees simultaneously dealt with damaged or lost homes and helping family members or loved ones, as well as managing the shock and trauma of experiencing the earthquakes. In these circumstances, workforce support was one of the most important types of help provided for businesses and organizations. Employee wage losses were offset with the Earthquake Support Subsidy provided by the national government for the 2010–2011 earthquakes, allowing employers to continue paying wages during loss of business (Stevenson et al. 2014). Retail, accommodation and food sectors had the largest unemployment (in that order). Female workers had the most job losses and construction had the largest gain of employment (Parker & Steenkamp 2012). Overall, Canterbury had a 17 percent gain in employment with a 23 percent increase in job placement for the period between September 2012 and September 2017. By 2017, retail trade and accommodation added 17,500 more workers, up 46 percent from 2011. Median incomes also rose 26 percent from 2010, nearly 5 percent higher than the national average (18 percent) in New Zealand (Stats NZ 2018).

Businesses and industries assisted one another to bridge ties to other networks and network actors to maintain operations. For example, pharmacies temporarily shared premises or made orders through another pharmacy supplier. They assisted one another with deliveries, and used storage and warehouse facilities in Wellington. Within Canterbury, local economies impacted by the earthquakes obtained 70 percent of this assistance from organizations located in Canterbury (so a high level of rural support), 24 percent from elsewhere in New Zealand, and 4 percent internationally. However, 40 percent of the financial resources used to manage recovery were obtained outside of Canterbury due to the spatial distribution of monetary resources, discounts and credits used by businesses (Stevenson et al. 2012).

Christchurch's Central Business District (CBD) experienced severe damage, resulting in local government and CERA implementing cordons to restrict access. Over 700 of the total of 1,000 commercial buildings initially designated for demolition were demolished. In the short term, CBD businesses were not allowed to operate and had to be temporarily relocated, resulting in a 31 percent permanent business closure. Suburban commercial space charged higher rents with multi-year leases. Business interruption insurance was available for some firms but often faced claim challenges, such as denial-of-access terms to allow businesses denied access to their building to be still be eligible for insurance pay-outs. The CBD's long-term outlook was uncertain because of firm relocations, concerns over insurance pay-outs, total demolitions, total buildings being reconstructed, policies on building standards and treatment of heritage buildings (Chang et al. 2014).

Global–local geographies of financial flows and linkages occurred due to bankruptcies of local insurance companies, liabilities for reinsurance companies and the reorganization of EQC finances. The New Zealand property insurance market has been reregulated, resulting in dramatic increases of insurance premiums for all New Zealand property owners as well as reassessment of risks as evidenced by heritage buildings deemed too expensive to insure or outright uninsurable (Gibson 2013a, 2013b, 2013c). Massive sums of money changed hands but these were not flows from rural to urban areas. Rather, inter-corporate and global transfers occurred, facilitating or constraining local rebuilding capacities. Neither local geographies, linkages or flows produced are necessarily marked by a rural–urban divide. In addition, there were flow-on effects well beyond Canterbury, including the reprioritization and delay of infrastructure projects elsewhere due to either government funding or lack of capacity to manage reconstruction recovery. Thus, the disaster continues to have financial effects, not necessarily in rural Canterbury, but throughout New Zealand.

7.4 Waste

Waste management policies were not considered part of the Christchurch planning process so were managed by local and national government agencies and contractors. CERA adopted a "quick pick and go" method to direct waste to its end-use market (Domingo & Luo 2017). CBD building demolitions created a significant amount of debris and issues for waste management. This resulted in investment in processing facilities at landfills to manage possible reuse of materials and avoid potential drinking water contamination. Since the CBD was cordoned off, a controlled construction zone for pre-sorting and concrete-crushing was possible and allowed building owners to sell salvaged materials (Chang et al. 2014). However, recent findings indicate treatment of waste at debris sites was either mishandled or ignored (Brown et al. 2011; Domingo & Luo 2017).

Approximately 4.25 million tonnes of demolition waste were processed at the Burwood Resource Recovery Park. Land reclamation was used to dispose of "clean" waste but most waste was sent to landfills due to the inadequate separation of waste during removal resulting in more waste. Surcharges were applied at the landfills to cover the handling of asbestos waste from demolitions. However, levies usually assessed on waste disposal in order to reduce waste transferred to landfills were eliminated to encourage recovery (Domingo & Luo 2017).

Despite numerous damage reports, the potable water system proved to be much more resilient than expected and services were quickly restored. Māori Wardens and community volunteers assisted the New Zealand Armed Forces in distributing chemical toilets and often responded to issues with sanitation services (Kenney & Phibbs 2014). Approximately 780 port-a-loos were distributed around the Christchurch region with an additional 250 in transit from other regions in New Zealand and 963 from the United States, as well as another 30,000 requested by CCC (Potangaroa et al. 2011).

8 Discussion

This investigation of the centralized approach to the Christchurch earthquake recovery programmes and economic impacts of the disaster reveals the recovery process as an example of an abrupt event with unexpected consequences despite extensive planning and potential risk reduction. Government responded to "shocks" with "responsive action" as a "resilience" style under the Leach et al. (2010) framework. Fundamental, long-term and wide-ranging socio-economic system transformations were planned. For example, part of the city will never be rebuilt: It was located in the wrong place due to environmental and geotechnical factors. Significant funds were available for recovery, since nearly all property and infrastructure was fully insured. New governance shaped geographies of recovery stories inside the Canterbury region but these do not adhere to rural–urban divides, linkages and flows.

The "drawn-out" rebuilding of the city centre contrasts with both the quick resumption of business-as-usual in many rural and suburban areas and the long-term paralysis associated with red zone property futures. Miles (2012) contends that CERA's role became politicized, seen as a vehicle for the top-down decisions, obstructing opportunities for the affected community to be active in the creation of the recovery plan, while emphasizing residents' roles as taxpayers, ratepayers and consumers of services rather than as citizens. New governance relations reclassified some property rights. This perception is not shared by all commentators, but certainly the chosen leadership and governance styles influenced by planners, engineers, designers, disaster specialists, NGOs, and the local and national government were all, one way or another, shocks to the community. More importantly, they were shocks to the adaptive capacities of residents across the region, favouring some and penalizing others. Yet, the new political climate did not clearly divide the region on urban versus rural lines. Rather, the new governance relations involved the temporary dissolution of local governance and the promotion of experts and corporations from outside the region.

New mobility patterns, including migration to rural areas, occurred as a result of the February earthquake events as residents resorted to their extended support networks. The flows proved difficult to discern because of the multiple earthquake series and disruption of normal data gathering, but movements went well beyond migration to adjacent rural areas to include migration to greater New Zealand and emigration. For residents, such as many Māori, who were unwilling or unable to move, national and regional support began to be delivered through Christchurch-based service providers, and notably the city's maraes also supported affected rural communities. Further, these responses were soon overridden by a wave of immigration of construction workers from overseas. Thus, the framework's narrative of mobilizing rural support for urban recovery is less relevant in the Christchurch recovery than the use of global, national and regional resources, many of which could be brought to Christchurch.

The earthquakes disrupted Christchurch CBD businesses, forcing relocation of operations and acceptance of assistance from the national government or other Canterbury firms or networks to stay in business. Rural to urban support did occur, but the precise geography of these flows of finance and assistance varied by business networks and access. In addition, the earthquake recovery induced massive financial flows from the global insurance industry into New Zealand. While these flows were delayed in reaching Christchurch, they had profound effects including facilitating strategic investments in the Canterbury economy that would not otherwise have occurred and channelling construction capabilities away from other New Zealand regions to Christchurch. Operations at Christchurch's vital South Island transport infrastructure, the port and airport, were only partially disrupted by the earthquake events, but recovery has enabled large-scale reinvestment in transport and tourism-related infrastructure, facilitating increased agricultural export and tourism activity. Such flows were not expected in existing regional economic models whose parameters and trends have been transformed by the earthquakes and recovery.

9 Conclusion

The analysis and discussion makes it evident that: (1) The elements in the rural–urban linkages framework are interconnected; (2) the relationalities assumed in Srivastava and Shaw's (2013, 2016) framework do not always hold; and (3) emphasis on rural–urban linkages may obscure other geographies of the recovery. This recovery involves rural transformation where rural infrastructure is repaired, semi-periphery housing is needed, and agricultural intensification is planned. Simultaneously, it requires urban transformation: A new, smaller CBD is built and the red zone is demolished to allow restoration of vital ecosystem services. It also involves global flows and linkages: Insurance funds and construction workers flow in from overseas; there is some outmigration to other regions and countries as well as the urban periphery; international insurance companies suffer losses; New Zealand earthquake risks are reset; there are flow-on effects to other New Zealand regions. Ultimately, "the long series of physical aftershocks carries on and the local, national and global implications of Canterbury's loss continue to reverberate" (Pickles 2016, p. 6).

The disaster and recovery involved tele-coupling between regions, and between physical systems (atmosphere, land and ocean), but also among economic and social systems and at all scales: The global, national, inter-regional, urban, peri-urban and rural are entangled. With such surprise events as these, the idea that economic geographers can be prepared to deploy their carefully researched models of (socio-ecological or regional economic) systems at the right regional scale to advise on building back better is a highly questionable endeavour. Such an abrupt event transforms research questions, governance structures, ideas about resilience and framings of economic systems that do refer to the environment. Instead, economic geographers can understand "resilience" as a narrative of recovery within a transition framework and therefore as a specific and shifting politics of recovery with contested terms of reference. The challenge for economic geographers is to come to terms with "resilience" as a narrative within a transition framework.

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Micro-level assessment of regional and local disaster impacts in tourist destinations

Jürgen Schmude, Sahar Zavareh, Katrin Magdalena Schwaiger and Marion Karl

Department of Geography, Ludwig-Maximilians-University Munich, Germany

ABSTRACT

The tourism sector faces severe challenges due to the economic impacts from changing natural environments as seen with the increased frequency of natural disasters. Therefore, analyses of disaster impacts models are necessary for managing successful tourism recovery. Typically, disaster assessments are conducted on a countrywide level, which can lead to imbalanced recovery processes, and a distorted distribution of recovery financing or subsidies. We address the challenges of recovery using the tourism disaster management framework by Faulkner. To calculate precise damage assessments, we develop a micro-level assessment model to analyze and understand disaster impacts at the micro-level supporting tourism recovery in an affected destination. We examine economic consequences of a disaster at a small regional scale arguing recovery from a natural disaster is more difficult in individual areas because of differences in geographic location or infrastructure development. The island of Dominica is chosen as an example for the model using statistical data from the tourism sector to outline and detail the consequences of a disaster specifically for communities. The results highlight the importance of damage assessments on a small-scale level, such as communities in order to distinguish between individual regions facing severe changes for resident livelihoods and the local tourism sector. We argue that only after identifying regional impacts it is possible to apply adequate governmental subsidies and development strategies for a country's tourism sector and residents in a continuously changing environment in the hopes of mitigating future financial losses and future climate change impacts.

摘要

随着自然灾害频繁发生, 自然环境的变化带来的经济影响, 旅游部门面临着严峻的挑战。因此, 对灾害影响模型的分析是成功复苏旅游业的必要条件。通常情况下, 灾难评估是在全国范围内进行的, 这可能导致复苏过程的不平衡, 以及资金或补贴分配的扭曲。我们利用福克纳(2001)的旅游灾害管理框架来应对旅游复苏的挑战。为了计算精确的损失估价, 我们开发了一个微观层面的评估模型, 分析和理解受灾目的地微观层面上支持旅游业复苏的灾难影响。我们在一个小规模的区域范围内研究灾难的经济后果, 认为由于地理位置或基础设施发展的不同, 个别地区自然灾害的恢复更加困难。多米尼加岛被选为该模型的范例, 利用旅游部门的统计数据, 对一场专门针对社区的灾难后果进行描绘和详细说

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CONTACT Jürgen Schmude j.schmude@lmu.de

明。这些结果突出了对小规模（例如社区）的损害评估的重要性，以便区分居民生计面临严重变化的地区和当地旅游业面临严重变化的地区。我们认为，只有在确定了区域影响之后，才有可能在不断变化的环境中为一个国家的旅游部门和居民提供适当的政府补贴和发展战略，以减轻未来的财政损失和气候变化的影响。

Introduction

Natural disasters range from volcanism, earthquakes, hurricanes and tropical storms bringing destruction and severe consequences such as flooding, landslides, or built infrastructure destroyed to the impacted region. The severity of disaster impacts largely depends on a country's wealth, the state of its economic development and diversification (Hallegatte & Ghil, 2008; Heger, Julca, & Paddison, 2008; Kahn, 2005; Neumayer, Plümper, & Barthel, 2014; Toya & Skidmore, 2005). Impacts of natural disasters can be assessed as four types of damages: direct damages referring to impacts on housing or roads; indirect damages such as job losses or health deterioration; quantitative damage (tangible effects) related to the absolute monetary losses caused by destruction of buildings; and qualitative damage (intangible effects) signifying insecurity or social disruption (ECLAC, 2003; Hallegatte & Przyluski, 2010; Merz, Kreibich, Thieken, & Schmidtke, 2004). Countries with greater economic development and diversity at the time of a disaster tend to experience lower disaster losses, whereas countries largely dependent on tourism alone are more likely to be impacted by disaster events (Kim & Marcouiller, 2015; Noy, 2009). Moreover, natural disasters are likely to increase due to the challenges brought about by climate change resulting from changes in air temperatures, precipitation rates, sea level rise, an increased frequency of heat waves, hurricanes, tropical storms, and higher tropical-cyclone-related rainfall rates (IPCC, 2014; Knutson et al., 2010; Trenberth, 2011).

Small island developing states ('SIDS') are especially vulnerable to hurricane and tropical storm hazards (Briguglio, 2003; Collymore, 2011; Forbes, James, Sutherland, & Nichols, 2013; IPCC, 2007; Méheux, Dominey-Howes, & Lloyd, 2007; Mimura & Nurse, 2017). The likelihood of natural disasters in small islands is attributed to their limited resources, size, their location surrounded by ocean waters, and rising sea levels (Ferdinand, Haynes, & Richards, 2014; Mimura et al., 2007; Pelling & Uitto, 2001). SIDS are some of the most disadvantaged places affected by global warming (IPCC, 2007), and viewed as one of Earth's barometers of climate change (Kelman & West, 2009). Furthermore, climate change is an important factor leading to increased hazard exposure in the tourism sector for island destinations (Becken, Mahon, Rennie, & Shakeela, 2014; Tsao & Ni, 2016). Many SIDS are dependent on tourism and are susceptible to the consequences of climate change due to increased damages to tourism infrastructures (Becken & Hay, 2007; Ibarrarán, Ruth, Ahmad, & London, 2009). This is referred to as 'endangered future' for tourist destinations because tourists are less likely to choose destinations where they perceive increased hurricane risk (Forster, Schuhmann, Lake, Watkinson, & Gill, 2012). This further illustrates the high influence disasters have on the tourism industry and the reputation of a destination (Durocher, 1994; Méheux & Parker, 2006).

Most research on disaster impact assessment is from a macroeconomic perspective only addressing consequences and impact analysis, yet tourism-based communities are rarely discussed independently in dealing with natural disasters (Kim & Marcouiller, 2015;

Tsai & Chen, 2011). Studies largely focus on entire countries without providing more detail on specific damages for smaller regional scales while omitting regional particularities of a countrywide disaster. Misleading conclusions about the gravity of the disaster are likely if damages are solely assessed at a national level or do not consider the scale of impacts. These kinds of analysis do not provide the disparity of damages created from the disaster where some areas are more affected than others, thus making it more difficult to distribute governmental and financial assistance, or other available subsidies to residents. Financial assistance must not only be given to the entire country, but should be distributed accordingly to those areas with the worst impact in a time-efficient manner to avoid additional disaster aid barriers created by long negotiations with donors (Pelling, Özerdem, & Barakat, 2002). While dealing with the aftermath of disasters requires structured and accurate governance, sub-national distribution of economic support is necessary (Scolobig et al., 2014; Strobl, 2012).

To date, developing models estimating damages at local scales has not taken place within tourism research. We address this challenge by developing a micro-level assessment model (MLAM) to determine precise damage assessments. Dominica was chosen as study area due to the significance of the tourism sector for the island, the increased likelihood of hurricanes and tropical storms, as well as the additional dangers faced from climate change (e.g. sea level rise). Pre-disaster adaptation measures generally are preferable, such as improved hurricane warnings may decrease damages from disasters (Sadowski & Sutter, 2005), or the use of pre-disaster risk estimations to manage post-disaster losses (Tsai & Chen, 2011; Tsao & Ni, 2016). Implementing such measures is costly and requires the consideration of more than one hazard exposure (Anderson, 1995). We highlight the importance of regionally differentiated impact analysis using possible forced adaptation measures as described by Tervo-Kankare, Kajan, and Saarinen (2016), because they can be viewed as 'benefits' for future disasters. While MLAM is a tool that primarily aids in post-disaster damage evaluation, it may be relevant for governments and institutions supporting appropriate disaster recovery processes for communities to decrease future vulnerabilities. The model is described in greater detail first by providing a literature review of disaster impact assessments, second a discussion of the study area and disaster implications, and third by identifying the methodology used to determine the financial consequences for the tourism sector to draw conclusions from the disaster and recovery process.

Literature review

Islands are known for their vulnerabilities to natural hazards creating substantial risks for tourism industry economies (Becken et al., 2014). Although there are myriad forms of natural disaster impact assessments in the literature, the tourism sector has often not been a focal point of research in the context of natural disasters (Kim & Marcouiller, 2015; Tsai & Chen, 2011). Current analysis is conducted from a macroeconomic perspective estimating general impacts on local economies in terms of costs and consequences of individual disasters on a wide range of scales (Baade, Baumann, & Matheson, 2007; Horwich, 2000; Selcuk & Yeldan, 2001; Vigdor, 2008), including entire countries or even continents (Cavallo, Powell, & Becerra, 2010; Jovel, 1989). The most common variables used for economic damage assessments are the number of people killed or number of persons affected (Jovel, 1989, Kim & Marcouiller; 2015; Noy, 2009; Vigdor, 2008), the rise in external transfer payments and grants (West & Lenze, 1994), monetary damages (Baade, Baumann, & Matheson, 2007; Cavallo et al., 2010; Jovel, 1989; Kim & Marcouiller, 2015; West & Lenze, 1994), production losses (Hallegatte & Przylusky, 2010), macroeconomic growth rates or general changes in the GDP (Albala-Bertrand, 1993; Benson & Clay, 2004; Horwich, 2000; Strobl, 2012), and employment changes (Coffman & Noy, 2011; Ellson, Milliman, & Roberts, 1984; Ewing & Kruse, 2005).

There is a need for disaster phenomena research specifically related to tourism (Faulkner, 2001; Faulkner & Vikulov 2001; Ritchie, 2004). Lee and Chi (2013) provide examples as to how to analyze disaster impacts on tourism by measuring the change of annual visitors in Taiwan at scenic spots after the 1999 earthquake. Tsai, Wu, Wall, and Linliu (2016) conducted qualitative interviews with local communities in Taiwan measuring perceptions of tourism impacts on communities, thereby demonstrating that the impact of disasters on the tourism sector is critical to understanding tourism disaster recovery.

Apart from assessments of social components such as visitors or impacted community residents after a disaster, it is common in literature to use economic indicators for disaster impact analysis. Irrespective of a disaster impact, standard assessments of economic impacts (e.g. by the tourism industry) for a region are conducted with input–output (IO) or computable general equilibrium models (CGE) (Dwyer, Forsyth, & Spurr, 2004; Kumar & Hussain, 2014). Advantages and disadvantages of both approaches for disaster impact analysis have been assessed, and IO models in general are considered insufficient for estimating potential substitution effects for impacted regions (Koks et al., 2016). Although the two common models of economic impact analysis are valuable methods to estimate economic impacts after natural disasters, micro-level assessments on a small regional level are omitted from these calculations.

Specific damage assessments in the Caribbean demonstrate further ways of estimating social and economic effects of natural disasters (volcanoes, hurricanes, and earthquakes) calculated on the macro-level (Cross, 2007; Jovel, 1989). Countrywide assessments of financial damage of hurricanes David in 1979 and Hugo in 1989 were conducted by Benson, Clay, Michael, and Robertson (2001), and Benson and Clay (2004). Rasmussen (2004) evaluated the long-term macroeconomic effects of disasters from a country-level perspective highlighting the effects of fiscal balances, as well as the necessity of pre-disaster risk reduction plans essential for recovery. Aspects of recovery are visible in media portrayals of disasters suggesting damage to the entire country (Faulkner, 2001; Huang & Min, 2002), or portrayals of large financial losses by emphasizing additional negative economic impacts (Albala-Bertrand, 1993). How well the tourism sector manages to convince the public that everything has returned to normal business is seen as the short-term basis for disaster recovery (Rowe, 1996). However, natural disasters are seen often as a national problem experienced at local levels with varying impacts on the supply and demand side of the economy (Cole, 1995). This is likely to result in a weakened economic development for a region or country despite having an adaptable tourism industry (Faulkner, 2001). Although the disaster may trigger new economic growth through the stimulus of reconstruction activities, there should be adequate financing, local personnel, and materials made available (Skidmore & Toya, 2002). Hallegatte and Przyluski (2010) collected data on the global effects from the 2010 earthquake in Port-au-Prince and Hurricane Katrina 2005 to calculate direct and indirect losses, changes in housing prices, length of reconstruction phases, and the stimulus effect of a disaster that is triggered by reconstruction activities. Pelling et al. (2002) further recognized the necessity of integrating disaster vulnerability into pre-disaster development planning in assessing direct financial and indirect damages by applying a holistic accounting of macroeconomic impacts with multiple disaster case studies.

Sector-specific research and micro-level analyses of financial disaster effects are not the main focus in natural disaster assessments. Instead, much of the analysis and focus addressed the problems of landslides (DeGraff, James, & Breheny, 2010; DeGraff, Romesburg, Ahmad, & McCalpin, 2012; Maharaj, 1993). The current focus on macro-economic damage assessment in research should include examinations of individual economic sectors that were impacted by a disaster. Large differences among geographic regions and the shortage of available data at the micro-level are key reasons why existing research on natural disaster impacts seldom addresses damages and consequences at such small scales. Analyses lack a micro-level perspective for post-disaster impact analysis in these studies to provide a more in-depth critique of disaster recovery and impacts on financial aspects, particularly in the tourism industry. This implies real danger of distorting and misunderstanding disaster impacts.

Disaster impact analysis can be incorporated in various disaster assessment frameworks currently in the literature with small-scale disaster assessment in mind (Faulkner, 2001; Hystad & Keller, 2008; Lindell, Prater, Perry, & Nicholson, 2006). This should be simultaneously examined as part of sustainable disaster recovery planning, especially at the community-level given that there are significant vulnerability variations impacting potential disaster recovery (Lindell, 2011). Disaster recovery processes involve different aspects of physical, social, economic, and environmental elements for communities through pre and post-event (Smith & Wenger, 2007). Pre-event and post-event planning both are an integral part of Faulkner's (2001) tourism disaster management framework and Hystad and Keller's (2008) disaster management framework. Lindell et al. (2006) developed a disaster impact model emphasizing three emergency management interventions for the pre-disaster phase (hazard mitigation, emergency preparedness, and recovery preparedness) and a post-disaster phase (mitigation of physical and social impacts). The role of individual stakeholders is particularly emphasized by Hystad and Keller (2008). They show when stakeholders are involved in the post-disaster resolution phase then they are more likely to be better prepared for future disasters. Pre- and post-disaster recovery planning are important elements of disaster recovery theory for sustainable communities (Smith & Wenger, 2007). Often the tourism industry tends to be ill prepared for disasters regardless of having knowledge of existing vulnerabilities (Becken & Hughey, 2013). Therefore, we focus on a post-disaster impact assessment at the local-scale to support sustainable disaster recovery in order to reduce vulnerabilities for the tourism sector.

Methodology

Study area

We selected the island of Dominica as study area specific to tourism disaster recovery for three reasons. First, tourism plays an important role for island destinations resulting in economic dependency where tourist destinations are particularly susceptible to the consequences of climate change (Becken & Hay, 2007). Second, the SIDS Dominica and according tourism sector will continue to face severe challenges and consequences due to climate change since it poses the most threat for island communities (Forbes et al., 2013). Third, islands can be regarded as isolated systems, allowing measuring all economic input and output flows including the tourism industry.

Dominica is located within the Lesser Antilles in the Caribbean. Dominica is characterized by a mountainous interior covered in tropical rainforest, and a variegated coastline. Formerly reliant on the single export commodity bananas (Payne, 2008), the island is transitioning towards a promising tourism development. Dominica's Tourism Master Plan sees tourism as the main income generator of the future, drawing attention to the importance of sustainable development (Commonwealth of Dominica, 2013). Accordingly, the island is advertised as the 'nature island' boasting 'sustainable tourism' (DDA, 2013); a claim made plausible by the absence of mass tourism due to the island's geography (Timms & Conway, 2012).

Dominica's disaster vulnerability results from extensive zones of weakened rock, over steepened slopes, large rainfall amounts and occasional seismic activity that facilitate landslides (Teeuw, Rust, Solana, & Dewdney, 2009), and one of the highest concentrations of potentially active volcanoes in the world (Lindsay, Smith, Roobol, & Stasiuk, 2005). Due to its location in the tropical hurricane belt, each year hurricanes and tropical storms pass over the entire region, each one affecting different islands and to various extents. From 1872 to 2015, Dominica was hit by 22 hurricanes and 32 tropical storms (Hurricane City, 2016).

Tropical storm Erika

On 27 August 2015, tropical storm Erika passed over Dominica bringing extraordinary rainfall resulting in rapid flooding and landslides throughout the island, particularly affecting the south and southeast parts of the island (Commonwealth of Dominica, 2015). Tropical storm Erika reached peak wind speeds of 50 mph, within the wind speed range of tropical storms according to the Saffir Simpson scale (39–73 mph; National Hurricane Center, 2016). Each location of Dominica's climate stations recorded more than 200 mm of precipitation within four hours, while some areas reached a maximum of 400 mm in the same period. The rainfall peak occurred between 4 AM and 10 AM while most residents were still in their homes when the series of flashfloods and landslides began. The situation was further aggravated by surface runoff from steep interior parts of the mountainous island reaching the coastal areas within just a few hours. The island's steep water catchments faced quick and intense runoff, exacerbating the effects of the rainfall and together resulting in severe impacts for just a few areas.

Officials claimed Dominica had been set back 20 years in tourism development as a result of tropical storm Erika with nine communities declared 'special disaster areas' by Prime Minister Roosevelt Skerrit (Commonwealth of Dominica, 2015). The storm resulted in the death of twelve people, 20 injured, 22 persons were listed as missing, 574 as homeless, 713 had been evacuated, and 7229 were living in a disaster area (IFRC, 2015). Storm Erika generated total financial damages of US$ 482.84 million, corresponding to 90% of Dominica's GDP in 2015 (GFDRR, 2015). The tourism sector was the fourth highest affected sector with total financial damages of US$ 31.18 million (Table 1), resulting in severe

Table 1. Storm Erika damages and losses by sector.

Sector	Damage (US$ millions)	Loss (US$ millions)	Total (US$ millions)
Roads and bridges	239.45	48.28	287.53
Housing	44.53	9.61	54.15
Agriculture, fisheries, forestry	42.46	4.87	47.33
Tourism	19.48	11.70	31.18
Water and sanitation	17.14	2.38	19.52
Others	16.38	2.08	18.36
Air and sea ports	14.90	0.08	14.98
Industry and commerce	9.13	0.56	9.69
Total	403.28	79.56	482.84

Source: Recreated by authors using GFDRR (2015).

Table 2. Dominica change in over-night arrivals by accommodation type, May 2015 and May 2016.

Accommodation type	Over-night arrivals May 2015	Over-night arrivals May 2016	Change May 2015 vs. May 2016
Bed & Breakfast	79	32	−59.5%
Guest house	406	231	−43.1%
Hotel	1730	1057	−38.9%
Apartment/cottages	655	438	−33.1%
Dive/eco lodge	174	194	11.5%

Source: Statistical Office Dominica (2016).

damage to the national economy due to its dependency on tourism. Furthermore, indirect costs for tourism were caused by impacts to roads and bridges, further aggravating the island's tourism sector since it is highly dependent on a functioning infrastructure to access individual tourist areas.

Among the island's 95 hotels, 31 suffered direct losses, including 11 hotels that ceased operations, and two hotels were completely destroyed. The hotel losses alone add up to a financial damages of US$ 15 million for Dominica (GFDRR, 2015). As a consequence, the number of overnight arrivals decreased from 7097 in May 2015 to 5645 in May 2016, corresponding to a net loss of 20.5% (Statistical Office Dominica, 2016). Over-night visitors comparing May 2015 and May 2016, decreased for all types of accommodation within a range of 30% to 60% (Table 2).

Apart from direct effects, one example of secondary effects of the storm was the cancellation of the Creole Music Festival in October 2015, which added to the additional loss of revenue for the tourism sector. This can be illustrated by the number of over-night arrivals in the fourth quarter of the years 2013–2015 (Table 3). In 2015, the fourth quarter saw a decrease in over-night arrivals by 29.3% in comparison to 2014. For the festival month of October, there was a 46.3% decrease between the same years. Influence of the

Table 3. Dominica quarterly over-night arrivals, 2013, 2014, and 2015.

Quarterly arrivals	2015	2014	2013	Change 2015 vs. 2014
(1) Quarter	20,695	20,470	20,334	1.1%
(2) Quarter	18,211	18,614	16,622	−2.2%
(3) Quarter	20,690	21,372	20,407	−3.2%
(4) Quarter	14,878	21,055	20,914	−29.3%
-October	4611	8584	8982	−46.3%
Total	74,474	81,511	78,277	−8.6%

Source: Jacob (2016).

Creole Music Festival on tourism arrivals is also illustrated by a monthly comparison of stop-over arrivals. In October 2014, the number of overnight arrivals was 8584, exceeding the arrivals during the season in January and February (6422 and 7400 arrivals, respectively). Consequently, the drastic decrease in overnight arrivals in the fourth quarter in 2015 compared to 2014 can be attributed to the cancellation of the festival, yet it cannot be determined whether arrivals statistics have recovered or will recover in the long-term.

Furthermore, the decrease of arrivals can partly be attributed to the destruction of several accommodation facilities. The Jungle Bay Resort ('JBR') was one facility located within the community of Petite Savanne, and provided a substantial source of income for several communities in Dominica (Figure 1). This is in large part due to the accessibility of JBR from the northern parts of the island, which do not allow for employees to have long-distance commutes outside the community. As the fourth largest hotel in Dominica by room numbers, JBR displayed higher personnel expenditure than other hotels of comparable or larger size due to the focus on sustainable tourism as a luxury resort. JBR will be used as case example to illustrate the disaster impact assessment model which can be used to estimate direct and indirect economic effects of natural hazards on tourism and regional development.

Historically, the area in which JBR was located has been devoid of landslides and severe hurricane activity. Unpredictable landslides following intense rainfall caused complete destruction of the resort facilities and major flooding carrying debris cut-off the main road connecting the southwestern and southeastern parts of Dominica. To date, this break in the main road is irreparable. The communities most severely impacted (e.g. Petite Savanne, Delices, and Boetica) were unprepared for a tropical storm with such devastating destruction. Ultimately, JBR's destruction led to severe economic consequences for areas with a large share of employees or suppliers because JBR cannot be rebuilt in the same area due to its status location classified as a permanent disaster area. JBR was the only large employer in this area, and facilitated a detailed assessment of communities' job markets without being influenced by many other economic factors.

Research model and data

The tourism disaster management framework proposed by Faulkner (2001) is used as the theoretical background. The relevance and application of Faulkner's (2001) framework for this study is due to the specific focus on destinations' tourism sector based on the literature review of relevant frameworks. Faulkner (2001) emphasizes the importance of scale, specifically community scale in describing disaster stages regarding disaster response. Community scale analysis is needed because of how disaster impacts and recovery differ among tourism regions and stakeholders (Faulkner, 2001). Ritchie (2004) expands on this framework, stressing disaster recovery is a crucial aspect within the tourism industry, but there is also a need for local level approaches to test and verify models utilized in the tourism disaster management.

The framework addresses six phases of a disaster requiring different types of tourism disaster strategies:

(1) Pre-event: strategies to mitigate or prevent disaster effects.
(2) Prodromal: strategies needed when a disaster is imminent.

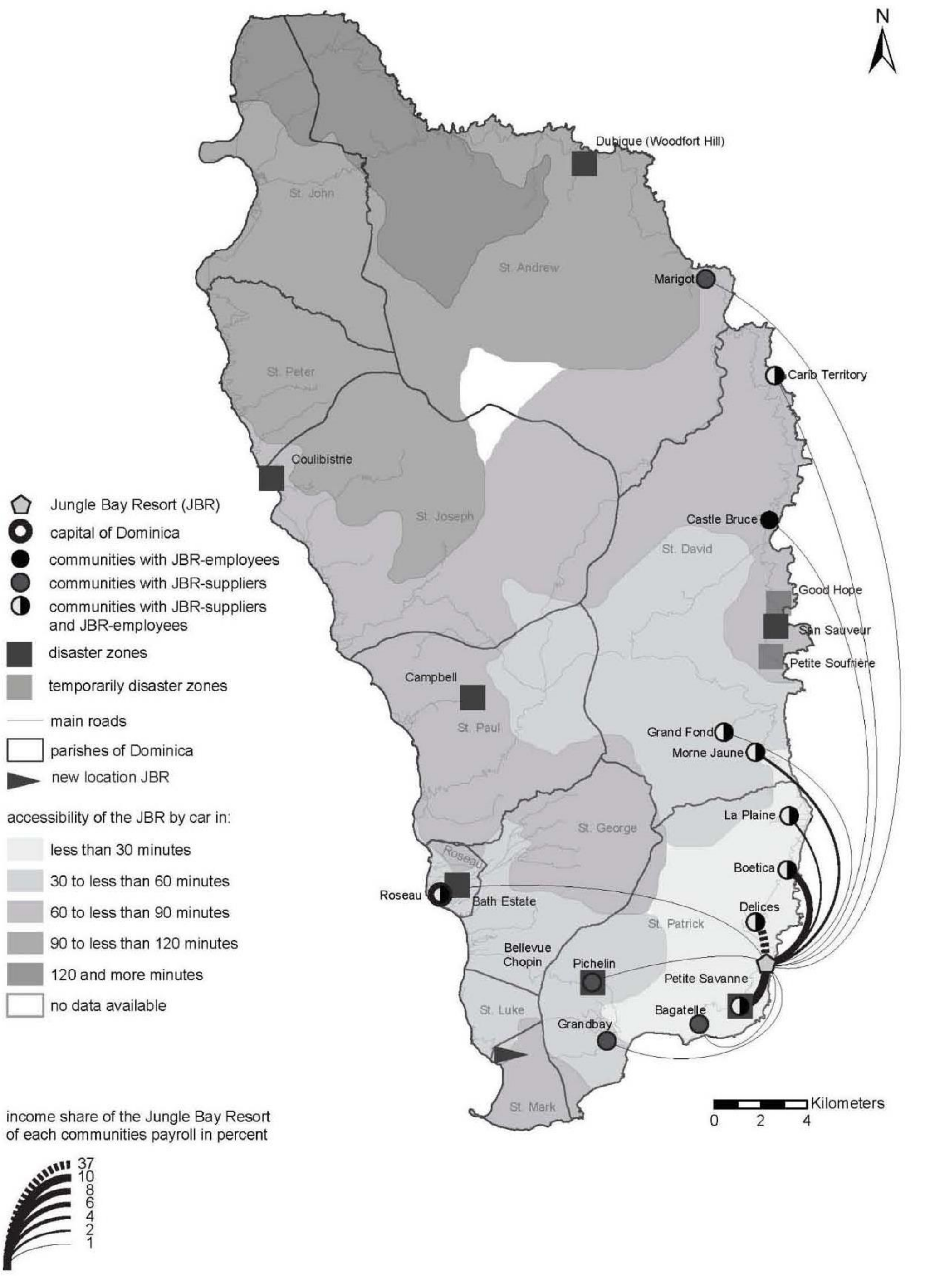

Figure 1. Research area and JBR effects on the regional labor market. Source: Designed by authors according to GFDRR (2015) and JBR (2015); database: Diva GIS.

(3) Emergency: action needed during the effect of a disaster.
(4) Intermediate: short-term measures.
(5) Long-term (recovery): continuation of phase (4).
(6) Resolution: restoring routine.

Mair, Ritchie, and Walters (2014) note that there have been few cases where Faulkner's (2001) tourism disaster framework has been tested and suggest that there is a need for detailed models at each phase of the crisis or disaster lifecycle (e.g. reduction, readiness, response, and recovery). Due to this necessity of micro-level post-disaster damage assessment in the tourism sector, we focus on the precise handling of phases (4) and (5) to facilitate a successful and time-efficient phase 6 of resolution for Faulkner's (2001) framework.

Generally, disaster impacts can be investigated focusing on aspects such as material destruction causing direct economic loss (e.g. houses, infrastructure), disruptions of social structures (e.g. family linkages) or indirect economic consequences (e.g. loss in income). This model focuses on the economic consequences of the material destruction of touristic infrastructure accompanied by a loss in income in a community. Ritchie (2004) stresses the importance of the tourism sector and disaster management needing to understand the interdependence and impacts on economies and livelihoods. This aspect is particularly relevant since this can be an important indicator of livelihoods or adequate standards of living when estimating disaster impacts due to the loss of income affecting a community (e.g. indirect impacts due to the decline in revenue in the community or migration forced by the loss of employment). However, financial compensations are generally paid based on the material destructions, which do not cover the actual economic impacts of a disaster on a community. These indirect economic consequences so far have not been investigated on a small spatial level since data on the loss of jobs in most cases is only available on a regional or national level. Therefore, such information would be crucial for the development of adequate disaster recovery strategies. Calculations of monetary damages alone, even if regionally differentiated do not provide adequate information about the economic disaster aftermath for local or national recovery programs for residents. It is necessary to measure micro-level impacts on local economic situations for disaster areas in order to allocate appropriate financial programs and implement adequate recovery programs supported by local and national governments as suggested by Pelling et al. (2002) and Skidmore and Toya (2002). Areas where large parts of the job market and income sources for residents have been terminated or reduced from disasters require more financial assistance than areas with limited economic impact relying on the reconstruction of tourism infrastructure or the tourism economy.

For these reasons we developed an economic calculation model capable of analyzing natural disaster damage in a specific localized region to obtain calculations of losses for communities managing recovery. The calculation of economic impacts in this research model is based on three spatial levels (local, regional and national) in relation to the pre-disaster touristic infrastructure incorporating data such as employment rates on countrywide and community-based levels, as well as community-by-community aggregated income. Detailed data about the precise income structures of one major tourism employer which has been destroyed during the disaster is used to calculate direct financial consequences for the corresponding dependent communities. The pre-destruction share of income of employees in specific areas provides a better understanding of the impact to the regions' job market and economic state for the residents.

Micro-level impact assessment

MLAM is calculated on the basis of data on the countrywide (Dominica), community-based and at a specific local-level (case study JBR) from the year 2015 (Figure 2) to

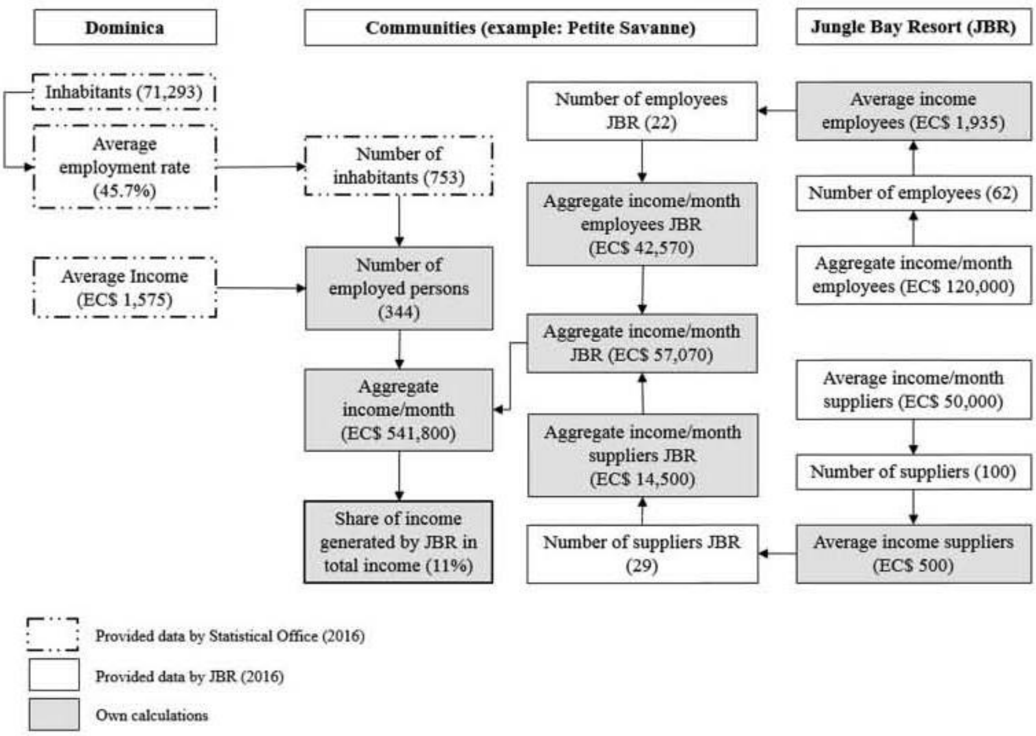

Figure 2. Micro-level analysis model (MLAM): calculation of JBR income share in total income for a sample community. Source: Formula and calculations by authors from data received by JBR (2015) and Statistical Office Dominica (2016).

estimate financial consequences for community residents formerly employed at JBR. The calculation of financial losses from JBR's destruction utilizes average numbers for Dominica's employment rate and the monthly income. Average values are used for the income of JBR employees and suppliers (e.g. room service, reservation manager, and housekeeper) and for the general level of income in Dominica, as it is not possible to determine regionally differentiated values in terms of urban versus rural areas, and job type (e.g. agricultural versus tourism sector employee), even within JBR. Petite Savanne serves as an example to illustrate the steps undertaken to calculate the share of income generated by JBR for the total income of the community. Analogously, economic impacts of employment were calculated for all communities (Table 4).

To estimate the number of employed persons in each community, Dominica's average employment rate (45.7%) was applied to the number of community residents. In 2015, 344 people were employed in Petite Savanne, 22 whom were employees of the JBR. Average incomes were calculated both countrywide and JBR-specific using average monthly wages at countrywide and local levels to determine the differences in average wage structures. The average income of EC$ 1575/month and the number of employed persons in communities were used to calculate community-wide monthly revenues of EC$ 541,800 in Petite Savanne. Dominican average monthly income (EC$ 1575/month) is below the average income for employees of JBR (EC$ 1935/month), emphasizing the significance of JBR as an employer for the region and impact on the affected communities. The average income of a JBR supplier is EC$ 500/month, resulting in aggregate incomes of JBR

Table 4. JBR community share of employees and income, 2015.

Community	Employees of JBR	Share of JBR employees	Suppliers of JBR	Share of JBR income
Delices	20	21.1%	33	37.0%
Petite Savanne	22	6.4%	29	10.5%
Boetica	4	5.9%	2	8.2%
La Plaine	6	1.2%	5	1.7%
Roseau	4	0.1%	13	0.1%
Others	6	0.1%	18	0.1%
Dominica	62	0.2%	100	0.3%

Source: Calculation by authors according to data from JBR (2015).

employees and suppliers yielding approximately EC$ 120,000/month for JBR employees and EC$ 50,000 for JBR suppliers. In the case of Petite Savanne, the aggregate income per month generated by JBR is EC$ 57,070 (employees and suppliers included). This results in the share of income generated by JBR to the total income of communities (11% for Petite Savanne) (Table 4). The share of income refers to the share of income generated by suppliers and employees in the overall income of specific communities. This calculation was possible due to the availability of community-wide monthly revenues using aggregate income/month related to JBR and the aggregate income/per month for the entire community.

The resort's destruction by tropical storm Erika left 62 direct employees unemployed and immediately ceased arrangements with 100 suppliers. In 2015, 6.4% of employed people in Petite Savanne (suppliers not included) were employed by JBR. Overall income of 11% in the community was generated by employees' and suppliers' income. The highest losses of community income (employees and suppliers) are found in Delices, where 37% of income has been terminated. On a countrywide level, only 0.3% of revenue was terminated, highlighting the differences among regional losses further supporting the need to conduct analyses on a small regional scale rather than at a countrywide scale. While this share of revenue appears to be minor, the largest income shares of the JBR in community wage bills are Delices, Petite Savanne and Boetica (Figure 1). These communities were all in close proximity to JBR.

Discussion and conclusion

Financial damages of tropical storm Erika are illustrated on a countrywide level and examined as well on a smaller regional level. Commonly assessed country-level consequences of natural disasters help raise awareness of the destruction faced after a disaster. We affirm the importance of Benson et al. (2001) and Benson and Clay (2004) calling for attention to the country-level damages of disasters. Yet, we take a further step by analyzing damages at a small-scale level in order to estimate region-specific impacts as seen with of the community income loss between 2% and 37% resulting from the destruction of a significant employer. Such stark differences highlight the need for disaster funding and resources to be allocated on a community-by-community basis. The applied case study emphasizes the impacts of natural disasters are not equally shared across the island where some areas were declared disaster zones, and other areas only suffered minor damage. Therefore, a regional differentiation of financial disaster impacts is imperative for the development of effective relief measures and an adequate distribution of governmental subsidies. Calculations of impacts using MLAM can be used to identify communities with severe impacts needing immediate assistance. MLAM is a practical and innovative tool to support disaster recovery as it facilitates time-efficient assessment of direct financial disaster impacts specific to communities or local regions. The model is transferrable to other regions, can be adapted to different geographic scales (e.g. local or countrywide), and can be applied to any economic sector (e.g. manufacturing or agriculture), disaster type (e.g. earthquakes or volcanic eruptions), or any kind of industry (e.g. gastronomy or manufacturing).

Furthermore, MLAM can be replicated and adapted to pre-disaster phases, corresponding to Faulkner's (2001) phases 1 (pre-event) and 2 (prodromal) of the disaster management framework. We reaffirm the importance of the development of pre-disaster risk assessment measures for the tourism industry as outlined by Faulkner (2001), Faulkner and Vikulov (2001), Ritchie (2004) and Tsai and Chen (2011). Specifically, our micro-level assessment focuses on the facilitation of phases 4 (intermediate), 5 (long-term recovery), and 6 (resolution phase) in Faulkner's (2001) framework emphasizing the importance of post-disaster recovery. The disaster framework phases are inter-connected where post-disaster strategies are likely to impact or influence pre-disaster planning phases. Therefore, MLAM is useful in post-disaster assessment by providing valuable incentives for pre-disaster planning such as mitigation efforts, development of hypothetical disaster risk modeling, or management and distribution of financial resources for emergency services.

Despite the practical application and benefits of MLAM there are some inherent limitations of the model that must be addressed for future application or development. The model requires specific data from the labor and economic market such as income levels, employer data, supplier data, and number of employed persons to apply the model. This often presents a challenge in data acquisition due to the difficulty developing and maintaining the data where it is frequently expensive to do so for small-scale communities. In our case (JBR) we used income data calculated as averaged values on a community level as well as on an individual level. The model outcomes would have been more precise using individual income data allowing for a more in-depth small-scale impact analysis compared to other communities when assessing overall disaster losses. Additionally, having total income figures for several communities would have also provided more accurate information pertaining to loss of income. Another example would be to have the detailed supplier data for all available economic sectors (e.g. hotels, restaurants, tour operators, and shops or small business owners) in a community and not just one in our case of JBR. By capturing all representative suppliers for MLAM the result would yield a more accurate depiction of total disaster damages and losses that directly and indirectly impact the tourism sector. Lastly, MLAM presently only measures financial damages and losses at the impact of the disaster that is not necessarily a representation of real-time losses to reveal a larger time scale of losses. However, this may be resolved by performing the calculation on a regular time scale (e.g. monthly or annually).

All social impacts as well as infrastructure destruction from a disaster should be analyzed with other tools for a more comprehensive understanding and assessment of the disaster as well contributing to future research of disaster recovery. Residents of affected communities had to be relocated, and it is not known whether social structures can be transferred to the new places being created for the residents. Presently it is unclear what kind of jobs are available for former employees in the future, and how they can be reintegrated into the tourism sector, or find alternative jobs. Communities in Dominica traditionally were dependent on agriculture or partly subsistent agriculture and is now largely dependent on the tourism sector as local business owners or employees. In this new economic landscape, it is worth assessing the dangers of having a high dependency on one employer or one sector, and if tourism is the best pathway for community development. Should the tourism sector be the future pathway and leading source of GDP revenue, there needs to be more research of stakeholder's disaster recovery responses, adding on to the research of Ritchie (2004), McCool (2012), and Scolobig et al. (2014) with specific focus on the hospitality industry.

It is not enough to discuss overall economic damage alone in measuring disaster impacts. Many sectors were impacted by the disaster that incurred monetary damages. The worst sectors affected were housing, agriculture, roads, and tourism (GFDRR, 2015). Tourism is further aggravated due to the labor intensive hospitality market and dependency on other sectors such as roads and housing. Infrastructure is a critical aspect for tourism in large part due to the number of roads needed for transportation and distribution of hospitality resources. The housing sector is also important due to the availability of employee housing, but also for available accommodation units for tourists such as bed and breakfast facilities. Since the island is becoming more reliant on the tourism sector, the impact is particularly devastating for communities unable to recover after disasters. The destruction of the Jungle Bay Resort as tourism employer had far-reaching consequences for local residents, communities, and economies beyond the tourism industry. While acknowledging the work of Pelling et al. (2002), we emphasize the greater importance of assessing sectors and geographic attributes individually when natural disasters strike.

The estimation of monetary losses and localized disaster impacts by sector can serve as a foundation for focusing on long-term effects and strategies of disaster recovery for pre-disaster and post-disaster mitigation planning. A key benefit of a disaster like Tropical storm Erika is the awakening effect regarding the necessity of zoning maps and pre-disaster risk reduction plans. Awareness has been raised not only within the affected population, but also within the political and institutional systems. The phenomenon of forced adaptation should be addressed in contrast to voluntary adaptation well in advance of a disaster to assist in tourism disaster recovery to the greatest extent possible (Tervo-Kankare et al., 2016). Likewise, in the face of changing environments resulting from climate change, the focus of tourism disaster management will likely shift to use of tourism disaster management frameworks, such as Faulkner's (2001) framework utilizing different phases in the disaster process to address issues such as zoning maps, warning systems, improved communication systems and education of industry stakeholders. MLAM is a tool that we consider not confined to post-disaster assessment and recovery phases of the tourism disaster management framework. Therefore, further research should include the integration of models such as MLAM into pre-disaster planning phases, especially in the face of environmental changes such as increased hurricane frequencies or more intensive rainfall. MLAM can provide an investigative tool for pre-disaster management planning or can concentrate on other phases of Faulkner's (2001) framework to identify vulnerable communities' dependent on the tourism sector needing adequate disaster recovery planning for economic viability.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Jürgen Schmude is a professor of economic geography and tourism research at the Department of Geography, LMU Munich. The impact of global change on the tourist industry is a core element of his research.

Sahar Zavareh is a research associate at the Department of Geography, LMU Munich, Germany. Her research is focused on long-term disaster recovery of housing, tourism, and insurance.

Katrin Magdalena Schwaiger is received the PhD degree from the Department of Geography, LMU Munich. Her research focused on tourism in the Caribbean with special focus on hospitality and sustainability.

Marion Karl is a postdoc researcher at the Department of Geography, LMU Munich, Germany. She concentrates her research on travel decision-making and relevant influencing factors, among them perceptions of risk.

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Dynamic economic resilience scenarios for measuring long-term community housing recovery

Sahar Zavareh and Gordon M. Winder

Department Geographie, LMU Ludwig-Maximillians-Universität München, München, Germany

ABSTRACT

The research measures post-disaster long-term housing recovery to assess community resilient recovery using the case of Broadmoor, a community located in New Orleans. Dynamic economic resilience scenarios calculate post-disaster housing recovery and differences of rebuilding using three housing recovery scenarios (baseline, reference recovery and dynamic economic resilience). The baseline scenario projects changes in housing market values without a disaster. The reference recovery scenario calculates post-disaster housing reconstruction values (e.g. repair rates and housing rebuilding permits), and a hypothetical housing recovery profile using damage assessments and building permits for rebuilding based on available investments (insurance and buy-outs). The dynamic economic resilience scenario models all potential and accelerated investments (uninsured versus insured, or buyouts for homeowners). A future dynamic economic resilience recovery scenario takes into account the benefits of housing reconstruction improvements, (e.g. levee and pump investments). The results identify an ideal sustainable long-term recovery threshold of three years after the disaster event. The results reveal the conceptualised dynamic economic resilience scenarios leads to shorter time-paths for recovery, and that the sustainable long-term recovery threshold is approximately three years after the disaster event.

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1. Introduction

Housing recovery has been identified as one of the most important factors contributing to overall post-disaster recovery success due to its influence on community economic and business recovery (Comerio, 1998; Peacock et al., 2018; Tierney et al., 2002). Specifically, the return of permanent housing is seen as the most critical factor (Peacock et al., 2007, 2018). Quarantelli (1982) developed a housing recovery typology – emergency shelter, temporary shelter, temporary housing, and permanent housing – to characterise the recovery process. The most common process for household resettlement after disasters consists of those forced to relocate seeking new permanent housing or temporary housing until they are able to return to the original site (Iuchi, 2014). Smith and Deyle (1998) emphasise there is a distinction between short-term and long-term recovery

CONTACT Sahar Zavareh sahar.zavareh@geographie.uni-muenchen.de Department Geographie, LMU Ludwig-Maximillians-Universität München, Luisenstraße 37, München, 80333, Germany

planning. Research also finds long-term housing is little studied and understood by researchers (Peacock et al., 2007). Although literature has addressed housing damage and household recovery, studies seldom use longitudinal data to assess long-term housing recovery (Peacock et al., 2014). The question remains how to measure recovery of a place from a disaster when disaster recovery measures are not well theorised (Chang, 2010; Cheng et al., 2015; Peacock et al., 2018; Rose, 2004; Smith & Wenger, 2007). Most local, state or federal government officials when tasked with the post-disaster recovery process have no existing guidance on how to measure recovery (Cheng et al., 2015).

This paper addresses these challenges by using dynamic economic resilience scenarios to measure long-term community housing recovery. The community of Broadmoor impacted by Hurricane Katrina has been chosen due to the significance of housing losses, the number of households managing housing rebuilds, the increased likelihood of future disasters, as well as the additional risks faced from climate change (e.g. sea level rise). The scenarios assist in post-disaster damage evaluations, but may also be relevant for communities seeking to reduce future vulnerabilities and support resiliency initiatives. The dynamic economic resilience approach is described in detail first by reviewing the disasters literature on measuring recovery (housing), second discussing the study area and housing recovery process, third by identifying the methodology used to measure long-term housing recovery and application to the case of Broadmoor, and lastly demonstrating how dynamic economic resilience scenarios can contribute to disaster recovery research and gaps in the literature.

2. Disaster recovery and resilient recovery

Haas et al. (1977) offered the first comprehensive research into the recovery process, identifying policy and lessons from rebuilding. Subsequent work (Rubin et al., 1985) noted that recovery was more complicated than the model presented by Haas et al. (1977) and suggested researchers should use qualitative data to evaluate the process of recovering in order to improve upon the speed and quality of recovery. Using a decade of data for small and large cities, Johnson (1999) completed one of the first studies providing a long-term view of recovery from the 1989 Loma Prieta earthquake. The study identified four phases critical to post-disaster recovery: immediate response of those endangered and of property; restoration of utilities and short-term housing; short-term recovery to restore pre-disaster levels for functioning households and businesses; and permanent reconstruction to repair, rehabilitate and redevelop the community. Smith and Deyle (1998) emphasise that short- and long-term recovery planning must be different. Schwab et al. (1998) determined that recovery should not come at the expense of quickly attempting to restore normal activities and functions for the public. More recently, this tension is expressed as a source of conflict between the aim to rebuild as quickly as possible and the aim to deliberately recover and rebuild to ensure a better result (Olshansky & Chang, 2009). The notion of 'Build Back Better' (BBB) was developed in an effort to improve reconstruction and recovery practices for communities. A BBB approach is centred in disaster recovery and reconstruction processes that improves resilience (Fernandez & Ahmed, 2019). However, BBB has no clear definition for housing recovery, and more importantly, lacks a people-centred housing recovery approach (Maly, 2018). BBB largely ignores the lack of choices, opportunities or capabilities among housing reconstruction processes (Vahanvati & Rafliana, 2019).

At any one time, communities and households may be engaged in various recovery activities. This has contributed to the limited attempts by researchers to focus on the timescales of disaster recovery (short-term vs. long-term) as opposed to specific recovery functions needed (Lindell, 2013). Housing issues are some of the most complex aspects of disaster recovery (Sapat & Esnard, 2016). Property damage resulting from disasters creates losses in asset values that can be measured by the cost of repair or replacement. Disaster losses are difficult to determine because they do not reside in one place, nor are they managed by one organisation (Lindell, 2013). Comerio (2014) suggests measuring recovery requires analysis at different scales over different timescales. It is suggested that this measurement should occur over three scales of input over different timeframes: geographical scale where recovery is measured (e.g. individual, household, community, state or national), the timeframe measured (e.g. months, years, or decades), and lastly the perspective of the evaluator's assessment (e.g. family, community, government, or funder/financier stakeholder). Measuring recovery has largely been addressed through methodological approaches such as surveys, case studies and computer modelling (Chang, 2010). The two major approaches to measuring recovery either attempt to assess recovery in relation to either pre-disaster conditions or broader impacts of the economic environment with no pre-existing scenarios for comparison. The second approach often takes into account that there is a new normal instead of a pre-disaster state to return to, that recovery can be indexed to track progress, and the use of geospatial technology such as GIS or remote sensing can assist with tracking recovery (Cheng et al., 2015). Housing repairs are critical, however, are viewed as insufficient for measuring housing recovery (Sutley et al., 2019). Few studies model temporal and social aspects of housing recovery (Sutley et al., 2019).

Researchers often refer to the term 'resilience,' when discussing a community or a city's ability to withstand disasters (Harrison & Williams, 2016). Resilience is generally understood to be a property of a range of systems, that are able to remain stable when facing shocks and stresses, recover following an event, and adapt to new circumstances (Tiernan et al., 2019). Disaster resilience is defined simply as the capacity to rebound from future disasters (Cutter et al., 2008). Resilience builds upon three pillars: resistance, recovery and adaptive capacity (Thieken et al., 2014), each employing a different set of strategies. Resistance focuses on limiting disaster impacts. Recovery is concerned with the timescales to return to pre-disaster states. Adaptive capacity emphasises preparation and mitigation of future events (Slavíková et al., 2021). However, it is important to distinguish between resilience and *resilient recovery*, or also known as *resilience of recovery*. Resilient recovery focuses on recovery efforts to manage reconstruction to pre-disaster levels, as well as addressing risks and vulnerabilities in an effort to build back better (Slavíková et al., 2021). BBB frameworks have attempted to evolve and simplify the BBB concept, however, they lack ways to measure disaster impacts and recovery for resilient recovery (Fernandez & Ahmed, 2019; Maly, 2018). Resilient recovery seeks to advance housing rebuilding by focusing on financing recovery schemes. The role of resilience in disaster recovery financial schemes is largely neglected (Slavíková et al., 2021). Most recovery funding is focused on early restoration efforts (Thomalla et al., 2018), rather than supporting disaster resilience for recovery processes (Sandink et al., 2016; Slavíková et al., 2020).

Resilient recovery highlights three paradoxes related to financial schemes: policy, compensation and social equity (Slavíková et al., 2021). The policy paradox seeks to rebuild as quickly as possible, which may or may not reduce disaster risks and vulnerabilities. Recovery funding schemes do not always support resilient recovery. The speed and bureaucratic compensation policies impact resilience forming the second pillar of compensation in financial schemes. Lastly, social equity ensures that each person has equitable access to recovery schemes (Slavíková et al., 2021). Resilience requires more than just coping or rebuilding from a disaster. Therefore, this requires the advancement of recovery schemes in order to achieve resilience recovery (Fekete et al., 2020).

In relation to disaster recovery, economic disaster resilience research concentrates on the actions taken before and after events to reduce losses and overall risk (Bruneau et al., 2003; Rose, 2016, 2017; Rose & Dormady, 2018). Economic disaster recovery research focuses on repairs and reconstruction of building and infrastructure as well as efforts needed to restore the workforce, but also to reestablish social and political institutions. Economic recovery timescales from a disaster event are related to resilience concepts (Xie et al., 2018). Two types of economic resilience are applicable to disaster recovery: static economic resilience and dynamic economic resilience (Rose, 2004). Static economic resilience is concerned with the ability or capacity of a system to maintain function when experiencing a shock. Measures of static economic resilience then focus on whether resources are efficiently used to maintain function or to compensate for deficiencies, such as through conservation, substitution or relocation. Dynamic economic resilience is seen as the ability and speed of a system to recover from a shock, by managing investments (which are time dependent) made for repairs and reconstruction as efficiently as possible (Xie et al., 2018). The time dependent variability of investment is linked to resilience: by accelerating recovery and shortening the recovery period; or by slowing and lengthening the recovery and thererfore contributing further economic losses (Ayyub, 2014). Thus, dynamic economic resilience provides a temporal perspective to housing recovery from a system rebounding from a shock (Pant et al., 2014). Therefore, this paper addresses community long-term housing recovery by applying dynamic economic resilience scenario modelling.

3. Methodology

The purpose of this research is to measure long-term disaster housing recovery to assess overall long-term community recovery by applying the concept of dynamic economic resilience. This is done by using housing recovery scenarios (baseline, reference recovery and dynamic economic resilience) to analyse the differences among the levels of rebuilding in each of these scenarios, such as the use of housing buy-outs and insurance as thresholds for community housing resilient recovery. In addition, a future dynamic economic resilience recovery scenario is modelled, taking in account the benefit of dynamic housing reconstruction improvements to assist with future disaster recovery policy planning.

A case study examining the community housing recovery from Hurricane Katrina is used to measure and answer what is the long-term housing community recovery. This natural disaster case study was chosen because it was a major event in recent decades inside an affluent economy, in a well-established insurance market, which was also subject to a governance system with a clear implementation process for disaster recovery policies and management. The focus is on documenting and evidencing the housing reconstruction progression in the context of the rebuilding strategies at work throughout the recovery process. The aim is to understand the impacts, timelines of recovery, how the recovery was managed and financed, what decisions were made and when, and the eventual housing resilience outcomes in terms of speed and quality of recovery. The analysis attempts to move beyond the traditional assessment of taking a physical accounting of housing stock pre and post-disaster to compare and contrast housing recovery. This is done by applying resilience scenarios that are dynamic, and reflect the recovery systems, in an attempt to better understand the role of community leadership in developing post-disaster housing recovery policies, quick and efficient use of financial reconstruction funding, and the practice of building permits used for rebuilding efforts. Multiple data sources including interviews, field research, news reports, official government policy documents, city assessor records, property records, physical property assessments for each community case study, community propriety internal housing records and documents, news and media reports, and government disaster property damage assessments were used to develop the case study and community housing database. A total of 227 semi-structured interviews with stakeholders took place in New Orleans over a 3-year period representing a diverse set of organisations and interests including but not limited to residents, city council members, news and media officials, academic institutions, historians, non-profit agencies, private planning consultants, health and wellness representatives, environmentalists and environmental planning specialists, tourism officials, commerce and economic policy planning officials, architects, engineers, builders, construction companies, teachers, local red cross organisations, churches and religious leaders, insurance experts, reinsurance experts, government officials and offices tasked with recovery efforts, local planning, Road Home Program, disaster mitigation policy planning, insurance policy planning, urban planning, and resilience specialists. We began the first interviews in April 2015 that provided stakeholder insight leading up to the 10-year anniversary festivities. The next round of interviews then took place between August and September 2015 in New Orleans. Initial interviews included stakeholders on the basis of their expertise and direct contact with community residents. This was followed by interviews with secondary stakeholders as well as recommendations made by the first round of interviewees, totalling 227 semi-structured interviews. Interviewees were asked to discuss the disaster housing recovery process, their long-term recovery reflections, and the role of insurance or home buy-outs. Additionally, a physical inventory of each property in Broadmoor was conducted to document the long-term housing recovery process. Follow-up interviews took place with residents in April and May 2018 to discuss the Broadmoor housing recovery inventory and calculation used to create the dynamic economic resilience scenarios, post-reflection of the 10-year anniversary event weekend, as well as the changing local political landscape and its impact on Broadmoor (during this time the former Broadmoor Improvement Association President, LaToya Cantrell had been elected as the first female Mayor of New Orleans). Note that only official FEMA reported funding and payments are used in this research paper. We are grateful for the cooperation of those interviewed. Their responses offered many insights into long-term housing recovery processes and outcomes.

The results from the research demonstrate how dynamic economic resilience can be applied to measure long-term community housing recovery. We see this as an initial step towards a better measurement of long-term disaster recovery and supporting overall community resilient recovery. This step supports an alternative community housing resilience perspective. The results challenge the common belief that disaster financing alone is able to effectively manage long-term housing rebuilding and recovery.

3.1. Research model and framework

This research involves the development of a dynamic economic resilience framework providing an analysis for the necessary physical and labor resources necessary for housing rebuilding. This includes the insurance and claims process, sponsored buy-out housing programmes, and financial investments needed by homeowners for reconstruction (e.g. permits, claim deductibles, etc.). The dynamic economic resilience assessment (adapted from Xie et al., 2018) is estimated from a housing inventory damage calculation. The housing inventory damage is calculated using a baseline scenario (non-disaster scenario), reference recovery scenario (damaged housing inventory and actual post-disaster reconstruction scenarios), and a dynamic resilience scenario (scenarios with additional insurance coverage, and/or government buy-outs, increased reconstruction funding, and new technology investments). These measurements provide ways in which to describe and evaluate the overall long-term community housing recovery profile by using a case study. In what follows, details related to the framework assessment used in the case study, such as the general long-term disaster recovery and housing rebuilding governance processes, housing insurance, stakeholders, risk reduction through structural and land-use planning efforts, social recovery, and economic recovery, as well as data sources are provided.

3.2. 2005 Hurricane Katrina case study

Hurricane Katrina struck the US Gulf Coast On August 29, 2005. It is estimated that there were more than 1200 deaths, an estimated $US 125 billion in damages, $US 60 billion in insurance losses, and more than 1.7 million claims across six states (Allianz, 2015; Dolfman et al., 2007; Insurance Information Institute [III], 2010). The Federal Emergency Management Agency (FEMA) made a federal disaster declaration, totalling more than $110 billion in federal funding. Louisiana established the Louisiana Disaster Recovery Fund for state recovery initiatives. The Bring New Orleans Back Commission (BNOB) was established by the city in an effort to rebuild the city (Johnson & Olshansky, 2017). The Office of Recovery Management (ORM) merged into the Office of Recovery Development and Administration (ORDA) in 2008, focusing on city and local government recovery (Johnson & Olshansky, 2017). FEMA and ORDA partnered together for ongoing federal recovery projects to provide funding and assistance specifically for redeveloping blighted and abandoned properties. The City Council established the New Orleans Redevelopment Authority (NORA) to expropriate abandoned or blighted properties. The city enhanced codes and permits in 2008 to reduce and mange existing blighted properties by using fines, or seizing properties for demolitions or resale (Johnson & Olshansky, 2017). New regulations included higher standards for elevating homes above ground levels, and potential flood zones to reduce general flood risks. Mitigation funding was then tied to housing modifications (e.g. heights, setbacks, shape or building forms). However, many residents faced fatigue from what they regarded as excessive planning. Planning was continuous and undecided as with the case of the Master Plan for building and permit issuance that took ten-years post disaster for final approval (Collins, 2015).

For years, confusion and uncertainty surrounded Hurricane Katrina recovery. This resulted from the activities of multiple funding sources, as well as numerous conflicting statements concerning roles and responsibilities made by local, state and national government officials (Storr & Haeffele-Balch, 2012).

The private and public sectors made disaster recovery funding available to homeowners through insurance, direct aid, disbursements, tax breaks, tax credits, and subsidies (Kunreuther, 2011). National Flood Insurance Program (NFIP) provides flood insurance for residents and businesses (Kunreuther & Dinan, 2017). It is estimated that no more than 30% of residents had flood insurance in Louisiana (King, 2005), with the average NFIP homeowner receiving $US 100,000 per claim (Michel-Kerjan & Taglioni, 2017). Hurricane Katrina created numerous logistical and coverage challenges for insurers (Eaton & Treaster, 2007; Watson 2013), and exposed NFIP and private insurer financial debts, forcing many to declare insolvency (Linnerooth-Bayer & Mechler, 2009). NFIP processed over 95% of claims within nine months, yet many were unable to challenge or dispute claims settlements. Hurricane Katrina resulted in many new NFIP policy and claims management reforms (Linnerooth-Bayer & Mechler, 2009; OECD, 2015; US Government Accountability Office [GAO], 2006).

Additionally, in December 2005 the U.S. Congress appropriated $US 19.8 billion for the Community Development Block Grant Program (CDBG) to address the lack of flood insurance and housing recovery, with $US 13.4 billion allocated to Louisiana. The funding initiative established the Louisiana Homeowners Assistance Program (HAP) and the controversial Road Home Program (Road), as a conduit to provide assistance with homeowner repairs or buy-outs. Road grants were limited to $US 150,000 per application with three options: compensation for rebuilding and repairs, sell property and relocate within the state, or sell the property becoming a renter or move out of state (Louisiana Office of Community Development, Division of Administration [LCD], 2019).

3.2.1. Broadmoor

The community of Broadmoor located in New Orleans is examined as part of this case study because it was identified as one of the six districts in the controversial BNOB recovery plan facing forced relocation (Donze & Russell, 2006). Broadmoor flooded between five and eight feet from Hurricane Katrina with more than 90% of homes damaged from flooding. Broadmoor consists of 365 acres made up of mainly single and two family residential homes, and 12 acres of commercial land. In 2000, Broadmoor had approximately 2,915 occupied housing units with less than 10% vacancy (Broadmoor Improvement Association [BIA], 2006). Established in 1930, the Broadmoor Improvement Association (BIA) is the neighbourhood's association. Aided by BIA, Broadmoor residents challenged BNOB and built partnerships to transform their community (Amdal, 2012; BIA, 2006). In July 2006, BIA together with residents created the *Broadmoor Redevelopment Plan* (BRP). BRP addressed perceived housing recovery injustices by challenging the opposing redevelopment plans and by seeking ways to directly manage community recovery for residents by acting as an intermediary for government recovery systems (BIA, 2006). Harvard University has cited their efforts and initiatives as a model for post-disaster reconstruction planning (Ahlers, 2013).

At the time of the disaster, property tax assessments were organised among seven different districts and assessors, which was not based on a standardised system, nor did they reflect current market values. A 2006 ruling that was implemented in 2010, created one assessor in order to establish a uniform calculation amongst all districts using data from recent sales and current market values. This poses significant challenges in determining pre-disaster and post-disaster market values in Broadmoor. In this research, the Broadmoor residential market inventory calculation uses a sales comparison approach to determine the median housing price and housing index for insured and uninsured losses. Consequently, the dataset assumes the median home value solely for Broadmoor in 2005 to be $US 193,176 (cf. $US 228,620 for greater New Orleans), and the 2005 market value rate per square foot to be $US 95 (cf. $US 114 for greater New Orleans). It is assumed 80% of Broadmoor homeowners did not have any type of flood or disaster insurance for these calculations. Flood damage estimates available per property are calculated from the City of New Orleans Katrina damage assessment reports. Flood damages ranged from 4% to 100% of homes in Broadmoor, with the weighted average of 39% of current (2005) home values.

The initial Broadmoor housing database contained 2,335 properties comprised of single or multi-dwellings, and commercial buildings. This was adjusted to reflect properties designated in the Broadmoor boundaries as set forth by the City Planning Commission and Assessor of New Orleans Broadmoor boundaries. The Road Program states that 873 properties received compensation totalling $US 86,302,735 in Broadmoor. These figures were then compared to land records data obtained from the City of New Orleans and the BIA housing database applicable to Option 2 and 3. Data was not available to cross reference properties under Option 1. Between 2007 and 2015, a total of 36 properties (less than 2% of all properties) were identified as having received a Road buyout (Option 2 or 3) averaging $US 110,841 per household, and totalling $US 3,990,258. It is difficult to assess the Road settlements against published figures provided by Road without having more property details. Instead, the numbers provide insight into how long the application process took for those known (36) properties where a majority of the settlements occurred in 2007 (10) and 2008 (16). In interviews, residents discussed the cumbersome process of understanding the application and approval process. Estimated average household flood losses are $US 74,239 and average household NFIP insurance claims settlements were $US 92,549 for Broadmoor residents. Residents receiving Road home buy-outs in most cases had fewer overall net losses compared with those with NFIP insurance or uninsured losses.

4. Findings and results

The community long-term housing measurement is calculated using housing recovery scenarios (dynamic economic resilience) for the case study. Here detailed findings are provided for each scenario for Broadmoor.

4.1. Baseline scenarios

Two baseline scenarios are calculated. A *non-disaster scenario* with no reduced housing stock (2,026) assumes a normal housing market growth average (12% yearly average increase) using market values from the previous five years (Table 1), and then projects what the future market values would have been without having a disaster. The *post-disaster market values* are plotted from time of the event to the 10-year anniversary and reflect an average of two percent loss (10% yearly average increase) with at no time market prices reaching pre-disaster levels before the ten-year review (Figure 1). The scenario demonstrates how the slope (growth rate) of the post-disaster curve is lower than the *non-disaster* curve. For this scenario sales prices are not a valid indicator for measurement of recovery.

4.2. Reference recovery scenario

The *reference recovery scenario* (Figures 2 and 3) provides a snapshot of reduced community housing with actual post-disaster reconstruction values. To create these scenarios, actual permits issued by the City of New Orleans and official City damage assessment reports (Table 1) were used to construct the repair rates. The City permit analysis was filtered to include only those issued for repair damages directly caused by hurricane or flood damages. Permit types included electrical repair, emergency permits, general mechanical, new construction, structural and non-structural renovation and repair. Permits for demolitions and 'simple' work for reconnection of power were not considered for this analysis. In Figure 2, the cumulative ratio of the sum of these permits is plotted, versus time of issuance. Due to the lack of data reporting, the actual work completion dates of the permits remain unknown. However, it is reasonable to assume that repairs would have taken anywhere from several months to years for new construction. Hence, the real repair rate values would be slightly shifted to the right on the graph. Permit data was only available from the City through 2011, a time at which supported Broadmoor community recovery was reporting recovery rates of 84.5% (Wilke, 2010). It is evident from the individual yearly repair rates, that the years from 2005 to 2007, had the highest repair rates, followed by years of steady decline in repair rates.

Table 1. Scenario data sources.

Scenario	Types of Data and Sources
Baseline	Broadmoor Improvement Association housing database
	City of New Orleans Assessor
Reference recovery	Broadmoor Improvement Association housing database
	City of New Orleans Assessor
	City of New Orleans Hurricane Katrina damage assessment reports
	City of New Orleans permits
	Interviews with Broadmoor residents and those involved with the Hurricane Katrina recovery management in New Orleans
Dynamic economic resilience	Broadmoor Improvement Association housing database
	City of New Orleans Assessor
	City of New Orleans Hurricane Katrina damage assessment reports
	Road Home Program
	US Census Bureau building statistics
	FEMA Hurricane Katrina reconstruction/payouts reports
	Interviews with Broadmoor residents and those involved with the Hurricane Katrina recovery management in New Orleans

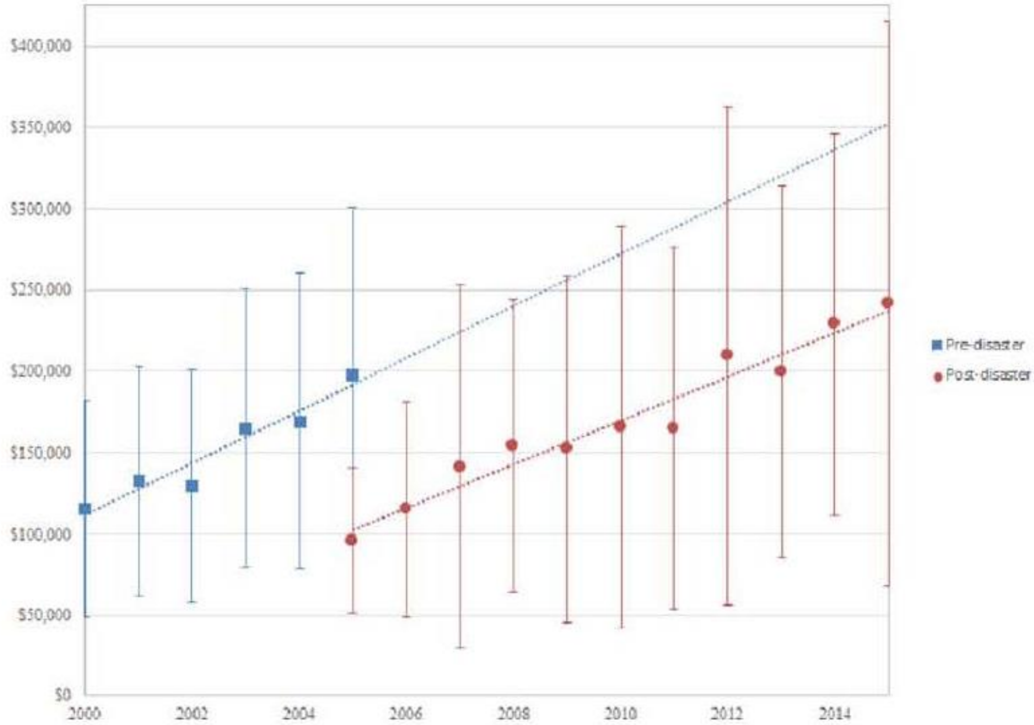

Figure 1. Broadmoor baseline scenario estimation of residential housing market values.

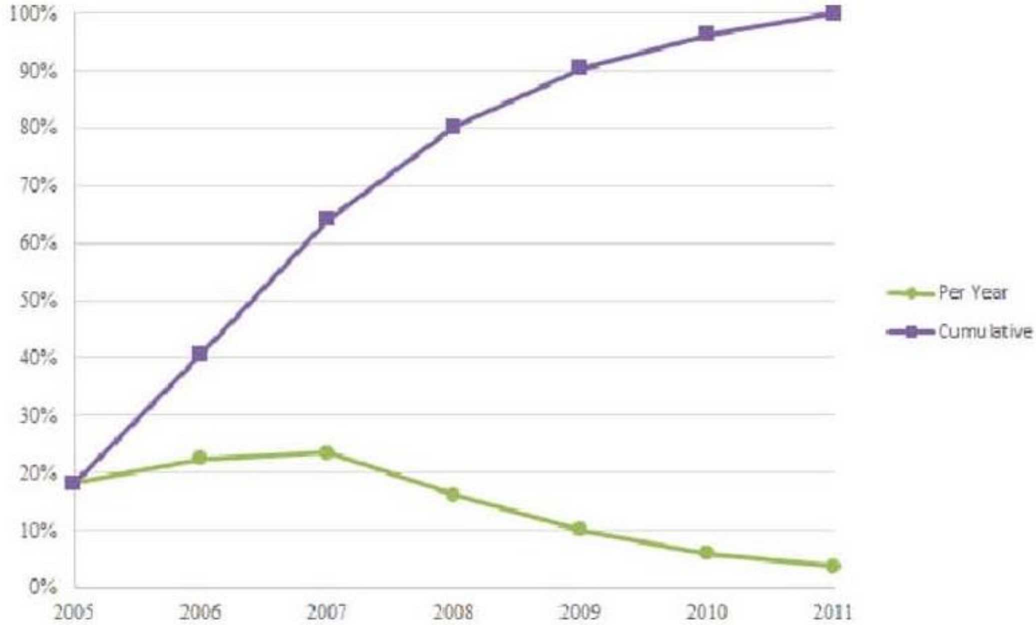

Figure 2. Broadmoor reference recovery scenario – repair rate based on number of permits issued for hurricane damage repairs.

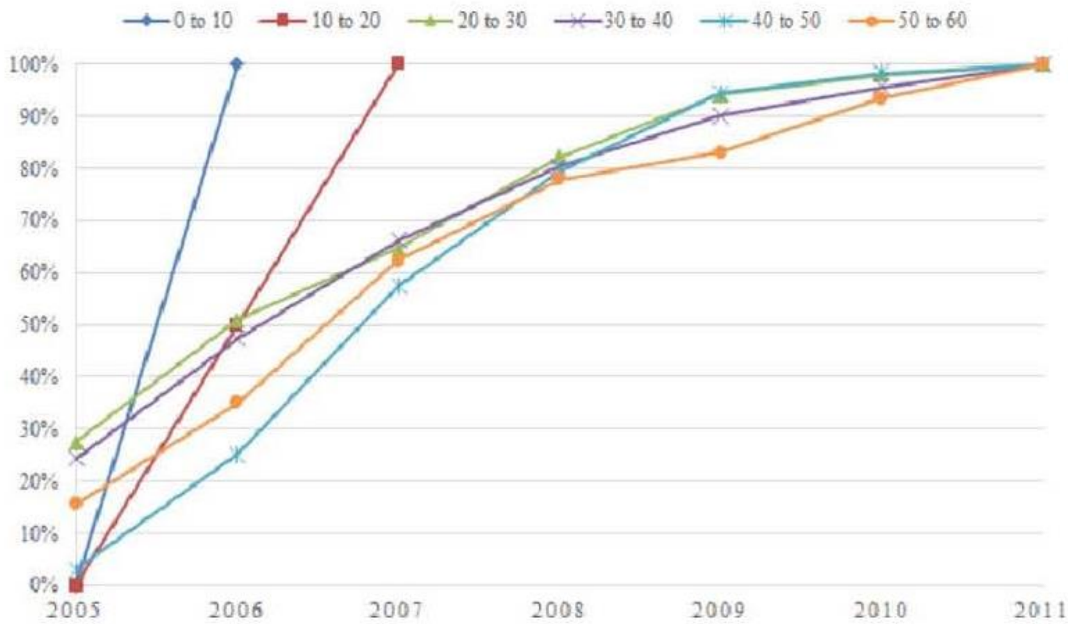

Figure 3. Broadmoor reference recovery scenarios – repair rate using city damage assessment correlated with housing rebuilding permits issued.

The data were additionally cross-referenced with City Hurricane Katrina damage assessment reports, and sorted into total percent damages for each property and then sorted by categories with intervals of 10% to provide a cumulative repair rate assessment by damage category (Figure 3). The results also feature the differences between those damages ranging from 0% to 10%, and those between 10% and 20% occurring in different time-scales compared with those damages ranging between 20% and 60%. In the latter case, the speed and level of repairs rate is far more spread out. The variations in slope indicate that especially in the early years of recovery, houses with damages between 40% and 60% have a lower rate of repair, in comparison to houses with lower amounts of damages. However, it is interesting to note that the long-term repair rate for damages between 20% and 60%, does not differ as much as one would expect. Here, factors other than the actual damage appears to be more decisive in influencing the recovery.

The assumed community housing repairs and reconstruction timeline pathway has a replacement value of 10% for damaged properties in Year 1, mainly due to the city and community recovery governance process. All remaining years are then aggregated against property damage loss values with the assumption that a majority of repairs are reached by 2009, and complete repairs (95% or more) are reached in 2010. These values help distinguish between normal and reconstruction investments. A physical housing assessment (Figure 4) was conducted at the ten-year anniversary to compare and contrast these results with Figures 2 and 3. Here we see that housing rebuilding was slightly above 90% but still contained a larger amount of vacant properties with no foreseeable new construction.

Broadmoor's governance process was largely managed through a grass-roots community-based approach, which gained momentum as residents mobilized to challenge and

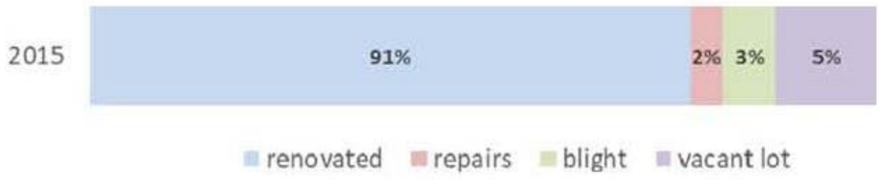

Figure 4. Broadmoor 2015 housing recovery assessment.

resist the initial city disaster housing recovery policies and planning. By taking this approach, Broadmoor was able to link directly to local, state and federal government processes, such filing paperwork for Road buy-out applications or getting permit approvals for demolitions, to assist households with direct rebuilding and relocation efforts. Frequent and regular internal assessments (surveys, interviews, and community meetings) within the first three years of the disaster aftermath provided immediate feedback where the most critical resources were needed, such as access to utilities, acquisition of entry to properties from the city government, and assistance filing relevant funding claims paperwork. Broadmoor continues to operate using this resident feedback system well after the 10-year anniversary in an effort to address overall community resilient recovery. The general New Orleans disaster and housing recovery process was largely confusing, unorganised or unstructured with competing institutions and policies overlapping, or undermining one another. This was further complicated by the lack of a transparent and accountable insurance claims process, adding further delays to the rebuilding process noted during interviews.

It took residents an average of three to four years to receive a Road buy-out. Insurance settlements amongst residents were not common, and often received less than what a Road buy-out provided for resettlement. Broadmoor residents expressed in interviews an overwhelming sentiment that there was a lack of trust and confidence in the disaster recovery processes (insurance, state or government funded schemes and recovery systems) to actually work. There was general disbelief over fair compensation whether it be with Road or insurance working in a corrupt system. This perspective echoed discussions held with Allianz Global Corporate & Specialty SE headquarters in Munich, where interview partners expressed similar frustrations which, it was said, contributed to the final decision to no longer have a carrier in the US providing homeowners with insurance products. This was mainly due to the mismanagement and mishandling of Katrina claims.

Aiming to rebuild their homes, Broadmoor residents sought alternative pathways, an action that can be seen as a sign of dynamic economic resilience. Once residents' realised that, due to BNOP, there would not be support from the local and federal governments to help rebuild their community, the community itself recognised they had a diverse set of skills and expertise that could come together and create their own community vision plan for rebuilding. This community vision plan was based on aligning themselves with partnerships, with what they could realistically accomplish, residents taking leadership roles and a process that reflected their true needs. Latoya Cantrell was the BIA President at the time of the initial post-disaster recovery and now serves as the City Mayor. Cantrell expressed how important it was to step up into strong leadership roles within the community of Broadmoor, otherwise they would have been left behind, ignored or worse lose their homes to city redevelopment plans. There were many battles residents had to face

Cantrell reflected at the 10-year anniversary. Yet, these struggles seemed rather invisible in light of their success ten years later. This included the tedious and political process of getting access permits to re-enter and rebuild homes, filing documents if you had insurance or finding access to funding sources, reconnecting with loved ones, the political debates over how to re-establish the public school systems, and the health and well-being issues related to the disaster trauma, that once again resurfaced at the ten-year city anniversary celebrations in the form of post-traumatic stress disorders. Then there was the problem of not knowing if Broadmoor would rise above and succeed in their campaign of building a more resilient Broadmoor.

4.3. Dynamic economic resilience scenario

Since we are dealing with an observable historical event, the *dynamic economic resilience scenario* (Figure 5) uses a combination of data (e.g. damage assessments and building permits) provided from the recovery aftermath, and a conceptualised approach to presume levels of housing investments (insurance and buy-outs) to calculate a *sustainability threshold*. The results of the Roads assessment verify that 37 properties, each with more than 60% damage according to the City damage assessment report, each received a buy-out. No new properties are included for the buy-out, but it is assumed residents received funding for Option 1 (funding for repairs or rebuilding) when their properties (approximately 1,900 properties) sustained 30% or more in total damages. The additional reconstruction investment funding provided by Roads, in addition to having faster insurance claims payments (on approximately 600 properties), along with the expansion of the demolition and building permit process are all factored in when determining a *new*

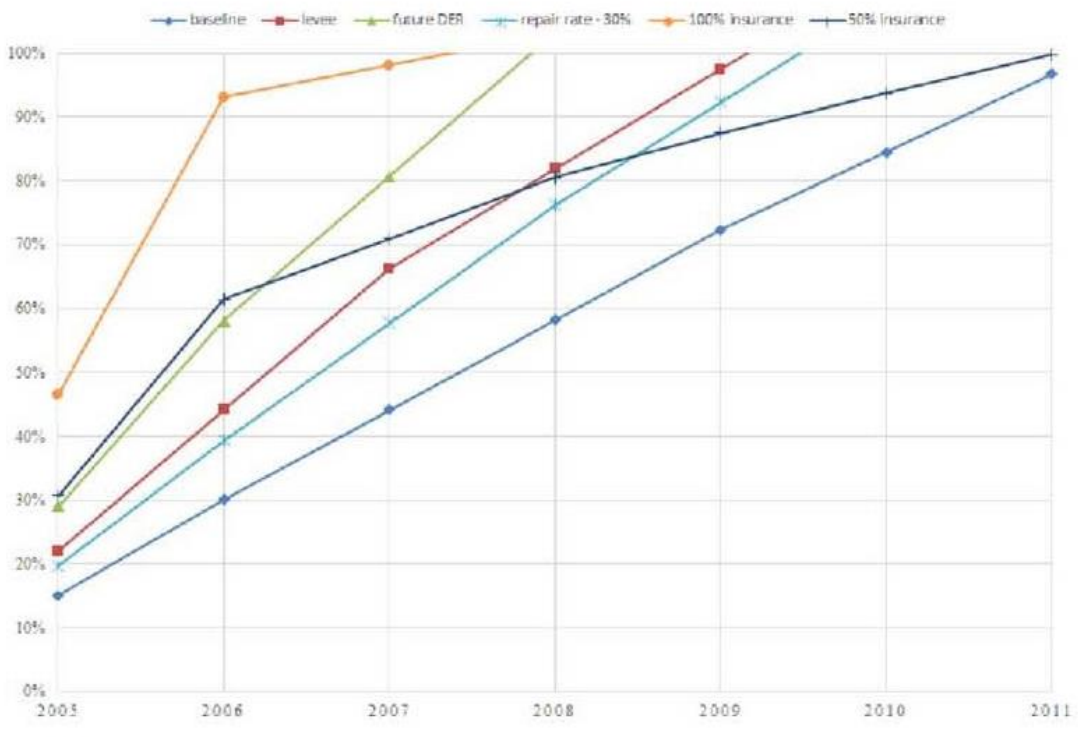

Figure 5. Broadmoor dynamic economic resilience scenario.

sustainable housing reconstruction. Typical new construction is considered to take anywhere from six to twelve months based on building statistics from the US Census Bureau (US Census, 2020). The scenario assumes the rate of rebuilding fluctuates between a six-month construction time period for those with 30% or less housing damages, and twelve months if greater than 30%. These assumptions are used to determine the total housing reconstruction time pathway.

The *repair rate scenario* (repair rate – 30%) assumes that no changes were made to financial reconstruction investments, but rather that the time-path or rate at which existing compensation was provided occurred 30% faster than evidenced from the reference recovery scenarios (Figures 2 and 3). Over time this reduces the length of the rebuilding process. Under the repair rate scenario, the reference recovery scenario long-term recovery housing threshold (84.5%) is reached two years earlier.

In consideration of additional or improved *financial reconstruction investments* (50% insurance), an increase in the total number of insured homes is considered and estimated at a 50% market penetration. This scenario models reflects prompt and efficient claims management processes for households to begin immediate repairs. This scenario demonstrates possible effects of having adequate systems in place to allow residents to begin the process of rebuilding, despite having possible building reconstruction resource constraints. It is assumed that with more rapid compensation, those with less than 30% in housing damages are able to have full repair within one year, and the remaining houses are repaired using an aggregate based on normal investment times and reconstruction in relation to total damages. The results show that the long-term recovery housing threshold is reached approximately in 2008.

The effects of having a fully insured community (based on the fact flood insurance being available in the market) is then considered (100% insurance scenario). In the *fully insured scenario,* the assumption is made of having the entire community insured with an efficient claims management system. This then indirectly influences the total repair rates aggregated amongst normal investment and reconstruction timelines. This scenario provides the fastest long-term housing recovery for Broadmoor of one year simply based on the fact that rapid investments would account for adequate distribution of resources.

In order to demonstrate the benefits of applying dynamic economic resilience scenarios into future planning and policy making, additional future dynamic economic resilience scenarios are presented. The *levee scenario* (Figure 5) applies a significant overhaul and investment into addressing the levee infrastructure for the City of New Orleans. This assumption is based on the recent findings from Munich Re on Hurricane Katrina disaster risk modelling (Kron, 2015). It was determined that the single most important contribution to hurricane and storm damage risk reduction measures after constructing 76 different kinds of hypothetical event simulations, was connected to city flood infrastructure improvements: higher and more resistant dykes and flood protection walls, along with efficient emergency pumps to drain water, thereby significantly reducing overall flood damages and risks to residents. These results provided a direct 90% reduction of total flood loses to residents for another 100-year flood event or 75% reduction of losses for a 500-year flood event (Kron, 2015). In addition to the infrastructure improvements, increases in Roads applications for Option 1 are assumed to be given for homeowners with more than 30% in total housing damages. By applying the levee and pump adaptations along with increased Road funding, the *future dynamic economic resilience scenario* (future DER) supports the reduced housing losses and overall reduction of risk for New Orleans as proposed by Munich Re. This scenario is also contrasted with the existing Baseline scenario to draw attention to the overall community housing resilience for Broadmoor. A *future dynamic economic resilience scenario* (future DER) estimates a hypothetical levee improvement investment, and a modified repair rate factor (similar to repair rate – 30%). Here we find substantial developments in identifying a new sustainability threshold for housing within a three-year recovery time frame.

The results from considering the *dynamic economic resilience scenario* provide an indication of how significant implementation of new policies and procedures, centred on a more efficient handling of applications for building permits, as well as financial claims for rebuilding or buy-outs, and a more effective management of constrained reconstruction resources for community rebuilding might be. This is especially important in the case of Broadmoor considering the role of BIA, and the Broadmoor Development Corporation (BDC), established by BIA, which provided technical and community resources to NORA and the Road program. Through this unique partnership, BDC was able to take receivership of homes and redevelop them to reinvest in the community, by providing new or rebuilt homes at affordable market values for homeowners. It is arguably one the single most important decisions made by the community and by the leadership of BIA. Actions under this framework contributed more than 80% of the community long-term housing recovery. However, due to limited access to funding for BDC they were not able to work faster to obtain more housing inventory, or manage a higher rebuilding rate to meet the actual long-term housing needs of the community as desired in interviews with BIA leadership. Broadmoor residents voiced the view that long-term housing recovery occurred at much slower time scales than expected from their knowledge of recovery policy and planning, or imagined by themselves. This led to recognition of a false sense of security and truth as they experienced their own personal reality of recovery resulting in new kinds of trauma for individual recovery.[1] When examining a future dynamic economic resilience scenario for Broadmoor, it was assumed that investments were being made to upgrade and maintain the levees to sustain a 100 or 500-year flood loss event. Additional corrections were also made to reconstruction investment funds to help identify that the *sustainable long-term recovery threshold* was approximately three years after the event. These results also supported the Munich Re disaster risk modelling studies to improve flood protection.

5. Discussion and conclusion

The case study examined the long-term community housing recovery of Broadmoor, highlighting the problems of disaster recovery governance and the challenging rebuilding process. Hurricane Katrina and its aftermath demonstrated the community's exposure to a complex set of interacting and interdependent factors unique to New Orleans. Hurricane Katrina's overall recovery efforts resulted in numerous reforms amongst federal, state and local government agencies in response to the immense media and political pressure which stimulated demands for better responses to natural disasters. The housing recovery scenarios allow us to place the housing rebuilding time-path into perspective. They help to reveal how rebuilding was influenced by governance systems, land-use regulations, and adaptation measures contributed from the physical attributes of disaster recovery management. The community systems embedded in the recovery process largely relate to the social systems and local resources adapted to define their implementation of local resilience measures. The *dynamic economic resilience scenario* allows us to assess differences between the dynamically resilient time-path, and the baseline and reference scenarios. In order to estimate the dynamic resilient time-path, additional housing funding (insurance payments or buy-outs), rapid financial compensation and investments in new technology (levee repairs and upgrades) are considered and assessed. This conceptualised approach allows us to compare the time-paths, and the contribution of dynamic economic resilience to accelerating initial stages of housing recovery, and shortening the overall housing rebuilding time-compression. Therefore, dynamic economic resilience depends on effective investments, not measured by the level of investment, but rather by the length and time-path recovery, or reductions in housing losses. This is especially important given that the majority of Broadmoor residents specified their housing damages were related to flood losses from the pump failures and physical breakdown of the city levees, and not the actual hurricane event itself.

This case demonstrates the role of measuring long-term housing is necessary to better understand the housing recovery processes in different market types combined with stakeholder perception data. The resilient recovery of a community, such as Broadmoor, cannot simply be read from the number of total houses repaired or rebuilt in a community: such figures do not accurately depict the community's ability to cope with the stresses in response to social, political and environmental changes. The data used in this analysis only goes as far to tell us how long the initial reconstruction phase would have been delayed or lasted, assuming funding and reconstruction sources needed for any major repairs being undertaken. The analysis reveals delays beyond what might be expected, and so supports the views, revealed in interviews, of residents, who, when asked about their own personal rebuilding experiences in Broadmoor, stated the actual post-disaster recovery process and undertaking of most major repairs was a long and tedious process, one that could not be facilitated without the support of the community coming together, and together with some major investment from a bank, insurance, government programme, or private fund.[1] Regardless of how the recovery financing was employed, the most significant factors appear to be the rate at which households were able to successfully apply for building permits combined with rapid access to adequate financial resources. These two aspects of access to rebuilding and financial resources are interconnected for the success of long-term community housing resilient recovery. Successive events or extreme events, such as the arrival of Hurricane Rita in New Orleans one month after Hurricane Katrina, place considerable additional burdens on complex institutional systems (local, state, national) that are often disruptive in a non-linear recovery process. The Broadmoor case also highlights that the speed of recovery was greatly influenced by adopting a community-based approach to managing local and regional resources. Given the lack of adequate financial resources available to reduce housing damage liabilities across households, the action of residents to manage resources collectively was the main factor influencing the apparent success of long-term housing recovery in the district. Hence, the use of *dynamic economic resilience scenario* analysis in this case study indicates that having (1) a local community agency providing assistance, (2) quick and efficient access to financial reconstruction funds, either from insurance, government funded buy-outs or rebuilding grants, and (3) appropriate and timely access to building permits for reconstruction, in combination, could facilitate more effective and resourceful management of disaster recovery and rebuilding in the future.

Notes

1. Personal Communication with Broadmoor residents, August–September 2015 and April–May 2018; New Orleans, United States.

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