

Analysis of the Impact of Fragmented Coordination During Natural Disaster Responses on
Access to Drinking Water Following Cyclone Idai - Beira Case Study

by
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Abstract

Globally, disasters affect every domain of human activity and cause devastating losses across the human, economic and environmental domains. While they are extremely difficult to predict and prevent, the global society is, in principle, more than capable of mitigating many of the most severe consequences. Worryingly, while the prevailing efforts often fall short future disaster impacts are likely to become even less effective because of several compounding factors.

Among the various novel perspectives that emerged to resolve the shortcomings of current disaster risk management efforts, a promising insight is offered by the lens of institutional vulnerability. This research provides a strong rationale for the recognition of institutional vulnerability as an insightful tool in addressing the most common areas of criticism around the existing DRM approaches. These findings are based on a case study analysis that centers around the 2019 Cyclone Idai and its impact on the City of Beira.

The research reveals that institutional vulnerability is both a factor in the progression of vulnerability, but also a key mitigating variable in the development of the disaster. By expanding the analysis of the progression of vulnerability to include institutional vulnerability, it is possible to create a more comprehensive account of how a disaster unfolds and recognize the key role that institutional vulnerability has in amplifying or mitigating the disasters.

Keywords: Disaster Risk Management, Institutional Vulnerability, Climate Change, Actor Fragmentation

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Dedication

This thesis is dedicated to all the people affected by Cyclone Idai.

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1. Introduction and Research Justification

1.1. Problem Statement

Globally, disasters affect every domain of human activity. While they are extremely difficult to predict and prevent, the global society is, in principle, more than capable of mitigating many of the most severe consequences. Within the academic literature, multiple pathways to disaster risk management have been offered and many more continue to become apparent:

- Applying public administration in emergency management (Urby & McEntire, 2014).
- Catastrophe risk models for evaluating disaster risk management investments (Michel-Kerjan et al., 2012).
- Approach of liabilities and capabilities (McEntire, 2011).
- Community-based disaster risk management (Tobin, 1999; Pearce, 2003; Maskrey, 2011; Scolobig, 2015;).
- Sustainable disaster recovery (Smith & Wenger, 2007).
- Integrating climate change adaptation, disaster risk management and urban planning (Birkmann & von Teichman, 2010; Rivera & Wamsler, 2014; Oleson et al., 2015; Kelman, 2017).
- Sustainable hazard mitigation (Rozdilsky, 2001; Shim & Kim, 2015).
- Financial instruments for disaster risk management and climate change adaptation (Linnerooth-Bayer & Hochrainer-Stigler, 2015).

Despite the multitude of approaches, issues around disaster risk management persist and from the practical perspective, very little is being done by way of mitigation. The scope of the problem is best described by Eriksen et al. (2017), who stated that: “Interventions remain more reactionary than visionary and have not included any long-term consultative process to formulate clear goals and objectives commensurate with ground realities. They do not address the need for broader social and economic reforms that might contribute to reducing longer-term vulnerability. As a result, they have different and sometimes conflicting priorities and response mechanisms” (p. 69).

Most efforts aimed at minimizing the damage done by disasters come in the form of post-disaster response rather than comprehensive Disaster Risk Management (DRM) planning. In the past, it has been shown that the bilateral and multilateral donors allocate 99% of their disaster management funds for relief and reconstruction and only 1% to reduce future loss exposure and vulnerability (Michel-Kerjan et al., 2012). Unfortunately, relief and reconstruction, albeit much needed, offer very little by way of risk reduction and mitigation of potential future disasters (Tobin, 1999; Rozdilsky, 2001; Folke, 2006; Birkmann & von Teichman, 2010; Michel-Kerjan et al., 2012; Birkmann, 2014). This means that many of our communities are poorly, if at all, equipped to withstand the effects of disaster events. Band aid solutions persist and fail to prepare vulnerable communities for future disasters (Rivera & Wamsler, 2014; Schipper et al., 2016; Filho et al., 2019).

The global push for infrastructure development makes this problem worse. Current developmental paths undertaken by nations across the globe place little, if any, emphasis on disaster risk management measures (Shim & Kim, 2015; Uitto & Shaw, 2016). Rather, much of the global development is done in a way that further exposes the communities it seeks to serve to disaster hazards. This is because development often fails to consider the long-term impacts on disaster susceptibility, community and ecosystem resilience, macroeconomic fallout, and an array of ancillary consequences (McEntire, 2004; Folke, 2006; Smith & Wenger, 2007; Greve, 2016). As such, disaster risk management continues to receive little adequate systemic consideration which leads to ever more dangerous and costly outcomes of disaster events.

The prevailing efforts prove lacking at best in the current environment, but as this review will outline, they are likely to become even less effective because of several compounding factors. Those variables will make disasters more persistent, severe, costly, and difficult to manage in the

ensuing decades. Climate change, population growth, urbanization, availability of financial resources and governance issues can amplify the vulnerabilities present across communities around the world and undermine their resilience capacity. They are the result of human progress, increasing globalization, development and many other factors which define our modern-day world. As a result, they are likely to persist in the ensuing decades. These trends amplify the deficiencies in disaster response present under the current post-disaster response paradigm. This is very problematic as it can mean that disasters become even more destructive and unpredictable.

1.2. Literature Boundaries and Research Gap

1.2.1. Failure of Existing DRM Approaches

There is a growing recognition in the DRM literature on the failures of many of the existing approaches. Perhaps Ghosh & Boyd (2019) are most direct in their description of this problem, stating that “existing approaches are failing spectacularly to enhance resilience of communities, address disaster frequency and mitigate loss and damages” (p. 101236).

Much of the current research in this area supports this conclusion. Literature in the areas of disaster risk, adaptation and mitigation indicates that the present disaster response paradigm suffers from a variety of weaknesses. Those include: lack of systems thinking when approaching the problem (McEntire, 2004; Folke, 2006; Smith & Wenger, 2007; Greve, 2016), failure to place more emphasis on multi-level governance approaches (Shim & Kim, 2015; Pearce, 2003; Uitto & Shaw, 2016), lack of focus on risk reduction and long term perspectives (Birkmann, 2014; Rozdilsky, 2001; Michel-Kerjan et al., 2012; Folke, 2006; Tobin, 1999; Birkmann & von Teichman, 2010), shortsightedness (McEntire, Crocker & Eklong, 2010; Mileti & Gailus, 2005), lack of adequate regulatory, operational and planning instruments (Rivera & Wamsler, 2014; Schipper et al., 2016; Filho et al., 2019).

1.2.2. New Research Frontier - Institutional Vulnerability

In general, vulnerability research has predominantly consisted of four main aspects: social, physical, economic, and environmental (Diaz-Sarachage & Jato-Espino, 2019). While governance plays a tangential role in each of these lenses for analysis, “most assessments do not sufficiently capture issues of governance as core aspects in their assessment” (Diaz-Sarachage & Jato-Espino, 2019, p. 442). It is for this reason that, “treating institutional issues as an own vulnerability dimension might help to improve assessment methods for actually assessing different qualities of governance and their impact on the vulnerability of people or socio-ecological systems” (Birkmann, 2013, p. 31).

Yet, despite the efforts of Birkmann and other scholars in the field of vulnerability research and DRM research, “institutional vulnerability to natural hazards has not been thoroughly investigated until now” (Papathoma-Kohle, Thaler & Fuchs, 2021, p. 044056). Diaz-Sarachage & Jato-Espino (2019) conducted a study of 72 vulnerability assessment frameworks published between 1998 - 2018 and found the institutional lens was mentioned in only 7 of the publications. This indicates that historically the institutional lens has hardly been considered in analyzing the role institutional vulnerability plays in impacting to abilities of governance institutions to provide an effective disaster response. This scarce analysis of the institutional lens has hampered our shared ability to better understand and prepare for disaster events. However, the authors also found that the largest number of references to vulnerability assessment frameworks in DRM literature were published in the 10 years between 2010-2020, with 32 of them being published between 2016-2020. In addition, all the references to the institutional vulnerability lens were published in the 10 years between 2010-2020. This illustrates that while historically the vulnerability lens has not received much attention in DRM literature, more recently, there has been a significant uptick in

the research in this area. This is not to say that institutional vulnerability research has not been advancing. Rather, it is a new and rapidly developing field of research and analysis that has received prominence in the fields of vulnerability and DRM research.

1.2.3. Research Gap

While theoretical analysis of institutional vulnerability as a lens for improving our approach to disaster risk management continues to build credibility and receive attention, to date, limited applied research has been undertaken to explore the relevance of considering the institutional vulnerability dimension in assessing the disaster risk management efforts, especially from the perspective of secondary cities.

From the close analysis of the literature on institutional vulnerability, it appears that the lack of context-specific analysis of institutional vulnerability is the most notable literature gap in this new and rapidly developing field of research and analysis.

The theoretical analysis of institutional vulnerability as a lens for improving our approach to disaster risk management provides a strong rationale for the recognition of institutional vulnerability as an insightful tool in addressing the most common areas of criticism around the existing DRM approach. However, while theoretical analysis provides a strong foundation for this approach, additional research is needed to further advance the knowledge in this field and help produce recommendations that might one day lead to more comprehensive disaster risk management frameworks.

It is for this reason that the central focus of this dissertation is to conduct applied research that looks at the relevance of considering the institutional vulnerability dimension in assessing the disaster risk management efforts through a specific case study. It is the belief of the researcher that

this would serve as the natural next step to help bridge this research gap and add to the growing body of knowledge around institutional vulnerability.

1.3. Research Aims and Objectives

1.3.1. Research Problem

This research looks at how institutional vulnerability impacts disaster response and amplifies the disruptions in essential services following disaster events. Within the umbrella of institutional vulnerability exist various concepts and themes. Among them, one has been chosen to illustrate the applicability of the broader insight of institutional vulnerability research. For the purpose of this research, actor fragmentation has been chosen as the lens of investigating the applicability of institutional vulnerability in disaster risk management research. The term refers to “the lack of coordination, collaboration integration, poor communication, and diversity of specializations of contractual partners and various functional disciplines” (Alashwal & Hamzah, 2014, p.5). Actor fragmentation is an exemplar concept to investigate the broader field of institutional vulnerability as it allows the researcher to explore how the interactions between actors involved in disaster response planning impact the disaster outcomes. With this in mind, the research problem that is at the center of this dissertation is to investigate how fragmentation among institutional actors involved in disaster response amplifies the disruptions in essential services following disaster events.

Additionally, a disaster setting has been identified to provide context-specific analysis of the theoretical insight offered by the institutional vulnerability lens. The setting selected for this purpose is the City of Beira, Mozambique. This setting has been selected for several reasons. Firstly, on March 14th, 2019, Beira experienced a disaster, that had and continues to have a lasting impact on the community, in the form of Cyclone Idai. Additionally, Beira is a secondary, coastal

city and can serve as a comparable context to many other secondary coastal cities. Beira's feature as a coastal secondary city is of particular importance given the climate-compounded risk that cities and settlements of this specification are likely to face in the ensuing decades. Furthermore, Beira has historically struggled with disasters and relies on a variety of disaster risk management frameworks in the development of their DRM plans.

1.3.2. Central Research Question

Everything considered, the complete research question that guides the ensuing analysis is:

How does fragmented coordination among institutional actors involved in disaster response impact access to drinking water following disasters?

Provided that the ensuing analysis will largely follow the format of a case study analysis, the research question has been modified to better reflect the case study context and has been rephrased as:

How does fragmented coordination among institutional actors involved in disaster response impact access to drinking water following Cyclone Idai?

1.3.3. Sub-Research Questions

- 1) What was the impact of Cyclone Idai on the access to drinking water for residents of Beira?
- 2) Who were the institutional actors responsible for maintaining freshwater access following the disaster? Are the relationships among those actors fragmented?
- 3) How does this fragmentation impact the extent of the disruption in freshwater access following Cyclone Idai?

1.3.4. Hypothesis

Considering the literature surrounding the subject matter considered prior to arriving at the research question, the hypothesis given the research question stated is:

The disruption in access to drinking water following Cyclone Idai was amplified by a fragmented coordination among actors involved in disaster risk management planning.

Operationalization

Cyclone Idai - focus on the impact in Beira, reference to secondary cities, parallel can be drawn across secondary cities in the developing world.

Amplified - the achieved response significantly departs from what could be expected if coordination among actors was not fragmented.

Actors involved - organizations, groups, ministries both formal and informal whose efforts all form a part of the disaster risk management effort.

Disaster response- process by which institutional actors come together to form a plan of action that seeks to reduce the risks of potential disaster events.

1.3.5 Research Objectives

To support the thesis, a set of research objectives has been identified to address each sub-research question and shape how they are addressed in the subsequent data analysis. Those research objectives are:

- Trace the extent, magnitude and characteristics related to the disruption in access to fresh water following Cyclone Idai.
- Identify the network of actors involved in disaster response associated with drinking water access following Cyclone Idai.

- Evaluate whether the network of actors involved in disaster response associated with drinking water is fragmented. Discuss how this fragmentation amplified the disruption in water access following Cyclone Idai.

2. Literature Overview

2.1 Prevalence of Disaster Around the World

In 2019, the same year as Cyclone Idai struck Mozambique, it is estimated that world-wide disasters resulted in over 9,000 deaths and over \$150 billion dollars worth of damages. Within the financial costs, only \$52 billion dollars worth of damages was insurable while the rest had to be covered by governments, NGOs and private citizens (Insurance Information Institute [III], 2020). The deadliest event was Cyclone Idai which struck Mozambique, Malawi, Zimbabwe and South Africa in March and resulted in over 1,000 deaths (III, 2020). Financially, the costliest events were Typhoon Hagibis, (\$10 billion in insured losses), Typhoon Faxai (\$7 billion in insured losses) and Hurricane Dorian (\$4 billion in insured losses) (III, 2020). In terms of environmental damages, the Australian fires are likely to bear the gravest consequences. Over 18 million hectares of forests have burned, destroying over 5,900 buildings including over 2,800 homes. An estimated billion animals, and many more bats and insects, are likely to die as a result of lost habitat and food sources (UNEP, 2020).

Yet despite these tremendous damages, 2019 is by no means the costliest year. In fact, it is one of the rare years in the last few decades where a large-scale disaster did not take place. Since the beginning of the 21st century, the world has experienced several truly cataclysmic occurrences. In 2004, the Indian Ocean Earthquake and Tsunami killed more people than any other tsunami in recorded history accounting for 227,898 dead or missing in 14 countries across the Indian Ocean. The total estimated material losses in the Indian Ocean region were \$10 billion and insured losses were \$2 billion (World Vision, 2018b). In 2008, Cyclone Nargis made landfall in Myanmar and resulted in over 138,000 fatalities (Fritz et al., 2009). Over 2.4 million people and 50 townships were affected. Many of the low-lying villages were impacted and the Delta

region, a crucial agricultural area, was severely damaged (Lateef, 2009). The Haiti earthquake which struck in 2010 resulted in between 200,000-250,000 people dead or missing and cost an estimated US\$13.9 billion (Cavallo, Powell & Becerra, 2010).

One year following that, the Japan earthquake and tsunami flooded more than 200 square miles of coastal land. In the aftermath, an estimated 20,000 people were dead or missing and close to 500,000 people were forced to evacuate. It was also the costliest disaster to date, with the economic loss estimated at \$360 billion (World Vision, 2018a). The second costliest disaster in terms of economic impact was Hurricane Katrina. It came in 2005 and its economic impact was about \$250 billion (World Vision, 2018a).

2.2. Amplifying Disaster Risk

2.2.1. Growing Global Population

The world population has been growing at an unprecedented pace over the past century and continues along the same trajectory. In 1970, the global population was just under 4 billion (OECD, 2012). In 2022, the global population reached just under 8 billion people (United States Census, 2022). While, in 2050, it is expected to reach almost 9.2 billion (OECD, 2012). This means that in little over 50 years the world population has doubled. In addition, a further 1.2 billion extra humans are expected in the following 30 years.

We are already close to exceeding earth's carrying capacity. Among the various studies estimating this capacity, the UNEP Global Environmental Alert Service (2012) finds that most of the projections estimate the Earth's carrying capacity at about 8 billion. Although the estimates range from 2 billion - 1,024 billion, most estimates fall under the 8 billion range. This would

indicate that a population of above 8 billion is likely to require more resources to sustain than Earth is able to provide us with.

The most resilient communities can perhaps withstand the disruption of ecosystem services. This can be done through innovation, strict policies, investment in certain sectors, enabling legislation, and many other approaches. However, not all communities have this capacity. Unfortunately, those that are the least able to respond effectively to the threat of a growing population and the ensuing disruption of key ecosystem services, are also those most susceptible to it. Additionally, those communities are also the most likely to experience population growth.

According to the OECD Report on the Environmental Outlook to 2050 (2012), population growth rates are going to be rather low in OECD countries. This group is composed of high-income economies, with a high Human Development Index (HDI). They are also commonly referred to as developed nations. Among the OECD countries, the average population growth is expected to be 0.2% per year between 2010 - 2050 (OECD, 2012). Among the BRIICS countries (Brazil, Russia, India, Indonesia, China and South Africa), growth in the same period is expected to be around 0.4% per year. This represents a slowing of population growth in the most industrialized economies, compared to recent historical averages. Conversely, the growth in non-BRIICS or developing countries is projected to reach around 1.3% per year in the period between 2010 - 2050.

The non-BRIIC or developing countries are home to the most vulnerable populations. This expected growth is very likely to make matters worse for them. In the context of disaster response and mitigation, rapid population growth is a grave hazard. When discussing the vulnerabilities shared by many of the developing nations, several trends exist. Those

communities often have deficient infrastructure and poor urban planning. They are often associated with inadequate governance and scattered communication channels. Oftentimes, communities develop in a haphazard way that makes them vulnerable to disaster events. If those types of communities experience a population growth, many of the already existing concerns become amplified and further deteriorate whatever resilience capacity exists.

2.2.2. Urbanization

Global population growth is not the only concerning aspect of the shifting human demographic. Another key feature is the massive migration of populations into cities. This trend is more commonly known as urbanization. Urbanization entails a shift in population distribution between cities and rural areas. In recent decades, more and more people have decided to move into the cities and abandon the rural settlements. The world population is becoming increasingly urbanized.

As recently as 1970, roughly 36% of the world population lived in urban areas. By 2009, 50% of the world population lived in urban areas. This trend is expected to continue. The OECD predicts that by 2050 this shift is likely to reach 70% (OECD, 2012). Naturally, this population shift will not be equally distributed across the globe. In OECD countries, the share of the population is estimated to reach 86% by 2050 (OECD, 2012). This would mean that a smaller percentage of the population will live in urban areas in the developing world. Nonetheless, it will still be in the range of over 50%. Even at 50%, this shift represents a significant increase from its present-day levels. It also, presents several challenges in the governance of and management of urban areas in the poorest metropolitan areas around the globe.

As mentioned previously, population growth at large can increase regional vulnerabilities and lead to more risk of disasters. Concentrating this increasing population in and around urban centers only serves to amplify those vulnerabilities.

Urban centers can be problematic in terms of disaster risk. This is mainly because they concentrate populations, economic activity, assets and political power (Birkmann et al., 2016). Cities are home to valuable infrastructure and a significant share of the world's poor (Hallegatte & Corfee-Morlot, 2011). Many of them are also located in highly vulnerable areas, especially along coastlines. Unplanned development often overwhelms local administrative capacities, and the most disaster-prone settlements develop in the most disaster-prone areas (Birkmann et al., 2016). As a result of this, cities become increasingly vulnerable to global and regional effects of climate change (Wilbanks et al. 2007). This is true especially where cities expand without sufficient attention being given to the link between urban planning and risk (Rivera & Wamsler, 2014). This lack of systemic thinking about potential risks in urban development, compounded by increasing risks associated with climate change increases the potential for disaster.

Urbanization also has an aggravating effect on the effects of climate change. Filo et al. (2019) indicate that urbanization aggravates, “incidences of heat waves, drought, storms, erratic precipitation, strong winds, tropical and mid-latitude cyclones, among others” (p. 1776). This is due to a variety of reasons. For one, cities concentrate polluting activities in small areas. Urban settings are dense environments which create concentrated, air, water and solid pollutants. These pollutants are not easily dispersed into the environment due to high local concentration levels. As a result, additional land needs to be developed in order to manage and dispose of them. Alternatively, they end up being released into the atmosphere in dangerous concentrations.

Albeit, management is the far superior option, both result in further environmental damage, disruption of ecosystem services and increased vulnerability.

Cities are also composed of a mostly built environment. This type of setting has different properties when being distressed by a natural event. Built environments lack many of the negative feedback loops which keep natural ecosystems in a state of equilibrium. As a result, cities can, and often do, aggravate disaster events. This aggravation of these already damaging phenomena leads to an amplification of the disaster event itself. It also has the effect of increasing vulnerability. Filo et al. (2019) add that these weather events affect cities though, “sea-level rise, storm surges, scarcity of water, landslides, air pollution and inland and coastal flooding” (Filho et al., 2019, p. 1776). However, the degree of damage will vary. In cases where rapid urbanization is not accompanied by economic growth and development, these effects are felt the most (Garschagen & Romero-Lankao, 2013). The most troubling reality is that many of the rapidly expanding urban settings find themselves in this exact predicament.

2.2.3. Climate Change

The growing threat of climate change is expected to amplify the destruction caused by the disaster events. Climate change has and will pose a “global systemic risk to society” (OECD, 2012, p. 72). It does so primarily by expanding the risks and uncertainty associated with extreme climate events (Uitto & Shaw, 2016) and compounding the factors that “increase severity and frequency of triggering events” (Greve, 2016, p. 13).

Climate change is not just adding to uncertainty (Kyte, 2012). It acts as an amplifier of existing vulnerabilities. Countries are already struggling to navigate the complex web of food, water and energy security. The effects of climate change are only worsening these crises. The lack of direct effects and scattered distribution of impact all lead to a misapprehension of the

problem of climate change. Yet a more concerning factor is slowly emerging. The climate is a very complex and dynamic mechanism. It takes a magnanimous force to disrupt it and once in play, it is likely to persist for a long time. Such is the case with climate change. The continued release of greenhouse gasses has already led to severe changes in our atmospheric makeup and climate patterns. Not only is this process difficult to reverse, but it is also likely to propagate itself. It will do so through the continued release of carbon emissions as well as a spectrum of positive feedback loops that are already in play. In its entirety, this is going to pose a very difficult problem in terms of disaster preparedness.

2.2.4. Disaster Outlook

Disasters pose grave threats to infrastructure, institutions, communities and ecosystems across the globe. The impacts of disasters in terms of human lives lost, economic damages and ecosystem degradation have been steadily rising. Several factors contribute to this amplification of disaster risk. The most prominent among them include increasing population, urbanization (and development) as well as the changing climate. Many efforts are underway to reduce and mitigate the damages cause by disasters and create interventions that would moderate the impact of the abovementioned amplifying factors.

We have come to rely on our institutions to develop and implement strategies that can help us reduce and mitigate the threats posed by disasters. Unfortunately, these strategies are often not sufficient to address the growing range, intensity and frequency of disaster events. Having expanded on the definition of disaster risk beyond the lone consideration of the disaster event, there is now a growing recognition of the vulnerabilities that expose systems and communities to disaster risk. Among the different dimensions of vulnerability, institutional vulnerability (institutional capacity) focuses on the role of governance and institutional actors in

the disaster risk management setting. In doing so, this perspective can serve as a baseline for understanding how to best address the governance aspect of disaster risk management.

2.3. Disaster Risk

2.3.1. Basic Elements

When talking about the possibility of disasters, researchers often speak of disaster risk. In simple terms, it refers to a potential loss of life, injury, and destroyed or damaged assets that results from a disaster event. In general, disaster events can be naturally occurring phenomena, human-caused or human-amplified. However, for the purpose of this dissertation, the focus is on naturally occurring disaster events.

2.3.2. Evolution Over Time

In its early iterations, the focus of disaster risk analysis was largely centered around the hazard event. Throughout much of our history, disasters were seen as either the unavoidable processes of nature or acts of divine intervention. In fact, the dominant perspective on disasters up until the 1980s considered disasters as the result of extreme variance in geophysical processes (McEntrie, 2004). Over time, the definition took on a dualistic nature which expanded the concept of disaster risk beyond the hazard event, to include a second part in the form of an analysis of how the features of the system exposed interact with it (Depietri, 2020).

This dualistic nature has been expressed differently by various academics throughout time. Consideration of the hazard event (also referred to as: natural hazard sphere, physical event or hazard's features) remains a key consideration. However, several different variables have been employed to explore the other dimensions of disaster risk. In discussing those features, Davidson (1997) refers to 'exposure, vulnerability, capacity and measures'. Olivier-Smith (1999) addresses

the ‘vulnerability of the system itself’; while Wisner et al. (2004) focus on the ‘social sphere of vulnerability’.

Even earlier attempts at the expansion of the concept came from Marx and Weber. In line with the core tenets of their socialist ideology, they broadened the view of disasters to include an analysis of how socio-economic status determines disaster susceptibility. In their view, poverty has a causal relationship with disaster. Efforts at dealing with disaster must, by necessity, be aimed at the reduction of poverty. The link between poverty and disasters continued to be developed by the likes of Watts and Bohle (1993), Bohle (2001, 2002a, 2002b). With an added nuance of the historical perspective, these authors stress how configurations of poverty, hunger and famine define the space of vulnerability.

More recent research has taken on a broader outlook, one that integrates much of the previous research, when discussing the variable dimensions of disaster risk. Birkmann’s (2013) work has become a core reference point in this domain. In his view, the key dimensions of disaster risks concern the vulnerability of society, infrastructure, economy, environment and governance systems. Further work by Barredo et al. (2012), Perez et al. (2015), Lopez-Martinez et al. (2017) coalesces around this framework and identifies vulnerability as a key aspect of disaster risk. In this way, disaster risk has come to be understood as a result of the interaction between a hazard event and the vulnerability of the system exposed (Liverman, 1990; Dow, 1992; Smith, 1992; Cutter, 1993; Bohle et al., 1994; Birkmann, 2006; Cardona, 2007; McEntire et al., 2010).

2.3.3. Focus on Vulnerability

Interestingly, there is a difference in approach and understanding, depending on whether the emphasis is placed on the vulnerability aspect or the hazard aspect, which leads to different

types of interventions. A hazard-focused disaster risk management strategy focuses on disaster avoidance and various forms of structural protection. Whereas a vulnerability focused approach is often more associated with the social and other determinants of vulnerability and how best to address them (Eriksen et al., 2017).

As of late, the predominant approach taken by the disaster risk management community has been centered around vulnerability (Tobin, 1999; Alexander, 2006; Cannon, 2008). In this new paradigm, disaster risk management is becoming a lot more concerned with the human sphere and less so with the natural sphere. A key aspect of this shift is the increasing understanding that while our capacity to affect the natural sphere is limited, there is unrealized potential in mitigating disasters through the management of the vulnerabilities in the human sphere. As such, considerable attention has been given to the field of vulnerability in disaster risk management.

2.4. Vulnerability Research

2.4.1. Main Features and Key Concepts

Broadly speaking, vulnerability is a complex and multifaceted concept that is often socially defined (Birkmann, 2013; Maskrey, 1993). As such, it is also scale-dependent, dynamic and subjective (Vogel & O'Brien, 2004; Fuchs, 2009; Birkmann, 2013; Lopez-Martinez, 2017). In short, vulnerability varies across settings and contexts. Ciurean et al (2013) denote some of those characteristics to include: “hazard types, due process characteristics, generation mode, rate of onset, intensity, area affected, temporal persistence in the environment and type of element at risk” (Ciurean et al., 2013, p. 12).

As a concept, vulnerability has received a lot of attention in the academic literature. However, more practical approaches, in the form of vulnerability measurement frameworks, have also been employed and redeveloped. Some of these vulnerability measurement frameworks include Wisner's Pressure and Release Model (PAR) (Wisner, 2004), Holistic Approach to Vulnerability (Carreno et al., 2007), The MOVE Framework (Birkmann, 2013), PEARL Vulnerability Assessment Framework (Sorg et al, 2018) or The IRGC (Inclusive Risk Governance Council) Framework (Schweizer & Renn, 2020). A core concept present in the preamble of those and many other vulnerability measurement frameworks is the evasiveness of the concept of vulnerability to measurement. Authors often stress concepts such as 'flexible methodologies' (Sorg et al., 2018), 'comprehensive and multidisciplinary perspective' (Carreno et al., 2007) and 'inclusive, interdisciplinary, transdisciplinary, adaptable and problem-oriented approaches' (Schweizer & Renn, 2020) among others, all in an effort to account for the multivariate nature of the concept. Importantly, while many recognize that it is difficult to define and measure vulnerability (Adger, 2006; Birkmann, 2006; Sorg et al., 2018), identifying, assessing and reducing vulnerability is seen as a key step towards disaster risk management, climate change adaptation and resilience building (Birkmann, 2013, p. 10; IPCC, 2012). This complexity is uniquely encapsulated by Birkmann (2006) who denotes that "we are dealing with a paradox: we aim to measure vulnerability, yet we cannot define it precisely".

2.4.2. Operational Definition

Having settled the multiplicity of understandings that concern the concept of vulnerability, it is now possible to arrive at a workable definition. In its most broad iteration, vulnerability refers to the capacity of society to deal with hazard (IPCC, 2012). Seen through a more focused lens, UNDEP defines vulnerability as "a human condition or process resulting

from physical, social, economic and environmental factors, which determine the likelihood and scale of damage from the impact of a given hazard” (UNDP, 2014).

To elaborate further, the concept of vulnerability stresses “the fundamental importance of examining the preconditions and context of societies and communities and elements at risk to effectively promote risk reduction and climate change adaptation” (Birkmann, 2013, p. 10). Two essential elements are highlighted by this definition: preconditions and context. Perhaps, the most ingenious insight offered by Birkmann (2013) is the stress placed on these two variables. This is because they highlight the variance in how vulnerability is experienced while creating room for human agency to enact meaningful change. It is through this understanding that the vulnerability perspective, as it has come to be understood, perceives the losses experienced by a system as, “mostly avoidable and contingent upon the ability of a system to adapt to potential hazards (Depietri, 2020, p. 589).

2.4.3. Resilience

A commonly identified strategy used to reduce vulnerability is resilience. Resilience is understood to be a key feature in withstanding disasters. It has also been identified as a key in setting up the policies and plans necessary. Several definitions have emerged over the past few decades. The most commonly referred to description was proposed by Holling (1973). He described resilience as “measure of persistence of systems and their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables” (Holling, 1973, p. 14). In other words, it means to “spring back from disturbances” (Shim & Kim, 2015, p. 14155). The core of the term’s definition has coalesced around this framework. However, some additions and slight alterations have been proposed. For example, Folke (2006) expanded the definition to include additional aspects of resilience. He recognized other important

aspects of resilience as - capacity for renewal, re-organization and development. Beyond that, Folke (2006) also noted that resilience recognizes opportunities that disturbances open up. Those opportunities create a potential to reconfigure the structures and processes that currently exist.

Importantly, resilience emphasizes that rather than just reacting to change, we should learn to embrace, adopt and utilize changes in how we reorganize and optimize our society. There is a cyclical linkage between the human, natural and built environment. Each time a disturbance occurs, it offers us a chance to review these relationships and see where improvements are needed. While it is often impossible to return to a prior state, it is also impractical. Disasters often expose our vulnerabilities. Those need to be analyzed and proper systems implemented in order to avoid similar outcomes in the future.

The work on resilience further emphasizes the needs to implement the transformative change framework in future disaster mitigation planning. Currently, disaster planners are too focused on trying to restore the system back to its pre-disaster conditions (Birkmann & von Teichman, 2010). As the research suggests, reestablishing the pre-disaster structure is not only physically unworkable, it is also theoretically discouraged.

2.4.4. Institutional Vulnerability

Definition

As the preconditions and contexts which define the space of vulnerability are considered, they often come to be viewed through specific lenses. This allows us to conceptualize and track certain key variables from a specific perspective. Albeit not exhaustive, a commonly acknowledged list of these vulnerability lenses includes social, economic, institutional, cultural

and historical dimensions. Focusing in on a specific aspect of vulnerability allows for a more nuanced exploration of the concept and can yield better answers and frameworks.

It has been previously noted that we have come to rely on our institutions to develop and implement strategies that can help us reduce and mitigate the threats posed by disasters. As such, we often deal with vulnerability through governance. Complex interactions between our institutions, institutional actors, regulatory frameworks, codes of conduct and an array of other governance mechanisms as well as actors, all factor into the governance aspect of vulnerability.

There is some debate whether the institutional dimension of vulnerability should be framed as a separate dimension. This is largely because issues of governance span across all the other dimensions of vulnerability and, “institutional vulnerability is strongly connected to all other vulnerability dimensions, and specific socio-economic and physical indicators” (Papathoma-Kohle, Thaler & Fuchs, 2021, p. 044056).

However, none of the other assessments pay sufficient attention to issues of governance as the core tenant of their analysis. Conversely, considering institutional vulnerability as an own dimension might help compare and assess various governance approaches and their impact on the vulnerability of socio-ecological systems (Birkmann, 2013). As a result, this lens may be the most adequate in understanding how institutions can lead us develop and implement systematic strategies that can help reduce and mitigate the threats posed by disasters.

Key Actors

Broadly defined, institutional vulnerability “refers to modes and constraints in governance, underlying rules and norm systems that govern society and also to the capacity or incapacity of (formal) organizations to deal with risks and adaptation challenges” (Birkmann,

2013, p. 30). In short, it looks at the role of governance in how vulnerabilities are appraised, addressed and mitigated. The scope of governance considered under the umbrella of institutional vulnerability is vast. For one, it considers the interactions between formal and informal institutions as well as the different vertical hierarchies among them (Birkmann, 2013; Shim & Kim, 2015). This is an important feature because governance is often associated with the more formal institutions such as governmental bodies and its various agencies. Rather, institutional vulnerability expands the scope of governance to include informal institutions alongside. Among the different groups considered, attention is paid to the “national, provincial and local spheres of governance, the private sector, civil society, non-governmental organizations, community-based organizations, research institutions and institutions of higher learning” (Niekerk, 2007; Malalgoda & Amaratunga, 2015, p. 104).

Albeit it is difficult to speak of more and less important actors, the literature acknowledges that among the various actors considered, particular attention is paid to local governments. This is largely because they are the main governing body based at the local scale where disasters often take place and are closest to the local population (Bendimerand, 2003; MacManus & Caruso, 2006; Kusumasari et al., 2010; Manyena, 2006; UN-ISDR, 2010; Malagoda et al., 2013; Birkmann, 2013). As a result, institutional vulnerability is often viewed through the mezzo scale with specific references to the interactions in the micro (individual) and macro (provincial, Central, international) scales.

Up until now, this review has focused on understanding disaster risk and its principal components. It considered the dual nature of disaster risk composed of the hazard event and vulnerability of the system exposed. Notably, the consideration of vulnerability has received a lot of attention in the literature given the potential it offers in decreasing disaster risk. Among the

various dimensions of vulnerability, the institutional lens, which is largely tied to issues of governance, has been highlighted as a key concept in the effort to help us reduce and mitigate the threats posed by disasters. However, this approach in understanding vulnerability is only a part of the effort required to reduce disaster risk. The institutional vulnerability perspective helps shed light on certain issues and create a context for understanding them. It is a tool for understanding how governance can lead to a reduction in disaster risk and what best strategies can be employed to this end.

With this in mind, this literature review now turns to discuss some of the current trends and areas of contention which have been garnering attention in the academic discourse around institutional vulnerability and governance research as of late.

2.5. Disaster Risk Governance

2.5.1. Definition of Governance

Above all else, the previous section illustrates the complexity in defining the space of disaster risk management. The field deals with a lot of uncertainties and a multiplicity of various institutional actors and contexts. Institutions in this space are the most important feature of the system because they shape the response to any given disaster through policies, allocation and fulfillment of various responsibilities, mitigation activities, aid programs and many other efforts. Yet while they shape the response to the disaster, they are also shaped and regulated by the broader political, social, economic and international contexts in which they operate (Eriksen et al., 2017).

Institutions involved in disaster management do not exist in a vacuum. They must work within the confines of the enveloping context. Vulnerability and its causes are linked to the broader structural processes and dynamics.

2.5.2. Overarching Disaster Management Governance Approaches

2.5.2.1. Top-Down (Classical Management)

In the past, many disaster management approaches were based on the top-down conception of governance. This means that decisions were made at the top level. In this approach, the responsibility rests on organizational shoulders. The public is perceived as a passive receiver of information, measures and plan. The technical information on risk assessment, preparedness measures, emergency plans, etc. is drafted and published by the governing organs (Scolobig et al., 2015). Upon reception of this information, the public is expected to act according to the set guidelines.

Many criticisms have been levied against this approach. Shim & Kim (2015) see the top-down approach as inefficient and ineffective. In their view, central government planning cannot provide an adequate solution for preparedness and recovery. This is mainly because there is too much local variability that cannot be accounted for and addressed under a broad, sweeping policy. The same hazards can materialize differently across various areas. Communities that belong to the same governance structure can have varying degrees of resilience and vulnerability, as a result of which disaster events yield different outcomes. Certainly, disaster risk is influenced by global and national factors. However, the way those threats present themselves is shaped at a more local level (Maskrey, 2011). Those individual characteristics are hard to account for and integrate into a centralized planning system. This is true especially when the public is perceived as a passive receiver of information, rather than an active co-creator.

Not only can the top-down approach be insensitive to the local contexts, but it is also slow in responding to disasters. The approach lacks flexibility and often fails to provide guidance in different types of situations (Urby Jr. & McEntire, 2014). As a result of this, the field of Disaster Risk Mitigation has been moving away from this style. Rather, the field is more inclined to entertain more actor participation and transparency (Scolobig et al., 2015).

2.5.2.2. Bottom-Up (Community-Based Disaster Risk Management)

In response to the shortcomings of the top-down approach, a new paradigm emerged. This paradigm centers around a shift towards a more community-based disaster management. It is also known as bottom-up management. More formally, it has come to be known as Community Based Disaster Risk Management (CBDRM). Its central tenant is the role of community in disaster planning and response. This stands in stark contrast to the top-down conception of governance where the public's role is minimized. CBDRM is mainly concerned with understanding the experiences of communities affected by disasters and harnessing this knowledge to achieve superior solutions. The approach uproots the sense of powerlessness experienced by community members after a disaster strikes. Under CBDRM people have the chance to become more than just passive victims. They can help develop strategies to become more resilient and protect themselves from the disasters. This approach ensures that the public is not just a recipient of disaster response plans. Through CBDRM, the public becomes an active co-creator.

This shift in responsibility has many benefits. For one, stronger public engagement can lead to stronger political and budgetary support for disaster management systems. It also leads to a more efficient implementation of those systems in the community (Scolobig et al., 2015). CBDRM is also more effective than traditional approaches because it can mobilize and unlock

resources faster. It can also lead to more adequate and suitable solutions through the public's involvement (Maskrey, 2011). This is primarily because the community that is put in charge of designing the management plan is also the body responsible for its practical implementation. This results in a reduction of red tape measures since the implementation pathway is shortened and public support is present.

There is a great deal of insight in traditional community knowledge that can be integrated into disaster response at a higher level. The government may be effective at designing plans that have the approval of engineers, managers, community leaders and bureaucrats. Yet, the practical outcomes are not always as easily predictable. Community based consultations can help illuminate key blind spots and distinguish superior solutions from those less adequate. Conversely, through community-based discussions, the community can learn more about the difficulties of drafting and implementing a disaster risk strategy. In this way, both parties can understand a little more about the context in which the decisions are made and how those decisions affect the community.

Nonetheless, despite those benefits, there are some deficiencies in this approach. For example, Laycock & Mitchell (2019) suggest that highly bonding social capital, “reduces organizational interactions and the potential for efficient knowledge mobilization” (p. 63). Seen in this way, CBDRM makes it difficult to arrive at solutions promptly. Integrating the various community actors, making sure that their opinions are all considered and subsequently synthesizing this knowledge into an actionable plan is a painstaking and lengthy process. It can be made even longer when community members have opposing viewpoints. The CBDRM process also reduces organizational interactions. This is problematic because coordinating an effective and efficient disaster response requires the insights and input from different agencies. In

short, it requires a systems thinking approach. However, a strictly community-based process is not sufficient to become truly integrative. There are aspects to any disaster event that require specialized knowledge in order to complete the picture. Aside from climate data, decision makers often look at financial analysis tools, migration projections, reduction in agricultural yields and an array of other metrics. All of this is required to understand the possible impact of the disaster event itself as well as the impact of mitigation measures. Various governmental departments are also important actors. Finance, infrastructure, business development, education, agriculture and many other sectors are deeply affected by the planning process, management system in place as well as the eventual disaster event. CBDRM is not ignorant of this complexity, yet it places the community at the forefront of this approach. The array of organizations and interactions that are normally considered in disaster planning is limited under CBDRM. Not doing so makes the whole process too lengthy and inefficient.

2.5.2.3. Hybrid Model / Collaborative Disaster Management

It has been argued that neither the top-down, nor the bottom-up approach are sufficient in isolation. But while they are not good enough on their own, each has its own benefits. If the two approaches could be integrated efficiently, the outcome would yield a superior strategy for responding to disasters. Many academics have already come to consider this hybrid model. For example, Maskrey (2011) recognizes that in disaster mitigation, governments are scarcely focused on reducing risk. As a result, it would be prudent to encourage communities to work on creating opportunities to reduce risk themselves through community-based disaster planning by playing to the strengths of community organizing. Ensuing from this process, the government could then streamline the findings into policy decisions, something that the government is more proficient in. Creating such synergies between local community groups and governmental

institutions would promote community resilience and reduce the burden for finding effective solutions on the managerial level (Scolobig et al., 2015).

Currently, one of the key focuses of the top-down model is to offer humanitarian assistance. It is a more expedient way of offering disaster assistance. Aid is often distributed for specific purposes and those are determined at the governmental level. While the rationale is often grounded in some type of analysis, it is not sensitive to the local needs. This can lead to inefficient use of financial resources. Conversely, if the humanitarian assistance is distributed while considering the community-based recommendations, the funds are likely to be appropriated towards the most impactful areas.

Despite its many advantages, even the hybrid approach has its shortcomings. Synergies between community-based responses and government interventions result in many benefits. Yet, those same synergies can lead to gridlock as well as increased bureaucracy. Furthermore, this will reduce responsiveness and increase vulnerability.

The dynamic of top-down versus bottom-up approach results in a very perplexing dynamic of disaster risk management. Neither is sufficient on its own and both suffer from multiple drawbacks. When integrated together, another set of issues emerges. The existing modes of community organizing and top-down management are at odds with each other and fail to create room for collaboration. In response to this, many approaches have been identified. For one, effective multilevel governance can be employed in disaster management (Shim & Kim, 2015). This would allow us to move away from the centralization and decentralization framework and create policies, plans of action and risk avoidance strategies on a multi-tiered platform. The platform utilizes the strengths of each governance approach in order to arrive at the best solution in the most efficient manner. An alternative approach is to allow for the shift of

power from the central state to a diversity of subnational and non-state actors (Burch et al., 2007). Doing so would diffuse the responsibilities and risks among various parties and help create a more integrated and diffused disaster response strategy.

All in all, there seems to be no consensus in the literature on what model of governance would be most suitable for disaster risk management. As mentioned above, there are several schools of thought. However, for every argument made, a counterpoint can be presented. More than anything, this underscores the need for a comprehensive disaster management framework that considers all of the trends that will increase the complexity of disaster risk management in the future, including governance.

The New Public Service (NPS) school of thought of Public Administration, nested within the broader field of Organizational/Management Theory. Much like SHM, this approach is cross-disciplinary and incorporates a broad subject matter. It gives consideration to political, social, cultural, legal and scientific contexts that have impact on public institutions (Shafruitz et al., 2011). Its main focus is on reconciling the top-down and bottom-up approaches. This is achieved by emphasizing “theories of democratic governance based on citizenship participation and the public interest” (Urby Jr. & McEntire, 2014, p.56). A particular emphasis is placed on the concepts of participation and citizenship. This new school of public service significantly departs from the old public management and new public management to integrate more voices into the political life and influence the political system (Denhardt & Denhardt, 2007). It is this key pivot that will be necessary from the organizational point of view in order to bring about the change necessary for effective disaster mitigation. The systems thinking perspective includes all of the voices, motivations, behaviors and contents of all system components in order to map out the

system dynamics and interdependencies. In this regard, consolidating the two approaches reinforces their individual strengths.

2.6. Theoretical Framework

2.6.1. Introduction

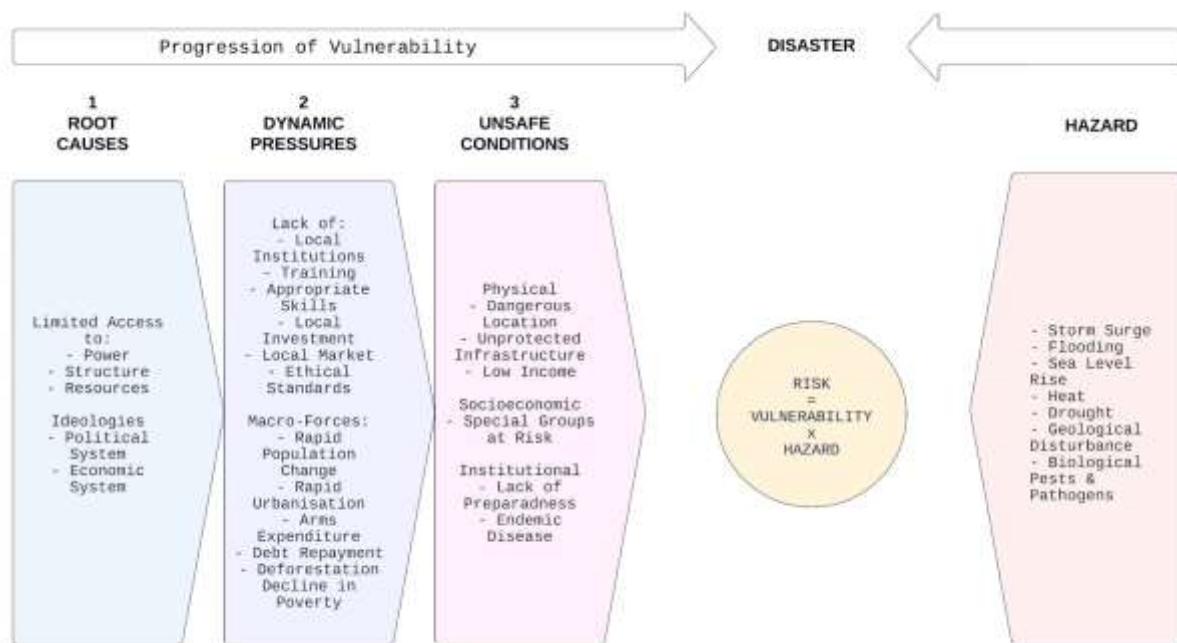
Following the reconceptualization of disaster risk that expanded its definition beyond the linear consideration of the hazard event, numerous approaches emerged that sought to encapsulate the variety of vulnerability metrics which factor into the disaster risk equation (which includes the vulnerability of the community affected along with the magnitude of the hazard event). These approaches, as mentioned in the previous section, are often referred to as vulnerability assessment frameworks. Notably, as has already been highlighted, a core concept present in the preamble of those and many other vulnerability measurement frameworks is the evasiveness of the concept of vulnerability to measurement. As a result, many of those frameworks vary in their conceptualization, analysis and complexity of the factors which characterize vulnerability.

2.6.2. Original PAR Model

This research relies on a revised version of the Pressure and Release Model (PAR), first proposed by Blaikie, Cannon, Davis & Wisner (1994) and later revised by Wisner et al (2004). The original PAR model was among the first frameworks to conceptualize vulnerability by explaining how structures and processes shape the vulnerability of communities exposed. It depicts disaster as the result of two opposing forces (vulnerability and hazard) that exert a pressure on a given ecosystem. The greater the scale of the pressure on either side, the greater the disaster event will be. Implied in this understanding is the notion that in order to reduce the disaster, it is necessary to reduce the pressure generated by the two forces (Wisner et al., 2004).

Yet, while it is difficult, if not impossible to control the hazard event, the necessary emphasis should be placed on arresting and reversing the progression of vulnerability. Consequently, the framework defines the progression of vulnerability by dividing it into three separate categories: 1) Root Causes; 2) Dynamic Pressures and 3) Unsafe Conditions. The original PAR model can be seen in the diagram below (Image 1: Original PAR model).

Figure 1: Original PAR model, (adopted from: Wisner et al., 2004).



Each of the steps in the progression of vulnerability builds on the previous and increases the pressure, leading to increased pressure on the system as a whole. The first step in the progression, root causes, operates on a structural level and defines the underlying conditions of any given society. Root causes include: limited access to power, limited access to structures, limited access to resources, aspects of the political system and aspects of the economic system.

The second step in the progression of vulnerability is dynamic pressures. These pressures are often the result of the root causes and often evolve as the underlying system undergoes changes, especially during disaster settings. Dynamic pressures include: lack of local Institutions, lack of training, lack of appropriate skills, lack of local investment, lack of a local market, lack of ethical standards, macro-forces (which include: rapid population change, rapid urbanization, arms expenditure, debt repayment, deforestation, decline in poverty).

The last step in the progression of vulnerability as defined in the PAR model are unsafe conditions. They are the most immediate risk factor in the evolution of disasters. Unsafe conditions include: the physical dimension (dangerous location, unprotected infrastructure, low income), socioeconomic dimension (special groups at risk), and the institutional dimension (lack of preparedness or endemic disease) (Blaikie, Cannon, Davis & Wisner, 1994) .

2.7 Analyzing the Failures of Existing DRM Approaches

There is a growing recognition in the Disaster Risk Management literature on the failures of many of the existing Disaster Risk Reduction approaches. Perhaps Ghosh & Boyd (2019) are most direct in their description of this problem, stating that “existing DRR approaches are failing spectacularly to enhance resilience of communities, address disaster frequency and mitigate loss and damages” (p. 101236).

Much of the current research in this area supports this conclusion. Literature in the areas of disaster risk, adaptation and mitigation indicates that the present disaster response paradigm suffers from a variety of weaknesses. Those include: lack of systems thinking when approaching the problem (McEntire, 2004; Folke, 2006; Smith & Wenger, 2007; Greve, 2016), failure to place more emphasis on multi-level governance approaches (Shim & Kim, 2015; Pearce, 2003; Uitto

& Shaw, 2016), lack of focus on risk reduction and long term perspectives (Birkmann, 2014; Rozdilsky, 2001; Michel-Kerjan et al., 2012; Folke, 2006; Tobin, 1999; Birkmann & von Teichman, 2010), shortsightedness (McEntire, Crocker & Eklong, 2010; Mileti & Gailus, 2005), lack of adequate regulatory, operational and planning instruments (Rivera & Wamsler, 2014; Schipper et al., 2016; Filho et al., 2019).

As evidenced by the list of authors above, a variety of criticisms emerged over the past few decades. This list is by no means exhaustive, but offers a snapshot of the most common themes in the literature addressing the sources of failures of existing DRM approaches. Narrowing this list further and grouping them into general thematic areas, three core themes emerge. Those include:

- 1) Need for more efficient role allocation;
- 2) Need for flexible methodologies, and;
- 3) Calls for the revision of existing frameworks.

The predominant difference among them lies in the focal point of analysis. Literature that centers around the need for efficient role allocation emphasizes the roles and responsibilities of the individual actors involved in the DRM setting. Focusing on flexible methodologies centers around adaptability across different settings and contexts in order to find optimal solutions. Lastly, calls for the revision of existing frameworks or the development of a new framework are the most radical as they emphasize a more comprehensive revisioning of the approach to DRM.

In short, these three themes present the common areas of criticism that the author observed around the existing DRM approach and are be discussed in more detail to outline the current themes in the literature. However, more recently, a fourth theme emerged. Although it has

observed far less scrutiny in the literature surrounding the topic, it touches on all of the other themes and seems to offer a very promising direction in addressing failures of existing DRM approaches. This most recent theme is categorized as:

4) Institutional vulnerability

As far as the current literature on the topic stands, it seems to offer invaluable insight into the problem of disaster risk management and encompass all other themes. Yet while theoretical analysis of institutional vulnerability as a lens for improving our approach to disaster risk management continues to build credibility, no applied research has been undertaken to explore the relevance of considering the institutional vulnerability dimension in assessing the disaster risk management efforts in any given setting.

It is be the ultimate conclusion of the ensuing discussion on the literature boundaries and literature gap that an exploratory investigation of how fragmentation among institutional actors involved in disaster response amplifies the disruptions in essential services following disaster events would serve as the natural next step to help bridge this research gap and add to the growing body of knowledge around institutional vulnerability.

Before arriving at this conclusion, this discussion begins with a detailed analysis of the above-mentioned three common themes in the literature addressing the sources of failures of existing DRM approaches. Subsequently, it turns towards an analysis of the newly emerging fourth theme, before finally concluding that an exploratory analysis would help bridge the research gap previously identified.

2.7.1 Themes on the Failures of Existing DRM Approaches

2.7.1.1. Theme #1 - Need for Efficient Role Allocation

The first theme observed in the literature surrounds the calls for more efficient role allocation in disaster risk management approaches. In their assessment of the failures of the existing DRM paradigms, several authors focus on the problem of efficient role allocation. When referring to ‘efficient role allocation’, the literature most of often points to an optimal description in, “the scope and responsibility of [...] central government and other related government organizations, community-based organizations, NGOs, private sector and the local community [groups]” (Malalgoda & Amaratunga, 2015, p. 115). It refers to a well thought out strategy for the coordination of roles and responsibilities among the actors involved in the DRM effort, with each actor having a clear understanding of their role in the overall effort.

Unfortunately, a widely shared consensus in the literature indicates that the coordination of roles and responsibilities among actors is often inefficient and leads to an increase in disaster risk exposure on societies (Lopez-Martinez et al., 2017). Among the different ways in which the academic literature echoes this sentiment, authors refer to the current efforts at the coordination of roles and responsibilities among actors as: inefficient (Lopez-Martinez et al., 2017), mismatched (Birkmann, 2013; Lopez-Martinez et al., 2017), rooted in entrenched institutional practices (Pal, Ghosh & Ghosh, 2017), often lacking a clearly defined scope of roles and responsibilities (Malalgoda & Amaratunga, 2015), and defined by conflicting priorities and response mechanisms (Eriksen et al., 2017).

Beyond offering a critique on the failures of efficient role allocation, several authors have made explicit calls for improvements in the coordination of agencies and actors within and across organizational and territorial boundaries (Wisner et al., 2012; Lebel et al., 2013; Malalgoda & Amaratunga, 2015; Coaffee, 2018; Huck et al., 2020).

Most notably, this criticism has been recognized by the United Nations in the context of Cyclone Idai, stating:

“The lack of clear directives/vision on how to engage and responsibly disengage in disasters, the uncertainty and contradictions about the scope of UNHCR’s response to Idai (and Kenneth), the disconnect from broader UN and development contexts, serious challenges in distribution of CRIs, as well as critical resource constraints (financial and human) resulted in a fragmented and irregular delivery of protection and aid to Internally Displaced People’s (IDP’s) and cross-border displaced people” (UNHCR, 2021, p. 5).

Perhaps this best underscores the academic consensus around the need for a more efficient role allocation. Fragmented and irregular delivery of protection and aid directly impacts the livelihoods of those most impacted by disasters and is the immediate result of poor allocation of roles and responsibilities among those involved in the disaster risk management efforts.

While there seems to be a consensus that effective disaster response necessitates an efficient role allocation, there is no consensus on what specific roles and responsibilities should be allocated to which specific actor. Rather, the central consideration is to ensure that within any central DRM paradigm, the corresponding roles and responsibilities are clearly defined and communicated to the actors involved. However, the literature acknowledges that a variety of DRM paradigms may be adopted, depending on specific countries, contexts, and unique community features. This recognition is the topic of the second theme identified.

2.7.1.2. Theme #2 - Need for Flexible Methodologies

Literature on the sources of failures of existing DRM approaches often points to the need for flexible methodologies. Numerous voices in the field, stress the need to develop DRM paradigms that are not rooted in fixed methodologies, but rather, can be adjusted (both slightly and heavily) depending on the country, context and unique community features (Ciurean, Schroter & Glade, 2013; Malagoda et al., 2013; Malagoda & Amaratunga, 2015; Shim & Kim,

2015; Nawab & Nyborg, 2017; Pal, Ghosh & Ghosh, 2017; Sorg et al., 2018; Toinpre, Mackee & Gajendran, 2018). This flexibility allows the DRM approaches to be more context specific and integrate the unique governance approaches that may be applicable in any given context.

Some authors argue that flexible methodologies allow for an improved decision making. As a result, they point to a need to, “design processes where a broad range of community members are brought into the decision-making process” (Nawab & Nyborg, 2017, p. 59). Designing the DRM approach in line in this way facilitates a “more transparent, participative and open process” (Ciurean, Schroter & Glade, 2013, p. 27). This allows a variety of actors to participate in the process and help strengthen it.

Discussion around flexible methodologies is most often accompanied by a broader discussion around DRM frameworks which set out the overarching approach towards DRM. Within this discourse, flexible methodologies are considered to be an important part in the design of any DRM framework. As Coaeffe (2018) recognized, “there is no one size fits all for DRM. [We] need to rethink the role of regulation, organization, resources and information to deliver results (p. 405). The authors rightly recognized that it is difficult and imprudent to apply the same strategies across different contexts, especially since the applicability of the same strategies across vastly different settings may vary significantly. Factors such as: natural geography, governance approaches, economic considerations, along with many other differentiating factors may have a limiting effect on many of the DRM strategies. As such, the literature stresses the need to develop “more effective planning tools that enable communities to organize effective risk management on the basis of self organizing units” (Schweizer & Renn, 2020, p. 17). In theory, those self-organizing units would have a much better understanding of the local context and would be able to better select the applicable methods and approaches to DRM.

Notably, the literature recognizes that while flexible methodologies are a necessary component of effective disaster management, the DRM approach must still utilize the most recent scientific knowledge in the areas of DRM and DRM and take note of the best methods and practices available across the globe - with the caveat that they are adequate given the local context. This idea has been summarized by Gaillard & Mercer (2013) in their recognition of the importance of reconciling “homogenizing strategies utilizing global scientific knowledge on hazards and vulnerability, on the one hand, and the context-specific nature of local knowledge and community-based actions on the other hand (Wisner et al., 2012).

2.7.1.3. Theme #3 - Calls for a New Framework

The above mentioned recognition of the need for efficient role allocation along with a need for flexible methodologies is often encapsulated through DRM frameworks. These frameworks often capture much of the current understanding and knowledge that has been learned through years of research and data collection on disaster risk management. Numerous DRM frameworks have been developed over the years. Among them, the most notable and often referred to frameworks include:

- Pressure and Release model (PAR) (Wisner, 2004)
- Holistic Approach to risk and vulnerability (Carreno et al., 2007)
- IRGC (Inclusive Risk Governance Council) Framework (Schweizer & Renn, 2020)
- MOVE Framework (Birkmann et al., 2013)
- Vulnerability assessment based on the MOVE Framework (Depietri, 2013)
- Vulnerability index on city level (Wolf & McGregor, 2013)
- Framework for the analysis of local vulnerability to urban heat stress (Wilhelmi & Hayden, 2010)
- Multiple stressors (O’Brien et al., 2004)
- PEARL Vulnerability Assessment Framework that can be applied to various case study areas and different types of hazards (Sorg et al., 2018, p.260).
- UN/ISDR Framework for Disaster risk management
- The Sustainable Livelihood Framework
- BBC Conceptual Framework
- Disaster Deficit Index (DD)

- Local Disaster Index (LDI)
- Prevalent Vulnerability Index (PVI)
- Risk Management Index (RMI)
- Hyogo Framework for Action

The abovementioned frameworks are just some of the examples that were highlighted in the literature on DRM. There are many other examples, some are more general while others target a specific disaster type/community context. The existing frameworks are developed by a variety of authors, some of which were devised by individual authors, while others were developed by larger organizations and institutions. These various DRM and DRM frameworks have been applied across the globe in a variety of contexts and continue to serve as the structural basis for disaster risk management efforts. Some of them serve more as a theoretical tool, while others follow a detailed methodology and specify key actions across the actor pool. Given the vast differences in these different DRM frameworks, the criticisms leveled against them vary and there are no universally recognized frameworks. Rather, different countries and communities often have to navigate through the catalog of available frameworks and select the one that is most applicable in any given context.

Most notably, while serving as a critical tool in the development and deployment of disaster risk management strategies, the literature in the field continues to call for amendments to the existing frameworks and for new frameworks to be developed as the existing frameworks suffer from a variety of shortcomings (Birkmann, 2013; Ciurean, Schroter & Glade, 2013; Nawab & Nyborg, 2017; Pal, Ghosh & Ghosh, 2017; Diaz-Sarachage & Jato-Espino, 2019). Among the criticisms offered, some authors stress that the DRM frameworks often fail to take into consideration the “capacities required to translate innovations into transformational change in day-to-day practices” (Coaffee et al., 2018, p. 405). Others suggest that “although a large amount of studies has reviewed the assessment of vulnerability from the perspective of a

particular hazard [there is still] the need for developing a new framework applicable to multiple hazards worldwide to bridge the identified gaps (Cardona et al., 2012, p. 70). This view is supported by (Diaz-Sarachage & Jato-Espino, 2019) who hold that, “the combined analysis involving all kinds of hazards and vulnerability dimensions in the urban context is uncommon” (p. 437).

2.7.1.4. Theme #4 - Institutional Vulnerability

The aforementioned three themes present the most common areas of criticism around the existing DRM approach. They include the need for more efficient role allocation, the need for flexible methodologies, and calls for the revision of existing frameworks. Together, they represent the various themes in which scholars in the field have attempted to address some of the failures of existing DRM approaches.

Building from this broader discourse in the literature, several novel perspectives emerged in an attempt to resolve the criticisms levied against many of the existing DRM paradigms and address the aforementioned themes on the failures of existing DRM approaches. The most pertinent among them is the addition of institutional vulnerability as an independent lens for assessing vulnerability.

Institutional vulnerability research has gained prominence in DRM research over the past decade (Birkmann, 2013; Diaz-Sarachage & Jato-Espino, 2019; Coutinho, Lucena & Henrique, 2020; Huck et al., 2020; Papathoma-Kohle, Thaler & Fuchs, 2021). As far as the current literature on the topic stands, it seems to offer invaluable insight into the problem of disaster risk management. Importantly, it provides a critical lens for the analysis of the failures of existing DRM approaches that have not sufficiently integrated issues of governance.

3. Methodology

3.1. Research Design and Epistemology

This research employs a constructivist theoretical framework. In plain terms, a constructivist theoretical framework posits that all human knowledge derives from human experiences. A more elaborate definition by David Elkind encapsulates the concept of constructivism as “the recognition that reality is a product of human intelligence interacting with experience in the real world” (Elkind, 2005, p. 334). Constructivism is often contrasted with positivism, which employs a more definitive approach to the creation of knowledge. The table below encapsulates some of the key differences among these two approaches across the categories of: the observer, human interests, explanations, research progresses through, concepts, units of analysis, generalization through and sampling requires.

Table 1: Comparison between positivism and constructivism

	Positivism	Constructivism
<i>The observer</i>	Must be independent	Is part of what is being observed
<i>Human interests</i>	Should be irrelevant	Are the main drivers of science
<i>Explanations</i>	Must demonstrate causality	Aim to increase general understanding of the situation
<i>Research progresses through</i>	Hypotheses and deductions	Gather rich data from which ideas are induced
<i>Concepts</i>	Need to be operationalised so that they can be measured	Should incorporate actor perspectives
<i>Units of analysis</i>	Should be reduced to simplest terms	May include the complexity of ‘whole’ situations
<i>Generalisation through</i>	Statistical probability	Theoretical abstraction

<i>Sampling requires</i>	Large numbers selected randomly	Small numbers of cases chosen for specific reasons
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The central question of this dissertation is to understand whether fragmented coordination among institutional actors involved in disaster response impact access to drinking water following disasters. To the extent that this research question is investigated, it is necessary to understand the authority structures, relationships among actors and the perceived roles and responsibilities of each actor identified. Each of those variables has both a formal as well as an informal component. The formal component is often identified through regulatory documents, job descriptions and other specific legal instruments. This aspect of the problem can often be identified through document analysis.

Conversely, the informal component of authority structures, relationships among actors and the perceived roles and responsibilities of each actor identified is often more nuanced. Understanding the informal nature of these variable requires an analysis of the context, observed relationships, tacit agreements among parties, informal rules of conduct, institutional culture and many other factors that are not explicitly stated in any formal guidelines.

It is for this reason that this research adopts a constructivist theoretical framework. Adopting this approach allows the researcher to better understand the informal setting of the context of the problem being investigated. The researcher can learn more about the nature of the authority structures, relationships between actors and the actors' own perceptions of their roles and responsibilities. As more information is obtained, the researcher can better fill in the gaps in knowledge and update his understanding of the problem. Consequently, as this understanding

improves and additional questions arise, the researcher can continue building on this understanding in an iterative way throughout the research process.

3.2. Case Study Approach

This research follows the blueprint of a case study approach. A case study approach is a form of qualitative research design, “used to generate an in-depth, multi-faceted understanding of a complex issue in its real-life context” (Crowe et al., 2011, p.1). Thus, the main features of a case study are twofold. First, a case study is used to acquire an in-depth understanding of an issue. This is done primarily by paying attention to the structural elements, systems in place, unique features, causal links and pathways as well as intervening variables that help characterize the problem (Crowe, 2011; Yin, 2009). There seems to be some flexibility in how authors define ‘in-depth’, however most sources center around the themes of detailed and focused pattern or relationship analysis (Crowe, 2011; George & Bennett, 2005; Stake, 1995; Yin, 2009).

Secondly, a case study achieves this in-depth understanding by analyzing the problem in the context in which it exists. Unlike experimental research design, in which a researcher deliberately selects and isolates variables of interest so that specific conclusions can be drawn, case study research allows for more breadth in the exploration of the problem (Sheikh, Smeeth & Ashcroft, 2002). As such, this approach is more exploratory and allows the researcher to draw conclusions from the research observation and follow up assessment. Sometimes when problems are viewed in isolation from the surrounding context and analyzed in a vacuum, researchers can mistakenly overlook critical components of the problem and fall short in problem analysis. Undertaking a case study approach to problem analysis has a built-in understanding that the researcher has to be cognizant of the features of the problems that inevitably surface during the

research and allows for the integration of newfound understandings into the problem analysis. Moreover, such organic revelations are not just built into the research design but expected.

3.2.1. Types of Case Study Research Designs

Stake (1995) identifies three types of case study approaches: 1) intrinsic (used to study unique phenomena); 2) instrumental (uses a particular case to study broader phenomena); and 3) collective (involves multiple cases in order to identify patterns).

3.2.2. Case Study of Beira, Mozambique and Cyclone Idai

This research follows the blueprint of an instrumental case study approach. It has as its focal point the setting of Beira, Mozambique and the aftermath of the 2019 Cyclone Idai. This case study examines whether fragmented coordination among institutional actors involved in the sourcing, preparation, delivery and maintenance of drinking water systems in Beira, Mozambique is a noteworthy factor in assessing the role of institutional vulnerability on access to drinking water following disasters. On a broader scale it helps illustrate the relationship between institutional role clarity and disaster outcomes that can be applied across a verity of other settings.

3.2.3. Rationale for Choosing a Case Study Approach

The case study approach has been chosen in the investigation of the main research question for several reasons. In the first place, it has already been identified that while theoretical analysis of institutional vulnerability as a lens for improving our approach to disaster risk management continues to build credibility and receive attention, to date, no applied research has been undertaken to explore the relevance of considering the institutional vulnerability dimension in assessing the disaster risk management efforts in any given setting. Despite the growing body of theoretical developments in the field of institutional vulnerability, there are no references to

real-life relationships where this knowledge can be applied and evaluated. The use of a case study in the analysis of the central research question is aimed at resolving this deficiency in the literature.

By employing the case study approach, the researcher can analyze the relevance of utilizing the institutional vulnerability perspective in a real-life relationship. The case study approach allows the researcher to analyze the nuances present within any given setting and respond to them by asking follow up questions, probing further into new areas that may have not been previously studied and consider dimensions of the problem that may not have been explored in the literature. Equipped with the theoretical knowledge but lacking comparable experimental research studies, the case study approach allows the researcher to better respond to new knowledge and findings as they emerge. This flexibility is a notable benefit of this approach. Given the novelty of the institutional vulnerability perspective in disaster risk management literature, there are no readily available frameworks or tools previously developed that could be utilized to study this phenomenon. Consequently, the case study approach is best suited for studying the relevance of the institutional vulnerability perspective in analyzing disaster impacts.

3.3. Case Study Background

3.3.1. Introduction

The case study chosen for the purpose of this study is Beira, Mozambique. This location is of particular interest due to a disaster event that took place in April 2019, Cyclone Idai. The case study description is informed by primary research, with some details supported and elaborated on through in-person interviews.

3.3.2. Geography

Mozambique

Mozambique is located to the southeast of the African continent at the Indian Ocean. It has a land area of around 800,000 km² and a total coastline of around 2,750 km (High Commission of the Republic of Mozambique, n.d.). This makes Mozambique the 36th biggest country in the world and one of the largest countries in the African continent (Encyclopedia Britannica, 2023). Mozambique borders 6 different countries, including: Malawi, South Africa, Eswatini, Tanzania, Zambia and Zimbabwe.

In terms of the altitude differences, Mozambique is predominantly covered by a vast low, grassland plateau, especially in the southern and coastline regions. Further inland as well as to the north, the elevation rises gradually into the mountainous regions. The country's highest elevation point, Monte Binga, can be observed in the central-western region, on the border with Zimbabwe. The differences between the sparse lowlands and the mountainous regions result in an average elevation of around 345 meters (Encyclopedia Britannica, 2023).

Figure 4: Map of Mozambique (Centers for Disease Control and Prevention, 2023)



Beira, Mozambique

Beira is a coastal city in central Mozambique. It is the capital of the Sofala province and the fourth largest city in Mozambique, after Matola, Maputo (country's capital) and Nampula. It is located on the Mozambique Channel part of the Indian Ocean at the mouths of river Púngoè

and Búzi (INE, 2023). The city of Beira covers an area of approximately 633 square kilometers. The port of Beira is one of the largest ports in the country as well as the region. It serves as the connecting node, bridging an extensive Mozambican hinterland and neighboring landlocked countries with the Indian Ocean (GFDRM, 2020).

The average elevation of Beira is around 14 meters with many areas lying just above the sea level. Being a coastal city at the mouth of two major river systems, Beira's natural flora is mostly characterized by swamplands and lowlands, with mangrove coasts (UN-Habitat, 2022).

Figure 5: Map of the Greater Beira Area Flooding (Copernicus, 2019).



3.3.3. Demographic Info

Mozambique

As of 2023, the total population of Mozambique is estimated to be around 32,513,805 (Central Intelligence Agency [CIA], 2023). This figure places it as the 45th most populous country on the planet. The population pyramid looks typical of a developing nation, featuring a triangular shape which indicates a rather young population with fewer people in the older age

brackets. This is usually representative of a population with a high birth rate, high death rate, and low life expectancy. 45% of the population is in the 0-14 years age bracket, 52.1% are in the 14-64 age bracket and only 2.9% are 65 years and over (CIA, 2023). The median age is only 17 years old. The population has a fairly rapid growth rate of 2.55%. This places Mozambique in the 17th place in the global order, largely due to a sizable birth rate (36.94 births/1,000 population) (CIA, 2023).

The population is largely distributed among three population clusters. The clusters are located in close proximity to Maputo, Beira and around the northern cities of Nampula, Cidade de Nacala, and Pemba. While Mozambique has been largely considered to be an agricultural country in which more than 80% of the labor force practices farming and agrarian modes of production, the rate of urbanization has been increasing steadily. As of 2023, 34.2% of the population resides in urban areas whereas 65.8% remains in rural settlements (CIA, 2023). However the expected rate of urbanization predicted for the period of 2020-2025 is expected to reach 4.24% annual rate of change, signaling a rapidly urbanizing population (CIA, 2023).

Beira, Mozambique

The population of Beira is estimated to be in the vicinity of 533,825 (Encyclopedia Britannica, 2023). In terms of the population distribution and other demographic features, it shares many of the same characteristics as the country at large; thus a more detailed analysis of the city of Beira is unlikely to offer any additional insight.

3.3.4. Socio-Economic Info

Poverty Rate

Despite being one of the larger countries on the African continent and a 36th largest country in the world, economically Mozambique ranks among the poorest in the globe. Among the various measures used to estimate poverty, the international poverty line is used most often. Currently, the international poverty line is set at \$2.15 per person per day based on 2017 prices (World Bank, 2022).

Analysis by the World Bank Group on the reduction of poverty in Mozambique between 2001-2020 displayed a rather grim outlook (World Bank Group, 2023). During the rapid economic growth experienced between 2001 - 2015, the economy was expanding at an average 4.7% annually. This period saw a reduction in poverty falling from 79.9% in 2002 to 64.6% in 2014. Albeit, not ideal, a change could be seen with a reduction in poverty totaling 15.2%. However, the poverty & equity analysis by the World Bank Group attributes this reduction to a temporary “role of the services sector in the labor market and a favorable macroeconomic framework that supported consumption growth” (World Bank Group, 2023, p.1). Additionally, the analysis points to the observation that the inequality actually worsened between 2008-2014, concluding that growth was not inclusive and only increased income disparity. In the years since 2016, the rate of growth decelerated and the annual per capita growth rate was negative until 2020.

In a motion to expand the definition of poverty beyond just monetary accounting, the multidimensional measure of poverty was also introduced. The Multidimensional Poverty index (MPI) is an instrument that measures multidimensional poverty across 10 indicators (nutrition, child mortality, years of schooling, school attendance, cooking fuel, sanitation, drinking water,

electricity, housing and assets) in 3 different dimensions (health, education, standard of living) (UNDP, 2023).

Further measurements by the Household Budget Survey 2019-2020 indicated that poverty spiked during 2019, at the peak of the COVID-19 pandemic and the progress made in reducing multidimensional poverty was reversed in the past few years. At present, according to the Multidimensional Poverty Index 2023 published by the UNDP, 61.9 percent of the population in Mozambique is considered to be multidimensionally poor, while 13.9% are classified as being vulnerable to multidimensional poverty (UNDP, 2023).

3.3.5. History of Beira Mozambique

In 1975, The Mozambique Liberation Front (Frente de Libertação de Moçambique)(Frelimo) led an armed rebellion against the Portuguese colonial rule and was successful in overthrowing the former government. In the aftermath of the rebellion, Mozambique became a people's republic (Thompson, 2013). Right from the outset, the government provided extensive investment in education, health care, and social services. However, these gains became undermined by the insurgency groups, such as the Mozambique National Resistance (Renamo). Nonetheless, the newly independent state began making strides to joining the global community joining the World Bank and the International Monetary Fund (IMF) in 1984. In the early 1990s, legislative reforms were introduced that would allow for multiparty elections and helped bridge the peace process that would help mend the fraught relationship between the Mozambique Liberation Front and the Mozambique National Resistance.

The multiparty elections of 1994 were the culmination of these efforts, and through the aid of the international community to supervise the electoral process, a new government was

established. Frelimo remained in power; however, Renamo was able to obtain recognition as an official state party and was strongly represented in the national government and the National Assembly (Thompson, 2013).

Despite the multiparty and the ensuing political peace accord, the ruling party continued to be affected by the lingering effects of war, albeit lessening as time went on. In the early 21st century, the country began experiencing an economic boom as international investors started pouring significant monetary resources to extract and develop newly discovered sources of coal and natural gas, rich deposits of minerals and metallic resources. (Thompson, 2013). Despite this tremendous economic growth, most Mozambicans did not benefit from the economic opportunities offered to those at the top and the political tension between Renamo and Frelimo resurfaced. This led to numerous insurgencies across the country culminating in October 2013. The friction between these two parties continued into the 2014 election and beyond; however, in August 2019 the leaders of both parties signed onto a shared agreement intended to end hostilities and foster peace and reconciliation (Thompson, 2013) .

Unfortunately, while the inter-part strife seems to have been concluded, a new insurgency has developed in the northern region. In 2017 An Islamic State-linked armed group known as Ahlu al-Sunnah wal-Jamaah (ASJ) began attacks in the province of Cabo Delgado. Various skirmishes occurred over the years, even prompting a response from the international community; however, a resolution is yet to be found. Until 2021, the ASJ is considered responsible for the deaths of more than 3,100 people and the displacement of over 800,000 people (Thompson, 2013).

3.3.6. Cyclone Idai

Introduction

Having described the broader country features, further analysis is provided on the circumstances surrounding Cyclone Idai. This includes: a description of the amplifying factors, review of the efforts leading up to the disaster, and lastly, a general overview of the key facts and impacts of Cyclone Idai.

Leading up to the disaster

While Cyclone Idai first made landfall on the City of Beira in Mozambique on March 14th, 2019, the weather warnings as well as preparedness efforts had been undertaken much sooner. The Meteorological office in Mozambique (INAM) was actively assessing the weather conditions in the weeks and days leading up to the disaster. The highest alert (evacuation order) was raised 3 days before the Cyclone, once the potential severity of the cyclone became abundantly clear (PCICR, 2019). Alongside the alert, safe zones had been created in rural areas of Mozambique for evacuation above the floodplain. Some people were also evacuated by boat right before the cyclone struck.

Yet despite all of these efforts, it was reported that many people in rural areas did not respond to the warnings or were not aware of them. Moreover, the flooding was far worse than expected and despite the establishment of safe zones above the floodplain, the flood waters were far higher than predicted, affecting even some of these areas. Mayor of Beira commented that the government failed to warn people in the areas worst struck while opposition groups in the government blamed the lack of preparedness on corruption (Maclean, 2019).

Key Facts

Cyclone Idai made landfall on the City of Beira in Mozambique on March 14th, 2019. Idai was classified as a ‘tropical cyclone’ - a typical classification of these types of weather phenomena that originate in the southwest Indian Ocean (ICRC, 2019; World Meteorological Organization [WMO], 2022). A key feature of tropical cyclones include: “violent winds, torrential rain, high waves and, in some cases, very destructive storm surges and coastal flooding” (WMO, 2022, p.1). In the case of Cyclone Idai, it brought winds of between 180 – 220 km per hour (PDNA, 2019). More than 200 mm of rainfall was observed within 24 hours of the initial impact. Additionally, storm surges between 3.5-4 meters high were observed. The storm surges had a devastating impact on the city of Beira, with flood waters reportedly rising above 10 meters. In the aftermath, up to 90% of Beira was considered damaged or destroyed by the impact of Cyclone Idai (ICRC, 2019). In total, the flooding affected nearly 3 million people in Mozambique, Malawi, and Zimbabwe (PDNA, 2019).

Death Toll and Displacement

The immediate impact of Cyclone Idai on the population of Mozambique was devastating; however, as the days went on, the true scale of the disaster became apparent. As of the end of April, more than 1.5 million people have been affected, 400,000 people had been displaced, 1,600 were injured and more than 600 people had died. More than 750,000 people needed urgent assistance, 433,056 affected households needed seed assistance and 240,000 households had their homes totally or partially destroyed (PDNA, 2019).

Environmental Degradation

Aside from the impact on individuals, Cyclone Idai brought about significant environmental degradation and tremendous economic losses. According to the PDNA (2019), 3,000 sq. km of land and 715,378 hectares of cultivated land were flooded by Cyclone Idai. There were 9,710 animal deaths recorded 4,309 ha of irrigated land needed rehabilitation and 116,476 m² of fish tanks affected.

Economic Impact

Economically, the Cyclone brought about generational devastation with the total scale of damages reaching USD 3.2 Billion (PDNA, 2019). These damages reflect “the necessary interventions to repair or rebuild infrastructure and physical assets with improved measures in line with the principles of building back better and disaster risk management to ensure future resilience (PDNA, 2019, p.31). In terms of macroeconomic impacts, the disaster led to a slowdown in real GDP growth as well as pressures on prices - which in turn led to a rise in inflation in the short and medium term (PDNA, 2019).

Amplifying Factors

This section looks at Cyclone Idai and its impact on the City of Beira. While the central focus of this analysis is to describe progression and the impacts of Cyclone Idai on Beira, a few additional factors are identified to help contextualize the disaster setting further.

The previous section has already analyzed some of the geographical, demographic, economic and socio-economic features of Mozambique to further explore the broader national context. It offers a general outlook on the historical roots, current trends and future predictions, across a variety of domains. Building on this prior description, the ensuing analysis looks at

more proximal factors that directly amplified the disaster impacts. This list of amplifying factors stresses those most important considerations that were identified in the Post Disaster Needs Assessment (2019) and were perceived to be of critical importance by the Government of Mozambique (PCICR, 2019). Those factors include: 1) Mozambique was already facing high levels of food insecurity, 2) Idai arrived at a time when important political processes were expected to unfold; and 3) Idai arrived in the ninth country with the lowest human development index. This additional disaster context further highlights the vulnerability of the region and the need for better disaster risk management.

Food Insecurity

According to the PDNA, even before Cyclone Idai struck Mozambique, “the country was already facing high levels of food insecurity” (PCICR, 2019, p. 15). According to the report, drought conditions across the region which persisted for much of 2018 and into 2019 severely reduced the agricultural productivity and production in many of the southern and central areas (PCICR, 2019). As a result, the Integrated Phase Classification (IPC) and Mozambique’s Technical Secretariat for Food Security and Nutrition (SETSAN) reported that between September and December 2018, 1,780,000 people experienced severe food insecurity (PCICR, 2019). Given Mozambique's population size of just around 30,000,000 around that time, those that experienced severe food insecurity in the months leading up to the disaster accounted for around 6% of the total population (CIA, 2023).

Importantly, this figure accounts for those who experienced severe food insecurity, with an additional portion of the population that continued to experience food insecurity at less severe levels. In terms of the relevance of this statistic in relation to the disaster context, it displays the already inadequate conditions relating to food security present before the disaster and stresses the

vulnerability of the country to any further shocks. This is important because in contexts where the pre-disaster conditions are already inadequate, any further shocks to the system can have catastrophic consequences.

General Elections

The arrival of Cyclone Idai also coincided with important political events, and the timing may have generated additional political inefficiencies that would further exacerbate the impact. More specifically, the national general elections were scheduled to take place in October 2019 and the leading parties were already garnering resources and turning their attention towards the campaign that was to shortly follow (PCICR, 2019).

Additionally, a few other important political processes included: “the new decentralization package of agreements, a peace process between the Government and Renamo, and the process of Demobilization, Disarmament and Reintegration (DDR)” (PCICR, 2019, p. 15). These political processes were considered important developments, especially given the tumultuous past that has led to these positive developments. This was highlighted in the PDNA, “these are vital for the country’s stability, and particularly for the consolidation of peace and democracy in Mozambique (PCICR, 2019, p. 15). As a result, much of the attention of those in government was certainly preoccupied with these events especially given the nature and national scope of these processes.

Human Development Index (HDI)

Lastly, the PDNA highlighted the relevance of the Human Development Index (HDI), in relation to the eventual impact of the disaster. Mozambique is ninth from the bottom in terms of the HDI in the world. It has a score of 0,437 which places it in 180th place among 189 countries

evaluated. In terms of the underlying figures that factor into such a low score, they include: “life expectancy is around 59, infant mortality rate is 67.3, maternal mortality stands at 452, and the illiteracy rate stands at 39% (males 27%; females 49%)”(PCICR, 2019, p. 15).

Moreover, the percentage of the population living below the national poverty line in Mozambique is staggering and figures around 46% (according to data collected in 2014/2015). This figure rises to 56% in rural areas and is also higher in the four provinces most affected by cyclone Idai: 62% in Zambezia, 50% in Sofala, 42% in Tete, and 35% in Inhambane (PCICR, 2019, p. 15).

Having now settled some of the more immediate amplifying factors, it is important to note that those are not all the amplifying factors as there are plenty of influences that play a role in how the disaster ultimately unfolds. Those factors discussed were selected because they appeared in the Post Disasters Needs Assessment and were of key importance by the authorities responsible for the development of the assessment document.

Impact on Fresh Water Access

The previous sections provided a broad overview of the disaster event itself and the social, environmental, and economic consequences. This section focuses on the impact most pertinent to the theme of this dissertation - the impact on water access in Beira, Mozambique.

Fresh water access for the city of Beira is supplied through the Beira/Dondo water supply system, which in turn is managed by FIPAG. As a result of Cyclone Idai, this water supply system was disrupted for 10 days, affecting more than 340,000 people (PDNA, 2019). It was partially restored to service on March 22, 2019; however, parts of the water delivery infrastructure remained damaged and many other areas in the network only received temporary

fixes, requiring more permanent solutions to be undertaken in the proceeding weeks and months. The sources of the disruption were identified as: “unstable and damaged energy supply system, the lowering of the water level collection intake, loss of chemicals for the water treatment and significant ruptures in the distribution network” (UNICEF, 2019, p.1). Following the 10-day disruption, the water system was reestablished at 90% of its capacity and households continued to experience intermittent water supply issues for months following Cyclone Idai.

The data available on the impact of water disruption was rather scarce in the aftermath of the disaster and for some time afterwards. It is for that reason that the first research objective of this dissertation was to conduct a survey in order to evaluate the impact of Cyclone Idai on the access to fresh water for residents of Beira. This data is discussed in the proceeding section. Nonetheless, some indirect observations made shortly after can also provide a glimpse into the broader context. For one, many families that were directly affected by the cyclone, including those that had their water supply service interrupted, were forced to buy bottled water or to get water from trucks with prices during the crisis up to 10 times higher than normal market values. On the other hand, many water points in rural areas based on wells and boreholes, fitted with hand or electromechanical pumps were affected by floods, leaving more than 40,000 families without access to safe water.

Once more referring to the PDNA, the total damage to water/sanitation infrastructure was USD\$14.9 million (USD\$8.9 million in public infrastructure damages, USD\$6.0 million in private infrastructure damages); whereas the total loss to water/sanitation infrastructure was estimated at USD\$5.6 million (USD\$2.9 million in public infrastructure damages, USD\$2.7million in private infrastructure damages). Beyond the infrastructure damages, the GoM estimated that USD\$106.2 million was needed for water/sanitation sector recovery in Beira. The

major losses reported by the water sector are those related to “the non-payment by water and sanitation services, to alternative water supply provision, for the rent or purchase power generators, and due to the increased costs of water treatment due to input water increased turbidity” (PDNA, 2019, p.31). In addition, losses included the necessary repairs on different components of water and sanitation systems to increase partial or total functionality of storm damaged system.

3.4. Research Objectives

The central question of this research is to Investigate how fragmentation among institutional actors involved in disaster response amplifies the disruptions in essential services following disaster events.

To support the thesis, a set of research objectives have been identified to address each sub-research question and shape how they are addressed in the subsequent data analysis. Those research objectives are:

- Trace the extent, magnitude and characteristics related to the disruption in access to drinking water following Cyclone Idai.
- Identify the network of actors involved in disaster response associated with drinking water and evaluate whether the network of actors is fragmented.
- Discuss how this fragmentation amplified the disruption in water access following Cyclone Idai.

3.5. Research Strategy

A strategy was developed to address each of the objectives identified above and has been summarized in the table below.

Table 2: Research strategy overview

Research Objectives	Data Sources and Methods	Methods	Description / Examples of Questions
1. Trace the extent, magnitude and characteristics related to the disruption in access to drinking water following Cyclone Idai.			
1.1 Identify the pre-disaster and post-disaster conditions	Beira Household Domestic Survey	Statistical Analysis	The following prompts are of particular importance: <u>Question 23</u>: As a result of Cyclone Idai, was your home destroyed, severely damaged, partially damaged, or was it unimpacted? <u>Question 28</u>: Before the disaster (March 15, 2019), what was the main source of drinking water in your household? <u>Question 29</u>: Was this household's access to this drinking water source disrupted immediately after Cyclone Idai (after March 15, 2019)? <u>Question 30</u>: What was the main reason for the disruption of this household's access to this drinking water source? <u>Question 31</u>: Is this household's access to this drinking water source still disrupted? <u>Question 32</u>: What is this household's primary source of drinking water now, after the disaster (since March 15, 2019)? <u>Question 33</u>: Is this drinking water source currently adequate for this household's needs (sufficient, clean, nearby)? <u>Question 34</u>: How long (in minutes) does it take to go to the current drinking water source for this household, get water and come back by your usual means of transportation?

			<u>Question 35</u>: Has your household experienced any of the following challenges in accessing the current drinking water source since Cyclone Idai (Since March 15, 2019)? <u>Question 36</u>: Currently, which household member(s) usually collect(s) drinking water for the household? <u>Question 50</u>: In the year before Cyclone Idai (March 15, 2018 to March 15, 2019), how often, if ever, did you or your household go without enough clean water for home use? <u>Question 57</u>: In the year after Cyclone Idai (March 15, 2019 to March 15, 2020), how often, if ever, have you or your household gone without enough clean water for home use? <u>Question 113</u>: What are the most important or priority needs to recover from the disaster?
1.2 Identify and classify the disaster outcomes	Beira Household Domestic Survey	Statistical Analysis	Disaster outcomes are defined as the difference between the post-disaster and pre-disaster conditions. Disruption in water access is the aggregate of individual disaster outcomes that pertain to fresh water access
2. Identify the network of actors involved in disaster response associated with drinking water and establish how fragmented this network is			
2.1 Identify institutional actors responsible for overseeing the	Mozambique Disaster Plan Document National Disaster	Document Analysis Expert Interviews	Identify the institutional actors that were responsible for disaster risk management and addressing disaster outcomes.

access to drinking water.	Planning Documents International Documents Consult with local authorities		
2.2 Illustrate how all of these institutional actors relate to each other and interact.	Institutional Actors identified under 2.1 and experts that were directly involved in disaster risk management in Mozambique.	Document Analysis Expert Interviews	Create a relationship map to illustrate how the different institutional actors from various agencies relate to each other and whether the nature of their interaction is cooperative or fragmented.
2.3 Analyze how the relationships described in 2.2 demonstrate fragmentation	Institutional Actors identified under 2.1 and experts that were directly involved in disaster risk management in Mozambique.	Expert Interviews	Discuss how the nature of the relationships described in 2.2 leads to fragmentation. Illustrate specific examples that confirm fragmentation is present Example 1: Funding (macro) Examples 2: Reliance on NGO's for aid (mezzo) Example 3: FIPAG and INDG approach to restoring generators. Discuss the typology of fragmentation and assign which typology most closely correlates to this case study.

3. Discuss how actor fragmentation amplified the disruption in water access following Cyclone Idai.			
3.1 Discuss examples that illustrate how fragmentation may have contributed to a negative disaster outcome	Beira Household Domestic Survey Expert Interviews	Thematic Analysis	Select specific examples of relationships that illustrate actor fragmentation. Discuss the circumstances surrounding those relationships in detail and integrate the different types of data collected in the relationship analysis. Possible Relationships to Identify: • Fragmentation between water supplier and INGD • Disconnect between Local Communities and Disaster Governance • Fragmentation between NGOs and Disaster Management Institutions

3.6 Data Collection

3.6.1 Mixed Methods Approach

In addressing the main research question, the researcher had to rely on a variety of research tools and utilized a mixed methods approach. This approach has been defined by Johnson, Onwuegbuzie & Turner (2007) as “a type of research in which a researcher or a team of researchers combines elements of qualitative and quantitative research approaches for the broad purpose of breadth and depth of understanding and corroboration” (p.123). Johnson, Onwuegbuzie & Turner (2007) further describe this approach as one that:

- 1) Relies on qualitative and quantitative viewpoints, data collection, analysis, and inference techniques combined according to the logic of mixed methods research to address one’s research questions; and,
- 2) Is cognizant, appreciative, and inclusive of local and broader sociopolitical realities, resources, and needs (p.129).

Utilizing both quantitative and qualitative research methods was indeed crucial in addressing the research question and allowed the researcher to develop a more nuanced and reasoned conclusions as each research method reinforced and build upon the accumulated findings. This approach also allowed the researcher to be more cognizant of the local and broader sociopolitical realities because the researcher was able to follow up on the quantitative data gathered with more narrative based and context specific qualitative probing that provided a much clearer picture of the realities experienced.

Accounting for the complexity of the research question and the lack of readily available examples of comparable research in institutional vulnerability, the expiration of the main research question had to rely on a variety of research methods in order to adequately address the central problem. Here, Johnson, Onwuegbuzie & Turner (2007) also point to the benefit of using the mixed approach in these types of relationships, stating that “this type of research should be

used when the nexus of contingencies in a situation, in relation to one's research question(s) suggests that mixed methods research is likely to provide superior research findings and outcomes" (p.129). This sentiment certainly rings true in this research as the mixed methods approach led to superior and more credible research findings. The research question was answered iteratively by employing various research approaches to continuously build on the previous findings, in order to ultimately address the central research question.

The mixed methods approach utilized for the purpose of addressing the central research question consisted predominantly of three different research methods: quantitative (household survey), qualitative (in-person expert interviews) and document analysis. Each of the research methods corresponded to one of the three sub-research questions and research objectives defined at the outset of the research process.

For each of the research objectives, a different methodology was chosen. This is because each of the sub-research questions required a different approach in addressing the guiding question. For the first research objective, it is necessary to establish a statistical database that can then be used to trace the extent, magnitude and characteristics related to the disruption in access to drinking water following Cyclone Idai. A survey was chosen for this purpose because it allows the researcher to make broader observations across time and across the entire population of the City of Beira. While there may be minor differences across population subsets and other demographic features, the survey is able to comprehensively answer the research question it seeks to address by looking at the statistical changes in the access to fresh water around the disaster event.

The second research objective relies primarily on document analysis in order to identify the network of actors involved in disaster response associated with drinking water access

following Cyclone Idai. The document analysis approach is perfectly suited toward accomplishing this objective because the primary responsibility for disaster risk management in any country falls onto the Government. As a result, governments often have guiding regulatory documents that define and describe the roles and responsibilities of different institutional actors. While informal relationships may exist beyond the scope outlined in the guiding regulatory documents, the central objective of this sub-research question is still best answered by looking through the official document analysis. This is because this sub-research question is primarily concerned with identifying those considered to be ‘responsible’, implying an official capacity. Such an official capacity would naturally be identified through official documents. A subsidiary role in this process is often taken up by NGOs, especially in countries such as Mozambique where the capacity of the Government to comprehensively address this problem is limited due to scarce resources. Yet, while NGOs often do not operate under a formal mandate from the government in fulfilling this role, they do create publications that outline their efforts.

Finally, the last research objective is the most explorative out of the three. It has the goal of evaluating whether the network of actors involved in disaster response associated with drinking water is fragmented and how this fragmentation amplified the disruption in water access following Cyclone Idai. The first two research questions were rather straightforward in terms of the reliance on data to achieve a suitable answer. However, for this research question, a more nuanced approach had to be undertaken. Establishing fragmentation and evaluating the impact of this fragmentation in a definitive capacity is a rather troublesome task, especially given the availability of information. As a result, the approach taken in order to address this research question relied on expert interviews, key actor insights and a thematic analysis ensuing from these observations. The key insights provided by experts and key actors involved in disaster

response associated with drinking water access following Cyclone Idai helped identify the key areas of actor fragmentation. Once those areas were identified, experts and key actors were further prompted to provide their insights on what impact this fragmentation had on the disruption in water access following Cyclone Idai.

3.6.2. Beira Domestic Household Survey

Between January to March 2021, the IDG Team conducted a survey of households in Beira to understand their experience of, and adaptation to, the impacts of Cyclone Idai. 1,000 households were randomly sampled out of a total of 139,027 buildings identified within the Beira city administrative boundaries. The data collection was done by a team that the researcher was a part of; however, the researcher did not directly take place in the on-the-ground data collection, enumeration, or formatting.

The Open Street Map (OSM) database was used along with a geoprocessing ‘clip’ tool to identify the building features and to establish the total sample size. Having established the sample size, buildings identified were randomly selected for sampling with the help of SPSS. The location of the buildings was then converted into a file format that made them easily identified through GoogleMyMaps so the enumerators could more easily identify the selected sample households.

The survey instrument collected data on the impacts of Cyclone Idai and the lived experiences of respondents. In total, there were 114 questions that were surveyed: demographic information, impact of Cyclone Idai on disabilities, infrastructure damages, water access, medical needs, school attendance, access to food, business impacts, employment opportunities, financial needs and assistance received. For this dissertation, the key focus of the analysis is on questions and variables related to infrastructure and water access. However, a broad overview of

the demographic information and some of the key general findings from the survey are discussed before converging infrastructure- and water- related questions.

Broadly speaking, the survey results provide insight into various aspects of the respondents' lives before and after Cyclone Idai hit the city of Beira. In total, 1,000 households were randomly sampled. Among those households, 33.2% of respondents were male, and 66.8% were female. Among the respondents, 47% were heads of the household, 32% were spouses of the head of the household, 14.5% were sons/daughters of the head of the household, and 6.5% were 'other'. The age of the respondents ranged from 18 to 83 years, with a mean of 38, a median of 34, and a standard deviation of 15.3, suggesting a relatively well distributed sample. Most respondents (59.6%) were born in Beira, while 34.3% were born in another city, and 6.2% in a rural area.

Female household heads

3.6.3.In-Person Interviews

In-person interviews were conducted between August 4 - 12, 2022 in Maputo, Mozambique and Beira, Mozambique. Existing research networks in Beira were utilized to help identify, contact, and schedule the sessions with key actors. The sampling strategy can be seen in Table 3 Below.

Central Government Officials / Formal Water Suppliers / Informal Water Suppliers - Interview

Sampling Strategy List

Table 3: Central Government Officials / Formal Water Suppliers / Informal Water Suppliers

Actor Group	Actor Category within the Group	Target Number of Actors to Interview
Water Government Agency	Central	2 - 3 Individuals
Water Government Agency	Provincial	1 - 2 Individuals
Water Government Agency	Municipal	3 - 4 Individuals
Formal Water Supplier	FIPAG	3 - 4 Individuals
Formal Water Supplier	Conselho de Regulação do Abastecimento de Água	1 - 2 Individuals
Informal Water Supplier	Various	3 - 5 Individuals

The actor categories were identified based on prior research on the major actors involved in the provision of freshwater services in the municipality of Beira, Mozambique. Contacts from the existing network in the region were then consulted to help identify which of the actors identified would be accessible and available to conduct an interview. After these consultations a preliminary list of actors and the target number of actors to interview were established. In the next place, the actors identified were contacted for an interview. There were two primary means through which these actors were contacted: through existing networks and email. Individuals from the existing networks that were present in the region and had a direct point of contact helped connect the researcher with the selected actors. Other actors that were not within the network were contacted through email (Appendix 2: E-Mail Invitation for In-Person Interviews).

Interviews were conducted in the offices of the corresponding agencies through a Research Assistant with the Lead Investigator present and the whole session was recorded. The

Research Assistant translated the interview in real time, allowing the Lead Investigator to ask follow up questions and build on the responses. The entire session was transcribed and analyzed. Additionally, participants were informed that they may only withdraw from the study before the publication of the final report (to be published on March 1, 2023).

3.6.4. Document Analysis

For the identification of relevant institutional actors, a detailed document analysis was conducted. The aim of the document analysis was to identify any official documents, sources and references that mention actors or agencies involved in disaster response associated with drinking water. In order to identify the relevant sources a search criteria list was prepared along with a list of databases where the search terms would be inputted. Table 4: Document Analysis Search Criteria illustrates 4 categories of search terms (#1: Terms for location; #2: Terms for water-related actors and agencies; #3: Terms for disaster risk management institutions; #4: Terms for actors and agency responsibility) with a list of corresponding terms in each category.

Table 4: Document Analysis Search Criteria

Search Criteria		
#1	Terms for Location	“Mozambique”; “Beira”; “Sofala”; “Centro”; “Regional”; “Provincial”; “District”
#2	Terms for Water-Related Actors and Agencies	“Water”; “Sanitation”; “Fresh Water”; “Hygiene”; “Sanitation”; “Drainage”; “Public Works”
#3	Terms for Disaster Risk Management Institutions	“Disaster Risk”; “Disaster Management”; “Disaster Mitigation”; “Disaster Adaptation”; “
#4	Terms for Actors and Agency Responsibility	“Organization”; “Agency”; “Department”; “Division”; “Actor”; “Management”; “Directorate”; “Ministry”; “Directorate”; “Regional”; “Institute”; “Council”; “Operator”; “Association”

Various combinations of the search criteria terms were tried in order to identify the relevant official documents, sources and references. The search terms were inputted into several databases. Those databases included:

- the official Government of Mozambique website (Portal do Governo de Moçambique: Início) (<https://www.portaldogoverno.gov.mz/>), along with other Government of Mozambique affiliated websites (usually ending in [.gov.mz](https://www.gov.mz))
- University of Waterloo Library database,
- United Nations database,
- World Bank database as well as
- Google Scholar.

Once the relevant official documents, sources and reference were identified, each of them was analyzed to identify to:

- Identify the institutional actors that were responsible for disaster risk management and addressing disaster outcomes.
- Create a relationship map to illustrate how the different institutional actors from various agencies relate to each other and whether the nature of their interaction is cooperative or fragmented.
- Discuss how the nature of the relationships described in the relationship map leads to fragmentation and illustrate specific examples that confirm fragmentation is present.

3.7. Ethical Considerations

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE #43049).

4. Findings and Results

4.1. Introduction

Having outlined the methodology for how the research question is investigated and analyzed, the focus turns to the three supporting research questions along with their analogous research objectives. The three sub-research questions are:

- What was the impact of Cyclone Idai on the access to fresh water for residents of Beira?
- Who were the institutional actors responsible for maintaining freshwater access following the disaster? Are the relationships among those actors fragmented?
- How does this fragmentation impact the extent of the disruption in freshwater access following Cyclone Idai?

It has already been established that based on the extensive literature overview, the thesis of this manuscript posits that the severity of the disruption in access to fresh water following Cyclone Idai was amplified by a fragmented coordination among actors involved in disaster risk management. To support the thesis and reject the null hypothesis, a set of research objectives have been identified to address each sub-research question and shape how they are addressed in the subsequent data analysis. Those research objectives are:

- Trace the extent, magnitude and characteristics related to the disruption in access to drinking water following Cyclone Idai.
- Identify the network of actors involved in disaster response associated with drinking water and evaluate whether the network of actors is fragmented.

- Discuss how this fragmentation amplified the disruption in water access following Cyclone Idai.

In the following section, the research thesis is supported based on the data collected. Each of the sub-research questions is introduced, along with the corresponding research objective. Subsequently, the framework for establishing each research objective is discussed. Then, relevant data analyzed and resulting conclusions drawn. This process is done for each of the three sub-research questions. In the end of this section, the results from each of the the sections are discussed together in order to provide a summary of what the data results reveal. The subsequent section builds on this and provide a more detailed discussion of these results and frame the discussion in the broader context.

4.2. Research Objective #1 Findings

Sub-Research Question 1:

What was the impact of Cyclone Idai on the access to drinking water for residents of Beira?

Research Objective 1:

Trace the extent, magnitude and characteristics related to the disruption in access to fresh water following Cyclone Idai.

4.2.1. Research Objective Overview - Methodology (Survey Data)

The purpose of this objective is to establish an impact of Cyclone Idai on access to fresh water for residents of Beira. For the purpose of this analysis, impact is considered to be a measure of whether there was a disruption in the provision of freshwater services immediately after Cyclone Idai struck the City of Beira. In order to establish whether this impact was present, this research objective is evaluated by using the Beira Household Domestic Survey. The survey

measures a variety of different variables, yet for the purpose of this dissertation, only two categories of questions are discussed. This includes questions pertaining to infrastructure damage and questions directly asking about clean water access before and after the disaster.

The research objective was answered by looking at three different measurements provided by the survey: 1) direct measures of impact, 2) comparison of pre-disaster and post-disaster conditions for certain variables; and 3) broader infrastructure damages.

Primarily, the survey included questions that directly probed the respondents whether the household experienced a disruption in access to fresh water. This question is the most relevant measure discussed in this section as it provides a direct measure of respondent's experience of clean water disruption following Cyclone Idai. Subsequently, there are two sets of questions that analyze the conditions surrounding freshwater access before and after the cyclone. They are relevant as they help to reinforce the findings from the first question by taking a different approach to answering research objective 1. By benchmarking the conditions present prior and measuring the conditions present following the disaster, the impact can be measured in terms of severity and magnitude. In addition, by looking at pre-disaster and post-disaster conditions, it is easier to establish the impact of the disaster event itself and account for the pre-existing issues of clean water scarcity. Lastly, this section looks at results surrounding infrastructure damages. In the City of Beira, clean water is made available through various infrastructure projects. As such, damages to infrastructure are likely to affect water access as well. Looking at observed infrastructure damages creates another lens for supporting the research objective and the central thesis. If large scale infrastructure damages can be observed, it is likely that they affected the availability of clean water as well.

4.2.2. Direct Measures of Impact

Among the probes included in the survey, the most direct measure of impact of Cyclone Idai on freshwater access was one which asked whether households' access to this drinking water source disrupted immediately after Cyclone Idai. The survey results reveal that 76.9% of respondents answered, 'yes' and only 23.1% answered 'no'. This information shows that approximately $\frac{3}{4}$ of all households experienced a disruption in their access to fresh water following Cyclone Idea. When viewed without the greater context, this is a dramatic statistic and paints a dire picture of the devastating impact of Cyclone Idai. However, as has already been mentioned, Mozambique faced issues of freshwater access prior to Cyclone Idai and the impact may not be devastating as this single statistic may suggest. The most valuable data point that could be used to establish the impact of the Cyclone alone would be a measure of the household's access to this drinking water source disrupted immediately after Cyclone Idai. Although the survey did not measure the disruption to household's access to this drinking water source immediately before Cyclone Idai, the respondents were prompted to identify whether the household's access to this drinking water source was still disrupted at the time the survey was conducted. The responses were as follows: 18.7% answered 'yes', and 81.3% answered 'no'.

This answer illustrates a significant shift from the conditions that were present immediately after the disaster. Although it does not allow for a comparison of the prevalence of freshwater disruptions before the cyclone to right after the cyclone, it is a great proxy for identifying the impact that the disaster is likely to have had on a household's access to fresh water. The change in water disruption is significant and stands at approximately 58.2%. Thus, even if one was to assume that the prevalence of freshwater disruptions was closer to the values measured immediately after the cyclone, it still follows that the null hypothesis outlined in this

research objective can be rejected and thus, it can be concluded that Cyclone Idai resulted in a disruption in access to drinking water for residents of Beira.

Interestingly, when asked whether the drinking water source is currently adequate for this household's needs, the responses were as follows: 90.9% answered 'yes', and 9.1% answered 'no'.

This is interesting because while 18.7% of the respondents reported that their drinking water source was still disrupted, at the time the survey was conducted, only 9.1% say that the current water source is inadequate for the household's needs. This may suggest that residents have developed some resilience in dealing with water disruptions and have developed contingencies to manage the intermittent water access issues. The data may suggest that there is a degree of resilience among residents of Beira, and they may be able to access water through a variety of other channels at present; however, fresh water was available in various regions and the majority of the previously existing water infrastructure was restored by the time the survey was conducted. As a result, some households may continue experiencing disruptions, owing to a variety of factors (such as a lack of funds to pay for water, intermittent service, or power outages), but may be able to find adequate amount of fresh water nonetheless (by getting it from friends and family, storing water reserves or collecting it from public water sources).

4.2.3. Comparison of Pre-Disaster and Post-Disaster Conditions

In the next section, there are two sets of questions that analyze the conditions surrounding freshwater access before and after the cyclone. They are relevant as they help to reinforce the findings from the first question by taking a different approach to answering research objective 1. By benchmarking the conditions present prior and measuring the conditions present following the disaster, the impact can be measured in terms of severity and magnitude. It is Important to

establish pre disaster conditions because Mozambique already battles issues of water access. As such, it is important to evaluate what the fresh water access looked like immediately before and after the disaster in order to establish what the impact of the disaster event itself was, rather than analyzing the already present, systemic issues.

The survey included two areas of questions that can be used to compare the pre-disaster and post-disaster conditions. Those areas include a comparison in 1) the main source of water; and, 2) frequency in the lack of clean water. These questions help establish the baseline and are supplemented by additional questions that directly probe the respondents on what their perceived impact on freshwater access was.

The first area of comparison analyzed through the survey was the change of the main source of clean water before and after the disaster. The prior and post conditions along with the column tracking the change can be seen in the table below (Table 4: Main Source of Water).

Table 5: Main Source of Water

Before Cyclone Idai	After Cyclone Idai	Change
76.2% Piped Water 22.0% Tube-Well/Borehole 0.0% Bottled Water 1.8% Other	78.5% Piped Water 19.5% Tube-Well/Borehole 0.4% Bottled Water 1.6% Other	+ 2.3% Piped Water -2.5% Tube-Well/Borehole +0.4% Bottled Water -0.2% Other

The table above does not illustrate a significant change in the main source of water for the residents of Beira. However, there are two major caveats that need to be considered when reviewing the table. Firstly, while the first prompt asks the respondents to identify their main source of water immediately before Cyclone Idai, the second prompt does not ask the respondents to identify their main source of water immediately after Cyclone Idai. Rather, the

second prompt asks about “the household’s primary source of drinking water now, after the disaster (since March 15, 2019)”. Thus, in the second prompt, the survey was referring to a time when the survey was conducted - between January to March 2021. This date is almost 2 years after the disaster took place and follows the completion of countless projects (both national and international) aimed at restoring freshwater access. As a result, the comparison of the conditions from before to after the Cyclone was one of long-term impacts, rather than immediate impacts. No results are available to identify the changes in the main water source immediately after the disaster took place. However, this table remains an important point of reference in the broader discussion around the importance of infrastructure in the delivery of freshwater services to the residents of Beira. Hence, the second caveat in the interpretation of this table is the slight increase in the use of piped water as the main source of water.

Overall, this table illustrates that there has not been a significant, negative, long-term change in the main source of drinking water before and after Cyclone Idai. There were minor changes observed; however, they are not significant enough to suggest any negative long-term impacts. Whereas the majority of respondents sourced their drinking water from piped sources (76.2%) before the disaster, a similar number of respondents (78.5%) did so after the disaster. In fact, the number has gone up by 2.3% and suggests that drinking water infrastructure has improved following the disaster. The second highest source of drinking water was tube-well/borehole. It was used by 22% of respondents before the disaster and decreased to 19.5% afterwards. This reduction almost perfectly matches the increase in the use of piped water, as the use of tube-well/borehole as the primary water source decreased by 2.5%. The remaining two answers were rather marginal, but it is interesting to note that the use of bottled water as the primary source of drinking water increased from 0% to 0.4%, suggesting that there are

households that have been entirely deprived of water use through water infrastructure access (this number converts to 4 households).

Overall, this comparison does not provide any significant indicators on the long-term impact of Cyclone Idai; however, it does illustrate the importance of water infrastructure in the delivery of drinking water to residents of Beira. It suggests that approximately 98% of residents acquire their water from institutional facilities or government made (and regulated) tube-well/borehole access points. In addition, whereas tube-well/borehole access points are more decentralized and can exist independently from one another, piped water access relies on centralized water infrastructure facilities that are much more prone to being impacted by disaster events. Both water sources can be impacted by disaster events; however, the growing reliance on piped water as the primary source of drinking water highlights the need to enhance the resilience of water infrastructure facilities to disaster events.

Next, a set of questions analyzed how often each household had gone without enough clean water for home use in the year prior to Cyclone Idai and in the year following the disaster. The answers can be seen in the table below (including the change from before to after in the 3rd column):

Table 6: Frequency in Lack of Clean Water

Before Cyclone Idai	After Cyclone Idai	Change
48% Never 28.1% Just Once or Twice 11.1% Several Times 11.4% Many Times 1.3% Always	35.4% Never 21.6% Just Once or Twice 21.2% Several Times 20.9% Many Times 0.9% Always	-12.6% Never -6.5% Just Once or Twice +10.1% Several Times +9.5%Many Times -0.4% Always

From the table above, there has been a shift in the number of times that each household experienced a lack of clean water. The greatest shift was in the number of households that never experienced a lack of clean water. That number changed from 48% before Cyclone Idai to 35.4% after Cyclone Idai. This means that 12.6% of households went from never experiencing any disruptions in clean water access before Cyclone Idai, to then having experienced it at least once. This means that whereas before the disaster, roughly $\frac{1}{2}$ of households in Beira experienced a lack of clean water at one point, this changed to $\frac{2}{3}$ immediately after the disaster took place. This change is a significant factor that confirms the impact that Cyclone Idai had on access to fresh water. Yet, beyond the increase in the number of households that had to face a lack of clean water, the frequency of those occurrences also increased.

The number of households that experienced disruptions in clean water access ‘several times’ and ‘many times’, both almost doubled. Households facing a lack of clean water ‘several times’ increased from 11.1% to 21.2%. Additionally, households facing a lack of clean water ‘many’ increased from 11.4% to 20.9%. Once again, this reinforces the observation that Cyclone Idai had a significant impact on access to fresh water. Taking all these figures into account, the survey suggests that 33.2% of respondents observed a negative change in the frequency of access to fresh water because of the disaster.

The only figure that seems to have improved for the better is in the number of households that experienced a disruption in clean water access ‘just once or twice’. This figure changed from 28.1% to 21.6%. While at first, the 6.5% decrease may seem like a positive movement (suggesting that fewer households experience a disruption in clean water access ‘just once or twice’), the overall impact seems to suggest that the trajectory of this change is in the negative direction and that those households are likely to experience a disruption in clean water access

more often. In other words, it seems that the decrease in households that experienced a disruption in clean water access ‘just once or twice’ does not mean that they experienced it less, but they likely shifted to categories of ‘several times’ and ‘many times’. This is because both of those categories increased in number, whereas the only category that would suggest a more positive outcome (‘never’) decreased in number.

4.2.4. Infrastructure Damages

Lastly, this section looks at results surrounding infrastructure damages. In the City of Beira, clean water is made available through various infrastructure projects. As such, broader damages to infrastructure are likely to affect water infrastructure and clean water access as well. Looking at observed infrastructure damages creates another lens for supporting the thesis in this research objective. If large scale infrastructure damages can be observed, it is likely that they affected the availability of clean water as well.

The scale of the damages to the City of Beira has already been discussed in the previous section as countless sources confirm the scale and magnitude of the damages present in the aftermath of Cyclone Idai. In addition to those reported impacts, the survey confirms many of the previously detailed observations. For example, when asked whether:

As a result of Cyclone Idai, was your home destroyed, severely damaged, partially damaged, or was it unimpacted?

Table 7: Extent of destruction of homes

18% Destroyed 26.7% Severely Damaged 54.5% Partially Damaged 0.8% Unimpacted

The responses provided clearly indicate that Cyclone Idai impacted virtually every resident of Beira, with 99.2% reporting impact (responses ‘destroyed’, ‘severely damaged’ and ‘partially damaged’ all added together) and only 0.8% respondents answering that their homes were unimpacted. From this, it is clear that the cyclone caused great damage to residential infrastructure. Therefore, due to the scale of the residential damages, it would be reasonable to assume that the infrastructure damages to the water facilities would also be immense.

Likewise, the survey indicated that public infrastructure, and water infrastructure in particular, were significantly impacted by the cyclone. When asked what was the main reason for the disruption of this household’s access to the drinking water source was, the answers provided were as follows:

Table 8: Main reason for the disruption of water access

50.4% Destroyed Water Source Infrastructure 24.3% Destroyed Water Access Infrastructure 9.7% Insufficient Funds 4.4% Geographically Inaccessible
--

Almost $\frac{3}{4}$ of respondents answered that destroyed water infrastructure was the main reason for the disruption of their household’s access to drinking water. Over half of the respondents cited destroyed water source infrastructure and just under $\frac{1}{4}$ cited destroyed water access infrastructure. This statistic adds an institutional dimension to the issue of freshwater disruption, but more importantly, it supports the previous findings that suggested $\frac{3}{4}$ of respondents had access to their drinking water source disrupted immediately after Cyclone Idai. These two distributions are consistent (both being around 75% of the respondents) and seem to

further support the hypothesis posited at the beginning of this research objective. Having established that 75% of respondents observed that household's access to this drinking water source disrupted immediately after Cyclone Idai and identified that 75% of households attribute this disruption to infrastructure damages, this section of the survey helped to establish what the frequency in clean water disruption looked like for households before and after Cyclone Idai.

4.2.5. Summary Of Findings

The purpose of this objective was to establish an impact of Cyclone Idai on access to fresh water for residents of Beira. In order to establish whether this impact was present, this research objective was evaluated by using the Beira household domestic survey. The research objective was answered by looking at three different measurements provided by the survey: direct measures of impact, comparison of pre-disaster and post-disaster conditions for certain variables, and broader infrastructure damages.

The survey results reveal that a vast majority of respondents (76.9%) experienced a disruption in the drinking water source immediately after Cyclone Idai. Two years following the disaster, this figure decreased significantly to 18.7% illustrating a significant shift from the conditions that were present immediately after the disaster and confirming the impact of Cyclone Idai on the experienced disruption. Additionally, the survey revealed that there has been a shift in the number of times that each household experienced a lack of clean water following the disaster. The trajectory of the change in frequency is in the negative direction which indicates that as a result of the disaster, households were likely to experience a disruption in clean water access more often. Lastly, this research objective looks at the broader damages to City infrastructure that is likely to affect water infrastructure and clean water access. The impact to residential and institutional infrastructure reported in the literature overview was confirmed by the survey results

with 99.2% of respondents reporting impact on their homes and $\frac{3}{4}$ citing that destroyed water infrastructure was the main reason for the disruption of their household's access to drinking water.

Importantly, amidst all of the reported damages and loss in access to fresh water, the number of households the reported sourcing their drinking water from piped sources has gone up by 2.3% and suggests that drinking water infrastructure has improved following the disaster. Additionally, the survey revealed that approximately 98% of residents acquire their water from institutional facilities or government made (and regulated) tube-well/borehole access points highlighting the need to enhance the resilience of water infrastructure facilities to disaster events.

In conclusion, the previous section answers the sub-research question and establishes that Cyclone Idai had an impact on the access to fresh water for residents of Beira.

4.3. Research Objective #2 Findings

Sub-Research Question 2:

Who were the institutional actors responsible for maintaining freshwater access following the disaster?

Research Objective 2:

Identify the network of actors involved in disaster response associated with drinking water access following Cyclone Idai.

4.3.1. Research Objective Overview - Methodology (Document Analysis and Expert Interviews)

The previous research objective looked at whether Cyclone Idai had an impact on access to fresh water for residents of Beira. Following an analysis of data found in the Beira Household Domestic Survey, it was concluded that Cyclone Idai indeed had a significant impact on the access to fresh water for residents of Beira. In order to continue building on the central thesis of this dissertation, the discussion turns towards the next research objective. The purpose of the second research objective is to identify the network of actors responsible for maintaining fresh water access following Cyclone Idai. Once this network is established, it can be analyzed to identify whether it is fragmented and how this fragmentation impacted the access to drinking water following Cyclone Idai. This analysis is the subject of the last research objective.

The analysis is composed of three parts. In the first place, the analysis looks at the overarching disaster management policy in Mozambique. In the next place, the focus turns towards identifying the institutional actors that could be considered responsible for disaster response associated with drinking water access following Cyclone Idai and the relationships among them.

Analysis of the second research objective begins with looking at the overarching disaster management policy in Mozambique and an overview of the major governmental departments and agencies that define the roles and responsibilities of the actors. In order to do this, document analysis was conducted and experts were interviewed to identify any gaps in the literature and help provide additional context. The document analysis covered official publications released by the Government of Mozambique, United Nations, International Governments and NGOs. The document analysis focused on publications that made references to disaster management

structures, disaster management planning and emergency coordination structures. The search included both disaster management plans prepared prior to the Cyclone, as well as assessment reports published afterwards. Several of those documents were found and included publications made available by the Ministry of Public Works, Housing and Water Resources (MOPHRH), USAid, United Nations World Food Programme and the World Bank (World Bank, 2010; DNGRH, 2017; PCICR, 2019; World Food Programme, 2020; USAID, 2021).

- Mozambique Public Expenditure Review for the Water Sector (World Bank, 2010);
- Action Plan of the Water Sector to Implement the Sustainable Development Goals - 2015-2030 (National Directorate of Water Resources management [DNGRH], 2017)
- Mozambique Cyclone Idai Post Disaster Needs Assessment (Post-Cyclone Idai Cabinet for Reconstruction [PCICR], 2019);
- Mozambique Water Resources Profile Overview (USAID, 2021).

Following the analysis overarching disaster management policy in Mozambique, the documents identified above were analyzed in order to gain a preliminary understanding of who are the institutional actors that could be considered responsible for disaster response associated with drinking water access following Cyclone Idai. Having completed the document analysis, experts were selected and contacted in order to schedule in-depth interviews. Experts interviewed included directors and high-ranking figures within the institutional water framework in Beira. They included representatives from: National Directorate of Water Resources Management (DNGRH), Regional Water Administrations (ARA), Cabinet of Reconstruction Post-Cyclones (GREPOC), Water Regulatory Council (CRA), Fundo de Investimento e Património do Abastecimento de Água (FIPAG), National Disasters Management Institute (INGD) and Laboratory for Hygiene and Water. In total 12 interviews were conducted with members from each of the organizations outlined above.

During the interviews, experts were consulted to confirm observations made through document analysis in relation to the list of institutional actors that could be considered

responsible for disaster response associated with drinking water access following Cyclone Idai. Subsequently, the experts were asked to help confirm and identify the relationships and dependencies present among them. Taken together, the document analysis and the expert interviews provide a comprehensive picture of the institutional actors involved in disaster response associated with drinking water access following Cyclone Idai.

4.3.2. Policy Framework for Disaster response

The document analysis revealed some of the broad organizational structures in Mozambique's disaster management policy. The modern iteration of Mozambique's disaster management policy can be traced back to 1999 and the introduction of National Policy on Disaster Management 1999 (Republic of Mozambique, 1999). Albeit the policy has evolved over the years, it set the foundation for disaster management, planning and responsibility allocation. The document identified the importance of warning systems, community involvement, allocation of funds for contingencies and the support of the recovery process.

4.3.3. Major Organizational Structures in Disaster risk management Planning

As outlined in the National Policy on Disaster Management, the responsibility for Disaster Risk Management is shared across multiple departments; however, the Coordinating Council for Disaster Management (CCGC) has been identified as the main decision-making body. It reports directly to the Council of Ministers. CCGC has a responsibility to ensure multi-sector coordination across all of the governmental and non-governmental departments. It does so primarily through policy decisions relating to disaster management. It is also supported by the Technical Council for Disaster Management (TCDM). The TCDM is a multi-sector organ that encompasses various thematic sub-committees that provide the CCGC with valuable data and guidance (World Food Programme, 2020).

While the CCGC and TCDM are primarily focused on setting the policy direction in terms of disaster management, the National Institute for Disaster Management (INGC) is the operational arm of the CCGC. It operates directly under the Ministry of State Administration and Public Function and is responsible for the coordination of disaster risk management activities across Mozambique. Its activities span national, provincial, municipal and community levels. INGC is further supported by the National Emergency Operations Center's (CENOE's), - each with a unique focus. The three regional emergency operation centers (CENOE's) handle: 1) cyclones and droughts (Vilankulos), 2) floods (Caia) and 3) cyclones (Nacala).

The authority structure across these institutions has been mapped out by INGC and illustrated in Figure 1 (INGC, 2019). In addition to the organizations already mentioned above, the figure illustrates various sub-committees which provide thematic data to the TCDM. Those include: meteorological services, water, agriculture, environment health, public works and housing, gender and social welfare, defense, transport, mineral resources, trade and industry, education, economy and finance. Other noteworthy structures which can be observed in the diagram include the regional, provincial and district delegations as well as the LCDRM (Local Committees for Disaster Risk Management). The delegations replicate the disaster management structure at the central level, while the LCDRM operate as more decentralized structures that can react to the community needs much quicker.

The National Civil Protection Unit (UNAPROC) supports CENOE with search and rescue activities. Lastly, the Humanitarian Country Team (HCT) is an inter-agency body composed of organizations that are a part of humanitarian efforts taking place following a disaster. Its primary purpose is to provide strategic direction for collective response (IASC, 2017).

Figure 5: Legend - Agency categorization for the following tables

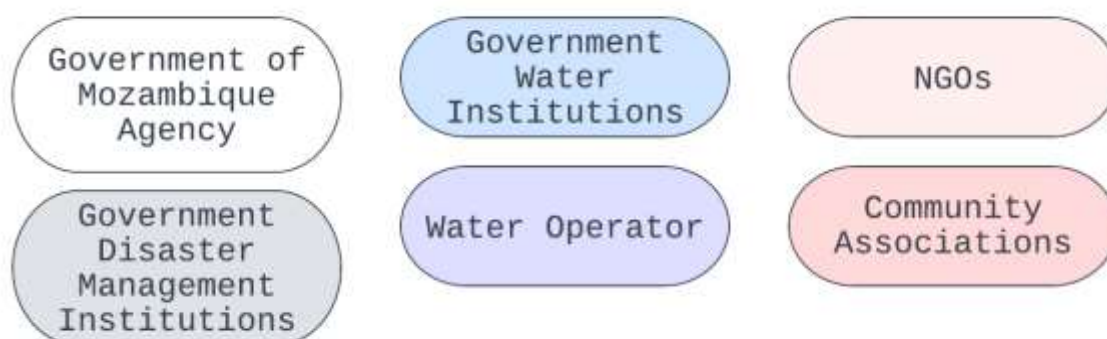
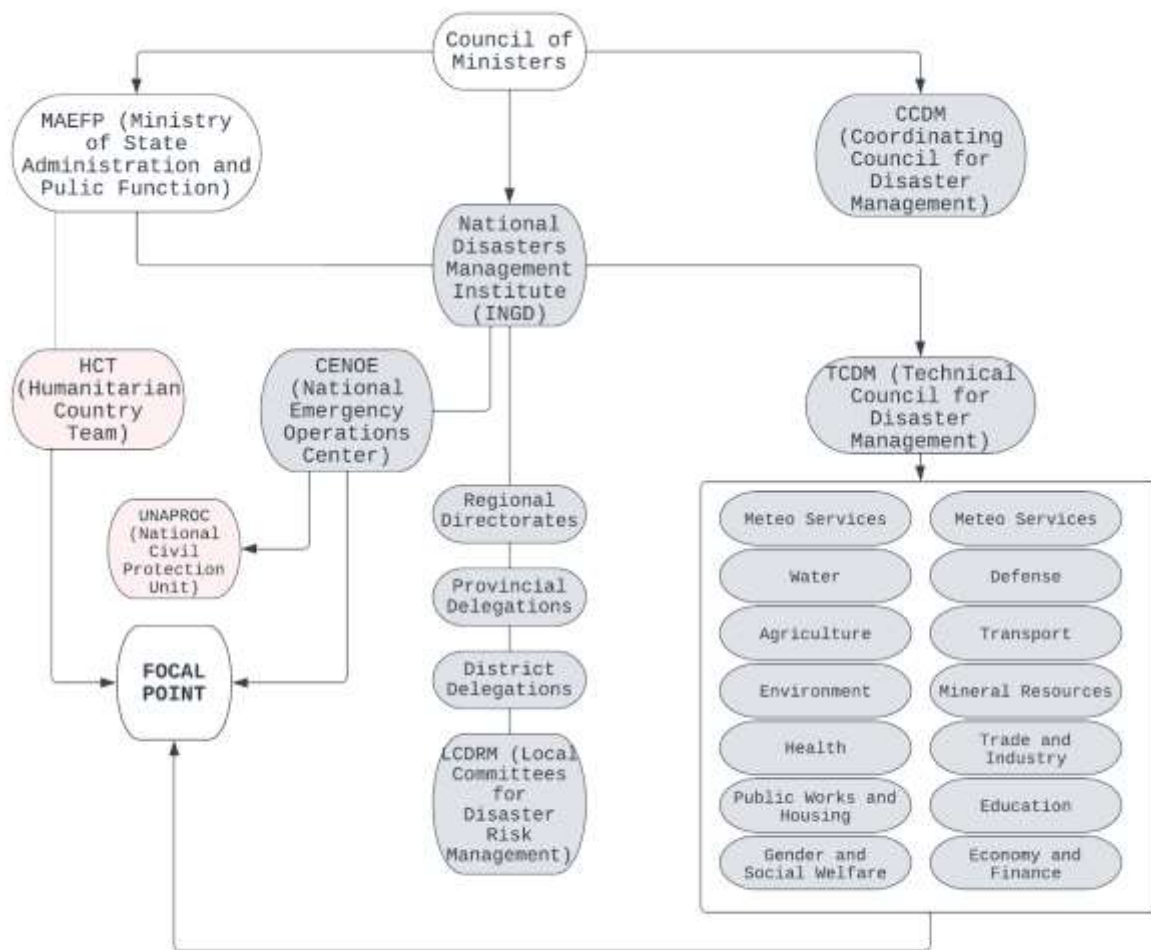


Figure 6: Disaster management structure in Mozambique



In addition to the national policy for disaster risk management, Mozambique relies heavily on the support partners in disaster preparedness, coordination, management and response. The partners include both international humanitarian agencies as well as national partners. The support received from the partners is classified into specialized clusters, which include: shelter, education, health, nutrition, water, sanitation, hygiene, food security, protection, early recovery, telecommunications and logistics. Importantly, the clusters are thematically paired with the four sectors of CENOE: communication, infrastructure, information and planning as well as social services.

HCT plays an important role in the coordination of humanitarian activities as it is charged with supporting and facilitating the coordination of disaster response efforts with the government authorities across the province. It does so primarily through cluster coordination. The linking role performed by the HCT as well as the integration of efforts by the cooperation partners can be seen in Figure 2.

overarching disaster risk management framework; however, few references are made to the coordination of efforts aimed at reduction planning associated with drinking water access and the specific agencies that may be involved in it.

Having completed the document analysis and identified the gaps in knowledge, experts were interviewed to help bridge the gaps in knowledge and provide additional context to the findings from the document analysis. The primary role of experts was to identify the institutional actors that were involved in disaster response associated with drinking water access following Cyclone Idai.

Institutional Actors Related to Water Access

This analysis has identified 13 institutional actors that are involved in disaster response associated with drinking water access. Among all those actors, several actor groups emerged. Those groups include: 1) government water institutions, 2) government disaster management institutions, 3) water operators, 4) international aid, 5) NGOs; and 6) Community Associations.

All those groups of institutional actors were intimately involved in the disaster response and often had to coordinate their efforts together in order to ensure that adequate access was restored as promptly as possible. Below is a list of the individual actors, categories they belong in along with a brief description of their roles and responsibilities. Following this table is a brief description of the actor scope of responsibilities.

Table 9: List of Actors and Responsibilities

ACTOR NAME(s)	ACTOR CATEGORY	SCOPE OF RESPONSIBILITIES
Laboratory for Hygiene and Water	Government Water Institutions	- Setting and monitoring compliance with drinking water standards.
Ministry of Public Works, Housing and Water Resources (MOPHRH)	Government Water Institutions	- Responsible for water supply, sanitation and rainwater drainage services.
National Directorate of Water Resources Management (DNGRH)	Government Water Institutions	- developing water management policies for river basins; - ensuring compliance with international treaties - regular analysis and assessment of water availability and demand from river basins; - formulating and managing basin-wide water management plans.
National Directorate for Water Supply and Sanitation (DNAAS)	Government Water Institutions	- Responsible for supplying drinking water and sanitation to populations, and ensures the implementation of supply programs water and sanitation
Regional Administration of Waters (ARA) ARA-Centro; ARA-Sul; ARA-Zambeze; ARA-Norte; ARA-Centro-Norte	Government Water Institutions	- Main role is in the management of resources (assessment of water beds and river basins). - Additional responsibilities include infrastructure management and water pollution issues.
Water Regulatory Council (CRA)	Government Water Institutions	- Responsible for setting the water and sanitation services standards and monitoring the service quality provided by the different service providers. - Works with those who are operating water systems.
Fundo de Investimento e Património do Abastecimento de Água (FIPAG)	Water Operator	- Water Operator in Major Cities - Responsible for the provision of water services. - Under management of: 1) MOPHRH; and, 2) Ministry of Finance
Administração de Infraestruturas de	Water Operator	- Water Operator in Secondary Cities

Abastecimento de Água e Saneamento (AIAS)		- Promote autonomous, efficient and financially sustainable management of public water supply and sanitation systems.
Informal small-scale independent water providers	Water Operator	- Water Operator in Rural Areas - Provide access to fresh water for rural areas that are not serviced by FIPAG
National Disasters Management Institute (INGD)	Government Disaster Management Institutions	- Coordinates disaster risk management activities across Mozambique. - Activities span national, provincial, municipal and community level. - Three regional emergency operation centers (CENOE) handle: 1) cyclones and droughts (Vilankulos), 2) floods (Caia) and 3) cyclones (Nacala)
Cabinet of Reconstruction Post-Cyclones (GREPOC)	Government Disaster Management Institutions	- Reconstruction of areas impacted by disaster - Post cyclone reconstruction cabinet
Government of UK Government of USA Government of Netherlands Government of Canada Government of Sweden Government of Switzerland	International Aid	- Funding for specific water projects
World Bank United Nations African Development Bank SETSUN WFP UNICEF World Vision	NGOs	- Funding for specific water projects
Local Associations	Community Associations	- Help identify those most in need and then help distribute aid. - Work directly with social services and INGD

Institutional Actor Category - Government Water Institutions

The primary agency responsible for water supply, sanitation and rainwater drainage services is the Ministry of Public Works, Housing and Water Resources (MOPHRH) (USAID, 2021). The agency provides the overarching direction for the overall maintenance, regulation and management of water resources and water institutions. Its responsibilities include setting the policy, analyzing the infrastructure needs and regulating the institutional actors responsible for the implementation of the policy. MOPHRM is the overseeing authority for all water supply, sanitation and discharge processes (DNGRH, 2017). As a result, all other ‘government water institutions’ fall under its umbrella.

National Directorate of Water Resources Management (DNGRH) is housed within the MOPHRM and is responsible for setting water management policies, strategies and management of water resources. The agency is responsible for developing specific policies for river basins, ensuring compliance with treaties that cover shared water resources, analyzing water accessibility and demand of river basins and creating water management plans (USAID, 2021).

National Directorate of Water Supply and Sanitation (DNAAS) is responsible for supplying drinking water and sanitation to populations, ensuring the implementation of supply programs for water and sanitation. It’s role is different from the DNGRM since it is not concerned with policy setting, but rather the implementation of policies, strategies, standards, regulations, and technical specifications as set out by DNGRM, ARA’s, CRA and other agencies in relation to the supply of drinking water and the provision of sanitation services. In addition, DNASS works to promote investment into water infrastructure and serves in a variety of monitoring and awareness building capacities (DNGRH, 2017).

Regional Water Administrations (ARA's) are responsible for the management of water resources. This includes the assessment of water beds and river basins, managing dam's, collecting hydrological data, granting licenses for water management, establishing protected areas, and managing conflicts among users of water basins. There are five autonomous ARA's across the nation and include: ARA-Centro; ARA-Sul; ARA-Zambeze; ARA-Norte; ARA-Centro-Norte (DNGRH, 2017). The Water Regulatory Council (CRA) is responsible for setting the water and sanitation services standards and monitoring the service quality provided by the different service providers. Works with those who are operating water systems. Laboratory for Hygiene and Water works with CRA to test water samples from various point sources to ensure that the quality of water provided by the water service providers meets all requirements and regulations set out by CRA and DNAAS.

Institutional Actor Category - Water Operator

Fundo de Investimento e Património do Abastecimento de Água (FIPAG) has responsibility for urban water through a delegated management framework. FIPAG was created to mobilize investments and manage the water supply systems in the provincial capitals, strategic cities and other large cities.

Administração de Infraestruturas de Abastecimento de Água e Saneamento (AIAS) is responsible for the management of the assets of the secondary public water distribution systems and those allocated to it, and for the public wastewater drainage systems, promoting their autonomous, efficient, and financially viable, through delegation to private operators or other entities.

Water supply for those not covered by FIPAG or AIAS systems is provided by informal small-scale independent water providers or individual water points under the national responsibility of DNAAS.

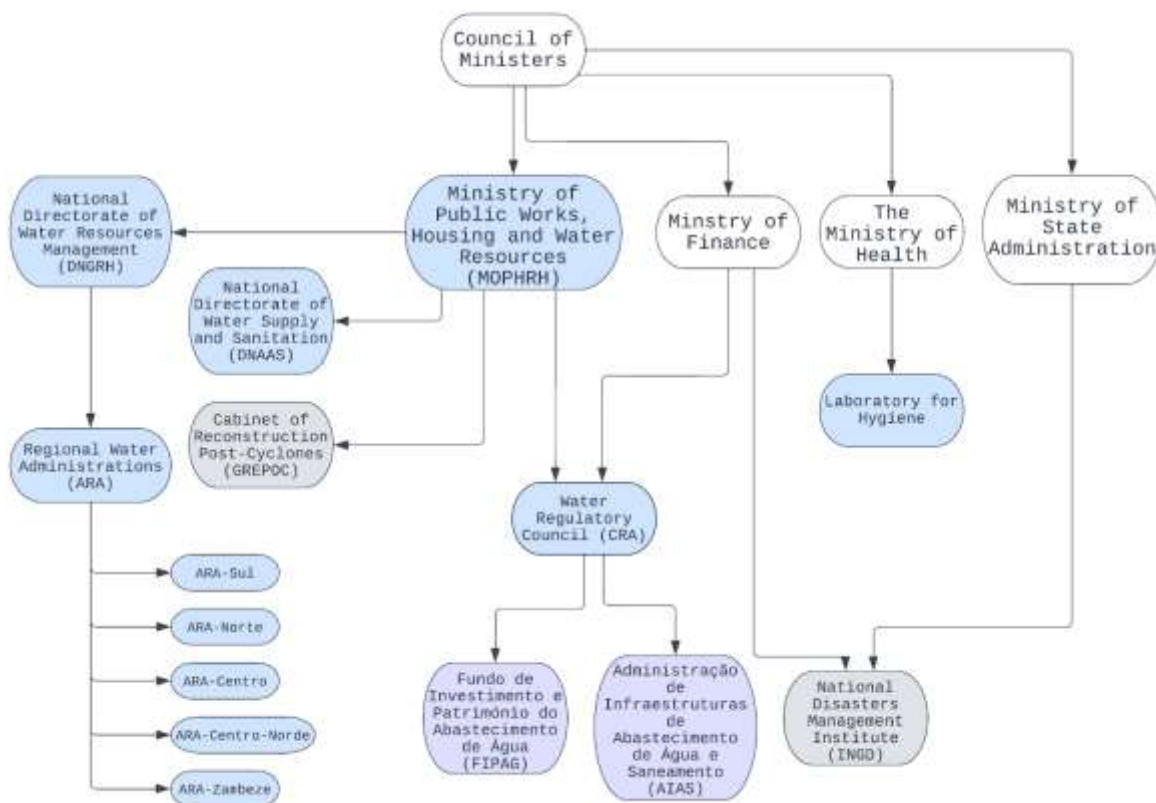
Institutional Actor Category - International Aid and NGOs

International aid pertains to nation states, whereas NGOs represent non-governmental organizations. By definition, these two actor classes are different from one another; however, in the context of their involvement in the disaster response, they fulfill the same role and can be considered one and the same. Both international aid and NGOs primary role is in the provision of financial resources towards water infrastructure projects and clean water services following Cyclone Idai.

Institutional Actor Category - Community Associations

Community associations play an important role in the dissemination of knowledge and information to community members. They work closely with various government organizations to help identify vulnerable community members and identify where aid is most needed.

Figure 8: Authority structure and departmental separation across government agencies and other actors involved in fresh water access.



4.3.5. Summary Of Findings

The purpose of this research objective research sub-objective was to identify the network of actors involved in disaster response associated with drinking water access following Cyclone Idai.

To establish whether this network was fragmented, this objective was evaluated by looking at the overarching disaster management policy in Mozambique and an overview of the major governmental departments and agencies that define the roles and responsibilities of the actors. Document analysis as well as expert interviews were used to support this analysis.

The findings are presented in Table 1: List of Actors and Responsibilities. Additionally, Authority structure and departmental separation across government agencies and other actors involved in freshwater access can be observed in Figure 3. Together, the two items depict the array of actors and authority structures present in the freshwater management structures within Mozambique.

4.4. Research Objective #3 Findings

Sub-Research Question 3:

Are the relationships among institutional actors fragmented? How does this fragmentation impact the extent of the disruption in freshwater access following Cyclone Idai?

Research Objective 3:

Evaluate whether the network of actors involved in disaster response associated with drinking water is fragmented. Discuss how this fragmentation amplified the disruption in water access following Cyclone Idai.

4.4.1. Research Objective Overview - Methodology (Expert Interviews)

The previous research objectives looked at whether Cyclone Idai had an impact on access to fresh water for residents of Beira. Following an analysis of data found in the Beira Household Domestic Survey, it was concluded that Cyclone Idai indeed had a significant impact on the access to fresh water for residents of Beira. The subsequent research objective was to identify the network of actors involved in disaster response associated with drinking water access following Cyclone Idai.

Having established that there was a significant impact on the access to fresh water and identified who the actors responsible for this are, this dissertation can now turn towards its final

objective. The last research objective evaluates whether the network of actors involved in disaster response associated with drinking water is fragmented and discuss how this fragmentation amplified the disruption in water access following Cyclone Idai. The objective of this inquiry is not to establish that the entire network of institutional actors is fragmented, but rather, to demonstrate specific cases of fragmentation among specific actors. Once the specific example of fragmentation is identified, it is discussed considering how it could have amplified the disruption in access to drinking water following Cyclone Idai.

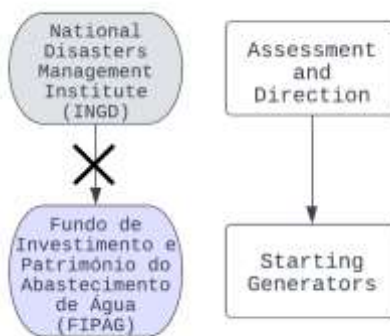
Three different examples of actor fragmentation are discussed in this section. The analysis of these examples are done primarily by looking at a variety of primary data collected. This data includes focus group discussions, expert interviews, and field visits. Secondary resources were also used to supplement as well as contextualize the findings obtained through primary data.

4.4.2. Institutional Fragmentation, Embedded Case Study 1 - Fragmentation between water supplier and INGD

Introduction

The first embedded case study of institutional fragmentation in the context of Beira following Cyclone Idai looks at the fragmentation between water suppliers and INGD. This embedded case study illustrates how actor fragmentation can have a direct and immediate impact on the provision of freshwater services immediately after the disaster took place. Moreover, the consequences of this actor fragmentation were not only felt in the immediate aftermath but were far more long lasting. The following graphic illustrates the chain of relationships that were involved in this embedded case study.

Figure 9: Embedded Case Study 1 - Fragmentation between water supplier and INGD



Relationship Description

Among the three embedded case studies that are discussed in this section, this one is the most direct and involves just two institutional actors. The embedded case study looks at the restoration of fresh water supply in the immediate aftermath of Cyclone Idai and the primary actors involved include: the National Disasters Management Institute and the Fundo de Investimento e Patrimônio do Abastecimento de Água (FIPAG). This embedded case study analysis discusses how the dissimilar set of objectives and responsibilities, and a lack of clear communication and efficient collaboration can prevent efficient and effective action. Moreover, this example illustrates how actor fragmentation can amplify the negative consequences of disaster events. In this case, it led to the disruption in access to fresh water for a significant segment of the population, for days following the disaster event.

The embedded case study being discussed has been summarized by Interview Respondent B5 during expert interviews. In the early hours of Cyclone Idai, FIPAG quickly became unable to supply water due to a lack of power. FIPAG had generators but the problem was with buying fuel. While fuel reservoirs would cost a lot of money and were not a viable

option for the operator, FIPAG was able to amass a small reservoir in the days leading up to the Cyclone, as it became increasingly apparent that the coming Cyclone would produce significant damages. Unfortunately, FIPAG was unable to start the generators as they had to await the permission from INGD. FIPAG had to wait almost a full day from when the water pumps went offline to when they finally received the go ahead from INGD to kickstart the generators. Nonetheless, by the time FIPAG was able to restart the pumps through the use of the generators, it was too late. The water filtration process was already disrupted, and a full system flush was required. It took 4 days until the system was restored and even then, it only operated at a fraction of its full capacity. In the meantime, desperate residents began digging up the water pipes in search of clean water and further amplified the damages to the water infrastructure. It would take weeks and millions of dollars until the water facilities would be back to their pre-Cyclone Idai capacity (Interview Respondent B5).

Embedded Case Study Analysis

National Disasters Management Institute (INGD) is the organization responsible for the coordination of disaster risk management activities across Mozambique. When discussing the chain of command with FIPAG authorities, they remarked that INGD has to be first in line after the disaster, other institutions have to wait for a signal (Interview Respondent B2). What this means is that any resource deployment and any major actions undertaken following a disaster need to be first cleared with INGD.

The major reason provided was that INGD has the best know-how in how to deal with disasters and while there are limited resources available, they need to be deployed in the most efficient way possible through a central authority (Interview Respondent B2). However, when probed how this plays out in practice, a senior INGD official remarked that INGD Protocols

make it difficult to collaborate (Interview Respondent A3). There are a lot of bureaucratic hurdles that need to be overcome and that often leads to major issues. There are numerous forms and protocols that need to be adhered to and they cannot be easily sidelined.

In addition to the above-mentioned challenges, a senior disaster management authority remarked that, “the INGD which is the organization in charge of disasters, but their mandate is always post-disasters. In their capacity they will not be able to handle the situation after Cyclone Idai - they have never been in a situation like Idai” (Interview Respondent A1). This further undermined the capacity of the institution of INGD to effectively conduct inter-actor collaboration activities and amplified actor fragmentation.

Fragmentation and Amplification of Disaster

This embedded case study illustrates fragmentation among institutional actors involved in the restoration of freshwater services following Cyclone Idai. A hierarchical approach to disaster risk management offers some benefits in as much as it allows for a coordinated response from a central agency. However, in times of crisis, where communication channels are disrupted, emergencies are present in virtually every aspect of the community and the organizational capacity to address each emergency in a prompt manner, this approach can generate fragmented actor relationships. Given the time sensitive nature of restoring the freshwater access and the delay experienced resulting from having to wait from the permission of other departments, this embedded case study clearly illustrates the features of actor fragmentation as outlined by Alashwal & Hamzah (2014):

- lack of coordination,
- lack of collaboration integration,
- poor communication, and

- diversity of specializations of contractual partners and various functional disciplines (p. 5)

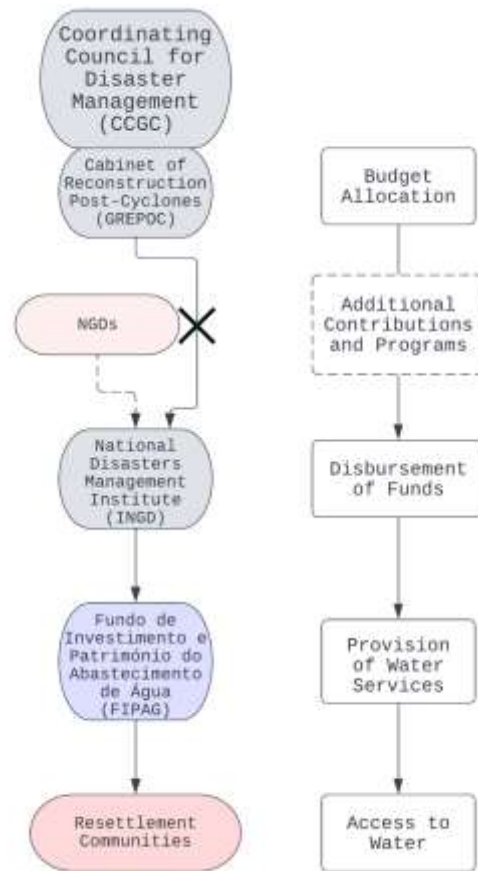
Furthermore, the lack of clear communication and directives between the two organizations led to the failure to restore freshwater services in the immediate aftermath of the disaster event, which then resulted in more severe consequences as the delay caused an array of secondary consequences that would result in the disruption lasting days. Notably, the Cyclone caused significant damages to the water facilities and was responsible for the reduction in the availability of clean water. The further disruption was not only caused by Idai, but also “by people who dig up pipes and break them in order to gain access to drinking water” (Dutch Water Sector, 2019, p. 1).

4.4.3. Institutional Fragmentation, Embedded Case Study 2 - Disconnect between Local Communities and Disaster Governance

Introduction

The next embedded case study of institutional fragmentation in the context of Beira following Cyclone Idai looks at the fragmentation between local communities and disaster governance agencies. This example illustrates a less immediate example of actor fragmentation, largely because this relationship evolved over the ensuing months as various institutional actors charged with the provision of fresh water services failed to establish a sustainable strategy to ensure its continued supply, or in the alternative, a suitable market alternative. The following graphic illustrates the chain of relationships that were involved in this case study.

Figure 10: Embedded Case Study 2 - Disconnect between Local Communities and Disaster Governance



Embedded Case Study Description

According to INGD, following Cyclone Idai 126,018 people were accommodated across 132 accommodation centers (Interview Respondent A3). The accommodation centers were only a temporary solution, and they were intended to be replaced by 21 resettlement areas where permanent communities could be built. During the field work, a focus group discussion took place at one of the resettlement areas during which the residents were probed to discuss any issues or challenges they may be facing in accessing fresh water.

According to the residents, initially, all resettlement areas were outfitted with a central water pump where anyone would have access to fresh water, “because it is a resettlement community, the government put in place infrastructure to provide water for the community” (Interview Respondent C5).

Embedded Case Study Analysis

FIPAG is the primary provider of water services in many of those resettlement areas. Initially, FIPAG provided some communities with free water, having received funding from the emergency fund. However, after some time, the fund ran dry, and the water services were shut off. In the words of one of the residents, “in August 2022 FIPAG stopped giving free access to water in the community and now we have to pay for it” (Interview Respondent C10). Following this closure, to have access to FIPAG water, each household needed to pay an installation fee to bring the water to their home, in addition to the cost per use. The focus discussions revealed that most households were not able to afford the cost and were left with the only available clean water source in the form of a public access pump which can be upwards of 1 km away from people’s place of residence.

Having learned of this situation, it was brought up in the latter expert interviews with one of the water supplier authorities who admitted that he was unaware of this situation and was under the impression that all resettlement communities had readily accessible fresh water sources (Interview Respondent B4).

Fragmentation and Amplification of Disaster

The problem of water access at the resettlement communities illustrates inter-governmental actor fragmentation. GREPOC is the main agency responsible for the budgetary

allocations that can then be used by INGD to pay FIPAG for the provision of water services. Without the budgetary allocation, FIPAG is unable to provide freshwater access to resettlement communities. This illustration of actor fragmentation is perhaps not as all encompassing as the one discussed in the first embedded case study, but it does highlight at least one of the features of actor fragmentation as outlined by Alashwal & Hamzah (2014), the lack of coordination. GREPOC, INGD and FIPAG failed to coordinate their efforts to ensure that the members of resettlement communities continued to access freshwater in their new place of residence.

This lack of coordination among the government agencies responsible for the provision of freshwater in the resettlement communities led to the amplification of the disaster, at least for those located within those resettlement communities. In many ways, the forced relocation of various communities into the resettlement communities is an extension of Cyclone Idai. The residents of those newly formed resettlement communities would not have been there had it not been for Cyclone Idai. As a result, and having placed them there in the first place, the government owes those resettlement communities a responsibility to provide freshwater services or ensure that easily accessible fresh water can be accessed in a reasonable manner. The failure to do so can rightly be considered an amplification of the disaster in the long term and is the direct result of the fragmented relationships among the GREPOC, INGD and FIPAG.

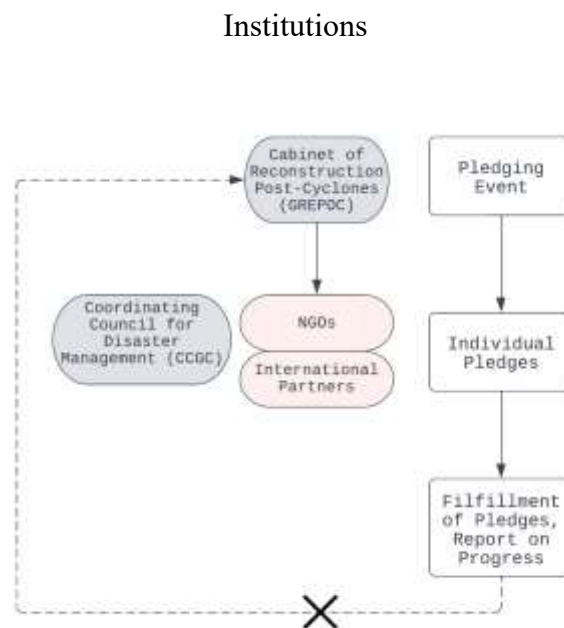
4.4.4. Institutional Fragmentation, Embedded Case Study 3 - Fragmentation between NGOs and Disaster Management Institutions

Introduction

The final embedded case study of institutional fragmentation in the context of Beira following Cyclone Idai looks at the fragmentation between NGOs and Disaster Management Institutions. This embedded case study illustrates the most evident example of actor

fragmentation. Similarly to the first embedded case study analyzed, this example clearly illustrates all of the features of actor fragmentation as outlined by Alashwal & Hamzah (2014): “lack of coordination, lack of collaboration integration, poor communication, and diversity of specializations of contractual partners and various functional disciplines” (p. 5). This example is more notable than the first embedded case study, because while the first embedded case study was mostly concerned with the fragmentation among two different institutional actor groups, this embedded case study displays fragmentation across more than 20 different organizations, all involved in essential disaster reconstruction priorities. The following graphic illustrates the chain of relationships that were involved in this embedded case study.

Figure 11: Embedded Case Study 3 - Fragmentation between NGOs and Disaster Management



Embedded Case Study Description

According to the post-disaster needs assessment documents, \$3.2 Billion USD was needed for reconstruction, while only \$1.2 Billion USD was promised in commitments (PDNA,

2019). As a result, GREPOC had to work with partners to assess and prioritize reconstruction needs. There were around 21 - 25 partner organizations. Broadly speaking, the \$1.2 Billion USD promised through commitments included:

- The reorientation of the national budget.
- The application of fiscal benefits to support reconstruction, including the granting of payment of Taxes and Fees by assessing the financial situation of each operator.
- The contribution of local governments.
- The contribution of the private sector.
- The contribution of cooperation partners, including multilateral agencies.
- The portion of the financing gap that donors can support (PDNA, 2019).

Partners were presented with a needs list, and they could choose which projects they wished to support based on their own initiatives and mandates. This process was described in the following way by one of the disaster management authorities working closely with the donor groups,

What they did is just to pick an item of that long list. You are the one referring to the government of Mozambique that tells them my list is this one and he (donor) is free to go to that long list and pick what they can provide as assistance. So, we do not have a choice on that one. But for a situation like we were in after the cyclone, everything on the list was a priority (Interview Respondent A1).

Yet despite the pledging event and the numerous commitments made many of the pledges did not materialize and there was very little that could be done in order to hold the partners accountable. Additionally, for the pledges that were committed to and reported as completed, they too had their drawbacks in terms of the reporting, the selection of relevant targets and even coordination of efforts.

Embedded Case Study Analysis

A senior disaster management authority noted that the partner organizations often do not report on their efforts or provide any accounting of what they were able to accomplish and what needs remain in need of fulfillment (Interview Respondent B2). Additionally, the selection of relevant targets proved to be a significant challenge. The same expert noted that while the need

for reconstruction was far greater than the aid promised through commitments, the government hoped that at least the most essential needs would be met. However, in practice this outcome did not materialize. He described this dilemma in the following way:

NGO's normally have a specific target. For example, if they say they like yellow colors, you will barely be able to change this preference to another color. If they say our goals or we feel or we think that we are doing the right thing by liking yellow colors, you cannot change that (Interview Respondent A2).

In this description, the expert encapsulates the idea that NGOs have their own targets and aims, and the disaster management institutions cannot change their goals, simply because the need is greater somewhere else.

It is for this and many other reasons that the coordination of efforts between disaster management institutions and partner organizations was described as a 'headache'. In fact, one of the experts even noted that, the disaster management institutions were not certain if it would be worthwhile to "spend more time talking to NGOs or if [it was more worth their time] to assist the most needy people" (Interview Respondent A1).

Focus group discussion confirmed that organizations that made promises to them have not delivered on many of these promises. Community leaders have not seen things improving since the Cyclone. Several community members noted that most NGOs bring their own plans that are not suitable for the local contexts and sometimes bring more harm than help (Interview Respondent C3, C9, C10). Several NGOs pledged significant resources towards those resettlement communities and initially delivered on those promises. It was not until a few months later that many of them began abandoning the settlement communities and leaving the residents without the vital aid and assistance that has become an integral resource in their struggle for survival. At the same time, the emergency provisions that were once provided by the government

began to diminish. At one of the focus group discussions, a local resident representative remarked that most NGOs bring their own plans that are not suitable for the local contexts. They arrive with the intention of fulfilling their mandate and leave as soon as they can accomplish their objective, without any consideration for the community left behind (Interview Respondent C9).

Fragmentation and Amplification of Disaster

The problem of coordination of efforts between NGOs and Disaster Management Institutions illustrates actor fragmentation. When the need for reconstruction is as great as it was following Cyclone Idai and the available resources are hardly able to cover $\frac{1}{3}$ of the total need, the efficient allocation of those resources is of utmost importance. For this to happen, the actors involved need to collaborate effectively and efficiently. The embedded case study presented previously illustrated how fragmented the relationship was among the NGOs and Disaster Management Institutions across many different domains. The analysis illustrated how the NGOs failed to report on their efforts and provide this information to the relevant authorities. As a result of this, the authorities could not establish whether a particular need has been met and if there are any additional steps that need to be taken. Additionally, the selection of relevant targets by partner organizations proved to be a challenge. The process through which the targets were selected was described as rather haphazard and did not include any strategic planning and coordination. Instead, it was mostly defined as random and not very purposeful. Lastly, the coordination efforts too proved to be a significant challenge, even to a point where some of the Disaster Management Institutions authorities considered whether further collaboration with certain partner organizations would be preferable to just spending the time and resources on trying to provide aid directly to the affected.

The actor fragmentation as experienced by the NGOs and Disaster Management Institutions in their shared effort to assess and prioritize reconstruction needs points to the conclusion that the effects of the disaster were amplified. The failed coordination of efforts amplified the disaster consequences for a variety of reasons. For one, the effort at coordination tied up valuable resources from the Disaster Management Institutions that could otherwise have been deployed in the most critical areas. The failure to report on their ongoing efforts by the partner organization also amplified the severity of the impact of Cyclone Idai, especially in areas where the pledges were not fulfilled, and the Disaster Management Institutions were under the impression that genuine efforts are taking place.

4.5. Summary of Key Findings

In terms of the first research objective, the analysis established that Cyclone Idai had an impact on the access to fresh water for residents of Beira. The survey results revealed that a vast majority of respondents experienced a disruption in the drinking water source immediately after Cyclone Idai. Two years following the disaster, this figure decreased significantly to 18.7% illustrating a significant shift from the conditions that were present immediately after the disaster and confirming the impact of Cyclone Idai on the experienced disruption. Additionally, the survey revealed that there has been a shift in the number of times that each household experienced a lack of clean water following the disaster. The trajectory of the change in frequency is in the negative direction which indicates that as a result of the disaster, households were likely to experience a disruption in clean water access more often. Lastly, this research objective looks at the survey results surrounding infrastructure damages. The impact to residential and institutional infrastructure reported in the literature overview was confirmed by the survey results with 99.2% of respondents reporting impact on their homes and $\frac{3}{4}$ citing that

destroyed water infrastructure was the main reason for the disruption of their household's access to drinking water.

Secondly, the network of actors involved in disaster response associated with drinking water was identified and presented in Table 1: List of Actors and Responsibilities. Research objective analysis has identified 13 institutional actors that are involved in disaster response associated with drinking water access. Among all of those actors, several actor groups emerged. Those groups include: 1) government water institutions, 2) government disaster management institutions, 3) water operators, 4) international aid, 5) NGOs; and 6) Community Associations. All of those groups of institutional actors were intimately involved in the disaster response and often had to coordinate their efforts together in order to ensure that adequate access was restored as promptly as possible. The actors included: Laboratory for Hygiene and Water, Ministry of Public Works, Housing and Water Resources (MOPHRH), National Directorate of Water Resources Management (DNGRH), National Directorate for Water Supply and Sanitation (DNAAS), Regional Administration of Waters (ARA), ARA-Centro; ARA-Sul; ARA-Zambeze; ARA-Norte; ARA-Centro-Norte, Water Regulatory Council (CRA), Fundo de Investimento e Património do Abastecimento de Água (FIPAG), Administração de Infraestruturas de Abastecimento de Água e Saneamento (AIAS), Informal small-scale independent water providers, National Disasters Management Institute (INGD), Cabinet of Reconstruction Post-Cyclones (GREPOC), Government of UK, Government of USA, Government of Netherlands, Government of Canada, Government of Sweden, Government of Switzerland, World Bank, United Nations, African Development Bank, SETSUN, WFP, UNICEF, World Vision and Local Associations.

Additionally, authority structure across government agencies and other actors involved in freshwater access was illustrated (Figure 3).

Lastly, the third research objective illustrated examples that display that the network of actors involved in disaster response associated with drinking water is fragmented and discussed how this fragmentation amplified the disruption in water access following Cyclone Idai. Three different examples of actor fragmentation were discussed in this section. The first embedded case study illustrated how the lack of clear communication and directives between FIPAG and INGD led to the failure to restore freshwater services in the immediate aftermath of the disaster event, which then resulted in more severe consequences as the delay caused an array of secondary consequences that would result in the disruption lasting days. The second embedded case study illustrated how a lack of coordination among government agencies responsible for the provision of freshwater in the resettlement communities led to the amplification of the disaster for those located within those resettlement communities. Lastly, the third embedded case study illustrated the problem of coordination of efforts between NGOs and Disaster Management Institutions and showed how this amplified the severity of the impact of Cyclone Idai, especially in areas where the pledges were not fulfilled, and the Disaster Management Institutions were under the impression that genuine efforts are taking place.

5. Summary, Implications and Conclusions

5.1 Research Context

Globally, disasters affect every domain of human activity and cause devastating losses across the human, economic and environmental domains. While they are extremely difficult to predict and prevent, the global society is, in principle, more than capable of mitigating many of the most severe consequences. Worryingly, while the prevailing efforts often fall short future disaster impacts are likely to become even less effective because of several compounding factors (climate change, population growth, urbanization, availability of financial resources and governance issues). Those variables will make disasters more persistent, severe, costly, and difficult to manage in the ensuing decades.

Within the academic literature, multiple pathways to disaster risk management have been offered and many more continue to become apparent. Yet, despite the multitude of approaches, issues around disaster risk management persist. Building from this broader discourse in the literature various novel perspectives emerge to resolve the criticisms levied against many of the existing DRM paradigms and address the themes on the failures of existing DRM approaches. The most pertinent among them is the addition of institutional vulnerability as an independent lens for assessing vulnerability.

The theoretical analysis of institutional vulnerability as a lens for improving our approach to disaster risk management provides a strong rationale for the recognition of institutional vulnerability as an insightful tool in addressing the most common areas of criticism around the existing DRM approach. However, while theoretical analysis provides a strong foundation for this approach and continues to build credibility in the DRM literature, additional research is

needed to further advance the knowledge in this field and help produce recommendations that might one day lead to more comprehensive disaster risk management frameworks.

It is for this reason that the central focus of this dissertation has been to conduct applied research that looks at the relevance of considering the institutional vulnerability dimension in assessing the disaster risk management efforts through a specific case study. It is the belief of the researcher that serves as the natural next step to help bridge this research gap and add to the growing body of knowledge around institutional vulnerability.

5.2 Research Problem and Research Questions

The aim of this research has been to investigate how institutional vulnerability impacts disaster response and amplifies the disruptions in essential services following disaster events. In order to address this broader question, the research question selected sought to analyze,

How does fragmented coordination among institutional actors involved in disaster response impact access to drinking water following disasters?

A disaster setting has been identified to provide context-specific analysis of the theoretical insight offered by the institutional vulnerability lens. The setting selected for this purpose is the City of Beira, Mozambique.

The thesis of this manuscript posits that the severity of the disruption in access to fresh water following Cyclone Idai was amplified by a fragmented coordination among actors involved in disaster risk management. To support the thesis a, a set of research objectives have been identified to address each sub-research question and shape how they are addressed in the subsequent data analysis. Those research objectives are:

- Trace the extent, magnitude and characteristics related to the disruption in access to drinking water following Cyclone Idai.
- Identify the network of actors involved in disaster response associated with drinking water.
- Evaluate whether the network of actors is fragmented. Discuss how this fragmentation amplified the disruption in water access following Cyclone Idai.

5.3. Summary of Findings

Based on the findings outlined in the analysis of results section, it can be concluded that fragmented coordination among institutional actors involved in disaster response impacts access to drinking water following disasters.

Beginning with the first research objective, the survey results revealed that a vast majority of respondents experienced a disruption in the drinking water source immediately after Cyclone Idai. In the second place, the network of actors involved in disaster response associated with drinking water was identified. Lastly, the third research objective illustrated examples that display that the network of actors involved in disaster response associated with drinking water is fragmented and discussed how this fragmentation amplified the disruption in water access following Cyclone Idai.

Taken together, the findings indicate that in specific circumstances, stakeholder fragmentation directly translated to a disruption in water access following Cyclone Idai. Referring to the definition of stakeholder fragmentation, the term has been defined as, “the lack of coordination, collaboration integration, poor communication, and diversity of specializations of contractual partners and various functional disciplines” (Alashwal & Hamzah, 2014, p.5). The case scenario selected for the purpose of this research illustrates several different examples that showcase the various aspects of the definition.

Three different examples of actor fragmentation were discussed. The first embedded case study illustrated how the lack of clear communication and directives between FIPAG and INGD led to the failure to restore freshwater services in the immediate aftermath of the disaster event, which then resulted in more severe consequences as the delay caused an array of secondary consequences that would result in the disruption lasting days. The second embedded case study illustrated how a lack of coordination among government agencies responsible for the provision of freshwater in the resettlement communities led to the amplification of the disaster for those located within those resettlement communities. Lastly, the third embedded case study illustrated the problem of coordination of efforts between NGOs and Disaster Management Institutions and showed how this amplified the severity of the impact of Cyclone Idai, especially in areas where the pledges were not fulfilled, and the Disaster Management Institutions were under the impression that genuine efforts are taking place.

5.4. Confirmation of Criticisms in the Field of DRM

In the introduction to the current themes in the literature on DRM, the paper recognized that there is a growing recognition in the DRM on the failures of many of the existing disaster risk management approaches. Once again referring to Ghosh & Boyd (2019), “existing DRM approaches are failing spectacularly to enhance resilience of communities, address disaster frequency and mitigate loss and damages” (p. 101236). These failures have been encapsulated in the discussion of the most common themes in the literature. They include:

- 1) Need for more efficient role allocation;
- 2) Need for flexible methodologies, and;
- 3) Calls for the revision of existing frameworks.

The case study of Cyclone Idai which struck Beira, Mozambique in March 2019 and the analysis conducted in this dissertation aligns with those criticisms and builds on the existing body of knowledge in Disaster risk management literature as well as research on vulnerability. Findings from the research objectives validate the major areas of criticism of the Disaster Risk Management paradigm present in the case study context.

From this research, there is a need for more efficient role allocation. Fragmented and irregular delivery of protection and aid directly impacts the livelihoods of those most impacted by disasters and is the immediate result of poor allocation of roles and responsibilities among those involved in the disaster risk management efforts. This was illustrated across the three case studies described. More efficient role allocation could have prevented the disruption in the filtration process that led to a full system flush and days-long delay in the restoration of freshwater. Clarity in the role distribution could have also reduced the disruption in freshwater services across the resettlement communities. What is more, the efficient role allocation across partner organizations could lead to a more efficient delivery of disaster aid and better outcomes.

Additionally, this research supports the conclusion that flexible methodologies are needed in the context of DRM. This case study outlined the unique conditions that define the study context of Beira, Mozambique. However, this determination is not unique, and diversity is found across every disaster context. It is for this reason that flexible methodologies need to be employed in the governing DRM paradigms. Examples of bureaucratic gridlock discussed in the relationship analysis illustrate why it is necessary to integrate flexibility into the DRM planning framework. A hierarchical approach to disaster risk management offers some benefits in as much as it allows for a coordinated response from a central agency. However, in times of crisis, where communication channels are disrupted, emergencies are present in virtually every aspect of the

community and the organizational capacity to address each emergency in a prompt manner, this approach generates fragmented actor relationships. By building in flexibility, any governing DRM paradigm allows for decision-makers to consider a wider variety of adequate responses and select those most pertinent to the situation at hand.

Lastly, this analysis also supports the assertion that there is a need for the revision of existing frameworks. This is largely because they fail to sufficiently integrate institutional vulnerability into their disaster risk management assessment.

5.5. Contributions

5.5.1 Theoretical Contributions

This research reveals how much insight into the analysis of vulnerability can be gained by looking at disasters from the institutional vulnerability perspective. The current literature on the topic of institutional vulnerability has recognized that this perspective can offer invaluable insight into the problem of disaster risk management. This is because it provides a critical lens for the analysis of the failures of existing DRM approaches that have not sufficiently integrated issues of governance. In response to this proposition, this research provides a strong rationale for the recognition of institutional vulnerability as an insightful tool in addressing the most common areas of criticism around the existing DRM approaches.

The theoretical framework that guides this research was developed based on the PAR model first introduced by Blaikie, Cannon, Davis & Wisner (1994) and later revised by Wisner et al (2004). The original PAR model was among the first frameworks to conceptualize vulnerability by explaining how structures and processes shape the vulnerability of communities

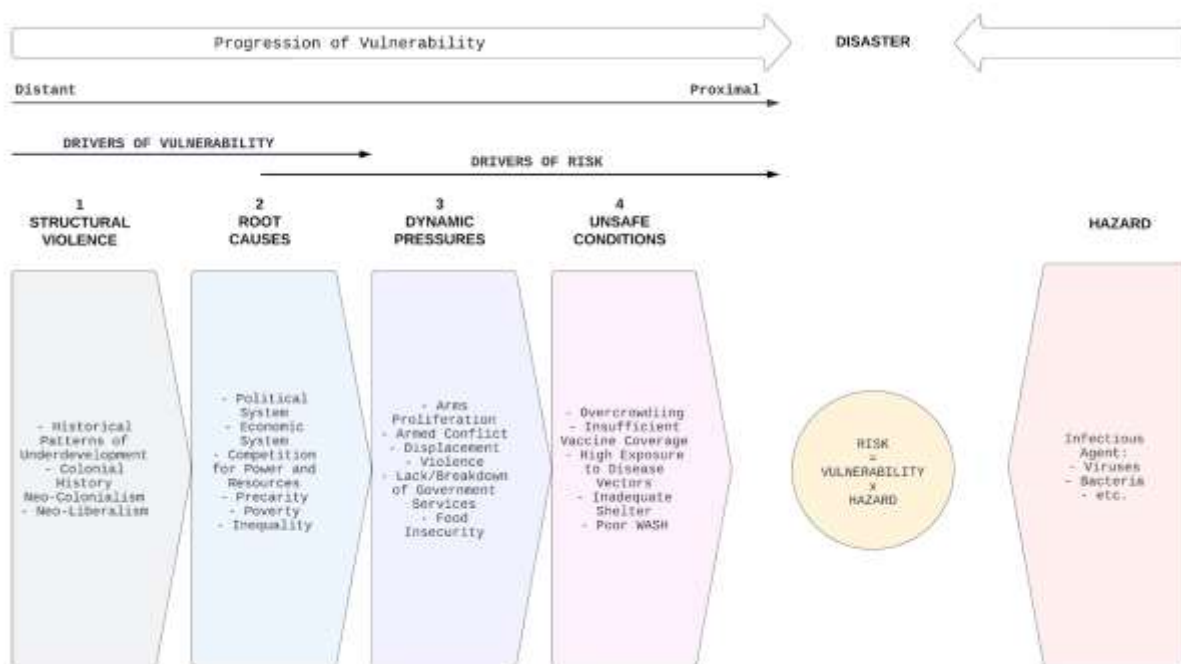
exposed. The adaptation of this framework as conceptualized in this research included the addition of ‘institutional vulnerability’ as the fourth category in the progression of vulnerability.

While the original framework integrates references to institutions, the main aid of this addition is to highlight how institutional vulnerability acts as a key filter in the progression of vulnerability and can serve to amplify all of the other factors, such as root causes, dynamic pressures and unsafe conditions. Beyond just expanding the PAR framework to include this new dimension, the insight proposed in this research seeks to also reconceptualize the understanding implied in the original PAR framework.

5.5.1.1. Adaptations of the PAR Model

The PAR model has served as the backbone for many researchers in the past 20 years in their analysis of vulnerability and disaster risk. Numerous iterations of this framework were conceived, and adaptations created, however the utility of the original concept and framework remains relevant to this day. Below is the reconceptualization of the PAR framework as it was adapted in Global Health.

Figure 2: Adaptation of the PAR Model for Health Emergencies, (adopted from: Hammer, Brainard, Innes, & Hunter, 2019).



As described by the authors of this reconceptualization of the PAR model, “this [approach] offers a theoretical model for renewed thinking about the meaning of risk and resilience and at the same time seeks to reconcile the language of health and medicine with the language of disaster studies and disaster response. The analysis of risk factors, augmented with the conceptual understanding of their place in the progression of vulnerability, is an important part of understanding how global health emergencies evolve” (Hammer, Brainard, Innes, & Hunter, 2019, p.1). While the authors make some adjustments on the originally stipulated factors that fall under the three stages in the progression of vulnerability, they largely accept their relevance and the revisions provided only serve as a more specific guide for health emergencies (as opposed to any other disaster type). Having largely relied on the PAR framework in their own conceptualization, the authors propose a more drastic addition, namely, a fourth pressure factor in the progression of vulnerability. They refer to this factor as ‘unsafe conditions’ (Hammer, Brainard, Innes, & Hunter, 2019). This factor includes concepts such as: “overcrowding,

insufficient vaccine coverage, high exposure to disease vectors, inadequate shelter, and poor water, sanitation and hygiene (WASH)” (Hammer, Brainard, Innes, & Hunter, 2019, p. 5).

The authors stress the need to consider the fourth factor and point to the literature in the topic of health emergencies and disaster risk management which unequivocally consider unsafe conditions to be a key risk factor for health emergencies. They further highlight that while the original three risk factors are, “undoubtedly the most direct risk factors, focusing only on them risks overlooking the complex causes of these unsafe conditions or risk factors”(Hammer, Brainard, Innes, & Hunter, 2019, p. 5).

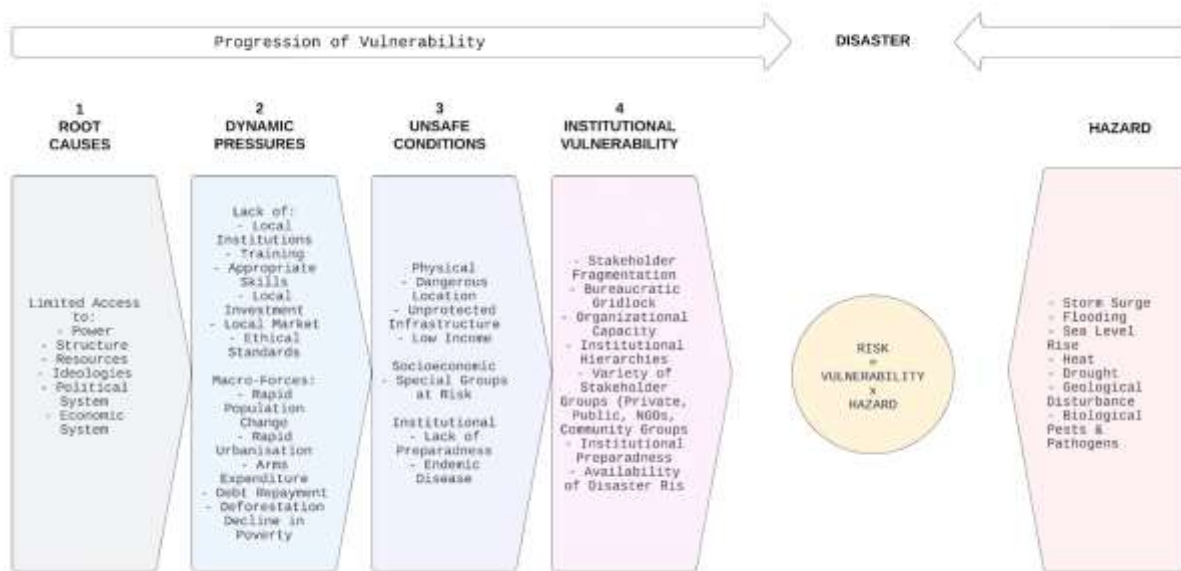
5.5.1.2. PAR Adaptation to Include Institutional Vulnerability

In a similar vein, this research proposes a similar expansion/reconceptualization of the original framework. The proposed framework will be largely the same as the original, with the addition of ‘institutional vulnerability’ as the fourth category in the progression of vulnerability. The proposed model adopts the same understanding of the progression of vulnerability as first proposed by Wisner et al. (2004). It recognizes vulnerability as the product of the progression of root causes, dynamic pressures and unsafe conditions across a disaster context. This model encapsulates the interactions and compounding nature these critical risk factors play in the disaster equation. While the original factors are, without a doubt, important considerations in the progression of vulnerability, focusing solely on them risks overlooking the critical role that institutional vulnerability has on the vulnerability of the system as a whole.

In terms of institutional vulnerability, this research proposes the inclusion of the following risk factors within the umbrella of institutional vulnerability: actor fragmentation, bureaucratic gridlock, organizational capacity, institutional hierarchies, composition of actor

groups (private, public, NGOs, community groups), institutional preparedness and availability of disaster risk management frameworks.

Figure 3: Adaptation of the PAR Model to Include Institutional Vulnerability



Actor fragmentation is the lack of coordination, collaboration integration, poor communication, and diversity of specializations of contractual partners and various functional disciplines. It leaves the various institutional actors responsible for disaster risk management activities working in isolation and failing to collaborate efficiently. The composition of institutional actor groups involved in disaster risk management activities is an amplifying factor in actor fragmentation as different arrangements of institutional actors necessitates different approaches and produces various inefficiencies. This is especially pertinent in developing nations which rely on external aid and support in the implementation of disaster risk management activities. This leads to gaps in disaster prevention actions and amplifies the negative

consequences disasters have on the communities involved (Birkmann, 2013; Diaz-Sarachage & Jato-Espino, 2019; Coutinho, Lucena & Henrique, 2020; Huck et al., 2020; Papathoma-Kohle, Thaler & Fuchs, 2021).

Bureaucratic gridlock and institutional hierarchies encapsulate the inefficiencies of existing governance frameworks that prevent efficient and effective action. Certain types of entrenched bureaucratic procedures and institutional hierarchies create unnecessary roadblocks towards effective disaster response and impede response efforts (Birkmann, 2013; Kita, 2017; Scolobig et al., 2015).

Lastly, institutional preparedness and availability of disaster risk management frameworks are critical in ensuring that disaster risk management plans have been created and are being implemented in line with the previously devised KPI's. Lack of preparedness and adequate planning can have devastating consequences when disasters strike not only in the immediate aftermath but also the medium- and long-term (Tierney, 2012; UNISDR, 2016; Jones et al., 2016; Kita, 2017; Coutinho, Lucena & Henrique, 2020).

The main aid of this addition is to highlight how institutional vulnerability acts as a key filter in the progression of vulnerability and can serve to amplify all of the other factors, such as root causes, dynamic pressures and unsafe conditions. Beyond just expanding the PAR framework to include this new dimension, the insight proposed in this research seeks to also reconceptualize the understanding implied in the original PAR framework.

In the original conceptualization of the PAR framework, the factors in the progression of vulnerability create a pressure that, when coupled with a hazard, turns into a disaster. As a result, a disaster is the product of these factors. The new approach proposed in this research expands on

this equation and considers the ongoing impact of institutional factors in the progression of the disaster event. The original three factors outlined in the PAR framework encapsulate the conditions preceding the disaster event and evaluate their impact of the disaster event.

The dimension of institutional vulnerability is different from the other three because it assesses the ongoing impact of institutional factors on the development of the disaster. On the one hand, institutional vulnerability considers the preceding institutional arrangements. But more importantly, this new approach gives recognition to the fact that those prior arrangements can play out in different ways as the disaster event develops. With this in mind, institutional vulnerability is both a factor in the progression of vulnerability, but also a key mitigating variable in the development of the disaster. The original three factors in the progression of vulnerability encapsulate the existing conditions that are a result of a number of historical, geographical, cultural, political, economic and other considerations. Those conditions are rather fixed and while amenable to change, this often occurs over longer time scales. Analyzing those factors is crucial in long term planning and setting of priorities but can have less immediate implications on the development of the disaster event.

Conversely, by expanding the analysis of the progression of vulnerability to include institutional vulnerability, it is possible to create a more comprehensive account of how a disaster unfolds and recognize the key role that institutional vulnerability has in amplifying or mitigating the disaster.

5.5.1.3. Utility of the Framework

Each of the risk factors identified under the umbrella of the term institutional vulnerability is a critical component of disaster risk analysis. Numerous scholars have referred to

these factors in varying contexts in their discussion on how to best address disaster risk from a governance perspective (Tierney, 2012; Birkmann, 2013; Jones et al., 2016; Kita, 2017; Diaz-Sarachage & Jato-Espino, 2019; Coutinho, Lucena & Henrique, 2020; Huck et al., 2020; Papathoma-Kohle, Thaler & Fuchs, 2021). This research proposes to unify this undercurrent and formalize it under the shared umbrella term of ‘institutional vulnerability’. In addition, this concept can be integrated within the PAR Framework as a critical factor in the progression of vulnerability. Institutional vulnerability is a worthwhile addition within this framework as it is a factor capable of amplifying vulnerability of the system exposed through actor fragmentation, bureaucratic gridlock, organizational capacity, institutional hierarchies, composition of actor groups (private, public, NGOs, community groups), institutional preparedness and availability of disaster risk management frameworks.

5.5.1.4. Relevance of the Proposed Framework in DRM Research

This dissertation illustrated the utility of integrating institutional vulnerability as the fourth dimension in the progression of vulnerability by showing how institutional vulnerability can act as a key filter in the progression of vulnerability and can serve to amplify all of the other factors, such as root causes, dynamic pressures and unsafe conditions.

In the original conceptualization of the PAR framework, the factors in the progression of vulnerability create a pressure that, when coupled with a hazard, turns into a disaster. As a result, a disaster is the product of these factors. The new approach proposed in this research expands on this equation and considers the ongoing impact of institutional factors in the progression of the disaster event. Each of the three relationships discussed in research objective #3 illustrated how actor fragmentation had an ongoing impact on the amplification of the disaster event in the immediate aftermath and well into the future. The consequences of institutional vulnerability

were not limited to the initial impact but also translated into the short-, medium-, and long-term responses of the institutional actors involved in disaster risk management planning.

The research findings support the conclusion that institutional vulnerability is both a factor in the progression of vulnerability, but also a key mitigating variable in the development of the disaster. Furthermore, by expanding the analysis of the progression of vulnerability to include institutional vulnerability, it is possible to create a more comprehensive account of how a disaster unfolds and recognize the key role that institutional vulnerability has in amplifying or mitigating the disaster.

It is for this reason that institutional vulnerability is a worthwhile addition within this framework as it is a factor capable of amplifying vulnerability of the system exposed through actor fragmentation, bureaucratic gridlock, organizational capacity, institutional hierarchies, composition of actor groups (private, public, NGOs, community groups), institutional preparedness and availability of disaster risk management frameworks.

The utility of this adapted framework was exemplified in the research analysis through the numerous examples of actor fragmentation and how this fragmentation led to an amplification of the negative consequences of the disaster event. Having shown the utility of this revision, the expanded application of this framework can serve as a tool for future researchers to strategically integrate institutional vulnerability into their disaster risk management assessment.

5.5.2. Empirical Contributions

This research also contributes to the growing body of research of institutional vulnerability. As has already been mentioned, while theoretical analysis of institutional vulnerability as a lens for improving our approach to disaster risk management continues to build credibility and receive

attention, to date, no applied research has been undertaken to explore the relevance of considering the institutional vulnerability dimension in assessing the disaster risk management efforts in any given setting.

The theoretical analysis of institutional vulnerability as a lens for improving our approach to disaster risk management provides a strong rationale for the recognition of institutional vulnerability as an insightful tool in addressing the most common areas of criticism around the existing DRM approach. However, while theoretical analysis provides a strong foundation for this approach, additional research is needed to further advance the knowledge in this field and help produce recommendations that lead to more comprehensive disaster risk management frameworks.

Findings of this applied research indicate that in specific circumstances, stakeholder fragmentation directly translates to negative disaster impacts. This finding provides a one of the first examples of applied research that illustrates the relationship between stakeholder fragmentation and negative disaster impacts, thereby supporting the position that institutional vulnerability is a worthwhile area of disaster risk management research.

5.5.3. Applied/Policy Contributions

Development of Disaster Risk Management Plans

This research identified the extent, magnitude and characteristics related to the disruption in access to fresh water following Cyclone Idai. This information can be extremely valuable for the authorities responsible for disaster risk management in the region as they can better understand what factors are most critical in the event of freshwater disruptions in the future. Findings from this research can help support prepare the relevant authorities and regulatory agencies responsible for disaster response and freshwater access by showcasing what the weak

points in the established disaster risk management framework are. Perhaps some of the areas that have been identified in this study are already familiar to the relevant water authorities but can serve as a reminder or a lesson that further improvements are required.

Disaster risk management efforts in Mozambique are also a collaborative effort. As has been mentioned previously, Mozambique ranks among the poorest countries in the globe and often relies on external aid and funding during disaster events. In the case of Cyclone Idai, roughly 1/3 of the estimated monetary need was met by partners and external donors with 2/3 remaining unfulfilled. In such a scenario, it is even more imperative that the scarce resources available are deployed with the greatest efficiency possible. This requires that the partners and donors are aware of the impact of their contributions and work closely with the relevant authorities to ensure that they can maximise the potential that the aid funds represent. It is the hope of the researcher that the findings from this research help inform this process and lead to better, more efficient solutions. Research objective 3 findings in particular highlight the need for better coordination of efforts between partner organizations and government agencies.

Additionally, The Government of Mozambique has committed to universal access to safe drinking water, sanitation, and hygiene services by 2030. The case scenario analysis presented in this research highlights some of the problems that may still need resolution for this commitment to be fulfilled.

Secondary Coastal Cities

In addition to being a coastal settlement, Beira is also a secondary city. As such, it is representative of a large pool of similar contexts that are facing a particularly worrisome set of dangers resulting from the changing climate. According to the Sixth Assessment Report of the

Intergovernmental Panel on Climate Change, “interactions between climatic and non-climatic drivers of coastal change are increasing the frequency and intensity of many coastal hazards, with settlement archetypes and the wider coastal zone subject to escalating risk” (Glavovic et al., 2022, p. 2163).

In addition, “secondary cities are home to most of the world’s urban populations vulnerable to climate change, yet researchers and policymakers have devoted less attention to them than large and megacities” (Glavovic et al., 2022, p. 2163). This means that beyond the already mentioned risk factors, Beira’s classification as a secondary coastal city further amplifies its risk to natural disaster. As a result of this, it is even more important to diligently evaluate and resolve deficiencies present in the disaster risk management framework utilized in the anticipation, preparation, mitigation, and adaptation to natural disasters. Findings from this research shed more light on those deficiencies present in the disaster risk management framework and can help other secondary coastal cities better prepare for disasters by developing or updating their own disaster risk management frameworks. This research contributes to the broader literature on secondary coastal cities and the threats they face as a consequence of the changing climate.

Relevance to SDG 13

Finally, this research also contributes to the shared effort of achieving Sustainable Development Goal 13: Take urgent action to combat climate change and its impacts (UN, 2024).

In particular, this research supports Targets 13.1, 13.2, 13.3 and 13.b:

- Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries;
- Target 13.2: Integrate climate change measures into national policies, strategies and planning;

- Target 13.3: Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
- Target 13.b: Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities (UN, 2024, p.1).

By highlighting the relationship between stakeholder fragmentation and negative disaster impacts, this research helps to identify the gaps in the current disaster risk management paradigm and thereby enhance our understanding on how to strengthen resilience and adaptive capacity.

Furthermore, this research highlights the threat posed by climate change that is expected to amplify the destruction caused by the disaster events while at the same time advocating for the integration of climate change measures into national policies, strategies and planning.

Moreover, this research focuses on the improvement of institutional capacity especially as it pertains to the improvement of cross-agency collaboration and effective communication.

5.6. Delimitations of Scope and key Assumptions

This research is among the first attempts at an applied analysis of institutional vulnerability as a factor in the progression of vulnerability. As a result, only limited conclusions could be drawn on the applicability of these findings on the broader field. The context chosen is also mostly comparable across secondary, coastal cities and different observations may be evident in comparable contexts as well as differing contexts. It is for this reason that further research is needed. This research did not rely on any previously developed frameworks that have been applied to similar studies or contexts. The methodology employed in this research was original to this research. While the findings are consistent with the theoretical assumptions present in the field of institutional vulnerability and across the broader discipline of disaster risk management, no comparable applied research examples have been found.

This research is also limited in terms of the number of institutional actors that have been interviewed. In person interviews were conducted between August 4 - 12, 2022 in Maputo, Mozambique and Beira, Mozambique. Existing research networks in Beira were utilized to help identify, contact, and schedule the sessions with key actors. As a result of this, only a small number of participants could be interviewed given the rather short timeframe. Additionally, many interviews were conducted in the native Portuguese. This provided several issues. For one, the researcher was often not able to extract the exact meaning that the interviewee had intended. This also meant that the researcher would not be able to respond directly to the answer with a follow up, since the translation would take up some time.

Moreover, given the context which was foreign to the researcher, all of the scheduling, interviews and formalities were done by members of the existing research network. However, while this significantly improved the efficiency and helped ensure that a maximum number of interviews could be conducted during the short research period, the researcher was dissociated from the majority of the logistics process and may have missed some nuances involved during.

The intention of this dissertation is not to identify what an adequate disaster risk management plan would look like, but rather to explore how fragmented coordination efforts impact the execution of these plans and illustrate a case where this can be best studied. The central aim of this research is to illustrate the negative consequences of actor fragmentation and highlight the need for a more thoughtful consideration of institutional vulnerability as a driving force of vulnerability.

5.7. Future Research

Institutional vulnerability offers invaluable insight into the problem of disaster risk management. Yet while theoretical analysis of institutional vulnerability as a lens for improving our approach to disaster risk management continues to build credibility, few, if any, exploratory analyses have been conducted. It was the aim of this research to address this gap and explore the disaster setting from the institutional vulnerability perspective. However, more exploratory research is needed across different, countries, contexts, and cultures to better understand the utility of this approach.

5.8. Final Conclusions

One thing is clear across all post disaster settings. The socio-political, governance and environmental setting gets turned upside down and it often takes extended periods of time to restore some semblance of normativity. This period of chaos and turmoil is daunting and causes grave devastation. However, this time also presents an opportunity to reinvent the socio-political and governance systems in place to prevent or reduce similar outcomes in the future. The old ways can become amended at a deeper level. This transformation can extend to legislative overhauls, setting a new policy agenda and reinventing governing institutions, committees, organizations, or departmental responsibilities. In the chaos left behind, poor management practices are not just exposed but greatly magnified. While those most in need of help often look to authorities for help, they are also likely to be more critical if the response is lacking.

As a result, the disaster environment presents an opportunity for both increased scrutiny and increased public participation. It creates ample room to revisit the frameworks, governing structures and embedded practices that may have played a role in the disaster or were not efficient in helping to mitigate the negative consequences. In as much as disasters cause grave

devastation and harm, Smith & Wenger (2007) argue that this setting provides opportunities to not only recover, but also exceed the pre-disaster conditions. Disasters such as Cyclone Idai offer scholars an opportunity to examine and analyze the disaster setting and learn valuable lessons about how to better prepare for such events in the future. This dissertation explored one such setting (Cyclone Idai) and showcased how institutional vulnerability has the potential to amplify the negative consequences of disaster events – both in the immediate aftermath, but also in the medium- to long-term timescale. Resulting from this analysis, this dissertation illustrates the theoretical utility of integrating institutional vulnerability as an insightful lens for conducting disaster risk management research. Additionally, several specific weak points in Mozambique's overarching disaster risk management plan have been identified. Notably, the lessons learned and key takeaways come at the cost of those who have suffered from Cyclone Idai, however, it is the hope of the researcher that those lessons will be relevant for future planning in both the chosen area of study but also any other regions that may share similar characteristics.

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Appendices

Appendix 1: Beira Household Survey Question Responses

Question 23: As a result of Cyclone Idai, was your home destroyed, severely damaged, partially damaged, or was it unimpacted? • 99.2% Report Impact • 18% Destroyed • 26.7% Severely Damaged • 54.5% Partially Damaged • 0.8% Reported No Impact
Question 28: Before the disaster (March 15, 2019), what was the main source of drinking water in your household? • 76.2% Piped Water • 22.0% Tube-Well/Borehole • 1.8% Other
Question 29: Was this household's access to this drinking water source disrupted immediately after Cyclone Idai (after March 15, 2019)? • 76.9% Yes • 23.1% No
Question 30: What was the main reason for the disruption of this household's access to this drinking water source? • 50.4% Destroyed Water Source Infrastructure • 24.3% Destroyed Water Access Infrastructure • 9.7% Insufficient Funds • 4.4% Geographically Inaccessible
Question 31: Is this household's access to this drinking water source still disrupted? • 18.7% Yes • 81.3% No
Question 32: What is this household's primary source of drinking water now, after the disaster (since March 15, 2019)? • 78.5% Piped Water • 19.5% Tube-Well/Borehole • 0.4% Bottled Water • 1.6% Other

Question 33: Is this drinking water source currently adequate for this household's needs (sufficient, clean, nearby)?

- 90.9% Yes
- 9.1% No

Question 34: How long (in minutes) does it take to go to the current drinking water source for this household, get water and come back by your usual means of transportation?

- m: 16.22
- M: 2
- SD: 35.55
- Range: 0 - 240

Question 35: Has your household experienced any of the following challenges in accessing the current drinking water source since Cyclone Idai (Since March 15, 2019)?

- 6.1% Transportation challenges
- 5.8% Personal safety challenges
- 4.6% Insufficient time challenges
- 12.3% Unsanitary water challenges
- 68% No. This household has not experienced these challenges

Question 36: Currently, which household member(s) usually collect(s) drinking water for the household?

- Head of household (30.5%)
- Spouse/partner (50.2%)
- Son/daughter (61.4%)
- Adopted/foster child/orphan (1.0%)
- Father/mother/in law (2.7%)
- Brother/sister (10.0%)
- Grandchild (8.4%)
- Grandparent (0.6%)
- Son-in-law/daughter-in-law (1.7%)
- Other relative (7.0%)
- Non-relative (1.1%)

Question 50: In the year before Cyclone Idai (March 15, 2018 to March 15, 2019), how often, if ever, did you or your household go without enough clean water for home use?

- 48% Never
- 28.1% Just Once or Twice
- 11.1% Several Times
- 11.4% Many Times
- 1.3% Always

Question 57: In the year after Cyclone Idai (March 15, 2019 to March 15, 2020), how often, if ever, have you or your household gone without enough clean water for home use?

- 35.4% Never (-12.6%)
- 21.6% Just Once or Twice (-6.5%)
- 21.2% Several Times (+10.1%)

- 20.9% Many Times (+9.5%)
- 0.9% Always (-0.4%)

Question 113: What are the most important or priority needs to recover from the disaster?

- Housing (71.5%)
- Health care (14.4%)
- Access to water (14.3%)
- Schools for children (31.3%)
- Food and/or water (42.1%)
- Seeds and tools to resume farming (4.1%)
- Cash vouchers (32.7%)
- Loans to resume business operations (9.3%)
- Restoring basic infrastructure (roads, bridges, etc.) (0.7%)
- Protection against insecurity, violence, etc. (0.5%)
- Restoring electricity (3.3%)

Appendix 2: E-Mail Invitation for In-Person Interviews

Greetings,

My name is J. Matthew Judyn. I am a PhD Candidate at the School of Environment, Enterprise and Development (SEED) at the University of Waterloo in Canada. I am an investigator in a research team that is examining relevant impacts of, and household adaptations to, Cyclone Idai in Beira. Within the broader effort, my research focuses on the severity of the disruption in access to drinking water and the role of institutions responsible for maintaining and restoring water access. In particular, the proposed research project seeks to evaluate the relationship between perceived role clarity among institutional actors and the magnitude of disruption in access to drinking water following Cyclone Idai. The Co-Investigators on this research project include: Bruce Frayne (Director of SEED at the University of Waterloo), Cameron McCordic (Assistant Professor in SEED at the University of Waterloo), Brent Doberstein (Associate Professor in GEM at the University of Waterloo) and Ines Raimundo (Professor at CAP at Eduardo Mondlane University)..

As a member of the Beira IDG Research Team, I would like to invite you to participate in an interview session that will help us evaluate the importance of role clarity among institutional actors in reducing the magnitude of disruption in access to drinking water following Cyclone Idai. These interviews will be focused around the following research objectives:

Define the roles institutional actors played in restoring water access in Beira post-Cyclone Idai.

Determine the extent that the Beira city master plan guided the roles that those actors took on.

Investigate the synergies or conflicts in the roles taken on by these actors.

Exploring these themes will help us (myself and my Co-Investigators) to understand how well the perceived roles and responsibilities of various institutional actors adhere to the overarching disaster management plan; and, what their impact is on the magnitude of disruption in access to drinking water following Cyclone Idai.

The interview sessions will be approximately 30-45 minutes in length. We are inviting all formal and informal institutional actors whose roles focused on mitigating the disruption in access to drinking water following Cyclone Idai. The interviews will be facilitated by myself, J. Matthew Judyn and one to two Graduate Research Assistants. The exact date for the Interview Sessions will be determined based on the participant's availability but we are hoping to hold the Interview Sessions between August 4 - 12 2022.

If you are interested in attending these Interview Sessions, please feel free to contact me either by email (jjudyn@uwaterloo.ca) or by phone (+1 416-700-0056), available on WhatsApp) to discuss your availability and any questions or comments you may have regarding these Interview

Sessions. This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee.

All the best!
J. Matthew Judyn

Appendix 3: Interview Informed Consent Form

Cyclone Idai Impacts and Adaptations - Institutional Actor Responses Interview Informed Consent Form

Water Governance and Distribution Agencies (Government Agencies, Informal/Formal Water Suppliers)

Greetings,

You have expressed an interest in participating in a research project that seeks to evaluate the relationship between perceived role clarity among institutional actors and the magnitude of disruption in access to drinking water following Cyclone Idai. The goal of this project is to understand how well the perceived roles and responsibilities of various institutional actors adhere to the overarching disaster management plan; and, what their impact is on the magnitude of disruption in access to drinking water following Cyclone Idai. This analysis will contribute to our understanding of institutional vulnerability and highlight some of the key issues associated with coordinating institutional responses following disaster events. This study is being conducted by J. Matthew Judyn (the Principal Investigator) at the University of Waterloo. This research project is being funded by the Social Sciences and Humanities Research Council of Canada. The purpose of this evaluation is to answer the following question:

1. How does a lack of role clarity among institutional actors involved in disaster response amplify the disruption in access to drinking water following disaster events ?

In this interview (which will last between 30 to 60 minutes in-person or through remote video conferencing), we would like you to share your perspective on the circumstances following Cyclone Idai which contributed to the loss and the ensuing shortage in access to freshwater among communities in Beira. We are interested in how you perceived your own role clarity within the organization as well as your perceived assessment of how your organization's efforts related to the broader Beira City Master Plan. In addition, we would like to know more about the synergies and conflicts among the different organizations that were involved in restoring water access. To learn more about this study, please contact J. Matthew Judyn at the University of Waterloo (jmjudyn@uwaterloo.ca).

Please note that you will not be remunerated for your participation in this study and your participation in this interview is voluntary. Any questions you choose not to answer in this interview can be skipped. You may also stop the interview at any time and/or withdraw from the entire study. If you decide to withdraw from the study, all notes, transcripts and recordings of your interview will be permanently deleted. Please note that you may only withdraw from the study before the publication of the final report (to be published on March 1, 2023). A voice recorder will be used during this interview and the interview recording will be summarized in notes or transcribed. All notes and transcriptions from this interview will be shared with you within one week of your participation for you to review and modify/clarify. Unless you choose to be identified by direct quotation or anonymous quotation in this interview, your contributions to this study will only be noted in aggregate form in any reports derived from this interview (no information will be

directly associated with your name in any report or paper derived from this study). That said, the report or paper may note that you were consulted in the process of the study. All completed interviews will be stored on a secure, password-protected, and encrypted hard drive. All data will be retained for at least six years. Your decision to participate will not, in any way, affect your current or future participation in activities with the University of Waterloo.

There are only minimal risks associated with your participation in this interview, however, you will have the chance to contribute to our understanding of institutional vulnerability and highlight some of the key issues associated with coordinating institutional responses following disaster events.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE #43049). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

I acknowledge that I have read and understood the information and consent form and have received a copy to keep for future use.

☐ Agree

☐ Disagree

I understand the purpose of this interview and I agree to participate.

☐ Agree

☐ Disagree

I agree to the use of direct quotations based on the information collected in this interview.

☐ Agree

☐ Disagree

I agree to the use of anonymous quotations based on the information collected in this interview.

☐ Agree

☐ Disagree

By signing this consent form, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

Name (please print): _____

Signature: _____

Date: _____

Appendix 4: Institutional Actor Responses Interview Guide and Instrument Form

Cyclone Idai Impacts and Adaptations - Institutional Actor Responses Interview Guide and Instrument Form

RESEARCH OBJECTIVE

Investigate and analyze how the strength of role clarity among institutional actors involved in disaster response amplifies the disruption in access to drinking water following disaster events.

DATA AND EXPERTS

- The data will be collected through in-person interviews that will take place between August 4 - 12, 2022 in Beira, Mozambique.
- The participants will include Central government officials, formal water suppliers and informal water suppliers. The sample size and description along with the strategy for reaching contacts will be as follows:
 - Sample Size
 - 4-7 Individuals from the Central Government (2-3 Central, 3-4 Municipal)
 - 4-6 Individuals from Formal Water Suppliers (3-4 from FIPAG, 1-2 from Conselho de Regulação do Abastecimento de Água)
 - ARA Centro-Administração Regional
 - 3-5 Informal Water Suppliers
 - Strategy for Reaching Contacts and Conducting Interview
 - Get in touch through existing networks in Beira to identify, contact and schedule the sessions with key actors.
 - In-person interviews conducted between August 4 -12, 2022.
 - Interviews will be conducted through a Research Assistant with the Lead Investigator present and the whole session will be recorded.
 - The Research Assistant will translate the interview in real time, allowing the Lead Investigator to ask follow up questions and build on the responses.
 - The entire session will be transcribed and analyzed.

INTRODUCTION

- Introduce yourself and the Graduate Research Assistant
- Introduce the results of the Beira survey and the rationale behind further research
- Review the overall study research objective
- Review the topic, structure and duration of the interview
- Provide a copy of the informed consent form and allow the respondent time to read and ask questions about the form before signing.
- Ask if the respondent has any further questions before beginning the interview.

INTERVIEW INSTRUMENT

A. Synergies Among Organizations

I. Under what mandate, do you conduct your fresh water restoration efforts in Beira?

II. Are you aware of the Beira City Master Plan 2035?

III. How would you rate your understanding of the relevance of the Beira City Master Plan 2035 as it pertains to your job?

IV. Were your agency's/organization's efforts in water restoration linked with the Beira City Master Plan 2035?

V. How would you rate how well your agency/organization integrated the Beira City Master Plan 2035 into its water restoration efforts? (On a scale of 1 - 10, where 1 means it was not consulted at all and 10 means the agency's/organization's response was mandated under the Master Plan)

VI. Are you aware of any agencies/organizations that were involved in water restoration efforts following Cyclone Idai?

i.If, so please list them.

ii. For each of the agencies/organizations listed, are you aware of specific roles that those other agencies had in disaster response?

iii. Are you or did you collaborate with any of them in the water restoration effort following Cyclone Idai? If so, which?

iv. For each of the agencies/organizations you collaborated with, how would you rate the effectiveness of each of these collaborations? (On a scale of 1 - 10, where 1 means least effective and 10 means most effective)

v. Have you run into any conflicts during those collaborations?
○ Would you be able to expand on the details?

○ What was the main issue?

- How was it resolved?

B. Individual/Organizational Role Clarity

I. Who sets the goals for you in terms of water access restoration in disaster settings?

II. How would you rate the role clarity that your organization has in responding to the disaster? (On a scale of 1 - 10, where 1 means least aware and 10 means most aware)

A. How would you rate your awareness of the individual tasks that your organization is supposed to accomplish?

B. How would you rate your awareness of the broader goals that your organization is supposed to accomplish?

C. How would you rate your awareness of how your work impacts the larger goals of the business?

D. How would you rate your awareness of how your work will be evaluated and measured?

E. Are you aware of the roles of other organizations involved in water access restoration following disasters?

C. Key Factors in Disaster Response

I. What would you say are the main factors that affect the disruption in clean water access following a disaster? (Select all that apply)

A. Financial Resources

B. Preparedness

C. Role Clarity

D. Synergies Among Participating Agencies/Organizations

- E. Other
- II. What would you consider to be the main factor? (Why? Please elaborate.)

E. Infrastructure Damages (Formal Water Suppliers)

I. Are you aware of the damages done to water infrastructure facilities?

- II. Were there any plans in place to restore/repair damaged infrastructure?
- A. If so, how well were they adhered to?

III. What was the main reason for why the repairs could not be done right away?

F. Informal Water Suppliers

I. Are you aware of the number of informal water suppliers that operate in Beira?

II. What was the role of informal water suppliers in re-establishing access to drinking water?

III. Why can formal water suppliers not supply all of the region?

CONCLUSION

- Ask if there is anything that the respondent would like to add that was not covered in the interview so far.
- Thank the respondent for their time and discuss the approximate timeline for:
 - Receiving any notes or transcripts from the interview
 - The publication of the final report
- Ask if the respondent has any remaining questions about the study or the interview process