Exploring Household Vulnerability: The Compounding Loss of Resource and Service Access in Post-Cyclone Idai Beira, Mozambique

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

The rapid urbanization of secondary cities in the Global South poses significant challenges for equitable household access to basic services and resources. Climate-related disaster impacts within these secondary cities can catalyze the loss of household access to basic services, such as medical care, and vital resources, such as cash income. Given the importance of household access to these resources and services to disaster mitigation, the loss of consistent access to these services and resources can subsequently increase household vulnerability to further climate disaster impacts. As a result, the consistency of household access to basic services and resources can reveal important insights into disaster impacts at a household level within secondary cities. However, there is limited research exploring the relationships between the observed loss of consistent access to resources and services in Beira, a secondary city in Mozambique, and how these relationships contribute to the compounding nature of loss in consistent access to resources and services.

In March 2019, Cyclone Idai made landfall in Beira, Mozambique, and resulted in one of the deadliest weather-related disasters in Southern Africa. This investigation explores the disastrous effect of Cyclone Idai and the multi-dimensional phenomena of resource and service loss experienced by Beira's households. In pursuit of that aim, this investigation analyzed socio-demographic vulnerabilities of sampled Beira households prior to Cyclone Idai, compared the consistency of access to resources and services pre- and post-disaster and assessed the extent to which the consistency of access to these resources and services was correlated. The findings indicate that respondent households carried significant vulnerabilities before Cyclone Idai; lost consistent access to several resources and services after Cyclone Idai; and ultimately, that the loss of consistent access to those resources and services was correlated. These findings suggest that the households experienced compounded (co-occurring) losses in the consistency of their access to each of the identified resources and services, potentially predisposing the sampled households to further vulnerability in the wake of Cyclone Idai.

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Section 1 – Introduction

1.1 Background

The rapid urbanization of secondary cities in the Global South has generated a crisis for countries that lack the resources to implement crucial disaster risk reduction strategies (United Nations, 2019). The effects of natural disasters and environmental change are a globally prevalent issue due to rising temperatures, deforestation, and loss of biodiversity that increase alongside the rapid growth of the global human population. For most developing countries, the unanticipated growth rate and expansion in urban centers have created extreme vulnerability for the urban poor when natural disasters occur. This vulnerability has increased because most impoverished people experience social, economic, and physical marginalization, which is magnified when disasters occur (Birkmann, 2006).

Beira is a secondary city in Mozambique, emergent as an economic hub and entry port into the African interior (Filipe & Norfolk, 2017). In March 2019, tropical Cyclone Idai made landfall in Beira, Sofala Province, Mozambique. Disastrous flooding and an extreme storm surge displaced over 52 percent of the population within Sofala, with most of the damage in the coastal city of Beira (Trujillo, 2019; IOM, 2019). Subsequently, in April 2019, a second tropical Cyclone, Kenneth, made landfall as one of the strongest cyclones to devastate Mozambique (Trujillo, 2019). As a result, Beira has experienced increased vulnerability related to the urban infrastructure, especially damage to informal housing, heightening insecurity for households that experience urban poverty.

This research theorizes respondent household's compounding loss of access to resources in post-Cyclone Idai in Beira, compares the consistency, extent, and interrelationships between loss of access to household resources and basic services, and interpret the results of this

investigation. This thesis reviews the current literature regarding natural disasters in developing urban cities, especially the impact of natural disasters, such as Cyclone Idai, on secondary cities such as Beira, Mozambique. Secondly, the thesis uses the underlying theory of the Hazards-of-Place model to guide the literature review of urban vulnerability and disaster, research questions, and the methodology used to answer these research questions.

1. 2 Problem statement

Disasters are increasingly prevalent in almost all parts of the world. Disaster risk reduction is the central priority of the Sendai Framework 2015–2030, a UNDRR agreement that seeks to safeguard development from the risk of disaster by emphasizing the inclusion of social resilience as an effective mechanism for reducing disaster risks. Disaster risk reduction strategies have become increasingly important in understanding and reducing disaster impacts within coastal cities. However, little research explores these household-level access to resources and basic services in Beira, Mozambique, and how they contribute to the compounding vulnerabilities of natural disasters in urban landscapes (Solecki et al., 2011). Over the last number of years, the importance of urban development has risen to the forefront of global development agendas such as the Sustainable Development Goals (SDGs) and New Urban Agenda (NUA) (UN, 2019). This concept of sustainable urban development includes addressing planning, infrastructure, and land tenure within African urban land governance systems (Shannon, 2019). The Brundtland Commission defines sustainable Development (SD) as development that meets the present's needs without hampering future generations' capability to meet their own needs (IISD, 2020). Since the introduction of the Brundtland definition, the guiding principles of sustainable development have focused on the three facets of human,

economic, and social development for the present and future spatial and temporal needs (Kates et al., 2005). Following the trend of DRR, the Sendai Framework for Disaster Risk Reduction (SFDRR) for 2015–2030 to implement a precise, focused, forward-looking, and action-oriented post-2015 framework (UNISDR, 2015). Therefore, it has provided a guiding pathway for promoting strategic and systematic methods to mitigate vulnerabilities and risks, including in an urban context.

In the context of urban climate adaptation, understanding the drivers of vulnerability is crucial in implementing climate resilience in relation to hazard assessment and disaster risk reduction in cities (Tyler & Moench, 2012). This research uses the Hazards-of-Place model as a guiding framework to explore the relationship between multiple predisposed vulnerabilities, and the impacts of Cyclone Idai on households in Beira, Mozambique.

1. 3 Significance of the Problem and Contributions of the Study

This research aims to explore co-occurring vulnerability to disaster impacts within Beira, in order to inform results which can help identify novel resilience approaches that can create resilience to the rising implications of climate-related weather events. In Beira, the lack of government resources and bureaucratic capacity has resulted in no customary or formal land rights, further heightening inconsistent access to basic resources (water, fuel, cash and food) and basic services (electricity, sanitation, medical care) (Jacobs & Almeida, 2020; Shannon, 2019). This vulnerability is evident through the implications of their climate adaptation strategies, such as resettlement initiatives, lack of engagement with community-level actors' desires, and the prioritized agendas of government, private, and third sector organizations (Chanpungu, 2020).

Research Gap

The current literature is limited in exploring the interconnections of social vulnerabilities that contributed to the severity and duration of impacts experienced due to cyclone Idai. This limited literature suggests an empirical research gap in examining the relationship between Beira's urbanization and the social consequences of Cyclone Idai's impacts. The limitation within the literature can be seen in the relationship between municipal government interventions to address urban land rights and geopolitics for vulnerable urban populations in relation to urban hazard-prone areas (Shannon, 2019).

Additionally, due to a lack of published literature post-cyclone Idai, there is limited information exploring community-level climate resilience approaches that could further inform Beira's disaster reduction policies and strategies (Carvalho & Boanada-Fuchs, 2019). There is also limited research empirically exploring the pre-existing vulnerability variables of disaster impact within urban centres at a household level. This investigation seeks to enhance the limited profiling of place-based vulnerability in Beira through a bottom-up investigation approach from a household to citywide scale. This research will contribute to a greater understanding of vulnerability data, which will make it possible to address better socioeconomic and environmental challenges faced by urban populations in Beira (Mavhura et al., 2017). The impact of hazards is only projected to increase due to climate-change-related variability, however, understanding the current severity of impacts and the root causes of vulnerability and hazard exposure can inform results towards novel resilience approaches that can address the rising implications of climate-related weather events for vulnerable urban populations.

1. 4 Research question and objectives

The primary purpose of this study is to empirically evaluate whether there is a compounded (co-occurring) loss of consistent access to resources and services during the occurrence of a natural

disaster. This research explores the relationship between disaster impacts and access to resources through the application of the Hazards-of-Place model, giving attention to the compounding effects of the disaster on access to vital resources and services necessary for the wellbeing of the urban populations in Beira, Mozambique. Given the research objective, the proposed project aims to address the following objectives:

Research Objective 1: Describe the socio-demographic vulnerabilities found within the Beira sample prior to Cyclone Idai.

Research Objective 2: Compare access to resources and services before and after Cyclone Idai in the sampled households in Beira.

Research Objective 3: Evaluate the extent to which any changes in access to these resources and services are correlated in the sampled households in Beira.

1. 5 Definitions of key terms

1.5.1 What is vulnerability?

In the broadest sense, the definition of human vulnerability to environmental hazards is the potential for loss (Cutter, 2003). The concept of vulnerability has been contested and reimagined within disaster management literature to encompass natural hazard exposure to social, economic, and political instability (Birkmann, 2006). Historically, Haas, Kates, and Bowden (1977) first introduced the notion of vulnerability by arguing that natural disasters are measured by pre-disaster trends rather than unpredictable phenomena (Weichselgartner, 2001). There are several different approaches to defining, measuring, and analyzing the multidimensional and differential nature of vulnerability (Birkmann, 2006; Patt et al., 2008). Vulnerability also provides a theoretical framework that encompasses the multidimensionality of

disasters (Blaikie et al., 1994; Cutter, 1996). The United Nations Development Programme (UNDP) 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" (2004, p. 11). This research will adopt the definition provided by UNDP, where vulnerability is a function of exposure, sensitivity, and adaptive capacity to climate. Disaster resilience is defined as "the ability of countries, communities, and households to manage change, by maintaining or transforming living standards in the face of shocks or stresses - such as earthquakes, drought or violent conflict - without compromising their long-term prospects" (DFID, 2017. p. 4). The term 'disasters' within this research refers to natural hazard-related disasters.

1. 6 Limitations of study

Due to the recency of Cyclone Idai (2019), there is a lack of relevant literature and data detailing the impacts of the disaster and other climatic shocks on the vulnerability of households in Beira (Carvalho & Boanada-Fuchs, 2019). Additionally, other than city-wide population estimates, there is limited recent census data to indicate population demographics within Beira. While representative sampling will be difficult in this context, the proposed survey methods aim to collect a large enough sample size to support intended statistical analysis. A cross-sectional study is a type of observational research that analyzes variables from the sample population that are taken at a specific point in time (Creswell & Creswell, 2018). This research follows a cross-sectional research design, meaning the research investigated the relationship between the variables included in this investigation at a previous point in time (i.e. pre-disaster) and again post-disaster (2019), and the present day (cross-sectional) impacts in Beira. However, due to the elapse of time between the disaster impact and my household

survey, cyclone survivors, including the most vulnerable groups, may have migrated, or been displaced beyond the administrative boundaries of Beira.

Additionally, respondents were surveyed based on their memory of the 2019 cyclone and its impacts, and as a result, they had to rely on memory to answer certain questions. This investigation is based on survey research, so the data collected will only be based on survey respondents' experiences and perceptions. Additionally, this research sought to understand household level vulnerability, but questions were answered by the household head or the closest knowledgeable equivalent. As a result, this research may not fully capture all groups that experienced the impact of Cyclone Idai in Beira.

Section 2.0 – Literature Review

This section reviews previous literature regarding the conceptualization of vulnerability in hazards and disaster management research. This review intends to identify one or more gaps within the literature and contributes to a greater understanding of vulnerability data, including its spatial representation, to identify present socioeconomic and environmental challenges faced by urban populations in developing areas. Secondly, this section explores vulnerability through resiliency theory and its historical application of risk in the production of vulnerability in natural social-ecological systems. Thirdly, this section reviews conceptual frameworks, including the Pressure-and-Release (PAR) model, which establishes the external and internal system processes that contribute to the progression of vulnerability. Lastly, using Cutter's (1996; 2003) Hazards of Place model, this section contributes to the working definition of place-based vulnerability and measurements of risk through social and biophysical vulnerability and its likelihood of occurrence to produce hazard potentials in my chosen case study area. These findings are summarized, and the implications of findings to the current vulnerability and natural disasters literature are provided (see Section 2.4).

2.1 Conceptualization of Vulnerability

The concept of vulnerability has emerged within hazards and development-based research as a tool to understand the capacity of a society to prepare for, absorb and adapt to risks produced by environmental shocks and natural disasters (Adger et al., 2003; Cutter et al., 2008; Pelling et al., 2014). These vulnerability definitions have been explored and derived through different academic disciplines (e.g., geography, environmental studies, and sciences, sociology, economics) that identify varying types of hazards and regional scales of measurements. The diversity of approaches towards the conceptualization of vulnerability within resiliency and

disaster risk reduction theory has provided numerous theoretical concepts and frameworks to explore the various perspectives towards the dimensions of vulnerability (Blaikie et al., 1994; Cutter, 1996).

2.1.1. Elements of Vulnerability

According to Watts & Bohle (1993), whose research explored the implications of vulnerability towards food security, the basis of vulnerability can be defined by the prevalence of risk – exposure to risk, capacity to cope with risk, and the impact of risk towards limiting resiliency, and subsequently, increasing vulnerability. From this conceptualization of vulnerability in relation to risk, those most vulnerable individuals, groups, and populations that experience the highest exposure to hazards (exposure), have the least adaptive capacity to hazards (capacity), which results in a greater likelihood of impact from disaster (potentiality), and the most limited capacity for recovery (resiliency) (Watts & Bohle, 1993; Turner et al., 2003). Through these components, vulnerability can be understood as a function of exposure, sensitivity, and adaptive capacities (IPCC, 2007). Exposure, the first component of vulnerability, is defined by biophysical and social stressors or shocks, such as a natural hazard, that increases the likelihood of change within the system to these aforementioned external stressors (Adger, 2006). This understanding of exposure has expanded in research within the risks and hazards literature to include external shocks and stressors, such as socioeconomic and sociopolitical conditions, that influence a socioecological system's exposure to hazards (Birkmann, 2006). Secondly, sensitivity, related primarily to exposure, refers to the resiliency (or lack thereof) in a system when exposed to external stressors and shocks (Turner et al., 2003). Lastly, adaptive capacity refers to the system’s ability to respond to, and evolve in reaction to, social and

biophysical hazards in order to cope. These core functions of vulnerability are described within the literature to identify, understand, and measure the social impacts of natural disasters on socioecological systems, and ultimately, increase resiliency amongst those identified as most vulnerable.

2.1.2. Resiliency and Vulnerability

This relationship of vulnerability to hazards has been theorized in resiliency theory, first introduced in a seminal article by Holling (1973), which defines resiliency as the increased capacity of a system to withstand extreme disturbances and improve social *and* ecological survival chances. Most importantly, resiliency theory encourages structural shifts within a system to cope with future conditions. Rather than focusing on our understanding of a system, it focuses on what we do not know about a system and the assumption of future unexpected events (Holling, 1973).

Furthermore, socioecological systems are inherently complex. Contextualizing the underlying causes of vulnerability within an urban population can contribute to understanding the overall resilience within a system. Firstly, it is more important for a system to be persistent and flexible rather than stable and efficient to better offer ecosystem services that benefit humans (Walker et al., 2004). Secondly, higher levels of resiliency encourage heterogeneity, as unpredictable changes stimulate systems to respond by changing different variables, which discourage homogeneity and increase the likelihood of survival in instances of high fluctuation. Meerow et al. (2016) defines the concept of resiliency as,

> The ability of an urban system-and all its constituent socio-ecological and socio-technical networks across temporal and spatial scales-to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity (p. 39).

In addition, according to Walker et al. (2004), ‘resilience’ indicates that strength and persistence towards future unexpected events, but in its more recent applications in urban sustainability, disaster management, and socioecological systems, resilience is understood to require flexibility, learning and change (Folke et al., 2016; Pelling et al., 2014; Folke, 2006).

Furthermore, resiliency allows for innovation to encourage novel solutions to sustainability issues (Folke, 2006). Westley (2011) argues that dramatic system disruptions, such as climate-related weather disasters, have the potential to incur ‘crises’ within a system that can disrupt all domain levels, which further facilitates collective innovation and actions to decrease social vulnerability. As a result, resiliency encourages self-organization within system pathways and further emphasizes adaptation and the importance of persistence (Holling, 1973). It emphasizes open-ended, broader spatial approaches and heterogeneity. Additionally, resiliency theory encourages human creativity, which contributes towards an understanding of systems within multiple scales, such as the concept of panarchy and overall institutional systems that influence societal challenges (Westley et al., 2011).

Resiliency, as a concept, discourages stability within a system and encourages increased fluctuation and variability, leading to a higher likelihood of the system moving from one system domain to another (Hollings, 1973). Therefore, resiliency within ecosystems will increase the ability for humans to incorporate future unexpected events, such as climate change, into a socioecological system without significant disruption (Walker et al., 2004).

Socioecological resiliency theory has been utilized to address sustainability issues by exploring socioecological systems through their ability to renew, reorganize and develop (Holling, 1973). In the context of climate change-induced disasters, Schipper & Pelling (2006) established that cities in developing countries experience a heightened risk due to poorer urban

infrastructure, high population densities, and ultimately, ongoing urban sprawl and informal settlements that result in vulnerable areas. Similarly, research in cascading effects of disasters explores the disruption of critical infrastructure that interacts with the disaster itself to a 'chain effect' like feedback loop within society to increase the probability of high impact future disasters (Pescaroli & Alexander, 2016). Pelling et al. (2014) describe low resilience systems as inherently vulnerable to disturbances, which in the field of disaster management can attribute to "underlying failures of development by linking adaptation, mitigation, and sustainable development" (p. 114). In the case of rising climate-related weather events, these systemic 'disturbances' experienced within urban systems challenge resiliency through the frequency and impact of natural disasters. Additionally, these systemic 'disturbances' can be magnified by barriers to climate resiliency, such as the social vulnerability of the urban populations.

Lastly, in addition to focusing on our understanding of a system, resiliency theory also focuses on what we do not know about a system, and places importance on both uncertainty and the probability of future unexpected events. Resiliency allows for humans to increase the long-term success of socioecological systems through their ability to renew, reorganize and develop from each system's history (Holling, 1973). Similar to Disaster Risk Reduction (DRR) theory, the resiliency framework does not merely allow for change but rather encourages structural shifts within a system and can absorb and accommodate the unexpectedness of future disaster impacts.

2.2 Conceptual Frameworks

2. 2.1. The Pressure-and-Release Model

Figure 1

The Pressure-and-Release (PAR) Model

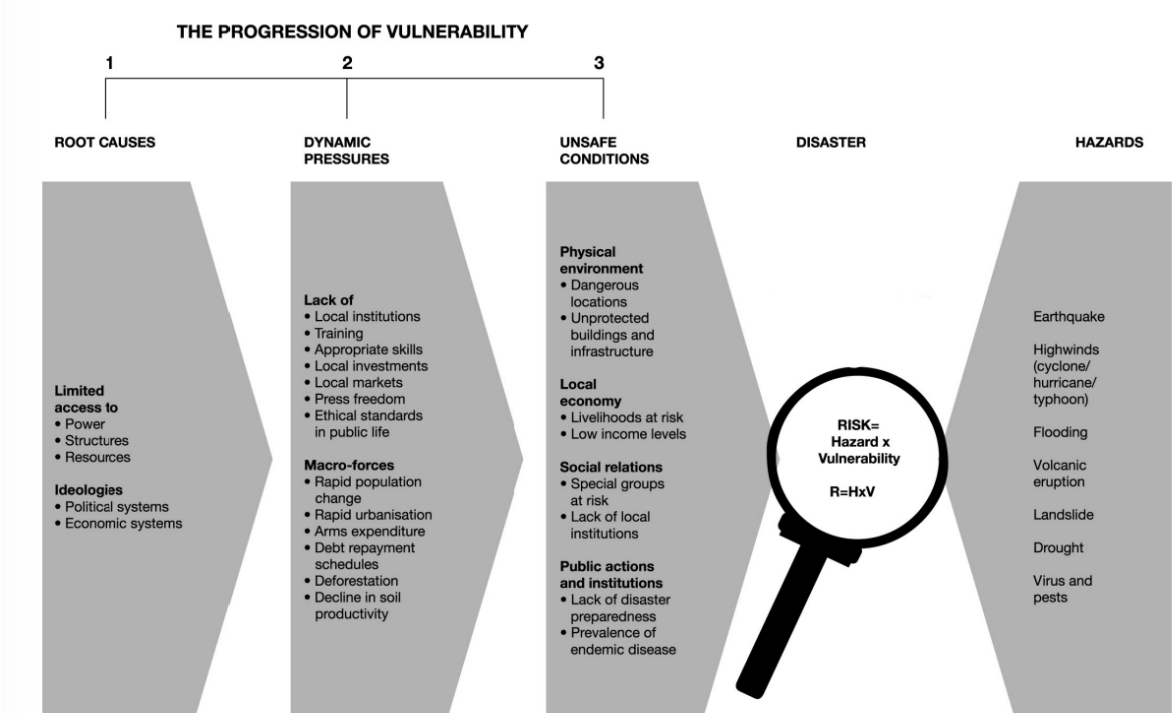

Figure 1: Pressure-and-Release (PAR) model: the progression of vulnerability (Wisner et al., 2004. p. 51)

Blaikie (1994) proposed a conceptual model known as the Pressure-and-Release (PAR) model, as a framework analyzing how disasters occur as a product of natural hazards affecting vulnerable populations. Built upon by Wisner et al. (2004), the term ‘vulnerability’ encompasses the social, economic, and political processes and underlying causes that exist separately from the disaster itself, yet when paired with natural hazards, results in heightened disaster impacts onto the vulnerable population (p. 50).

The PAR model, which explores the progression of vulnerability through the addition of socioeconomic pressures (root causes, dynamic pressures, and unsafe conditions) when

multiplied by physical exposure of natural hazards (flooding) that results in a risk of a natural disaster (vulnerability x hazard = risk) (Wisner et al., 2004). Each step in the progression of vulnerability builds on the previous actions and leads to increasing pressure on the entire system. Root causes in the PAR model include limited access to power, limited access to structures, limited access to resources, aspects of the political and economic systems (Wisner et al., 2004). Root causes lie within the structural level and describe underlying power dynamics that are ingrained in a system. According to the PAR model, these root causes can then lead to dynamic pressures, including lack of local institutions, local markets, local investments, rapid population change, and rapid urbanization (Wisner et al., 2004). Dynamic pressures are evolving systems that can lead to increased pressure and subsequently to unsafe conditions. Unsafe conditions include the physical environment, the local economy, social relations, and public actions (Wisner et al., 2004). These unsafe conditions represent the most immediate risk factors towards the progression of vulnerability produced within the PAR model. The PAR model provides further detail of the external stressors that contextualize the influence of social conditions that influence a system's capacity to cope and adapt in the event of a disaster.

2.2.2 The Hazards of Place Model

This section will review the Hazards-of-Place model as a guiding conceptual framework to quantify and measure how biophysical and social indicators contribute to the spatial dimensions of household place-based vulnerability. In the field of risk, hazards, and disaster mitigation, Cutter (1996) sought to define a previously ambiguous and debated conceptualization of vulnerability through the lens of environmental hazards that result in human social vulnerabilities. Through the application of vulnerability research, Cutter's (1996) exploration of

vulnerability seeks to delineate the interactions of internal and external stressors through spatial and temporal hazards. In this 1996 article, Cutter introduces the Hazards of Place Model, otherwise known as the Place Vulnerability Model, to examine and assess the relationship between biophysical and social vulnerability that contribute to place-based vulnerability.

Figure 2

The Hazards-of-Place model

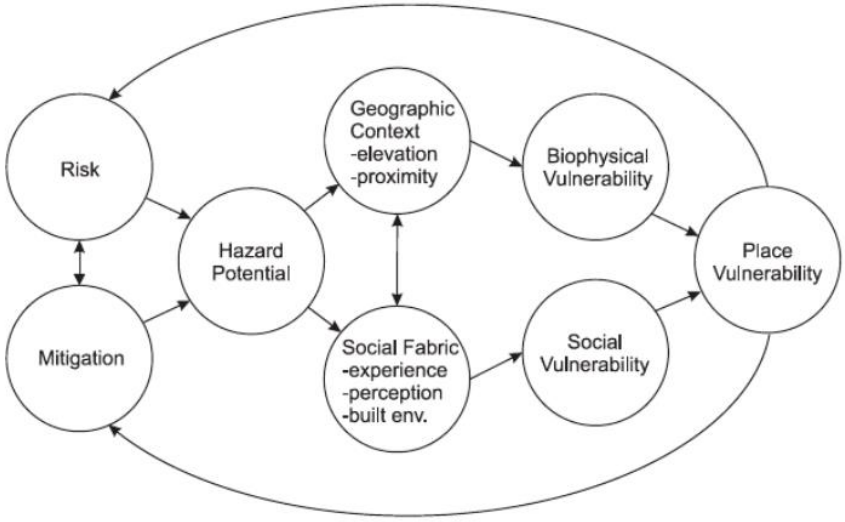

Figure 2: The Hazards-of-Place Model of Vulnerability (Modified from Cutter, 1996; Cutter, 2003. p. 244)

Cutter argues that populations with a higher degree of social vulnerability are more likely to experience increased shocks of disaster impacts. In addition to these findings, Cutter (1996) proposes that the degree to which a population is vulnerable to hazards is mainly dependent on two spatial indicators: biophysical and social vulnerability.

2.2.2.1 Biophysical Vulnerability to Natural Hazards

Biophysical vulnerability is indicated by proximity to the hazard or the nature of the hazards; social vulnerability is measured by sociodemographic characteristics and contributes to

the overall place vulnerability indicator (which can be interchanged between these two variables) (Cutter 1998; 2003). Several researchers have distinguished the vulnerability factors as being bio-physical (or natural) and social (or socioeconomic) factors. Previous approaches towards conceptualizing vulnerability have approached or biophysical vulnerability as dichotomous determinants towards one another, however, Cutter's Hazards of Place model approaches the biophysical and social vulnerability as independent but similar processes. Additionally, a feedback loop is incorporated into the Vulnerability Model, leading to an increase or decrease in risk, hence an enhanced or reduced vulnerability. This mechanism within the model is meant to provide ongoing feedback to identify those most susceptible to risk and inform decision-making processes in the event of a disaster.

Cutter, Mitchell & Scott (2000) further applied the Hazards of Place model to assess vulnerability through spatial dimensions of biophysical and social vulnerability indicators that contribute to the conceptualization of place vulnerability in Georgetown County, South Carolina. This research is the first noted application of the model in a case study area and is used to produce a Social Vulnerability Index (SoVI) in order to quantify the spatial significance of social vulnerability among different geographic locations. A Social Vulnerability Index (SoVi), first introduced by Cutter et al. (2003), takes an approach towards assessing the presence of social vulnerability through a set of community-specific variables that influence social vulnerability. Cutter et al.'s (2003) approach towards vulnerability indexes typically utilizes multivariate factorial approaches, such as principal components analysis (PCA), as a data reduction technique towards determining a set of predictive social vulnerability variables. Cutter et al. (2003) indicates that social dimensions, such as social class, are one of the most significant contributors to social vulnerability. Other dimensions include employment (type and stability), income,

savings, and education levels, quality of settlements (housing type and construction, infrastructure, and lifelines), tenure type, built environment, family structure, and population growth. In Cutter's SoVI research, these variables are a principal component of social vulnerability, particularly within identifying marginalized communities that experience factors beyond standardized vulnerability indexes. Lastly, the findings from this research indicate that in the event of a disaster, areas that have greater access to social safety nets will experience the greatest ability to absorb and recovery from losses as a result of biophysical risk. The principles of Cutter's Hazards of Place model have been applied in other studies on a regional scale to identify context-specific indicators of vulnerability within North America and further abroad (Mavhura et al., 2017). The findings from Cutter's research showed that for areas similarly impacted by disasters, those areas that experienced higher degrees of social vulnerability (e.g. less access to social safety nets), had a decreased likelihood of recovery from losses, and greater long-term impact due to disaster (Cutter et al., 2000).

The hazard place-based model in vulnerability research is considered a novel approach due to its focus on the vulnerabilities of people living in a location through the explorations of localized conditions and socioecological elements that result in the vulnerability of individuals, groups, and populations in a specific geographical area (Kumpulainein, 2006). Cutter's Hazards of Place model takes a divergent approach towards the categorization of vulnerability through distinctive progressions of the physical exposure to hazards, social conditions that create vulnerability to hazards, and lastly, how these two factors occur within a specific place or region – often a localized contextual analysis towards the occurrence of vulnerability.

2.2.2.2 Social Vulnerability to Natural Hazards

Social vulnerability is a compound variable measured by the physical, economic, and social factors that increase the propensity of individuals and communities to suffer loss (Uitto, 1998). Much like resilience, vulnerability is understood as the characteristics experienced by an individual or group that impact their ability to anticipate, cope with, resist and recover from the impact of a natural hazard. According to Schmidlin et al. (2009) "social vulnerability to natural hazards is the potential for loss and is a complex interaction among risk, mitigation, and the social fabric of a place" (p. 3). In addition, social vulnerability refers to the 'social realm of institutions' characterized by class structure, economic and political power, social status, and other social factors that determine vulnerability through inequality, marginalization, and lack of access to resources (Adger, 2006). Sen (1981) is a seminal reference across many areas of vulnerability research, which emerged out of Sen's research on famine and entitlement failure. Additionally, in recent years, the inclusion of livelihood entitlements (the individual right to access all goods and services) literature has been more heavily incorporated into socioecological-driven approaches towards climate change and disaster research in broader environmental systems studies. Several approaches towards the analysis of vulnerability are rooted in a lack of entitlements, such as a famine, through which vulnerability is exacerbated by inadequate coping responses and lack of resilience within a social system. In entitlements-based literature exploring vulnerability, social, political, and economic processes impact access to resources, and reduce opportunities for individuals (Adger, 2006). These processes can increase vulnerability to systemic shocks, such as natural hazards, limiting a population's access to entitlements (Bohle, 1994).

Within social research fields, generally, social vulnerability approaches are most often used to identify those groups that are most vulnerable to physical and ecological risk (Adger, 2006). Adger (2006) seeks to explore previous approaches to vulnerability and resiliency literature from a socioecological systems perspective. Within the reviewed literature, vulnerability is conceptualized as the exposure to external stressors, oftentimes physical and social, and measured through both the degree and duration of these hazards within a socioecological system. Furthermore, these instances of stress are observed and adapted to within the system itself. Adger (2006) analyzes the socio-political stressors as interrelated to resiliency research through the vulnerability of livelihoods to poverty theories.

Cutter (1996) describes this occurrence of vulnerability as a 'tempered response' through which a hazard, such as drought, famine, hunger, or climate change, is coupled with historical, cultural, social, and economic processes that inhibit a social group or society from responding and adequately coping with disaster. Additionally, determinant factors of social vulnerability result from social exclusivity and other multidimensional drivers of poverty from these same system actors that drive socioeconomic pressures. Therefore, populations that do not have the social and political-economic mobility to adapt are inherently inequitable. Therefore, biophysical and social vulnerability collectively produce the overall vulnerability of place. The hazard of place model explicitly focuses on location, depicts the overall conditions in that place, and presents various elements contributing to the vulnerability of people living in a specific geographic area. Additionally, previous studies have examined the frequency of place-based vulnerability using top-down approaches to capture a broader scale of regional and ward levels in order to investigate household vulnerability to natural hazards (Mavhura et al., 2017).

The hazards of place model is applied in this thesis to explore the relationships across multiple forms of vulnerability at a local level by quantitatively deriving risk towards future hazards. The effect of ongoing hazard potentials is only projected to increase due to climate-change-related variability; however, understanding the severity of impacts and the root causes of vulnerability and hazard exposure can inform results towards novel resilience approaches that can address the rising implications of climate-related weather events for vulnerable urban populations.

2.3 Thesis Conceptual Framework

Figure 3

Conceptual Framework

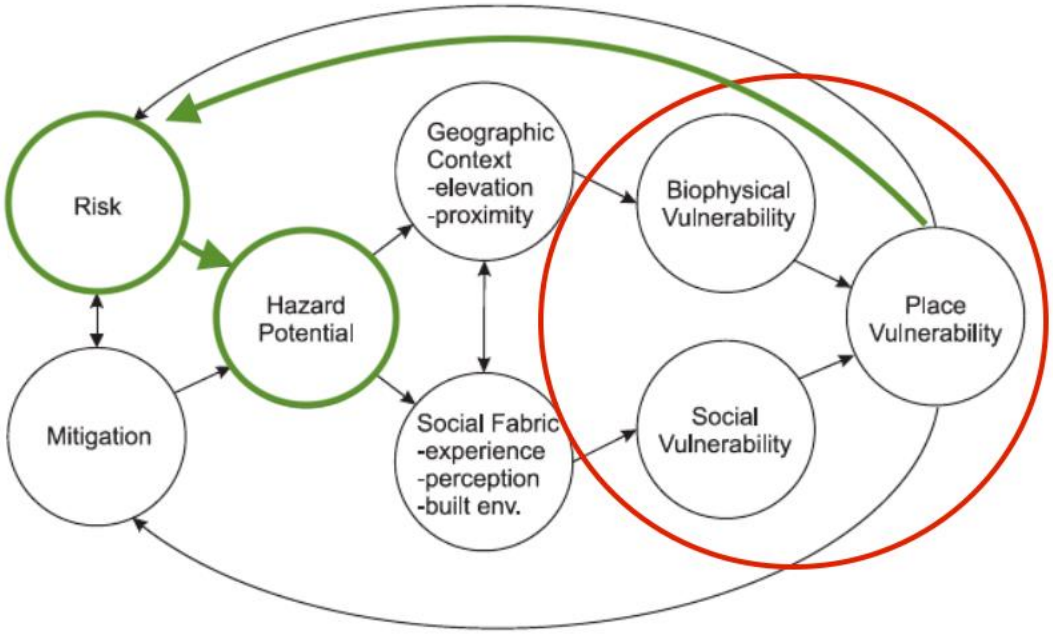

Figure 3: Proposed Conceptual Framework from Hazards-of-Place Model of Vulnerability (adapted from Cutter, 2003. p. 244)

The Hazard-of-Place model will be applied as a conceptual framework to examine the indicators of vulnerable places and populations in post-Cyclone Idai Beira, Mozambique. This research will investigate the components contained within Cutter's model (*figure 3*) and will identify risk (an objective measure of the likelihood of a hazard event) to produce estimates of hazard potential. Hazard potential is either mitigated or augmented by elements of geographic context (measured through proximity to site and situation of place) and the social fabric of the place (household experience with hazards, ability to respond to, cope with, recover from and adapt to hazards). The social fabric and geographic context of a place influence the social and biophysical vulnerability of its residents and interact to produce the overall place vulnerability. To narrow the scope of the research, I will only examine the components of the conceptual model that explore the relationships between households' place vulnerability co-occurs to produce compounded vulnerability for households in the aftermath of Cyclone Idai (as pictured in *figure 3*).

In the context of disaster risk reduction, understanding the drivers of vulnerability is crucial towards implementing climate resilience in relation to hazard assessment in urban social systems. The findings of this review present a clear relationship between the presence of vulnerability prior to and its contribution to the impact of natural disasters. Through the exploration of resiliency theory, the interactions between internal socioecological systems and external shocks and stressors can be understood as a product of social inequities and exposure to risks, such as natural hazards. Low resilience systems, such as those in rapidly developing urban systems in the Global South, may be more vulnerable to stress and shock in the event of natural disasters. Resiliency theory provides insight towards the presence of vulnerability and resiliency and its elements in a social system.

Through previous vulnerability conceptual frameworks, such as the Pressure-and-Release (PAR) model, the progression of vulnerability is established to be largely influenced by external system shocks, including social, economic, and political processes that increase the potential for compounding impacts of natural hazards. The PAR model serves as guide for the organization of external factors that influence a system as either human-induced stressors, such as social processes, and the presence of external hazards within the natural environment.

Lastly, using Cutter's (1996; 2003) Hazards of Place model, social and biophysical vulnerability are organized as separate, but equally weighted, root causes of vulnerability. Within the Hazards of Place model, Cutter (1996; 2003) establishes that social vulnerability as a theoretical approach is not sufficient alone to understanding the drivers of disasters impact. Instead, Cutter's Hazards of Place model integrates the presence of social vulnerability to biophysical system exposures through place-based approach towards understanding localized vulnerability within broader system. Therefore, place-based vulnerability must be understood as part of a more significant, broader approach that includes understanding environmental hazards, and that seek to address them with adaptive and resilient solutions.

Cutter's (1996) hazards-of-place model of vulnerability seeks to conceptualize traditional views of biophysical vulnerability (factors of risk within the natural environment) by introducing social vulnerability with a place-based approach in both situation and proximity to hazards. In theory, social vulnerability is derived from the interaction between the underlying 'social fabric' and the hazard potentials of a place. According to Cutter, the social fabric is characterized by "sociodemographic characteristics, perceptions and experience with risk and hazard, and overall capacity to respond to hazards" (Cutter et al. 2000. p. 717). In operationalizing this conceptual model, this study will focus on the components of sociodemographic characteristics within

Research Objective 1 (RO1. Describe the socio-demographic vulnerabilities carried by the Beira sample prior to Cyclone Idai) in order to establish pre-existing risks and mitigations of households towards consistency of access prior to Cyclone Idai.

According to Cutter et al. (2003), there are several foundational factors that influence social vulnerability, including lack of access to resources; limited access to political power; social capital; and type and density of infrastructure. When applied to my study, lack of access is explored as an influential factor of vulnerability. This 'lack of access' will be measured through an index scale that has been used in previous studies to measure the consistency of access to resources and services, the Lived Poverty Index (LPI) (McCordic, 2016). The LPI is a tool developed by Afrobarometer (2013) in order to measure the multidimensional nature of poverty and wellbeing (refer to Section 3.3.4 for index description). As derived from Cutter's concept of social vulnerability, infrastructure and lifelines are metrics of biophysical vulnerabilities (loss of sewers, water, transportation infrastructure, etc.) at a city-wide level measures loss of infrastructure (2003. p. 247). Within this research, the LPI scale will measure household access to Sanitation, Water, and Electricity as services that are derived from access to infrastructure and lifelines in Cutter's concept of social vulnerability.

In addition, Cutter's Hazards of Place model has served as a framework for several SoVI case studies, as a vulnerability indicator tool developed that quantifies elements of geophysical risk and social vulnerability. Several SoVI case studies at a localized level within the United States (Wood & Cutter, 2009). In recent years, this model has been utilized in different urban settings within countries such as São Paulo, Brazil (Goto & Suarez, 2022) and Bucharest, Romania (Armas & Gavris, 2013) but there is limited exploration of the model's operationalization for more place-based and context-specific indicators at more localized levels

of analysis in regions such as Southern Africa. Notably, Mavhura et al. (2017) conducted a SoVI study in Muzarabani district, Zimbabwe, by using focus groups, interviews and census reports in a Principal Component Analysis (PCA) to develop a regional and context-specific vulnerability index at the community ward dissemination level. In contrast to previous applications of SoVI studies in the Global North, Mavhura et al. (2017) found that lack of access to certain resources, such as proper sanitation, safe water, electricity and fuel (fuel versus wood burning) were heightened social vulnerability variables identified by community members within the study (p. 110). In addition, Mavhura et al. (2017) noted that these vulnerability variables likely arose from multi-dimensional poor socioeconomic conditions of community members.

In addition, Cutter (2003) indicates access to medical services, and proximity and availability to healthcare as a crucial post-disaster metrics to mitigate social vulnerability (p. 248). Within this study, medical services will be measured as a household's access to medical care and services within the LPI variable of 'Medical Access". Furthermore, metrics of social vulnerability, such as Cash Income, are influenced by factors of personal wealth that increase social dependence on Cooking Fuel and Food during post-disaster periods (Cutter, 2003). As established by Satterthwaite (2004) in an urban system, there are demographic, economic and social characteristics that more heavily influence poverty (in contrast to a rural area) due to the higher monetarization of housing, essential goods and services, and overall less access to resources that require no monetary expense. Mitlin & Satterthwaite (2013) In addition, for poorer urban households, Amis (1995) notes that low-income households are historically subjected to paying more for the provision of basic resources and services due to the increased cost for purchasing in small quantities (versus the cost of bulk purchases), and the fiscal barriers to access formal infrastructure services (in terms of capital and spatial proximity). For example,

Mitlin & Satterthwaite (2013) discuss the inequality and inequity of access to basic services in San Salvador, where low-income households were required to pay a higher proportion of their incomes in order to access to water due to the higher costs of installing connections to sanitation and water infrastructure (as opposed to high-income households which had benefitted from already having access) (p. 255). Overall, within an urban environment, there is an increased dependency on cash in order to maintain consistent access to other resources and resources (as opposed to a rural area) and there are increased monetary costs for low-income urban households in order to provision basic resources and services.

In addition, according to the literature presented within this section, there are limited case studies within developing urban centres exploring the post-disaster consistency of access to resources and services at a household level (Mavhura et al., 2017). Based on these findings, this research analyzes pre-existing indicators of household vulnerability, such as respondents' perception of socioeconomic status, housing formality, land tenure and access to household resources and services experienced by urban populations during the occurrence of natural disaster in high-risk urban areas, such as the floodplains and low-lying areas of the city. In summary, propose that these predisposing factors of vulnerability would influence the outcome variables, by heightening the disruption of access to basic resources and services, and ultimately, during the occurrence of natural hazards (such as Cyclone Idai) hinder the urban population's ability to prevent, adapt, and maintain in the case of a disaster in heightened social vulnerability.

Section 3.0 – Methods

3. 1. Research approach

This research explores the relationship between disaster impacts and access to resources through the application of the Hazards-of-Place model, giving attention to the co-occurring impacts of the disaster on access to vital resources and services necessary for the wellbeing of the urban populations in Beira, Mozambique (Cutter, 2003). In terms of methodology, a quantitative approach toward measuring the correlated relationship of variables is most applicable to exploring the interconnections of disaster impact and resource access at a household level. Additionally, there is limited research empirically exploring the consistency of access to the aforementioned variables as a result of disaster impact within urban centres at a household level. This research seeks to achieve the following objectives: 1) Describe the socio-demographic vulnerabilities carried by the Beira sample prior to Cyclone Idai 2) Compare access to resources and services before and after Cyclone Idai in the sampled households in Beira 3) Evaluate the extent to which any changes in access to these resources and services are correlated in the sampled households in Beira.

3. 1. 1. Case study city: Beira, Mozambique

Shannon et al. (2018) describes Beira as "one of Africa's most climate-vulnerable cities" due to its coastal vulnerability to the increasingly adverse effects of climate change such as flooding, sea-level rise, and extreme weather events (p. 4). Additionally, Neumann et al. (2013) utilized storm surge models to predict sea level rise scenarios that found by 2050, in addition to increasing threats of rising sea levels, the frequency of storms will be higher in the capital port city of Maputo, however, the risk of intense storm surges will be much greater in Beira. This

significance is evident in historical reports and flood simulations, as Beira has a sizable portion of low-lying areas that lack natural drainage, and in instances of extreme rainfall, severe flooding can occur (VanBerchum et al., 2020). Additionally, VanBerchum (2020) noted that due to inadequate drainage in Beira's lower-lying areas, there are higher likelihoods of inundation and flooding in areas primarily occupied by informal housing.

There is increasing evidence of impacts from climate-related weather events in Beira, resulting in extreme flooding, displacement, and food insecurity (Hope, 2019). Before 2019, Mozambique has experienced a history of at least fourteen tropical cyclones that displaced and affected nearly three million people (Asante et al., 2009). In 2019, approximately one month apart, tropical cyclones Idai and Kenneth made landfall in Mozambique, resulting in the strongest and deadliest cyclone disasters ever to devastate mainland southeast Africa (Emerton et al., 2020). It is also the first time that two tropical cyclones have hit Mozambique in the same season (OCHA, 2020). Cyclone Idai resulted in more than 1.85 million people in need of emergency humanitarian assistance (Emerton et al., 2020). Furthermore, within the four Mozambican provinces affected by Idai (Sofala, Beira is located, Manica, Tete and Zambezia) the damage to infrastructure and physical assets was estimated to be over $1.4 billion (USD), and $3.2 billion of damages and losses for the entirety of Mozambique (UNDP, 2020; Charrua et al., 2021). On March 14th to 15th, Cyclone Idai made landfall near Beira as a category four tropical cyclone, resulting in Beira being the first and most heavily impacted city from this cyclone disaster (Charrua et al., 2021).

Trujillo (2019) states that Cyclone Idai made landfall during low tide, and further hypothesizes that if it had hit Beira during high tide, rising seawater levels would have significantly worsened the extent and damage of flooding. Phiri & Nyirenda (2020) conduct a

geospatial analysis of water coverage pre-, during, and post-cyclone Idai in Beira to determine which areas were most prone to flooding for the future hydro-meteorological events (Phiri & Nyirenda, 2020). Findings from this research determined that over 75 percent of Beira's land surface area was underwater during cyclone Idai, and post-cyclone, there was an eight to twenty percent decline in the area covered by vegetation likely due to saltwater damage (Phiri & Nyirenda, 2020. p. 16).

Figure 4

Map of Mozambique and the City of Beira

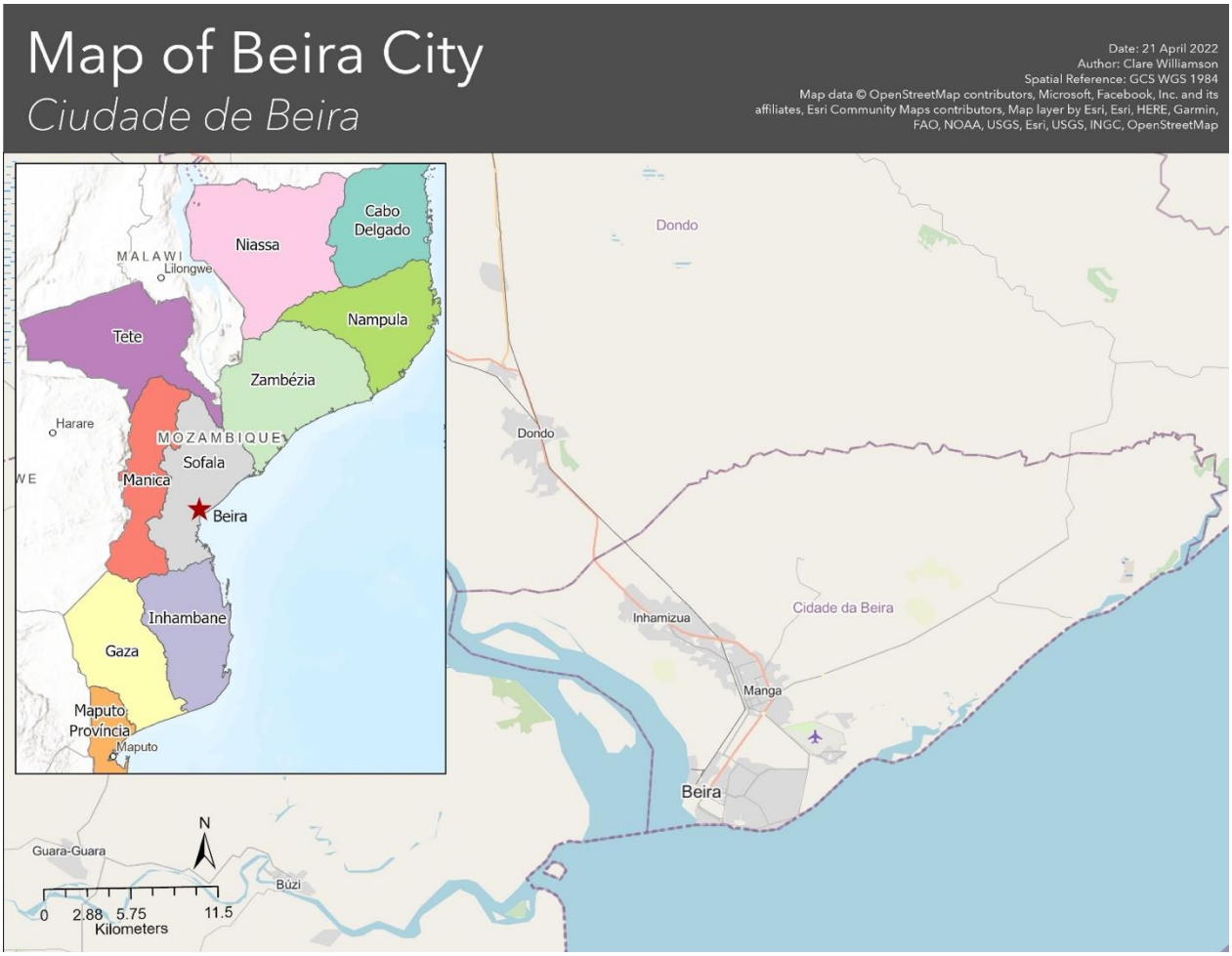

Figure 4: Map of Beira City and Mozambique inset (produced by author).

This overview intends to provide context towards the existence of vulnerability in Beira's urban population by understanding the presence of heightened risks posed by natural hazards and hypothesizing that the impacts of poor housing conditions and the city-wide adaptation and mitigation planning and policies for recovery in the aftermath of Cyclone Idai. Beira's urbanization has recently attracted an influx of migratory workers and subsequently increased the demand for equitable housing infrastructure (UN, 2015). The Beira Master plan 2035, which the municipality implemented in 2014, is intended to provide a framework for the resilient development of the city (Trujillo, 2019). However, Beira has no traditional land rights, especially

in informal settlements, due to a lack of government resources and bureaucratic capacity (Jacobs & Almeida, 2020). Therefore, Shannon (2019) argues that Beira's urbanization has contributed to the displacement of vulnerable populations due to the instability housing and land claims.

Secondly, foreign actors play a crucial role in Beira's housing infrastructure (Shannon, 2019). Vanbeers (2017) attributes a higher prevalence of informal settlements in more flood-prone areas, such as the floodplains near the Chiveve river, due to land being more available in hazardous areas and limited affordable housing alternatives. In contrast, Shannon et al. (2018) state that resettlement strategies from 'risk-prone' areas to 'safe zones' do not reduce the urban poor's social vulnerabilities in Beira, but instead force displacement in favour of land-based development investments from foreign investors. More specifically, Shannon et al. (2018) reference Special Economic Zones (SEZ) projects, such as urban river rehabilitation and stormwater drainage improvement in the Chiveve river, as drivers of the displacement of informal populations. Chapungu (2020) reiterates the implications of climate adaptation strategies, such as resettlement initiatives, that lack engagement with community-level actors' desires and instead prioritize the agendas of government, private, and third sector organizations. Sietz et al. (2011) argue that despite donor support for climate adaptation and resiliency measures, there are still barriers to government actors' institutional capacity to facilitate 'mainstreaming' climate adaptation initiatives. Lastly, Carvalho & Boanada-Fuchs (2019) critique Beira's housing strategies, such as the Beira Master plan 2035, which had limited opportunities for municipal government engagement with informal settlement dwellers for future inclusive urban resilience strategies.

Lastly, the impact of natural disasters further augments housing vulnerabilities for low-income residents of Beira's informal settlements. Within Sofala province, Beira was the largest

district impacted by Cyclone Idai, which destroyed nearly seventy percent of housing infrastructure within the vulnerable coastal city (Trujillo, 2019). Lequechane et al. (2020) identify some of the drivers of these impacts as being high population densities and the limited infrastructure servicing these vulnerable populations. Additionally, the communities most heavily impacted by cyclone Idai experienced prolonged barriers towards financial, social, and economic recovery due to significant monetary loss (Trujillo, 2019). The limitations within this review of the literature can be seen in the relationship between municipal government interventions to address urban land rights and geopolitics for vulnerable urban populations in relation to urban hazard-prone areas (Shannon, 2019). Additionally, due to a lack of literature post-cyclone Idai, there is limited information exploring community-level climate resiliency approaches to further inform disaster reduction policies and strategies (Carvalho & Boanada-Fuchs, 2019). The current literature is limited in exploring the interconnections of social vulnerabilities such as urbanization and poverty, and ecological impacts that contribute to the severity and extent of cyclone Idai. This suggests a gap in the relations of urbanization, governance, and the social consequences of these impacts when amplified by natural hazards. In conclusion, the implications of these findings insist that Beira's current infrastructure requires transformations to increase mitigation efforts and relieve vulnerable stressors on the urban poor.

3. 2 Paradigms, Ontological and Epistemological Considerations

The investigation of place vulnerability in Beira will be drawn from a post-positivist paradigm. This paradigm recognizes that although there is an objective reality, an understanding of reality can only be known through an individual’s subjective lens (Creswell & Creswell, 2018). The complexity of the human experience cannot be fully encapsulated within this

investigation. However, identifying critical components of vulnerability that may contribute to the household impact of Cyclone Idai aligns well with the scientific methods of post-positivist researchers. Due to the nature of the proposed quantitative research, variables and analysis, a post-positivist approach assumes that reality can only be known imperfectly, and therefore, this investigation does not seek to prove the hypothesis, but rather falsify this study's thesis statement (Philips & Burbules, 2000). The post-positivist paradigm also suggests that knowledge develops through falsification when new evidence is presented. Additionally, through an objective, reductionist approach towards quantifying the inconsistency of resources and service access experienced by households, these assumptions can be tested to determine whether the loss of consistent access to multiple resources could co-occur as a result from the impact of Cyclone Idai. Ultimately, this research aligns with a post-positivist paradigm that seeks to test and develop factual statements that explain the relationships between household vulnerability and inconsistency of resource/service access in Beira.

3. 3. Research Methods

3.3.1. Methodology

The primary purpose of this study is to empirically evaluate whether there are interrelationships between the loss of access to resources and services during the occurrence of a natural disaster. Stated more simply, the research examines whether the loss of one resource/service due to disaster triggers the loss of one or more other resources/services in a process of cascading impacts. This research used a quantitative approach towards capturing the pre-Cyclone Idai household socio-demographic vulnerabilities and the subsequent relationship between the loss of access to resources/services due the cyclone, and the extent to

which this occurs at the household level. The research used a survey to gauge whether there was a relationship on the consistent access to resources and basic services within households and the impact of natural disasters. Data collected from household surveys was conducted within the twenty-five of the twenty-six neighbourhoods in Beira, Mozambique, and investigated topics related to household demographics, livelihood, and socioeconomic conditions in line with the Hazards-of-Place model. The data was analyzed with the use of descriptive and frequency statistics, in addition to correlation analysis. The data collected was used to show high-scoring households of the Lived Poverty Index (LPI) to determine localized poverty and the impact of households' access to resources during the occurrence of disaster impacts.

3.3.2. Data Collection

This study's primary purpose is to explore whether there is an existence of co-occurring relationships between the households' consistency of access to resources and services in pre- and post-Idai Beira, Mozambique. A survey method was the preferred type of approach for this study. An experimental design was not viable due to the nature of the disaster phenomenon will study and the potential implications of manipulating household variables. Additionally, it would be exorbitantly challenging to control the phenomenon of natural disasters retroactively. This research undertook a retrospective and cross-sectional design. This research investigated the relationship between the indicators included in this investigation at a previous point in time, pre- and post-disaster (2019), and the present day (cross-sectional) impacts in Beira. Both survey questions pertaining to pre- and post- disaster

measures were collected at the time the survey was conducted during a 4-week period in September-October 2021.

Table 1

Timeline of Survey

Survey Collection Period (September 20 to October 14, 2021)		
Variable	Recall Period	Question(s) in Survey
RO1: Pre-Cyclone Idai Household Characteristics		
Number of people residing in household, structure of dwelling, type of land tenure.	Before March 15, 2019	Q8, 14, 17, 18
Household income	What was this household's income in the month before Cyclone Idai (before March 15, 2019)?	Q21
RO2 & RO3: Pre-and Post-Cyclone Idai Access to Resources and Services		
Pre-Cyclone Idai Lived Poverty Index Variables (Medical, Food, Water, Sanitation, Electricity, Fuel, Cash).	In the year before Cyclone Idai (March 15, 2018 to March 15, 2019), how often, if ever, the respondent's household went without access to a specific resource/service.	Q49-55
Post-Cyclone Idai Lived Poverty Index Variables (Medical, Food, Water, Sanitation, Electricity, Fuel, Cash).	In the year after Cyclone Idai (March 15, 2019 to March 15, 2020), how often, if ever, the respondent's household went without access to a specific resource/service.	Q56-62

Additionally, the investigation demonstrates the strength and quality of relationships between indicators at one point in time rather than longitudinally. This investigation also takes place at the household scale. While operating at this scale of measurement may mask individual differences in lived poverty among household members, a household level investigation in the context of post-cyclone Idai Beira captures the shared resilient or vulnerable characteristics of the entire household. Operating at this scale also assumes that livelihood and poverty are experienced similarly amongst household members. Also, this

scale is important given the definition of a household in this survey (group of members residing in the same dwelling that had experienced the impacts of cyclone Idai). Therefore, all the data in this investigation will be derived from household-level surveys.

The dataset was drawn from a larger Social Sciences and Humanities Research Council of Canada (SSHRC) funded project led by my supervisor, Cameron McCordic, under the Insight Development Grant (IDG) program. This larger project aims to explore the SDG-relevant urban impacts of, and adaptation to, Cyclone Idai. This SSHRC-funded project surveyed 975 households in Beira, Mozambique. Data collection was conducted in September-October 2021 by enumerator teams from Eduardo Mondlane University (EMU) in Maputo and the Center for Community Development Studies (CEDECA) at the Pedagogical University in Beira, Mozambique. The household survey instrument used the Post-Disaster Needs Assessment (PDNA) Guidelines for Assessing Human Impact of Disasters developed by the European Union (EU), United Nations Development Programme (UNDP), and World Bank (WB). The survey instrument incorporated measurement tools, including the Household Food Insecure Access Scale (Coates, Swindale, and Bilinsky, 2007), the Lived Poverty Index (Afrobarometer, 2013) and scales derived post-disaster impact assessment guidelines from the United Nations Sustainable Development Group (UNSDG, 2019). The instrument was designed to measure and compare the household experience and resulting impacts prior to and following the Cyclone Idai disaster.

Research partners from Eduardo Mondlane University arranged community entry permissions for the household survey in Beira. In addition, the survey instrument (Appendix B) received ethics approval from the University of Waterloo Research Ethics Board. When the survey was conducted in September-October 2021, all COVID-19 safety protocols were

adhered to by the enumerator team depending on relevant institutional and government mandates for the household survey.

3.3.3. The Population and Sample

According to the 2017 Mozambique Population and Housing Census, Beira has an estimated population of 500,000 (INE, 2019). However, other than city-wide population estimates, there is limited recent census data to indicate population demographics within Beira. The collected sample size was 975 households to support the intended statistical analyses. The sampling design consisted of a single-stage random sampling procedure. At the forefront, the use of GIS and city-wide land use data (available through the Humanitarian Data Exchange and OpenStreetMap) allowed a random sampling of building structures within the administrative boundaries of the City of Beira to be carried out (Thomson et al., 2017; Qader et al., 2020).

The survey sampling strategy was a single-stage random sampling strategy. Building structure data was collected from OpenStreetMap (OSM), an open-source geographic database that relies on community driven contributors to include features through collaborative efforts. In response to the Cyclone Idai disaster, the Humanitarian OpenStreetMap, a team of OSM dedicated to mapping humanitarian and community development response, digitized every building within the Sofala province using remote satellite imagery and sharing this geodata in the OSM database (Wagenaar et al., 2018). This process involves the conversion of rooved-like buildings to be automatically converted into a polygon feature of a building and deposited into the *Mozambique* dataset and available for download on Geofabrik. These building polygons are verified by map contributors to ensure

that abnormalities (such as reflective surfaces, darker craters, etc.) are edited and removed from the building layer. The building polygons dataset for Mozambique was retrieved from Geofabrik, a platform that extracts regional data from OSM on a regular basis for users to access. This building data is freely available on Geofabrik in multiple file formats and is updated on a weekly basis.

The file for Mozambique buildings layer was download and used on September 7th, 2021. All file customizations were made on ArcGIS Pro, and the random selection of buildings were made using Statistical Package for Social Science (SPSS) software. The Mozambique shapefile building layer was added to the map along with the Beira administrative boundaries layer which was retrieved from the UN Humanitarian Data Exchange. The file, titled 'INGC_Beira_Bairros_Neighbourhoods.zip' includes the official Beira Bairros (neighbourhoods) from INGC in a shapefile format. The accuracy of these shapefile administrative boundaries was confirmed with enumerator lead from EMU. A total of 139,027of the OSM building polygons that were located within the administrative boundaries of Beira. A random sample of 1,000 of these buildings was generated using SPSS. These building locations were mapped out and provided to the enumerator lead for survey sampling collection strategy.

Figure 5

Map of Beira Household Survey Coverage Area

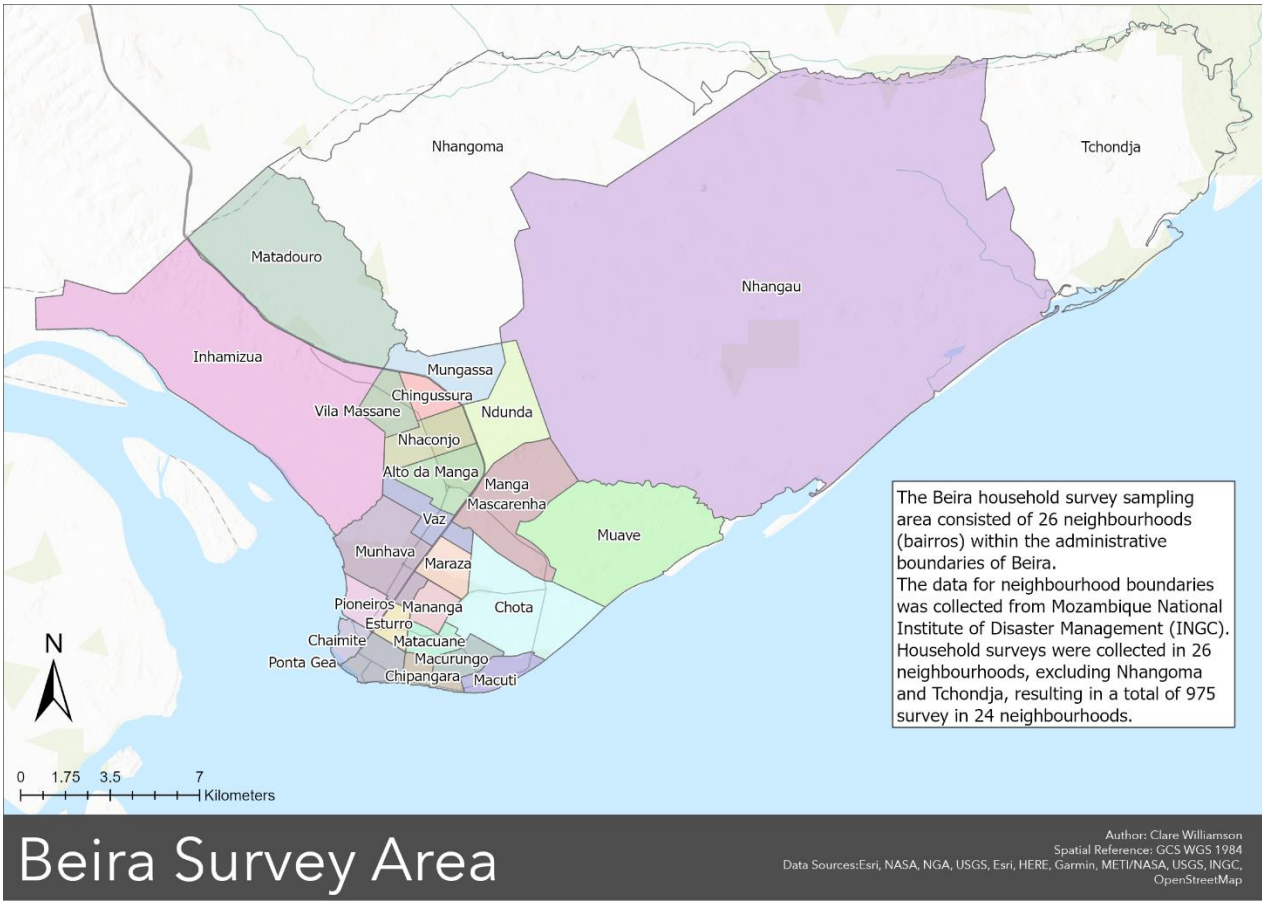

Figure 5: Map of Beira household survey coverage area by neighbourhoods (bairros) (produced by author).

There are a total of 26 neighbourhoods (bairros) within the administrative boundaries of Beira. In the random sampling, building locations were randomly selected in all 26 neighbourhoods. Due to the allocation of the random sample and population distribution, only some dwellings were sampled in Tchonja and Nhangoma. Some of the dwellings identified by GIS were destroyed or inaccessible, which resulted in both the exclusion of both neighbourhoods from the final survey sample.

Description of Sample Population

The sample population includes 975 respondents, of which over 66 percent self-identified as female. One respondent did not provide their sex. The survey was conducted in September-October 2021. At the time this survey was conducted, households reported a monthly mean income of 11157.37 MZN ($221.95 CAD). The highest reported income was 770000 Mozambican meticais ($15,317.35 CAD). (n=860)

Table 2

Respondent's relationship to household head

Variable	*n*	%
Head of household	463	47.5
Spouse/partner	312	32.0
Son/daughter	141	14.5
Adopted/foster child/orphan	1	.1
Father/mother/in law	4	.4
Brother/sister	9	.9
Grandchild	6	.6
Grandparent	5	.5
Son-in-law/daughter-in-law	13	1.3
Other relative	17	1.7
Non-relative	3	.3
Total	974	100.0

47.5 percent of respondents self-identified as the Head of Household (HoH), which lends validity to the representation of the entire household unit within the survey. 32.0 percent of respondents self-identified as the Spouse/partner. A total of 52.0 percent of respondents identified as a family member of the HoH, indicating that these households were multigenerational.

Table 3

Respondent's level of education

Variable	*n*	%
No formal education	119	12.3
Some primary school	193	19.9
Primary school completed	132	13.6
Some high school	226	23.3
High school completed	179	18.5
Some technical/vocational school training	26	2.7
Technical/vocational school completed	9	0.9
Some university/college	35	3.6
University/college completed	50	5.2
Total	969	100

At the time of the survey, over 12 percent of the respondents identified as having no formal education. 23.2 percent of respondents completed some high school education. Only 5.1 percent of respondents completed university/college and less than one percent completed a technical/vocational school. Something of interest is that the highest representation of education at 23.2 percent was some high school education.

Table 4

Summary statistics for the number of people living in the household

n	974
Mean	5.64
Mode	6
Range	17
Minimum	1
Maximum	18

The average household size was 5.64 people / per household. One respondent did not report their household size. The average size of the household may be due to the fact that multiple generations of the same family reside within a single household. There may also be multiple extended families residing within one household.

Table 5

The number of people living in the respondent household

Variable		*n*	%
# of household members	1	18	1.8
	2	44	4.5
	3	112	11.5
	4	161	16.5
	5	169	17.4
	6	175	18
	7	116	11.9
	8	79	8.1
	9	36	3.7
	10	31	3.2
	11	6	0.6
	12	12	1.2
	13	4	0.4
	14	5	0.5
	15	1	0.1
	16	3	0.3
	18	2	0.2
	Total	974	100

17.3 percent of respondents indicated a household size of five. 17.4 percent of respondents indicated a household size of five.

Home Dwelling Characteristics

Table 6

The current structure of the dwelling in which this household resides (note: answer based on the respondent's perception)

Structure of Dwelling	*n*	%
House in a formal area	594	61.6
Apartment in formal area	21	2.2
House in informal area	281	29.1
Shack in informal area	57	5.9
Other (Specify)	12	1.2
Total	965	100.0

61.6 percent of respondent households stated that they resided in a house in a formal area (based on the respondent's perception). Alternatively, only 2.2 percent of respondent households resided within an apartment in a formal area. In addition, nearly one-third (29.1 percent) of respondent households indicated that the structure of the dwelling they resided within was a formal house within an informal area.

3.3.4. Survey Instruments

The household survey was completed using android tablets. The tablets contained the digital version of the household survey using ODK collect. ODK collect is an open-sourced android application that can be used offline to administer surveys and then gather and organize the survey data into coded data sets. The data collected via ODK collect was uploaded to an encrypted online project database where the data is stored. The data was then downloaded from the online database and exported into an excel file for statistical analysis. In order to maintain

confidentiality, all the household survey information was encrypted on the tablet, on the online database and during storage.

Variables in the study

The LPI is a tool developed by Afrobarometer (2013) in order to measure the multidimensional nature of poverty and wellbeing. This experiential measure is based on a series of survey questions about how frequently people go without basic necessities during a year. The LPI measures the frequency with which a household has gone without access to electricity, water, medical care, and a cash income over the previous 12 months. Inconsistent household infrastructure access (to both social and physical infrastructure) is determined by the subscales in the Lived Poverty Index (LPI). Each basic service (electricity, sanitation, medical care) and resource (food, water, fuel and cash) is a subscale in the LPI.

Table 7

Lived Poverty Index (LPI) Variables

Variables	Level	Categories					Survey Question	Survey Items
Medical Access Loss	Categorical	Never	Just once or twice	Several times	Many times	Always	In the year before Cyclone Idai (and after) a household went without medicine or medical treatment	Q52, Q59
Food Access Loss	Categorical	Never	Just once or twice	Several times	Many times	Always	In the year before Cyclone Idai (and after) a household without enough food to eat	Q49, Q56
Water Access Loss	Categorical	Never	Just once or twice	Several times	Many times	Always	In the year before Cyclone Idai (and after) a household went without enough clean water for home use	Q50, Q57
Sanitation Access Loss	Categorical	Never	Just once or twice	Several times	Many times	Always	In the year before Cyclone Idai (and after) a household went without an accessible toilet facility	Q51, Q58
Electricity Access Loss	Categorical	Never	Just once or twice	Several times	Many times	Always	In the year before Cyclone Idai (and after) a household went without electricity in your home	Q53, Q60
Fuel Access Loss	Categorical	Never	Just once or twice	Several times	Many times	Always	In the year before Cyclone Idai (and after) a household went without enough fuel to cook your food	Q54, Q61
Cash Access Loss	Categorical	Never	Just once or twice	Several times	Many times	Always	In the year before Cyclone Idai (and after) a household went without a cash income	Q55, Q62

3.3.5. Data Analysis Plan

As a co-investigator, one of my primary roles was to ensure adequate data collection and management processes were carried out during the household survey. The survey collection process spanned four weeks in September-October 2021, and during this time, the collected data was analyzed on a rolling basis using Microsoft Excel and Statistical Package for Social Science (SPSS) software. The collected data was analyzed to provide preliminary geographic and statistical information on the experienced impacts of these cyclones using SPSS

statistical software. During the analysis, households were categorized according to Cyclone impacts and cross-referenced by household demographic information (to identify the variables associated with varied Cyclone impacts).

3.3.5.1. *RO1. Describe the socio-demographic vulnerabilities carried by the Beira sample prior to Cyclone Idai*

This research objective is achieved by analyzing the sample population using descriptive statistics to establish different indicators of socio-demographic characteristics. These characteristics were used to identify key patterns within the sample population that may indicate vulnerability to a loss of access to basic services prior to the occurrence of Cyclone Idai. Basic services are defined as commodities that, in an urban setting, must be purchased (Mitlin & Satterthwaite, 2014, p. 5). A descriptive analysis was conducted for all independent and dependent variables in the study. This analysis details the socio-demographic characteristics of the survey sample population in the month before the occurrence of Cyclone Idai. This analysis includes the mean, median and interquartile ranges for household income. In addition, the analysis also captures household characteristics, such as the frequency of household size, the structure of the dwelling, the formality of land tenure and residence, and further analysis of how these agreements were reached in the month prior to Cyclone Idai.

The chosen sociodemographic characteristics used within this study are based on previously existing measures of vulnerability from disaster literature (Cutter, 2003) that sought to apply quantitative vulnerability indicators. Furthermore, research utilizing quantifiable indicators at both the household level, regionally specific, and within urban areas that lack up-to-date census and demographic information, is applied in order to understand the characteristics of

a population in terms of identifying potentially vulnerable groups. For the purposes of this research, certain characteristics are collected, analyzed and discussed in order to capture pre-Cyclone Idai socio-economic information about the sample population, which will provide further context towards conditions of pre-existing vulnerabilities. This includes descriptive statistics about the sample household's monthly income in the month before Cyclone Idai, the household size at the time the survey was collected, and the structure of the dwelling prior to the occurrence of Cyclone Idai.

3.3.5.2. RO2. Compare the consistency of access to resources and services before and after Cyclone Idai in Beira

The data is analyzed using frequency distributions of each Lived Poverty Index (LPI) Score prior to, and after Cyclone Idai in order to compare sampled households' access to each resource or service. This includes household access to medicine or medical treatment, food, clean water, sanitation/toilet facilities, electricity, fuel for cooking, and cash income. These differences between pre- and post-Cyclone Idai access are further interpreted through other descriptive information about the population sample provided by the survey instrument. Lastly, the pre- and post-Cyclone Idai LPI scores are used to calculate the total difference in loss of resource/service access within the sample population to determine the change of access for each variable. The LPI scale seeks to categorically quantify the frequency of inconsistent access experienced by a household within the period of time. The concept of access and equity is further explored by measuring the differences in loss of access across LPI variables for households prior to, and in the year following the cyclone impact. This is achieved by collecting each variable score, pre-Cyclone, and calculating the score differences for that variable post-Cyclone Idai. The rationale

for determining the differences in loss between each variable is to further understand the proportion of movement for each variable towards greater access or heightened inaccessibility. This difference in loss of access is described within a range from 'no change in access,' characterized by a difference score of 0, to a 'complete loss of access' with the greatest difference of 5.

3.3.5.3. RO3. Evaluate the extent to which any changes in access to these resources and services were correlated

The differential scores of the LPI variables are used to conduct a correlation analysis in order to determine the nature and strength of the relationships between indicators. These differential scores are calculated by using the Post-Cyclone Idai respondents LPI rankings minus the Pre-Cyclone Idai ranking scores. In practice, a respondent's reporting for access to a resource/service (i.e. Never, Just once or twice, Several times, Many times, Always) in the LPI score ranges along a five-point scale from 0 (which is understood as no deprivation from the resource or service) to 4 (which would reflect a constant absence of the resource or service). The differences calculated Pre-and Post-disaster scores are then used to calculate the change in consistency of access to a basic resource/service. In other words, using the LPI scale, this investigation applied a correlation analysis to determine whether the household loss of consistent access to basic resources and services was correlated. Corder & Forman's (2009) correlation ranking system will be applied in order to determine the strength of the relationship between the variables for Spearman's Rho Key correlations included within this table (*Table 8*). Specifically, this statistical test attempts to reveal whether a household's change in access to resources/services coincides with another access to other resources/services. Moreover, this

analysis seeks to measure whether these changes in access amongst variables are positively correlated (e.g. the consistency of access decreases with more than one variable simultaneously).

In order to control for biases within the LPI scale measurement, this analysis is also applied to those who had consistent access to all LPI variables prior to Cyclone Idai. The rationale for also conducting this analysis with a subset of the sample is necessary due to the fact that the pre- and post-Cyclone Idai changes in LPI rankings (which seeks to measure the consistence of access to resources/services) are highly dependent on house LPI rankings measured before the disaster. For example, a household that has very inconsistent access to these resources/services may only indicate minor changes which could mask true correlation relationships when conducting the correlation analysis. Those within the sample that scored consistent access to all basic resources and services meets the requirement for those who had consistent household access prior to cyclone Idai (n=125). The difference in losses is also calculated for the n=125 sampling population in order to mitigate any external factors that may influence noise within the variance of scores in the entirety of the sample set. In other words, within the larger household sample, 850 households already experienced some degree of inconsistent access to one or more resource/service measured prior to Cyclone Idai. When measuring the extent of change post-disaster amongst households who had consistent access to all resources and services, this reflects the greatest representation for changes within the LPI variables in post-disaster consistency of access amongst households.

Spearman Rank-Order Correlation

The Spearman's rank correlation coefficient will be computed in order to evaluate the correlation coefficient amongst the LPI variables. The formula appears as so:

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2 - 1)}$$

ρ	=	Spearman's rank correlation coefficient
d_i	=	difference between the two ranks of each observation
n	=	number of observations

The Corder & Foreman's Ranking table is used within social science and humanities research as a justification for ranking the strength of correlation coefficients. This is applicable for this study's dataset due to the fact that the data is ordinal and scalar. In addition, this ranking system is sensitive to the increase and decrease of variable relationships strengths in tandem (the likelihood that one variable increases, another variable will also increase and vice versa), which is a key focus of this research and objectives.

Table 8

Cohen's (1992,1998) correlation coefficients relative strength ranking table

Correlation coefficient for direct relationship	Correlation coefficient for an indirect relationship	Relationship strength of the variables
0.0	0.0	None/trivial
0.1	-0.1	Weak/small
0.3	-0.3	Moderate/medium
0.5	-0.5	Strong/large
1.0	-1.0	Perfect

Limitations and boundaries

There are several external factors that contribute to the limitations of analysis within this research. Given the limited data and literature detailing the measurable impacts of Cyclone Idai on Beira's urban populations, the modifications and controlling parameters required in order to accommodate the scale of analysis at the household-level will be informed through similar household survey methods in studies other cities (McCordic, 2016). The households were surveyed through simple random sampling methods; however, surveys implemented within a clustered area such as an urban environment, the presence of spatial autocorrelation may become a potential influence on the strength of correlation within the access to resource variables. Additionally, the biophysical and social variables are derived from tested and reliable indexes, including the LPI, which indicates they are precise, replicable, and consistent across multiple studies. Lastly, given the lack of relevant recent census data to inform the scale and unit of analysis in the city of Beira, the survey sampling size will be based on post-disaster population estimates from international humanitarian agencies.

Within the sample dataset, if further spatial analysis is sought, there needs to be consideration and exploration towards the presence of spatial autocorrelation amongst the

mapped variables within the dataset. Spatial autocorrelation is understood as the positive correlation of variables that share similarities in values based on spatial proximity (or inversely if negative) (Li et al., 2012). According to Haining (2001) there may be several factors that contribute to the presence of spatial autocorrelation:

> *The presence of spatial autocorrelation is important, (a) because it is usually taken as indicating that there is something of interest in the distribution of map values that calls for further investigation in order to understand the reasons behind the observed spatial variation, and (b) because the presence of spatial autocorrelation implies information redundancy and has important implications for the methodology of spatial data analysis (para 1).*

As applicable within our survey sample, it is important to note that the strength of correlations amongst variables measured, the most applicable may be the "inheritance by one variable through causal association with another" (Haining, 2001. para. 1). This will require further exploration within future research in order to understand the influence of spatial proximity to variable correlations. Alternatively, in this study, in order to mitigate for the potential presence of spatial autocorrelation, all correlation analysis variables will also undergo bootstrapping for variables. In order to perform bootstrapping, the specification of analysis will require 1000 random samples collected from the dataset and analyzed using SPSS software. This will include a confidence interval of 95 percent and percentiles as confidence intervals. The results from the bootstrapped variables will need to show, within a 95% confidence interval, that all bootstrapped correlation values were positive.

Expected Results

I expected to find a relationship amongst loss of access to resources and services at the household level. Furthermore, I hypothesized that when households lose access to one

resource (food, water, electricity, medical access, etc.) that there will be an increased likelihood of loss experienced by one or more other resources. In addition, I expected to find that there will be a large proportion of the sample that has an increase in inconsistent access to at least one basic resource or service. Further, this investigation further illustrated the socio-demographics characteristics of the Beira sample population in order establish pre-existing conditions of vulnerability and overall development levels for those prior to the occurrence of Cyclone Idai.

Section 4.0 - Data Analysis

4.1. RO1. Describe the socio-demographic vulnerabilities carried by the Beira sample prior to Cyclone Idai

Research objective one sought to explore the sociodemographic vulnerabilities of the sample population in Beira prior to Cyclone Idai. Certain indicators that are represented within sociodemographic characteristics are derived from several indicators of social vulnerability presented within the literature (Burton & Cutter, 2008). Such indicators include employment (type and stability), income, savings, and education levels (Burton & Cutter, 2008; Cutter & Emrich, 2006; Cutter et al., 2003; Blaikie et al., 1994), the quality of human settlements (housing type and construction, infrastructure, and lifelines) tenure type, built environment, family structure and population growth (Cutter et al., 2003). These variables are a principal component of vulnerability, particularly in combination with other marginalization factors (Blaikie et al., 1994). These factors influence economic losses, injuries, and fatalities from natural hazards (Cutter et al., 2003).

Table 9
Household income characteristics of Survey Sample

		Household income in the month before Cyclone Idai
n		819
Mean		7582.23
Median		5000
Range		150000
Percentiles	Q1	3000
	Q2	5000
	Q3	8000

Households were asked to recall the household income for the month of February 15th, 2019, one month prior to the occurrence of Cyclone Idai on March 15th, 2019. The mean household income in the month prior to Cyclone Idai was 7582.23 Mozambican meticais (MZN) ($148.37 CAD[1]), which is significantly higher than the median (5000 MZN or $97.84 CAD) by over 41 percent. The difference seen between mean and median indicates that the data may be skewed towards the maximum reported monthly income. A more accurate picture of household income ranges is found within the quartile ranges, in which percentile 1 is 3000 MZN ($58.70 CAD), percentile 2 is 5000 MZN ($97.84 CAD), and percentile 3 is 8000 MZN ($156.55 CAD).

Household income is an important indicator of vulnerability. Firstly, income directly contributes to a household's ability to address other dimensions of well-being, such as food and utility costs, and consequently, livelihood instability decreases a household's overall coping capacity in the event of loss in terms of productive assets and household goods. In the event of Cyclone Idai, and subsequently, Cyclone Kenneth, the loss of a livelihood can exacerbate the overall impact and duration of vulnerability that households experience simultaneously with the loss of other essential needs, such as housing, and this impacts the overall coping capacity in order to recuperate and rebuild in the wake of disaster.

A total of 156 households did not report their income in the month prior to the occurrence of Cyclone Idai. A contributing factor for this large number of missing responses may be the possibility that respondents did not identify as Head of Household, and therefore, may have been unaware of the cumulative monthly income within the household. In the context of Mozambique, it is also quite common for spouses to be unaware of their partner's or the Head of Household's

[1] All currency conversions from Mozambican meticais to Canadian Dollars is current as of April 20th, 2022.

income. These results should also be interpreted with caution as they are open to recall biases, and as a result, there may be some recall issues.

Household Characteristics

This section will review the household characteristics of respondents prior to Cyclone Idai. This includes an overview of the number of people living within a household, the structure of the dwellings, and the status of occupancy, including land and home ownership and tenure.

Table 10

Pre-Cyclone Idai number of people living in a household

# of people	n	%
1	15	1.5
2	42	4.3
3	109	11.2
4	145	14.9
5	159	16.4
6	161	16.6
7	121	12.5
8	87	9
9	48	4.9
10	35	3.6
11	10	1
12	17	1.8
13	6	0.6
14	6	0.6
15	4	0.4
16	2	0.2
17	1	0.1
18	2	0.2
20	1	0.1
Total	971	100

At the time the survey was conducted, the most frequent household size reported by respondents were six household members at 16.6 percent (n=161), which was closely followed

by five household members, representing 16.4 percent of the sample population household size (n=159). 14.9 percent of respondents stated they resided in a household with four family members. In addition, 12.5 percent of households had seven family members. Within this sample, the most reported household sizes fell between three and seven members (representing a total of 71.6 percent of the sample). In addition, there are some outliers, including one reported household size of 17 members and one reported household with 20 members. Those households indicating five or more members may experience a degree of inconsistent resource/service access due to increasing level of consumption for basic needs in order to maintain food security (Mango et al., 2014; McCordic, 2016). Within the sample, the most-reported household size was six, which suggests that there is a higher increase levels of consumption amongst household members, and a higher likelihood of inconsistent access to resources such as food.

Table 11

Pre-Cyclone Idai household structure of the dwelling

Structure of dwelling	*n*	%
House in a formal area	593	61.4
Apartment in formal area	23	2.4
House in informal area	285	29.5
Shack in informal area	54	5.6
Other (Specify)	11	1.1
Total	966	100

The status of housing is a key factor to evaluate in order to assess the degree of vulnerability experienced at the household level, and to further contextualize pre-existing inequalities through characteristics of housing and land tenure. The common, informal status of

housing within Beira is important to emphasize here. In addition to formal government policies and legislative apparatus, Beira has no customary land rights that contribute to a legal reinforcement of housing security. However, at a municipal and neighbourhood level, widely accepted means of 'informal' or non-legal, processes exist in order to establish the agreements and understandings toward the development, occupancy, and tenure of housing in Beira (Shannon, 2019).

Drawn from the larger household survey, sixty-four percent of households stated they that owned the place they resided in pre-Cyclone Idai, while 36.0 percent of households did not own the dwelling they resided in. Within the subset of those who did not own their dwelling, 41.1 percent of respondents rented the dwelling that the household resided in, and 4.7 percent of households were allocated the dwelling that they resided in. In addition, 9.9 percent of households were given at DUAT (Direitos de Uso e Aproveitamento de Terrafrom), which an official 50-year land title from the municipality, and 1.6 percent were given a title deed. Thirty-nine point three percent of households inherited the place, which could be another contributing factor to the presence of multigeneration households within the sample. In addition. Twelve point nine percent of households were given permission to live in a dwelling from the family whose land it was on, and 10.6 percent were given a verbal agreement, suggesting that the majority of households within the sample held informal means of land tenure. In the event of disaster, the damage caused to dwelling structures can result in migration and displacement, and those households that lack legal land tenure face further barriers towards occupancy rights and housing security (Shannon et al., 2019).

4.2. RO2. Compare the consistency of access to resources and services before and after Cyclone Idai in Beira

Table 12

In the year before Cyclone Idai (and after) a household went without medicine or medical treatment

		Never	Just once or twice	Several times	Many times	Always
Pre-Idai Medical Access Loss	n	439	296	114	108	11
	%	45.4%	30.6%	11.8%	11.2%	1.1%
Post-Idai Medical Access Loss	n	359	285	186	130	8
	%	37.1%	29.4%	19.2%	13.4%	0.8%

Following the impact of Cyclone Idai, only 37.1 percent of the sampled households had consistent access to medicine or medical treatment (in comparison to 45.4 percent that had consistent access in the year before Cyclone Idai. In addition, post Idai, 0.8 percent of households that always experienced inconsistent access to medicine or medical treatment (whereas prior to Idai, 1.1 percent of households that always had inconsistent access). The number of households that experienced several times in which they went without medicine or medical treatment increased by 7.2 percent.

Table 13

In the year before Cyclone Idai (and after) households went without enough food to eat

		Never	Just once or twice	Several times	Many times	Always
Pre-Idai Food Access Loss	n	281	258	250	174	6
	%	29.0%	26.6%	25.8%	18.0%	0.6%
Post- Idai Food Access Loss	n	154	208	300	293	15
	%	15.9%	21.4%	30.9%	30.2%	1.5%

Within the sample population, after Cyclone Idai, only 15.9 percent of the sampled households had consistent access to enough food to eat in the year after Cyclone Idai (compared to 29 percent that had consistent access in the year before Cyclone Idai). An increase in households experiencing food insecurity is supported by the Pre-Cyclone Idai Household Food Insecure Access Prevalence (HFIAP) Category scale, which was also measured in the survey, indicating 77.9 percent of households were severely food insecure prior to the occurrence of Cyclone Idai. In addition, 3.3 percent of households scored as moderately food insecure, and 5.6 percent were mildly food insecure. Only 12.7 percent of households scored as food secure. The prevalence of high food insecurity within the sampled households indicates a pre-existing condition of inconsistent access and vulnerability to food insecurity.

Table 14

In the year before Cyclone Idai (and after) a household went without enough clean water for home use

		Never	Just once or twice	Several times	Many times	Always
Pre-Idai Water Access Loss	n	467	273	108	111	13
	%	48.0%	28.1%	11.1%	11.4%	0.6%
Post-Idai Water Access Loss	n	343	209	205	203	9
	%	35.4%	21.6%	21.1%	20.9%	0.9%

Post-cyclone Idai, only 35.4 percent of the sampled households had consistent access to enough clean water (compared to 48 percent that had consistent access in the year before Cyclone Idai). Furthermore, post-Idai, 35.4 percent of households experienced inconsistent access to enough clean water in contrast to 48 percent prior to the occurrence of Cyclone Idai (measured in the category of ‘never’ going without enough clean water). In addition, prior to

Idai, 35.4 percent of respondent households reported consistent access to clean water, whereas 48 percent of households had consistent access prior to Idai. Post-Cyclone Idai, there was a significant increase to 21.1 percent of households that went several times without enough clean water (whereas pre-disaster 11.1 percent of households reported going several times without access to clean water). Nearly 76.0 percent of the sample households relied on formal water infrastructure in the form of piped water as a source of main drinking water prior to the occurrence of Cyclone Idai. 21.9 percent of households relied on informal and inconsistent means, such as tube-wells, boreholes, and dug wells, in order to access water. Similarly, after the occurrence of Cyclone Idai, 78.5 percent of respondent households used piped water as a primary source of drinking water and 19.5 percent for tube-wells, boreholes and dug wells.

Table 15

In the year before Cyclone Idai (and after) a household went without an accessible toilet facility

		Never	Just once or twice	Several times	Many times	Always
Pre-Idai Sanitation Access Loss	n	626	140	62	95	45
	%	64.7%	14.5%	6.4%	9.8%	4.6%
Post-Idai Sanitation Access Loss	n	488	168	142	125	42
	%	50.6%	17.4%	14.7%	13.0%	4.4%

Post-Cyclone Idai, only 50.6 percent of the sampled households had consistent access to an accessible toilet facility (compared to 64.7 percent that had consistent access in the year before Cyclone Idai). *Table 15* displays an increased number of households that just once or twice, several times and many times went without an accessible toilet facility. Over half (51.0 percent) of households used a pit latrine as their primary toilet facility. The second most common form of toilet facility was a bucket, reported by 24.2 percent of households that used this as their

main toilet facility. Only 15.8 percent of households had a flush toilet, indicating a small number of households that had access to piped infrastructure within their dwelling.

Table 16

In the year before Cyclone Idai (and after) a household went without electricity in their home

		Never	Just once or twice	Several times	Many times	Always
Pre-Idai Electricity Access Loss	n	354	245	179	124	47
	%	37.3%	25.8%	18.9%	13.1%	5.0%
Post-Idai Electricity Access Loss	n	216	150	235	201	51
	%	22.7%	15.7%	24.7%	31.6%	5.4%

Only 22.7 percent of the sampled households had consistent access to electricity in their home in the year after Cyclone Idai (compared to 37.3 percent that had consistent access in the year before Cyclone Idai). Post-cyclone Idai, there was a notable decrease from 37.3 percent to 22.7 percent of respondent households that never went without electricity in their home. There was also a pre-disaster 13.1 percent to 31.6 percent increase in respondent households that went many times without electricity in their home. In addition, after Cyclone Idai 5.4 percent of respondents reported a 5.4 a constant state of inconsistent access to electricity in their home (whereas pre-disaster 5 percent of respondent households always went without electricity in their home).

Table 17

In the year before Cyclone Idai (and after) a household went without enough fuel to cook their food

		Never	Just once or twice	Several times	Many times	Always
Pre-Idai Fuel Access Loss	n	331	303	200	132	5
	%	34.1%	31.2%	20.6%	13.6%	0.5%
Post-Idai Fuel Access Loss	n	224	249	289	208	2
	%	23.0%	25.6%	29.7%	21.4%	0.2%

After the impact of Cyclone Idai, there was only 23 percent of the sampled households had consistent access to enough fuel to cook their food (compared to 34.1 percent that had consistent access in the year before Cyclone Idai). Post-Cyclone Idai, the sample of households that went many times without enough fuel to cook their food was 21.4 percent (in contrast to 13.6 percent of respondent households that had a higher frequency of inconsistent access by reporting they went many times without enough fuel to cook their food prior to Cyclone Idai). Post disaster, 0.2 percent of respondent households always had inconsistent access to fuel, compared to 0.5 percent of respondents prior to Idai. Prior to Cyclone Idai, the primary types of cooking fuel were charcoal, represented by 64.7 percent of households who used on charcoal as their primary source of energy for cooking fuel. 9.8 percent of households utilized wood as their primary source of cooking fuel. 7.2 percent of households used coal/lignite as their main source for cooking. In addition, only 0.3 percent of households used kerosene/paraffin, 1.4 percent used alcohol/ethanol. 0.7 percent had relied on gasoline/diesel, which indicates a low level of access to gasoline and chemical fuel sources.

Table 18

In the year before Cyclone Idai (and after) a household went without a cash income

		Never	Just once or twice	Several times	Many times	Always
Pre-Idai Cash Access Loss	n	193	275	289	199	13
	%	19.9%	28.4%	29.8%	20.5%	1.3%
Post-Idai Cash Access Loss	n	109	227	305	311	16
	%	11.3%	23.5%	31.5%	32.1%	1.7%

Only 11.3% of the sampled households had consistent access to enough cash in the year after Cyclone Idai (compared to 19.9 percent that had consistent access in the year before Cyclone Idai). Post-Cyclone Idai, over one third of the respondent households (32.1 percent) experienced a high frequency of inconsistent access to enough cash income (characterized by households reporting they went many times without a cash income). In addition, in the year prior to Cyclone Idai, 29.8 percent of households reported a high frequency of inconsistent access to enough cash income. After the occurrence of Cyclone Idai, 1.7 percent of respondent households reported always having inconsistent access to enough cash income (in contrast to 1.3 percent prior to Cyclone Idai). The mean household income in the month prior to Cyclone Idai was 7582.23 Mozambican meticais (MZN) ($152.26 CAD). In the month after Cyclone Idai, the mean income was 8312.07 Mozambican meticais ($164.80 CAD). This noted increase of income post-disaster could be attributed to the increase in emergency relief and development aid following the month after the impact of Cyclone Idai.

Table 1, Appendix A, titled *Descriptive statistics of the Access Loss in the LPI variables for the sub-sample population* (refer to Annex A) displays the difference between pre-cyclone Idai and post-cyclone Idai LPI scores within the household sample. This scoring scale is based

on the LPI scale of a household's experience of inability to access each resource or service within a year. It is characterized by a Likert scale (0-4) of never, just once or twice, several times, many times, or always, with always being the most severe case of inability to access a resource or service. The scoring for table is shaded in green, light to darker representing low to high percentages. Within this table, there was the least number of Access Loss noted within the '0' column. However, for those that did move on the scale, such movements indicated an increase in loss of access. In other words, *Table 1* (Appendix A) illustrates the that it within the sample, it was extremely uncommon to see households that did not experience a loss to some degree of access to at least one or more resources and service. For Water Access Loss, 18 percent of the sample experienced a minor loss in access, indicating an increase in one on the LPI scale. For Electricity Access Loss, in contrast to pre-Idai access, 18 percent of the sample reported experiencing a minor loss of access. Although difficult to prove conclusively, these changes in access may be attributed to the infrastructure relied upon to provide both electricity and water infrastructure to households and that may have been severely impacted as a result of Cyclone Idai.

4.3. RO3. Evaluate the extent to which any changes in access to these resources and services were correlated

Table 19

Spearman's Rho – Difference in LPI scores correlations in the sample population

		Medical Access Loss	Food Access Loss	Water Access Loss	Sanitation Access Loss	Electricity Access Loss	Fuel Access Loss
Food Access Loss	ρ	.233**					
	n	959					
Water Access Loss	ρ	.200**	.399**				
	n	962	961				
Sanitation Access Loss	ρ	.307**	.268**	.380**			
	n	959	958	961			
Electricity Access Loss	ρ	.271**	.382**	.467**	.349**		
	n	941	940	943	944		
Fuel Access Loss	ρ	.295**	.367**	.350**	.294**	.440**	
	n	964	965	967	963	946	
Cash Access Loss	ρ	.274**	.487**	.371**	.238**	.401**	.518**
	n	960	962	963	959	943	967

**. Correlation is significant at the 0.01 level (2-tailed).

ρ *= Rho*

All of the variables showed a positive correlation, indicating that an increase in the scale of one variable was correlated to an increase in the scale for other variables (i.e. a loss in access to one service was correlated to a loss in access to another service). Table 19 uses Spearman's Rho to assess the relationship between each variable's difference in pre-and post-cyclone Idai LPI scores. Using Corder & Forman's (2009) categories of correlation strength, the variables were analyzed to determine the strength of the relationship for Spearman's Rho Key correlations. All variables fell within a score of weak/small (0.1-0.299) and moderate/medium (0.3-0.499) (i.e. changes in one variable has a weak/small or moderate/medium effect on the other variable). Meaning, all variables were statistically significant at the 0.01 level on a 2-tailed test.

Relationships between two variables that displayed a weak or small relationship strength between one another include Food and Medical Access Loss (.233), Water and Medical Access Loss (.200), Sanitation and Food Access Loss (.268), Electricity and Medical Access Loss (.271), Cash and Medical Access Loss (.274), Cash and Sanitation Access Loss (.238), Fuel and Sanitation Access Loss (.294), Fuel and Medical Loss (.295).

Variables that displayed a moderate and medium relationship strength (i.e. changes in one variable has a moderate or medium effect on the other variable) include Water and Food Access Loss (.399), Sanitation and Medical Access Loss (.307), Sanitation and Water Access Loss (.380), Electricity and Food Access Loss (.382), Electricity and Water Access Loss (.467), Electricity and Sanitation Access Loss (.349), Fuel and Food Access Loss (.367), Fuel and Water Access Loss (.350), Fuel and Electricity Access Loss (.440), Cash and Food Access Loss (.487), Cash and Water Access Loss (.371), and Cash and Electricity Access Loss (.401). Cash and Fuel access loss (.518) demonstrated a strong relationship. In terms of relationship strength, the most notable variables Fuel and Cash Access Loss at .518, Food and Cash Access Loss at .487, Electricity and Water Access Loss at .467.

For the household sample (n=975), it is important to note the implications of the above-mentioned reported correlation strengths amongst variables of the LPI. Firstly, the LPI scale categorically measures the loss of access to LPI variables, scoring from ‘Never’ (households who have never lost access), which measures as a ‘zero’ within the scale, and then there are four additional categories which quantify and categorize the severity of loss of access experienced by households, ranging from lost access “Just once or twice”, “Several times”, “Many times” and “Always”. For households that fall within neither definitive category of “Never” and “Always”, quantifying and categorizing the frequency of loss within the LPI scale between values of “Just

once or twice", "Several times", "Many times" are more likely to based on respondents' perception and interpretation of the scale. Therefore, for households who experienced some loss prior to Cyclone Idai, the strength of correlation amongst the LPI variables is likely to be weaker due to the limited movement from one category to another within the LPI scale (e.g. a household moving from "Several times" to "Many times" has less overall movement within the LPI scale). In addition, for households that experienced a higher lack of access prior to the occurrence of Cyclone Idai, those that experience additional loss of access post-Cyclone Idai will show minimal movement within the LPI scale and the difference in loss may fail to capture the severity of loss of access. Therefore, in the section, the above descriptive analyses will be performed again for those households who reported consistent access all LPI variables prior to Cyclone Idai (n=125).

The specifications for the bootstrap (*Appendix A, Table 2*), which was performed in order to test the variability and accuracy of estimators within the dataset (i.e. bias) by replicating the random sampling process within the dataset into smaller samples. This is another form of resampling that utilized a total of 1000 samples of the dataset collected through a simple sampling method. This includes a confidence interval of 95 percent and percentiles as confidence intervals. The bootstrapped procedure confirmed previous observations of the statistical significance within a 95% confidence interval and a positive correlation direction.

Table 20

Descriptive statistics of the Access Loss in the LPI variables for households with consistent access prior to Cyclone Idai (n=125)

	No change in access		Minor loss in access		Majority loss of access		Most loss of access		Complete loss of access	
	n	%	n	%	n	%	n	%	n	%
Medical Access Loss	86	68.8	24	19.2	5	4.0	10	8.0	0	0.0
Food Access Loss	66	52.8	24	19.2	21	16.8	14	11.2	0	0.0
Water Access Loss	76	60.8	22	17.6	11	8.8	16	12.8	0	0.0
Sanitation Access Loss	95	76.0	15	12.0	6	4.8	9	7.2	0	0.0
Electricity Access Loss	72	58.1	17	13.7	17	13.7	18	14.5	0	0.0
Fuel Access Loss	73	58.4	20	16.0	17	13.6	15	12.0	0	0.0
Cash Access Loss	67	53.6	24	19.2	16	12.8	17	13.6	1	0.8

Table 20 represents the difference in pre-cyclone Idai and post-cyclone Idai LPI scores for households who experienced consistent access prior to the occurrence of Cyclone Idai. Similar to *Table 1, Appendix A*, the majority of households had no change in access to resources and services post Cyclone Idai, meaning these households maintained consistent access to all LPI variables prior to, and after, Cyclone Idai. However, for those households that experienced a loss of access, there was a notable decrease in consistency of access on the scale across several variables. For Medical Access Loss, 19.2 percent of households experienced a minor loss of access. In terms of Food Loss Access, 19.2 percent of households experienced a minor increase in loss, 16.8 percent displayed a major loss of access, and 11.2 lost most access. For Water Access Loss, 17.6 percent of the sample experienced a minor loss in access, indicating an increase of one on the LPI scale. Additionally, 12.8 percent of the sample experienced an increase in the majority loss of water access within the LPI scale. For Fuel Access Loss, 16

percent of the sample increased in a minor loss of access, followed by 13.6 percent for a majority loss and 12 percent in majority loss of access. Lastly, for households who experienced Cash Access Loss, over 19.2 percent of households experienced a minor loss in access, followed 12.8 majority loss of access, and 13.6 percent for most loss of access. To summarize, for households who had access to all basic resources and services prior to Idai, those that experienced any increase in loss was shown in a greater impact amongst more variables (in contrast to *Table 1 Appendix A).*

Table 21

Spearman's Rho – Access Loss in LPI scores correlations for households who experienced consistent access pre-Cyclone Idai (n=125)

		Medical Access Loss	Food Access Loss	Water Access Loss	Sanitation Access Loss	Electricity Access Loss	Fuel Access Loss
Food Access Loss	ρ	.645**					
	n	125					
Water Access Loss	ρ	.571**	.730**				
	n	125	125				
Sanitation Access Loss	ρ	.641**	.564**	.566**			
	n	125	125	125			
Electricity Access Loss	ρ	.534**	.724**	.774**	.562**		
	n	124	124	124	124		
Fuel Access Loss	ρ	.596**	.754**	.704**	.533**	.784**	
	n	125	125	125	125	124	
Cash Access Loss	ρ	.614**	.840**	.703**	.503**	.676**	.801**
	n	125	125	125	125	124	125

**. Correlation is significant at the 0.01 level (2-tailed).

***ρ** = Rho*

When the sample is restricted to only those households that had consistent access to all services (water, food, sanitation, electricity, fuel, and cash) prior to the occurrence of Cyclone Idai, the observed correlation relationships change. There is a significant increase in the correlation co-efficient within this sample size of 125, with Electricity Loss of Access n=124. According to Corder & Forman's (2009) correlation ranking system, a strong positive relationship (+0.5) is present between each variable's loss of access. Most notably, the strongest correlated variables were Water and Food Access Loss (.730), Cash and Fuel Access Loss (.801), Cash and Food (.840), and Fuel and Food (.754). In summary, compared to the larger sample (n=975) there is a stronger correlated relationship between decreasing consistency of access amongst households who had consistent access across all services and resources prior to Cyclone Idai (n=125).

Section 5.0 - Discussion and Conclusion

This research explores the relationship between disaster impacts and access to resources through the application of the Hazards-of-Place model, giving attention to the simultaneous effects of the disaster on access to vital resources and services necessary for the wellbeing of the urban populations in Beira, Mozambique. In order to investigate the prevalence of household loss, specifically, loss of access to resources and services as a result of Cyclone Idai, this research seeks to describe the socio-demographic vulnerabilities experienced by the households prior to the occurrence of the disaster. This is achieved by exploring the descriptive statistics of the sample population that establishes a prevalence of insecure characteristics, such as household size, income levels, and quality of dwelling structures, that contribute to vulnerability prior to Cyclone Idai. In addition, a facet of vulnerability is explored through the shift in the consistency of access to resources and services before and after Cyclone Idai in Beira, which demonstrates a considerable decrease in consistency of household access to vital services and resources post-Cyclone Idai. Lastly, the changes in access, measured by differences in pre- and post-disaster access to resources and services, are investigated in order to establish the extent to which these resources may be correlated, and contribute to the overall compounding nature of loss experienced by the household sample in post-disaster Beira.

5.1. RO1: Describe the socio-demographic vulnerabilities carried by the Beira sample prior to Cyclone Idai

The city of Beira is an urbanizing, economic coastal hub within the central region of Mozambique which has experienced a history of devastating impacts as a result of the increasing occurrence and intensity of climate-related weather events such as flooding, sea-level rise, and

cyclone disasters (Asante et al., 2009; Neumann et al., 2013; Emerton et al., 2020). In addition, infrastructure and services are continually within a state of recovery as sectors of economic activity such as trade and principal exports, are heavily disrupted due to critical infrastructure impacts prior to, and during, the occurrence of Cyclone Idai and Kenneth (IOM, 2019; Shannon, 2019).

Prior to Cyclone Idai, the average household income was reported as 7582.23 Mozambican meticais (MZN) ($148.37 CAD[1]), and the median income was 5000 MZN ($97.84 CAD). Household income is an influencing factor towards the ability of a household to maintain consistent access to resources, and for those households within the sample that earn within the lower percentiles, the proportion of income allocated towards maintaining consistent access to baseline needs, such as water, food, fuel, etc. become further strained. The average household size ranged between 4-7 people per household, with the highest reported number of six household members being 16.6 percent. Certain household characteristics, such as household size, indicate the consumption-level needs of a household. Mango et al. (2014) describes how the 'burden to feed' increases for larger households, and as a result, are more susceptible to experiencing food insecurity than smaller households (p. 631). In addition, the increasing size of households can lead to an increase in difficulty for households to maintain consistent access to resources and services, such as food and medical care access.

As a result, economic disruption unto household's livelihood and access to infrastructure resources remain highly inconsistent, as capture by the number of households within the sample population that experienced indicators of vulnerability even prior to the Cyclone Idai. Socio-demographic variables that are influential towards a household's ability to maintain access to resources and services include included income, number of household members, the structure of

the dwelling, and the status of occupancy. In contrast, these findings that indicate a high level of inconsistent access prior to Cyclone Idai are linked to the lack of effective Disaster Risk Reduction infrastructure, and overall conditions in the City of Beira (especially in poorer neighbourhoods dominated by informal housing) and may be less applicable in wealthier and more disaster resilient urban centres.

5.2. RO2: Compare the consistency of access to resources and services before and after Cyclone Idai in Beira

This section reviews and contrasts the access to resources and services one year prior to and one year following Cyclone Idai in order to measure the differences in the consistency of access experienced by households in Beira. Cutter et al. (2003) indicates that social dimensions, such as social class, are one of the most significant contributors to social vulnerability. Other dimensions include employment (type and stability), income, savings, and education levels, quality of settlements (housing type and construction, infrastructure, and lifelines), tenure type, built environment, family structure, and population growth. In Cutter's SoVI research, these variables are a principal component of social vulnerability, particularly in identifying marginalized communities that experience factors beyond standardized vulnerability indexes.

The purpose of this research objective is to quantify and compare the impacts of Cyclone Idai through the use of the Lived Poverty Index (LPI), a reliable metric for measuring levels of access to basic resources and services. The LPI scale aims to measure and describe household's frequency of inconsistent access, as the highest threshold, and further categorizes levels of inaccessibility within a period of time. As measured through the LPI scale to see the impact of Cyclone ideas, the majority of households lost access as a result of Cyclone Idai, and some had

increased access. Food insecurity was a prevalent issue. Over a third of the sampled households had consistent access to food prior to Cyclone Idai, but that percentage decreased to 15.9 percent after Cyclone Idai. Overall, there is a high prevalence of food insecurity within the sample, both pre-and post-disaster. Disaster impact doubled the percentage of households that always went without food (0.6 percent to 1.5 percent). Overall, a clear pattern is indicated an increase in the frequency that respondent households go without enough food to eat (fewer respondents indicated "Never" or "Just once or twice") indicated by a large movement in the sample of households that experienced inconsistent access to enough food (refer to bar chart in *Appendix A, Figure 1*).

In addition, other basic resources such as access to water, through both formal means of piped water and tube-wells, bore wells and dug wells were measured prior to, and in the month following the impact of Cyclone Idai. Prior to, almost half of the sample population (48 percent) never went without enough clean water for home use, indicating that there were no interruptions in access to water. However, in the wake of Cyclone Idai, only 35.6 percent households had consistent access to clean water. Overall, less households reported access to enough clean water, and proportionally, more respondent households reported higher levels of inconsistent access, including an increase in responses that characterized frequencies of in access as 'Several times', 'Many times' and 'Always' (10, 9.5 and 0.3 percent increases, respectively). This pattern of increasing inconsistency of access was observed across resources and services, including food, water, sanitation, electricity, fuel and cash (refer to bar chart in *Appendix A, Figure 2*). Post-Cyclone Idai, there was a decrease in the percentage of households that reported "Never" going without a resource or service and "Just once or twice" going without these LPI variables. In other words, there is a concurrent change from an infrequent lack of access to a more consistent lack of

access. Notably, for medicine and medical services, there were minimal differences in Pre- and Post-disaster access but reflected a similar increase in inconsistencies of access. For households that 'Never' went without access to medical services, there was only an 8.3 percent decrease post-disaster, and one reason for this may be the presence of emergency international and local emergency aid in the month following Cyclone Idai (Trujillo, 2019).

In summary, by comparing the consistency of access to these resources and services, these findings indicate that post-disaster measurements of access showed an overall decrease in households that experienced limited or no interruptions towards consistency of access, and an increased frequency of inconsistency of access falling within the 'Several' and 'Many times' categorizations. In other words, household access to resources and services became increasingly difficult after Cyclone Idai, a finding which is supported in disaster literature (Cutter, 2003). It is important to note that due to the differentiation between the measurement of the 'Several' and 'Many times' gauges, and the increasing pattern of inconsistent access, the quantification of these categories may be less precise than the extremes of the scale i.e., 'Never' and 'Always'.

5.3. RO3: Evaluate the extent to which any changes in access to these resources and services were correlated

This section intends to review and evaluate whether loss in access to resources and services were correlated, and the extent to which these correlations occur amongst these variables. As shown within *Table 19*, all variables, including resources such as food, water, fuel and cash, and services which include medical care, sanitation and electricity access were positively correlated, meaning that if households lost access to one of these resources they would likely loss access to another. In *Table 19*, according to Corder & Foreman's correlation

coefficient relative strength ranking table, three variable correlation coefficients fell within the higher end of a moderate to strong relationship strength (0.3-0.5). Firstly, Electricity and Water Access Loss scored a .479, which may be interpreted as being linked to the interdependence of these services i.e. integrated city infrastructure such as electrical grids and water systems are co-susceptible to the impacts of disaster. This has been noted in the literature on cascading disaster (Pescaroli & Alexander, 2016). These findings may indicate the existence of a synergistic and catalytic relationship amongst access to services, indicating the existence of sustainability and network effects within a system thinking perspective in cities. In addition, Food and Cash Access Loss scored .479, which within an urban context, is understandable since food is a commodity that must be purchased (Mitlin & Satterthwaite, 2014). Similarly, Fuel and Cash Loss had a correlation of .499, as cash resources directly influence the ability to acquire fuel.

As seen within *Table 21*, for those households who had consistent access to all resources prior to Cyclone Idai, these findings indicate that there is an increased probability that loss of access to one or more resources or services will occur if there is the loss of any other variable within the LPI scale. These correlated relationships may indicate the presence of feedback mechanisms, wherein households that experience the loss of access to one variable simultaneously will experience loss of another resource or service, and as a result, this relationship has the potential to further catalyze the degree of overall loss experienced. Losses may 'cascade' as the loss of one trigger the loss of another, however, a further investigation is required in order to understand the mechanisms behind these findings.

In addition, this research shows that the variance of loss of access experienced within the sample has led to a broader variation in development at the household-level, which is characterized by the fact that some households had no meaningful change, whereas others were

impacted by all variables within the scale, which in turn resulted in observed findings of greater inequality towards access to resources and services. These findings result in a broader inequality of development within the sample, which may be influenced by pre-existing conditions of access to resources, such as formal access to services such as water, electricity and sanitation infrastructure, and whether these services were more heavily disrupted as a result of the disaster impact in contrast to informal means of service access. As Mitlin & Satterthwaite suggested (2013), the multidimensional nature of poverty manifests within these findings in the variance and breadth of inconsistency of access experienced by households, influenced by a multitude of context-specific factors, such as pre-existing vulnerabilities exemplified in sociodemographic characteristics in the urban population. In addition, as explored within the Hazards-of-Place model, these vulnerabilities are place-based, meaning households that reside within areas that have higher degrees of exposure to natural hazards, informal or ill-built dwelling structures. Ultimately, further spatial distance to access to resources and services, as reflected in the Lived Poverty Index (LPI) scale, will ultimately be more susceptible to social vulnerabilities through lack of access in the occurrence of a disaster.

As Cutter (1996) established, historically, measurements of social vulnerability indicators are often single variables that related to multidimensional factors of wellbeing (p. 533). This research explored factors of vulnerability, including thematic sociodemographic characteristics outlined within Research Objective 1, such as income, household size, structure respondents dwelling and tenure of land. This research objective sought to explore Cutter's conceptualization of social fabric through sociodemographic characteristics in order to understand pre-existing conditions of household risk, that when compounded the existence of the disaster event itself, could contribute to a greater understanding of vulnerability at a household-level. In addition,

Research Objective 2 broadly explored another factor of social fabric through the perception of and experience of households to the hazard (Cyclone Idai) by quantifying and measuring both pre-disaster access to basic resources and services, and the disruption of access within post-disaster Idai. In terms of the third component of social fabric, there is still opportunity for future research to explore the "overall capacity to respond to disasters" (Cutter, 2000. p. 717). However, this research explores the impact of disaster directly following Cyclone Idai with the use of the LPI scale, which sought to measure the degree of impact experienced by household access to basic necessities. Operationalized from Cutter's Hazard of Place model, when applying a geographic filter, the increase in inconsistent access to crucial basic resources and services was observed as a consequence of both the physical location of Beira as a climate-vulnerable coastal city, and the hazard of Cyclone Idai itself.

In reviewing the implications of vulnerability for urban populations in Beira during the occurrence of Cyclone Idai, there is an opportunity to discuss resiliency, which also theorizes the mitigation of vulnerability through adaptation to change within socio-ecological and socio-network systems during the occurrence of an external shock, such as a natural disaster (Meerow et al., 2016). Resiliency is a crucial disaster risk reduction approach that is highly applicable for urban systems, such as Beira, that experience increasing frequency of disaster events, and subsequently, longer durations of climate-change-related impacts that hinder overall recovery and further adaptive capacities efforts for urban populations.

The Progression of Safety model (Appendix A, *Figure 3)*, proposed by Wisner et al. (2012) reverses the processes of the Pressure and Release (PAR) model (*Figure 1*) in order to understand how to reduce vulnerability to hazards through disaster risk reduction approaches. One such root cause of vulnerability is the distribution of resources, which contributes to societal

deficiencies and macro-forces (external stressors) which are targeted through mitigation and efforts to increase adaptive capacity within the Progression of Safety model (Append A, *Figure 3*). One listed mitigative effort in the Progression of Safety model that addresses unsafe conditions and unsustainable livelihoods within the PAR model is resistant buildings and infrastructure, in order to contribute to no loss of lives, fewer injuries, limited damage and livelihood security in the event of a natural disaster (p. 28).

When exploring disaster mitigation efforts and adaptation strategies in Post-Cyclone Idai Beira, further considerations for government actors should be focused on increasing the resiliency of urban infrastructures, such as vital water and sanitation infrastructure, through the compartmentalization of utilities. In the occurrence of Cyclone Idai, urban infrastructure was heavily impacted and, in the context of disaster risk reduction, compartmentalizing crucial formal infrastructure can provide key mitigation processes in order to increase resiliency to future disasters and reduce the period of recovery in order for government actors to systematically address weaker and more hazard-susceptible areas of formal infrastructure. Furthermore, in the context of electrical grid infrastructure, given the nature of cascading disasters, understanding that the initial disaster event will create rippling secondary and tertiary disaster events, there is an opportunity for a systematic approach to developing backup power systems for utilities and services so that electrical power loss does not cascade and result in further compounding loss of household access for urban populations in Beira.

As Wesley (2011) argues, from the perspective of resiliency approaches, during climate-related weather disasters, the resulting impact within a system is highly disruptive to all levels of the system domain. However, as the urban system recovers, this level of disruption can result in a system's ability to renew, reorganize and develop to allow for future preparedness for extreme

disturbances and improve overall social and ecological survival chances (Hollings, 1973). In the context of this research, exploring post-Cyclone Idai impacts in Beira, Mozambique, the scale of change required in order to increase system resiliency relies on the collective efforts of post-disaster actors, specifically relevant government stakeholders and humanitarian aid agencies, in order to provide necessary short-term relief and further increase the adaptive capacities of households to mitigate the effects of, and prevent, future compounding losses in Beira, Mozambique.

5.4. Considerations for Future Research

Based on these research findings and results, there are several considerations moving forwards for future research for this topic, that are presently beyond the scope of this study. Overall, this research establishes the simultaneous occurrence of multiple loss of access to resources and services, however, future research should explore the root causes and factors external to the household of how these impacts occurred, why loss of access varies so much between households, the degree and duration or such losses, and ways in which disaster prevention and mitigation efforts can reduce the likelihood of loss of access. In observed the loss of access, there is opportunity for future research to look into whether there is the existence of a feedback loop amongst the loss of one variable (resource or service) and the impact on another variable. Further research is required to capture the post-disaster recovery and resiliency of households, which could involve a longitudinal study that follows up with respondents after an elapsed period of time in order to understand which population was most impacted in terms of disruptions of access to resources and services from the disaster.

Future research could also capture further household socio-demographic characteristics regarding the Head of Household (HoH) prior to, and after the disaster, in order to quantify other dimensions of socioeconomic status such as fields of employment, individual income levels, as well as household income and earnings, including the number of household members employed. In addition, for the scaling and quantification of categorical variables within the Lived Poverty Index (LPI) the scale's extremes of 'Always' and 'Never' allow for clear interpretation from respondents, however, other scale categories may be less clear and would, therefore, allow for further context with qualitative research methods, such as respondent interviews, in order to further delve into these initial survey research findings. Stated another way, due to the ordinal nature of the LPI scale, there is opportunity for further research in order to explore survey responses with further exploration of qualitative data collection with survey respondents. Furthermore, the collection of more comprehensive neighbourhood datasets, such as a census-related data, could be used in order to further analyze and identify social vulnerability indicators for a SoVI case study. For example, a neighbourhood level analysis might be used in order to determine the city-wide variation in social vulnerability and biophysical risk to further develop insight into specific vulnerable areas of the city to enhance emergency response to disaster event that impact multiple neighbourhoods.

Ultimately, this research finds that there is a clear relationship amongst the loss of multiple resources and services that show a co-occurring relationship of loss experienced at the household level in post-Cyclone Idai Beira, Mozambique. These findings contribute towards our understanding of cascading disasters, by demonstrating the compounding nature of household vulnerability to disaster impact, and further bridging the field of disaster risk reduction and poverty reduction. These research findings can be used in further applications to engage with

academics, municipal policymakers and relevant regional disaster management experts to provide further relevant literature and data towards the enhancement of evidence-based decision-making in the understanding of place-based household vulnerabilities underlying disaster risk management in Beira.

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Appendices

Appendix A – Tables and Figures

Figure 1

How often households went without enough food in the home pre-and post-Cyclone Idai (n=969)

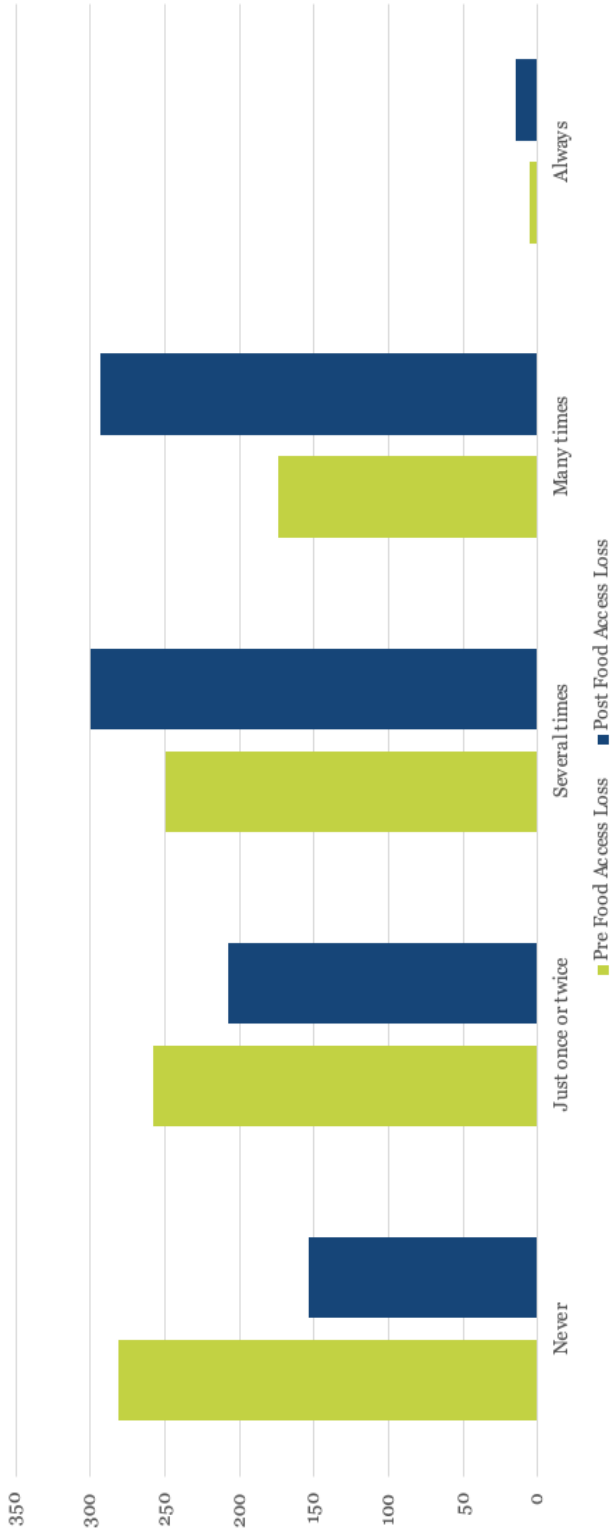

Figure 2

Households that had consistent access to resources and services (n=969) ('never' went without access)

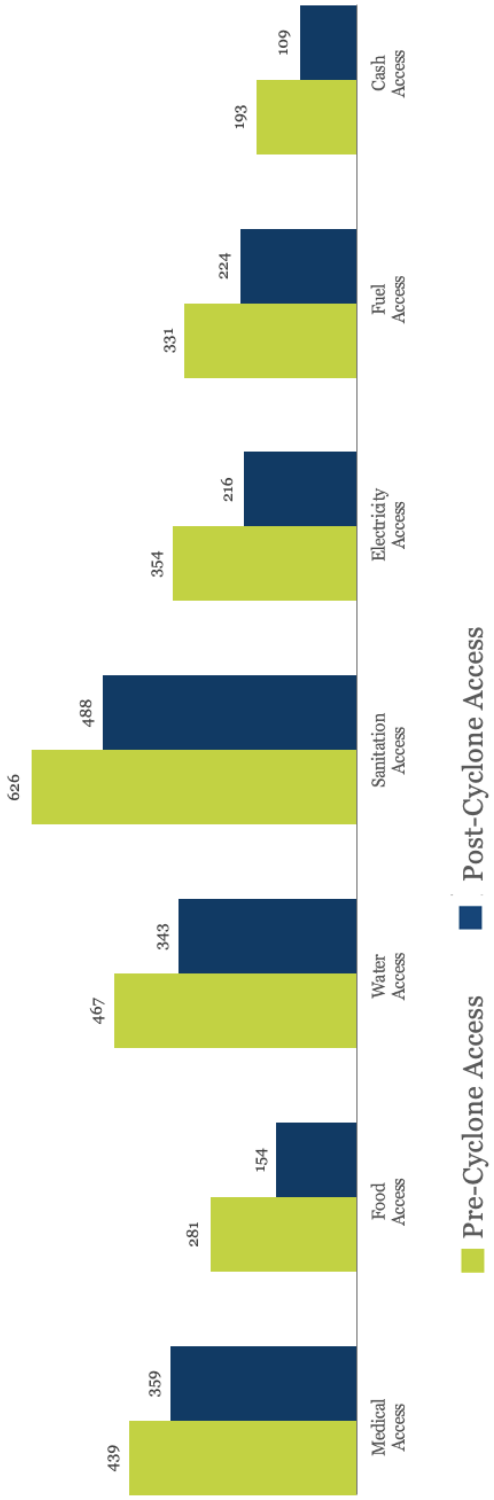

Figure 3

Progression of Safety Model (Wisner et al., 2012)

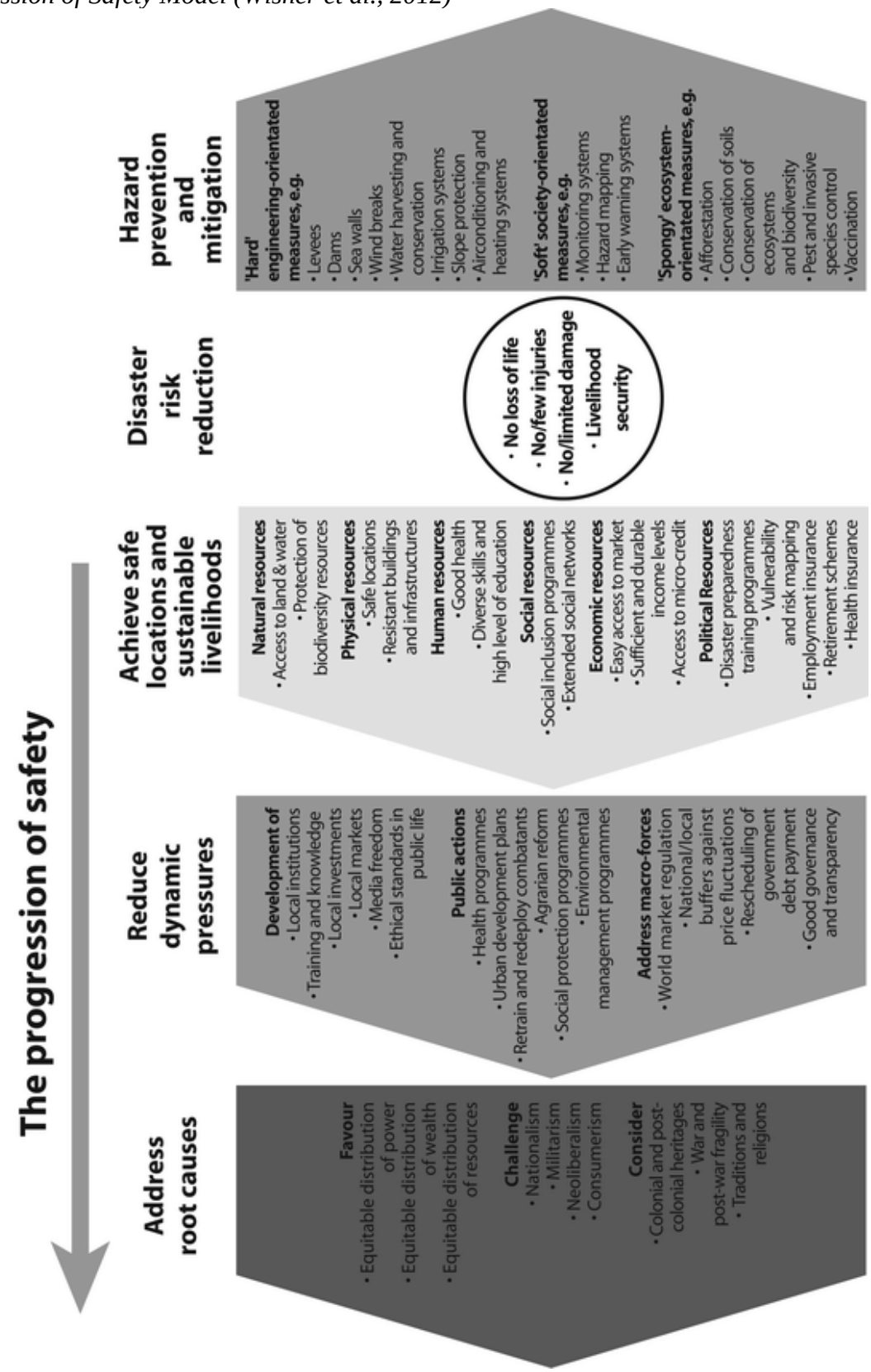

Table 1

Descriptive statistics of the Access Loss in the LPI variables for the sample population

Variable	Significant gain of access						Minor gain of access		No change in access		Minor loss in access						Significant loss of access	
	-4		-3		-2		-1		0		1		2		3		4	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Medical Access Loss	2	0.2	3	0.3	15	1.6	73	7.6	655	68	149	15.4	48	5.0	20	2.1	0	0.0
Food Access Loss	0	0.0	3	0.3	16	1.7	63	6.5	505	52	253	26.2	88	9.1	37	3.8	1	0.1
Water Access Loss	3	0.3	12	1.2	18	1.9	66	6.8	532	55	175	18.1	118	12.2	44	4.5	0	0.0
Sanitation Access Loss	2	0.2	11	1.1	6	0.6	43	4.5	677	70	124	12.8	70	7.3	26	2.7	6	0.6
Electricity Access Loss	4	0.4	7	0.7	15	1.6	65	6.9	467	49	170	18.0	141	14.9	69	7.3	8	0.8
Fuel Access Loss	1	0.1	5	0.5	15	1.5	87	9.0	539	56	207	21.3	82	8.4	35	3.6	0	0.0
Cash Access Loss	0	0.0	3	0.3	14	1.4	68	7.0	562	58	233	24.1	59	6.1	27	2.8	1	0.1

Table 2

Spearman's Rho – Difference in LPI scores correlations in the sample population (bootstrapped variables) (n=929)

		Medical Access Loss	Food Access Loss	Water Access Loss	Sanitation Access Loss	Electricity Access Loss	Fuel Access Loss
Food Access Loss	Lower	0.167					
	Upper	0.303					
Water Access Loss	Lower	0.119	0.339				
	Upper	0.258	0.464				
Sanitation Access Loss	Lower	0.241	0.208	0.314			
	Upper	0.376	0.337	0.446			
Electricity Access Loss	Lower	0.207	0.322	0.408	0.293		
	Upper	0.335	0.442	0.529	0.410		
Fuel Access Loss	Lower	0.224	0.312	0.265	0.243	0.380	
	Upper	0.363	0.441	0.402	0.371	0.504	
Cash Access Loss	Lower	0.197	0.427	0.303	0.178	0.351	0.466
	Upper	0.340	0.545	0.433	0.317	0.467	0.582

Table 3

Spearman's Rho – Access Loss in LPI scores correlations for households who experienced consistent access pre-Cyclone Idai (bootstrapped variables)

		Medical Access Loss	Food Access Loss	Water Access Loss	Sanitation Access Loss	Electricity Access Loss	Fuel Access Loss
Food Access Loss	Lower	.514					
	Upper	.775					
Water Access Loss	Lower	.426	.612				
	Upper	.733	.845				
Sanitation Access Loss	Lower	.476	.426	.417			
	Upper	.781	.698	.726			
Electricity Access Loss	Lower	.372	.582	.656	.414		
	Upper	.692	.836	.880	.706		
Fuel Access Loss	Lower	.459	.631	.560	.386	.651	
	Upper	.750	.861	.822	.694	.891	
Cash Access Loss	Lower	.472	.748	.569	.360	.539	.691
	Upper	.755	.920	.819	.661	.801	.903

Appendix B – Beira Survey Instrument

Themes to be Explored in the Beira Household Survey Instrument

1. Demographics and Geography of the Respondent
2. The SDG-relevant impacts of Cyclone Idai
3. The SDG-relevant household adaptations to Cyclone Idai

The dataset was drawn from a larger Social Sciences and Humanities Research Council of Canada (SSHRC) funded project led by my supervisor, Cameron McCordic, under the Insight Development Grant (IDG) program. This larger project aims to explore the SDG-relevant urban impacts of, and adaptation to, Cyclone Idai. This SSHRC-funded project surveyed 975 households in Beira, Mozambique.

Data collection was conducted in September-October 2021 by enumerator teams from Eduardo Mondlane University (EMU) and the Center for Community Development Studies (CEDECA) at the Pedagogical University in Maputo, Mozambique

The survey instrument incorporated measurement tools, including the Household Food Insecure Access Scale (Coates, Swindale, and Bilinsky, 2007), the Lived Poverty Index (Afrobarometer, 2013) and scales derived post-disaster impact assessment guidelines from the United Nations Sustainable Development Group (UNSDG, 2019). The instrument was designed to measure and compare the household experience and resulting impacts prior to and following the Cyclone Idai disaster.

Informed Consent

Please specify the city ward in which this interview is taking place.

1. *City-specific codes will be provided for the different locations in which this interview is taking place*

Please identify the GPS location for this interview.

1. *GPS input via tablet software*

Introduction: Hello! My name is (Insert Name) and I am administering a survey for Eduardo Mondlane University in Mozambique and the University of Waterloo in Canada among households in Beira impacted by Cyclone Idai. The survey is about the demographic and economic characteristics of households, the impacts of Cyclone Idai that were experienced by households, and the ways in which households have adapted to the impacts of Cyclone Idai. The survey will include questions about any impacts to food, water, health, employment, energy use, and household assets. The survey will be administered to over 1000 households in Beira. While we are collecting information on the location where surveys were administered, your identity will be confidential and when results are reported, your name or identifying information will not be included. This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board (ORE application number 43049).

Are you over the age of 18?

Code	***Label***
1	Yes
2	No

Are you able to respond on behalf of your household?

Code	***Label***
1	Yes
2	No

If no: How can I arrange to meet with the head of the household? (Record this information in your field notebook, report the rescheduled interview to your field supervisor, and exit the form without saving).

If yes: Were you living in any of the following Sub-Districts in the City of Beira when Cyclone Idai occurred in 2019? (A household is defined as the number of people who sleep in the same dwelling and eat from the same pot for at least 6 months of the year in the last year.)

Code	***Label***
1	Yes (Include a list of the sub-districts in the city of Beira
2	No

If no: Thank you for your time. Goodbye!

If yes: You do not have to answer any questions you do not feel comfortable answering and you have the right to terminate the survey at any time. Participation in this survey will not likely provide direct benefits to you or your business but we hope that the reports produced from this survey will help to inform policy makers in this city. We have assessed this survey as having minimal risks, although you may experience some discomfort with some of questions included in this survey. As a reminder, you do not have to answer any question that you do not wish to answer. We will be collecting contact information in case we need to double-check to make sure we accurately recorded your answers to this survey but this information will be destroyed by the

end of this research project (by July 2022) so that no one will be able to identify you in the final data set. The final data set will be maintained for at least 6 years after the survey. The data will be encrypted and stored on password-protected computers. The interview should last less than 30 minutes. If you should have any questions regarding this survey, please contact Dr. Cameron McCordic at the University of Waterloo in Canada (Dr. McCordic can be contacted at c2mccord@uwaterloo.ca). Are you willing to participate?

Code	***Label***
1	Yes
2	No

If yes: Thank you for participating in this survey!
If no: Just to reiterate, your answers will be incredibly useful and provide you with a means of sharing your story and participating in important research on the food system in your city. Your identity will be confidential and when results are reported, your name or identifying information will not be included. Are you willing to participate?

Code	***Label***
1	Yes
2	No

If yes: Thank you for participating in this survey!
If no: It is very important to us to hear your views, is there another time during which we could schedule this interview that would be more convenient for you?

Code	***Label***
1	Yes
2	No

If yes: Thank you for participating in this survey! When would be a good time for us to have this interview? (Record this information in your field notebook, report the rescheduled interview to your field supervisor, and exit the form without saving).
If no: Thank you for your time! Goodbye. (Please answer the following questions)
What is the reason for the survey refusal?

Code	***Label***
1	Respondent has insufficient time
2	Respondent is concerned for his/her confidentiality
3	Respondent is under the influence of drugs/alcohol
4	Respondent is aggressive
5	Respondent is not interested
6	Environment is unsafe
7	Other (Specify)

If yes: Thank you for participating in this survey! Please confirm that you understand and agree to the following statements about your participation in this survey.

Code	***Label***
1	I understand that my participation in the study is entirely voluntary and that I am free to stop at any time.

2	I understand that I cannot be identified by my answers and that my answers cannot be linked to me after the completion of this survey fieldwork.
3	I understand that I do not have to answer any question I do not wish to answer for any reason.
4	I agree that the information I give may be used in research reports and that these reports will not reveal my personal identity.
5	I have understood the information regarding my participation in the study and agree to participate in this study on the impact of Cyclone Idai in Beira.

Demographics of the Respondent

1. What is the sex of the respondent? (DO NOT READ ALOUD, answer this question based on your observation of the respondent. Select only one answer for this question.)

Code	***Label***
1	Male
2	Female
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

2. What is this household member's relationship to the household head? (The head of the household is the individual normally in charge of decision-making for household activities, including the use of household income. A household is defined as the number of people who sleep in the same dwelling and eat from the same pot for at least 6 months of the year in the last year. Select only one answer for this question.)

Code	***Label***
1	Head of household
2	Spouse/partner
3	Son/daughter
4	Adopted/foster child/orphan
5	Father/mother/in law
6	Brother/sister
7	Grandchild
8	Grandparent
9	Son-in-law/daughter-in-law
10	Other relative
11	Non-relative
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

3. How old were you at your last birthday? (Please provide this answer in whole numbers. Input 97 for refused, 98 for do not know, 99 for missing. If the age is between 97 and 99, round up to 100.)

Age of the respondent at his/her last birthday:

4. Where were you born? (Allow the respondent to answer freely and then categorize the answer given by the respondent into the following categories Select only one answer for this question.)

Code	***Label***
1	This city

2	Another city in this country
3	A rural area in this country
4	A foreign country
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

5. ***If respondent selected 2,3, or 4 for question 4***, What was the reason for migrating to this city? (input 97 for "refused to answer", 98 for "do not know", and 99 for "missing")

Reason for migration:

6. What is your highest level of education? (Allow the respondent to answer freely and then categorize the answer given by the respondent into the following categories Select only one answer for this question.)

Code	***Label***
1	No formal education
2	Some primary school
3	Primary school completed
4	Some high school
5	High school completed
6	Some technical/vocational school training
7	Technical/vocational school completed
8	Some university/college
9	University/college completed
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

7. How many people currently live in this household? (A household is defined as the number of people who sleep in the same dwelling and eat from the same pot for at least 6 months of the year in the last year; Please provide this answer in whole numbers. Input 97 for refused, 98 for do not know, 99 for missing. If the age is between 97 and 99, round up to 100.)

Number of Household Members:

8. How many people lived in this household before Cyclone Idai (before March 15, 2019)? (A household is defined as the number of people who sleep in the same dwelling and eat from the same pot for at least 6 months of the year in the last year; Please provide this answer in whole numbers. Input 97 for refused, 98 for do not know, 99 for missing. If the age is between 97 and 99, round up to 100.)

Number of Household Members:

9. Does your household currently include members living with any of the following disabilities? (Select all that apply. Please confirm that these disabilities should be diagnosed by a medical professional rather than inferred by the individual.)

Code	***Label***
1	Diabetes
2	Heart problems
3	Obesity
4	Malnutrition
5	Hypertension (high blood pressure/stroke)
6	Asthma
7	Arthritis
8	Tuberculosis (TB)
9	Chronic diarrhea
10	Cancer
11	HIV/AIDS
12	No. None of the household members have any of these conditions
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

10. Did your household include members living with any of the following disabilities before Cyclone Idai (before March 15, 2019)? (Select all that apply. Please confirm that these disabilities should be diagnosed by a medical professional rather than inferred by the individual.))

Code	***Label***
1	Diabetes
2	Heart problems
3	Obesity
4	Malnutrition
5	Hypertension (high blood pressure/stroke)
6	Asthma
7	Arthritis
8	Tuberculosis (TB)
9	Chronic diarrhea
10	Cancer
11	HIV/AIDS
12	No. None of the household members have any of these conditions
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

11. What is the current structure of this household? (A household is defined as the number of people who sleep in the same dwelling and eat from the same pot for at least 6 months of the year in the last year. Select only one answer for this question.)

Code	*Label*
1	Female centered (No husband/male partner in the household, may include relatives, children, friends)
2	Male centered (No wife/female partner in household, may include relatives, children, friends)
3	Nuclear (Husband/male partner and wife/female partner with or without children)
4	Extended (Husband/male partner and wife/female partner and children and relatives)
5	Other (Please Specify)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

12. What was the structure of this household before Cyclone Idai (before March 15, 2019)? (A household is defined as the number of people who sleep in the same dwelling and eat from the same pot for at least 6 months of the year in the last year. Select only one answer for this question.)

Code	*Label*
1	Female centered (No husband/male partner in the household, may include relatives, children, friends)
2	Male centered (No wife/female partner in household, may include relatives, children, friends)
3	Nuclear (Husband/male partner and wife/female partner with or without children)
4	Extended (Husband/male partner and wife/female partner and children and relatives)
5	Other (Please Specify)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

13. What is the current structure of the dwelling in which this household resides? (Select only one answer for this question.)

Code	*Label*
1	House in a formal area
2	Apartment in formal area
3	House in informal area
4	Shack in informal area
5	Other (Specify)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

14. What was the structure of the dwelling in which this household resided before Cyclone Idai (before March 15, 2019)? (Select only one answer for this question.)

Code	***Label***
1	House in a formal area
2	Apartment in formal area
3	House in informal area
4	Shack in informal area
5	Other (Specify)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

15. What kind of dwelling do you currently reside in since Cyclone Idai (since March 15, 2019)? (Select only one answer for this question.)

Code	***Label***
1	Shack
2	Corrugated iron dwelling
3	Stone house
4	Other (please specify)
97	Refused to Answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

16. What kind of dwelling did you reside in before Cyclone Idai (before March 15, 2019)? (Select only one answer for this question.)

Code	***Label***
1	Shack
2	Corrugated iron dwelling
3	Stone house
4	Other (please specify)
97	Refused to Answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

17. How did you get an agreement that this is your place? (Select only one answer for this question.)

Code	***Label***
1	The agreement was made publicly
2	I was given a declaration
3	We made a verbal agreement
4	The agreement was witnessed by others

5	The agreement was witnessed by a politician
6	I was given a title deed
7	The title deed is coming
8	I was given permission from the family whose land it is
9	I was given a DUAT from municipality
10	The DUAT is coming
11	I don't have an agreement
12	Other (please specify)
97	Refused to Answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

18. Did you buy this place? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to Answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

19. ***If respondent selected 2 for question 18,*** Which of the following applies to you? (Select only one answer for this question.)

Code	***Label***
1	You are renting
2	You were allocated this place by the municipality
3	You inherited this place
4	You are looking after it
5	You occupy this place
6	Other (please specify)
97	Refused to Answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

20. What has been this household's income over the past month? (This is defined as the amount of income received from all income sources for all members of the household over the entire month. Confirm whether the respondent is including the income earned by all members of the household. If the respondent cannot remember, help the respondent by asking if it was greater than or less than a given amount until the respondent remembers. If the respondent is hesitant to answer, remind them that their answers are kept confidential and ask if they would be more comfortable writing the number on a piece of paper from which you will record in the survey before handing the paper back to them or they can enter the information directly onto the tablet. Please estimate in the local currency. Round all estimates to the nearest whole

number. Input 97 for refused to answer, 98 for do not know, and 99 for missing. If number is between 97 and 99, round up to 100.)

Household Income:

21. What was this household's income in the month before Cyclone Idai (before March 15, 2019)? (this is defined as the amount of income received from all income sources for all members of the household over the entire month before Cyclone Idai. Confirm whether the respondent is including the income earned by all members of the household. If the respondent cannot remember, help the respondent by asking if it was greater than or less than a given amount until the respondent remembers. If the respondent is hesitant to answer, remind them that their answers are kept confidential and ask if they would be more comfortable writing the number on a piece of paper from which you will record in the survey before handing the paper back to them or they can enter the information directly onto the tablet. Please estimate in the local currency. Round all estimates to the nearest whole number. Input 97 for refused to answer, 98 for do not know, and 99 for missing. If number is between 97 and 99, round up to 100.)

Household Income:

22. What was this household's income in the month after Cyclone Idai (after March 15, 2019)? (this is defined as the amount of income received from all income sources for all members of the household over the entire month before Cyclone Idai. Confirm whether the respondent is including the income earned by all members of the household. If the respondent cannot remember, help the respondent by asking if it was greater than or less than a given amount until the respondent remembers. If the respondent is hesitant to answer, remind them that their answers are kept confidential and ask if they would be more comfortable writing the number on a piece of paper from which you will record in the survey before handing the paper back to them or they can enter the information directly onto the tablet. Please estimate in the local currency. Round all estimates to the nearest whole number. Input 97 for refused to answer, 98 for do not know, and 99 for missing. If number is between 97 and 99, round up to 100.)

Household Income:

The SDG-relevant impacts of Cyclone Idai

SDG 11: Housing Indicators

23. As a result of Cyclone Idai, was your home destroyed, severely damaged, partially damaged, or was it unimpacted? (Select only one answer for this question.)

Code	***Label***
1	Destroyed home
2	Severely damaged home
3	Partially damaged home
4	Unimpacted home
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)

99	Missing (DO NOT READ OUT LOUD)

24. Did your family lose any household items due to the disaster? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

25. ***If respondent selected 1 for question 24,*** which household items were lost in the disaster? (Select all that apply.)

Code	***Label***
1	Appliances (fridge, stove, television, radio, etc.)
2	Furniture (bed, table, chairs, clocks, etc.)
3	Cooking supplies
4	Transport (vehicle, bicycle, motorcycle, etc.)
5	Other (Specify)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

SDG 7: Energy and cooking fuel indicators

26. Before the disaster (before March 15, 2019), what type of energy source did your household mainly use for cooking? (Select only one answer for this question.)

Code	***Label***
1	Alcohol/ethanol
2	Gasoline/diesel
3	Kerosene/paraffin
4	Coal/lignite
5	Charcoal
6	Wood
7	Crop residue/grass/straw/shrubs
8	Animal dung/waste
9	Processed biomass (pellets)/woodchips
10	Garbage/plastic
11	Sawdust
12	Other (please specify) _____
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

27. Since the disaster (since March 15, 2019), what type of energy source does your household mainly use for cooking? (Select only one answer for this question.)

Code	***Label***
1	Alcohol/ethanol
2	Gasoline/diesel
3	Kerosene/paraffin
4	Coal/lignite
5	Charcoal
6	Wood
7	Crop residue/grass/straw/shrubs
8	Animal dung/waste
9	Processed biomass (pellets)/woodchips
10	Garbage/plastic
11	Sawdust
12	Other (please specify) _____
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

SDG 6: Water and Sanitation indicators

28. Before the disaster (before March 15, 2019), what was the main source of drinking water for your household? (Select only one answer for this question.)

Code	***Label***
1	Piped water
2	Tube-well, borehole, dug well
3	Water from a spring
4	Rainwater collection
5	Tanker-truck
6	Surface water (river, stream, pond, lake, canal, irrigation)
7	Bottled water
8	Other (please specify)_____
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

29. Was this household's access to this drinking water source disrupted immediately after Cyclone Idai (after March 15, 2019)? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)

99	Missing (DO NOT READ ALOUD)

30. ***If respondent selected 1 for question 29,*** What was the main reason for the disruption of this household's access to this drinking water source? (Select only one answer for this question.)

Code	***Label***
1	Insufficient funds
2	Geographically inaccessible water source
3	Destroyed water source infrastructure
4	Destroyed water access infrastructure
5	Other (Specify)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

31. ***If respondent selected 1 for question 29,*** Is this household's access to this drinking water source still disrupted? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

32. What is this household's primary source of drinking water now, after the disaster (since March 15, 2019)? (Select only one answer for this question.)

Code	***Label***
1	Piped water
2	Tube-well, borehole, dug well
3	Water from a spring
4	Rainwater collection
5	Tanker-truck
6	Surface water (river, stream, pond, lake, canal, irrigation)
7	Bottled water
8	Other (please specify)_____
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

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

Code	***Label***
1	Yes

2	No
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

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? (If the respondent cannot remember, help the respondent by asking if it was greater than or less than a given amount until the respondent remembers. Please estimate in minutes. Round all estimates to the nearest whole number. Input 97 for refused to answer, 98 for do not know, and 99 for missing. If number is between 97 and 99, round up to 100.)

Minutes:

35. Has your household experienced any of the following challenges in accessing the current drinking water source since Cyclone Idai (Since March 15, 2019)? (Select all that apply)

Code	***Label***
1	Transportation challenges
2	Personal safety challenges
3	Insufficient time challenges
4	Unsanitary water challenges
5	No. This household has not experienced these challenges
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

36. Currently, which household member(s) usually collect(s) drinking water for the household? (Select all that apply)

Code	***Label***
1	Head of household
2	Spouse/partner
3	Son/daughter
4	Adopted/foster child/orphan
5	Father/mother/in law
6	Brother/sister
7	Grandchild
8	Grandparent
9	Son-in-law/daughter-in-law
10	Other relative
11	Non-relative
97	Refused to answer (DO NOT READ OUT LOUD)

98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

37. Before the disaster (before March 15, 2019), what kind of toilet facility did members of your household usually use? (Please select one response.)

Code	***Label***
1	Flush toilet
2	Pit latrine
3	Bucket
4	Chemical toilet
5	None
6	Other (please specify)
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

38. What is this household's primary kind of toilet facility after the disaster (since March 15, 2019)? (Select only one answer for this question.)

Code	***Label***
1	Flush toilet
2	Pit latrine (concrete)
3	Open latrine (temporary)
4	Chemical toilet
5	Open air
6	Other (please specify)
97	Refused to answer (DO NOT READ ALOUD)
98	Do not know (DO NOT READ ALOUD)
99	Missing (DO NOT READ ALOUD)

SDG 3: Health indicators

39. As a result of Cyclone Idai, did any members of your household need medical attention, for any reason? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

40. ***If respondent selected 1 for question 39,*** which household member(s) needed medical attention as a result of Cyclone Idai? (Select all that apply.)

Code	***Label***

1	Head of household
2	Spouse/partner
3	Son/daughter
4	Adopted/foster child/orphan
5	Father/mother/in law
6	Brother/sister
7	Grandchild
8	Grandparent
9	Son-in-law/daughter-in-law
10	Other relative
11	Non-relative
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

41. ***If respondent selected 1 for question 39,*** Did all members that needed medical attention as a result of Cyclone Idai receive health care? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

42. ***If respondent selected 2 for question 41***, What were the reason(s) for the member(s) not receiving the needed health care? (Select all answers that apply.)

Code	***Label***
1	Insufficient funds
2	Geographically inaccessible health care facilities
3	Destroyed health care facilities
4	Other (Specify)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

43. Compared with the situation before Cyclone Idai (before March 15, 2019), how would you describe your household's access to general health services after the disaster? (Select only one answer for this question.)

Code	***Label***
1	Better
2	Same

3	Worse
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

44. Does any member of your household currently have a long-term disability as a result of Cyclone Idai? (Select only one answer for this question. Please note that all disabilities should have been diagnosed by a medical professional.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

SDG 4: Education indicators

45. Before Cyclone Idai (before March 15, 2019), were there any children (17 years old and younger) in the household attending school? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
3	Not applicable (no children resided in the household)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

46. ***If respondent selected 1 for question 45***, After Cyclone Idai (after March 15, 2019), did any of these children (17 years old and younger) stop attending school? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

47. ***If respondent selected 1 for question 46***, Why did these children (17 years old and younger) stop attending school after Cyclone Idai (after March 15, 2019)? (Select all answers that apply.)

Code	***Label***
1	Insufficient funds
2	Geographically inaccessible schools
3	Destroyed schools

4	Other (Specify)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

48. ***If respondent selected 1 for question 46***, How many months have the children (17 years old and younger) in this household not been attending school since Cyclone Idai (since March 15, 2019)? (If the respondent cannot remember, help the respondent by asking if it was greater than or less than a given amount until the respondent remembers. Please estimate in months. Round all estimates to the nearest whole number. Input 97 for refused to answer, 98 for do not know, and 99 for missing. If number is between 97 and 99, round up to 100.)

Months:

SDG 1: Poverty Indicators

I would now like to ask you about the resources that your household has access to in the Year BEFORE the Cyclone Idai disaster (March 15, 2018 to March 15, 2019).

49. 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 food to eat? (Select only one answer for this question.)

Code	***Label***
0	Never
1	Just once or twice
3	Several times
4	Many times
5	Always
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

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? (Select only one answer for this question.)

Code	***Label***
0	Never
1	Just once or twice
3	Several times
4	Many times
5	Always
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

51. In the year before Cyclone Idai (March 15, 2018 to March 15, 2019), how often, if ever, did you or your household go without an accessible toilet facility? (Select only one answer for this question.)

Code	***Label***
0	Never
1	Just once or twice
3	Several times
4	Many times
5	Always
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

52. In the year before Cyclone Idai (March 15, 2018 to March 15, 2019), how often, if ever, did you or your household go without medicine or medical treatment? (Select only one answer for this question.)

Code	***Label***
0	Never
1	Just once or twice
3	Several times
4	Many times
5	Always
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

53. In the year before Cyclone Idai (March 15, 2018 to March 15, 2019), how often, if ever, did you or your household go without electricity in your home? (Select only one answer for this question.)

Code	***Label***
0	Never
1	Just once or twice
3	Several times
4	Many times
5	Always
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

54. 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 fuel to cook your food? (Select only one answer for this question.)

Code	***Label***
0	Never
1	Just once or twice
3	Several times
4	Many times
5	Always
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

55. In the year before Cyclone Idai (March 15, 2018 to March 15, 2019), how often, if ever, did you or your household go without a cash income? (Select only one answer for this question.)

Code	***Label***
0	Never
1	Just once or twice
3	Several times
4	Many times
5	Always
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

Now, I would now like to ask you about the resources that your household has access to in the Year AFTER the Cyclone Idai disaster (March 15, 2019 to March 15, 2020).

56. 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 food to eat? (Select only one answer for this question.)

Code	***Label***
0	Never
1	Just once or twice
3	Several times
4	Many times
5	Always
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

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? (Select only one answer for this question.)

Code	***Label***
0	Never
1	Just once or twice
3	Several times
4	Many times
5	Always
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

58. In the year after Cyclone Idai (March 15, 2019 to March 15, 2020), how often, if ever, have you or your household gone without an accessible toilet facility? (Select only one answer for this question.)

Code	***Label***
0	Never
1	Just once or twice
3	Several times
4	Many times
5	Always
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

59. In the year after Cyclone Idai (March 15, 2019 to March 15, 2020), how often, if ever, have you or your household gone without medicine or medical treatment? (Select only one answer for this question.)

Code	***Label***
0	Never
1	Just once or twice
3	Several times
4	Many times
5	Always
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

60. In the year after Cyclone Idai (March 15, 2019 to March 15, 2020), how often, if ever, have you or your household gone without electricity in your home? (Select only one answer for this question.)

Code	***Label***
0	Never
1	Just once or twice
3	Several times
4	Many times
5	Always
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

61. 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 fuel to cook your food? (Select only one answer for this question.)

Code	***Label***
0	Never
1	Just once or twice
3	Several times
4	Many times
5	Always
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

62. In the year after Cyclone Idai (March 15, 2019 to March 15, 2020), how often, if ever, have you or your household gone without a cash income? (Select only one answer for this question.)

Code	***Label***
0	Never
1	Just once or twice
3	Several times
4	Many times
5	Always
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

SDG 2: Food Security Indicators

I would now like to ask you about the food situation in your household in the 4 weeks BEFORE the Cyclone Idai disaster (February 15, 2019 to March 15, 2019).

63. In the four weeks before Cyclone Idai (February 15, 2019 to March 15, 2019), did you worry that your household would not have enough food? (This question asks the respondent to report their personal experience with uncertainty and anxiety about acquiring food during the previous month. The interviewer should also read the definition of a "household" that was developed during the preparation of the questionnaire. Mention that this definition of household applies to all the questions with that term. Select only one answer for this question.)

Code	***Label***
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

64. In the four weeks before Cyclone Idai (February 15, 2019 to March 15, 2019), were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources? (One domain of food insecurity (access) is having limited choices in the type of food that a household eats. This question asks whether any household member was not able to eat according to their preference due to a lack of resources. Preference can refer to the form of a particular food (i.e., whole rice vs. broken rice), type of staple (i.e., millet vs. corn) or a high quality food (i.e., a piece of meat or fish). Preferred foods may or may not be nutritionally high quality. The interviewer should also read the definition of a "lack of resources." Mention that this definition of household applies to all the questions with that term. The respondent needs to answer on behalf of all household members. Select only one answer for this question.)

Code	***Label***
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

65. In the four weeks before Cyclone Idai (February 15, 2019 to March 15, 2019), did you or any household member have to eat a limited variety of foods due to a lack of resources? (This question asks about dietary choices related to variety – i.e., whether the household had to eat

an undesired monotonous diet (little diversity in the different types of foods consumed). The interviewer should read the description of what a monotonous diet might be. The respondent needs to answer on behalf of all household members. Select only one answer for this question.)

Code	***Label***
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

66. In the four weeks before Cyclone Idai (February 15, 2019 to March 15, 2019), did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food? (This question, which also captures the dimension of limited choices, asks whether any household member had to eat food that they found socially or personally undesirable due to a lack of resources. Often these are foods or food preparations that are consumed only under hardship. Different people may consider different foods to be undesirable, so it is best not to provide examples here at first. The respondent needs to answer on behalf of all household members, according to his or her own perception of the types of food household members ate during the previous four weeks. If more encouragement is required, the interviewer may give some examples using any examples included in the questionnaire and reviewed during training. For all questions, it is important to remind respondents that the examples are not an exhaustive list. Select only one answer for this question.)

Code	***Label***
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

67. In the four weeks before Cyclone Idai (February 15, 2019 to March 15, 2019), did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food? (This question asks whether the respondent felt that the amount of food (any kind of food, not just the staple food) that any household member ate in any meal during the past four weeks was smaller than they felt they needed due to a lack of resources. The respondent should answer according to his or her perception of what constitutes enough food

for the needs of the household members. The respondent needs to answer on behalf of all household members. Select only one answer for this question.)

Code	*Label*
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

68. In the four weeks before Cyclone Idai (February 15, 2019 to March 15, 2019), did you or any household member have to eat fewer meals in a day because there was not enough food? (This question asks whether any household member, due to lack of food, had to eat fewer meals than the number typically eaten in the food secure households in their area. The respondent needs to answer on behalf of all household members. Select only one answer for this question.)

Code	*Label*
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

69. In the four weeks before Cyclone Idai (February 15, 2019 to March 15, 2019), was there ever no food to eat of any kind in your household because of lack of resources to get food? (This question asks about a situation in which the household has no food to eat of any kind in the home. This describes a situation where food was not available to household members through the households' usual means (e.g., through purchase, from the garden or field, from storage, etc. Select only one answer for this question.)

Code	*Label*
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

70. In the four weeks before Cyclone Idai (February 15, 2019 to March 15, 2019), did you or any household member go to sleep at night hungry because there was not enough food? (This question asks whether the respondent felt hungry at bedtime because of lack of food or whether the respondent was aware of other household members who were hungry at bedtime because of lack of food. The respondent needs to answer on behalf of all household members. Select only one answer for this question.)

Code	***Label***
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

71. In the four weeks before Cyclone Idai (February 15, 2019 to March 15, 2019), did you or any household member go a whole day and night without eating anything because there was not enough food? (This question asks whether any household member did not eat from the time they awoke in the morning to the time they awoke the next morning due to lack of food. The respondent needs to answer on behalf of all household members. Select only one answer for this question.)

Code	***Label***
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

Now, I would now like to ask you about the food situation in your household in the 4 weeks AFTER the Cyclone Idai disaster (March 15, 2019 to April 15, 2019).

72. In the four weeks after Cyclone Idai (March 15, 2019 to April 15, 2019), did you worry that your household would not have enough food? (This question asks the respondent to report their personal experience with uncertainty and anxiety about acquiring food during the previous month. The interviewer should also read the definition of a “household” that was developed during the preparation of the questionnaire. Mention that this definition of household applies to all the questions with that term. Select only one answer for this question.)

Code	***Label***

0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

73. In the four weeks after Cyclone Idai (March 15, 2019 to April 15, 2019), were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources? (One domain of food insecurity (access) is having limited choices in the type of food that a household eats. This question asks whether any household member was not able to eat according to their preference due to a lack of resources. Preference can refer to the form of a particular food (i.e., whole rice vs. broken rice), type of staple (i.e., millet vs. corn) or a high quality food (i.e., a piece of meat or fish). Preferred foods may or may not be nutritionally high quality. The interviewer should also read the definition of a "lack of resources." Mention that this definition of household applies to all the questions with that term. The respondent needs to answer on behalf of all household members. Select only one answer for this question.)

Code	***Label***
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

74. In the four weeks after Cyclone Idai (March 15, 2019 to April 15, 2019), did you or any household member have to eat a limited variety of foods due to a lack of resources? (This question asks about dietary choices related to variety – i.e., whether the household had to eat an undesired monotonous diet (little diversity in the different types of foods consumed). The respondent needs to answer on behalf of all household members. Select only one answer for this question.)

Code	***Label***
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)

99	Missing (DO NOT READ OUT LOUD)

75. In the four weeks after Cyclone Idai (March 15, 2019 to April 15, 2019), did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food? (This question, which also captures the dimension of limited choices, asks whether any household member had to eat food that they found socially or personally undesirable due to a lack of resources. Often these are foods or food preparations that are consumed only under hardship. Different people may consider different foods to be undesirable, so it is best not to provide examples here at first. The respondent needs to answer on behalf of all household members, according to his or her own perception of the types of food household members ate during the previous four weeks. If more encouragement is required, the interviewer may give some examples using any examples included in the questionnaire and reviewed during training. For all questions, it is important to remind respondents that the examples are not an exhaustive list. Select only one answer for this question.)

Code	***Label***
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

76. In the four weeks after Cyclone Idai (March 15, 2019 to April 15, 2019), did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food? (This question asks whether the respondent felt that the amount of food (any kind of food, not just the staple food) that any household member ate in any meal during the past four weeks was smaller than they felt they needed due to a lack of resources. The respondent should answer according to his or her perception of what constitutes enough food for the needs of the household members. The respondent needs to answer on behalf of all household members. Select only one answer for this question.)

Code	***Label***
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

77. In the four weeks after Cyclone Idai (March 15, 2019 to April 15, 2019), did you or any household member have to eat fewer meals in a day because there was not enough food? (This question asks whether any household member, due to lack of food, had to eat fewer meals than the number typically eaten in the food secure households in their area. The respondent needs to answer on behalf of all household members. Select only one answer for this question.)

Code	***Label***
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

78. In the four weeks after Cyclone Idai (March 15, 2019 to April 15, 2019), was there ever no food to eat of any kind in your household because of lack of resources to get food? (This question asks about a situation in which the household has no food to eat of any kind in the home. This describes a situation where food was not available to household members through the households' usual means (e.g., through purchase, from the garden or field, from storage, etc.). Select only one answer for this question.)

Code	***Label***
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

79. In the four weeks after Cyclone Idai (March 15, 2019 to April 15, 2019), did you or any household member go to sleep at night hungry because there was not enough food? (This question asks whether the respondent felt hungry at bedtime because of lack of food or whether the respondent was aware of other household members who were hungry at bedtime because of lack of food. The respondent needs to answer on behalf of all household members. Select only one answer for this question.)

Code	***Label***
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)

97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

80. In the four weeks after Cyclone Idai (March 15, 2019 to April 15, 2019), did you or any household member go a whole day and night without eating anything because there was not enough food? (This question asks whether any household member did not eat from the time they awoke in the morning to the time they awoke the next morning due to lack of food. The respondent needs to answer on behalf of all household members. Select only one answer for this question.)

Code	***Label***
0	No (answer to question is 'No')
1	Rarely (once or twice)
2	Sometimes (3 to 10 times)
3	Often (more than 10 times)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

SDG 8: Decent Work Indicators

81. Did you or any of your household members own a business immediately before Cyclone Idai (before March 15, 2019)? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

82. ***If respondent selected 1 for question 81***, Was the business equipment, stocks or supplies damaged or lost as a result of Cyclone Idai? (Select all answers that apply for this question.)

Code	***Label***
1	Equipment damaged
2	Equipment lost
3	Stocks damaged
4	Stocks lost
5	Supplies damaged
6	Supplies lost
7	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

83. Did you or any of your family/household members lose their job for at least 3 months because of Cyclone Idai? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

84. ***If respondent selected 1 for question 83***, Which family/household member(s) lost their job(s) for at least 3 months because of Cyclone Idai? (Select all answers that apply for this question.)

Code	***Label***
1	Head of household
2	Spouse/partner
3	Son/daughter
4	Adopted/foster child/orphan
5	Father/mother/in law
6	Brother/sister
7	Grandchild
8	Grandparent
9	Son-in-law/daughter-in-law
10	Other relative
11	Non-relative
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

85. ***If respondent selected 1 for question 83***, What type of job(s) was lost for at least 3 months because of the disaster? (Select all answers that apply for this question.)

Code	***Label***
1	Formal Full-Time Wage Work
2	Formal Part-Time Wage Work
3	Formal Casual Work
4	Informal Full-Time Wage Work
5	Informal Part-Time Wage Work
6	Informal Casual Work
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

86. ***If respondent selected 1 for question 83***, How is the household generating income now, after Cyclone Idai (after March 15, 2019)? (Select all that apply.)

Code	***Label***
1	New/different job(s) (which member(s) of the household, and what type of job?)
2	The children are now working (the children are now out of school)
3	Household members have temporarily/permanently migrated (where to?)
4	Receiving assistance from relatives/neighbours
5	Begging
6	Other (Specify)
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

87. How does your household's income compare now with the income before Cyclone Idai (before March 15, 2019)? (Select only one answer for this question.)

Code	***Label***
1	Increased
2	The same
3	Decreased
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

88. What would you estimate were the total cost, in Meticais, of all the impacts that your household experienced as a result of Cyclone Idai (e.g. home reconstruction + loss of income +medical/burial costs)? (this is defined as the total estimated value, in Meticais, of all household-level losses due to Cyclone Idai. Confirm whether the respondent is including all losses in the estimate. If the respondent cannot remember, help the respondent by asking if it was greater than or less than a given amount until the respondent remembers. If the respondent is hesitant to answer, remind them that their answers are kept confidential and ask if they would be more comfortable writing the number on a piece of paper from which you will record in the survey before handing the paper back to them or they can enter the information directly onto the tablet. Please estimate in the local currency. Round all estimates to the nearest whole number. Input 97 for refused to answer, 98 for do not know, and 99 for missing. If number is between 97 and 99, round up to 100.)

Total estimated losses:

The SDG-relevant household adaptations to Cyclone Idai

89. In order to cope with the impact of Cyclone Idai, have you or any member of your household spent household savings? (Select only one answer for this question.)

Code	*Label*
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

90. In order to cope with the impact of Cyclone Idai, have you or any member of your household borrowed to meet basic needs? (Select only one answer for this question.)

Code	*Label*
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

91. In order to cope with the impact of Cyclone Idai, have you or any member of your household reduced spending on education (withdrawing children from school)? (Select only one answer for this question.)

Code	*Label*
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

92. In order to cope with the impact of Cyclone Idai, have you or any member of your household reduced spending on non-essential consumption items? (Select only one answer for this question.)

Code	*Label*
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

93. In order to cope with the impact of Cyclone Idai, have you or any member of your household sold assets such as livestock? (Select only one answer for this question.)

Code	*Label*

1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

94. In order to cope with the impact of Cyclone Idai, have you or any member of your household relied on in-kind or cash support from relatives or community members within this city? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

95. In order to cope with the impact of Cyclone Idai, have you or any member of your household received increased remittances (cash or in-kind) from relatives outside the city? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

96. In order to cope with the impact of Cyclone Idai, have you or any member of your household accessed government relief assistance? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

97. In order to cope with the impact of Cyclone Idai, have you or any member of your household accessed local, national or international non-governmental humanitarian aid? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)

99	Missing (DO NOT READ OUT LOUD)

98. In order to cope with the impact of Cyclone Idai, have you or any member of your household taken on informal or casual work? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

99. In order to cope with the impact of Cyclone Idai, have you or any member of your household taken on hazardous work? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

100. In order to cope with the impact of Cyclone Idai, have you or any member of your household engaged in child labour? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

101. In order to cope with the impact of Cyclone Idai, have you or any member of your household diversified sources of livelihoods/income among family members? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

102. In order to cope with the impact of Cyclone Idai, have you or any member of your household taken out (formal or informal) loans (moneylenders, bank, microfinance, cooperative, etc.)? (Select only one answer for this question.)

Code	*Label*
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

103. In order to cope with the impact of Cyclone Idai, have you or any member of your household borrowed in-kind (for example, from local shops for food)? (Select only one answer for this question.)

Code	*Label*
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

104. In order to cope with the impact of Cyclone Idai, have you or any member of your household sent family members to look for work outside of the affected areas? (Select only one answer for this question.)

Code	*Label*
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

105. In order to cope with the impact of Cyclone Idai, have you or any member of your household migrated to other city(ies) outside of Beira? (Select only one answer for this question.)

Code	*Label*
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

106. ***If respondent selected 1 for question 105,*** Which city did you migrate to? (97 for "refused to answer", 98 for "do not know", and 99 for "missing")

Type in response:

107. In order to cope with the impact of Cyclone Idai, have you or any member of your household moved to displacement camps? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

108. In order to cope with the impact of Cyclone Idai, did your household send children residing in the household to live elsewhere? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
3	Not applicable, no children resided in the household
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

109. In order to cope with the impact of Cyclone Idai, have you or any member of your household sold or mortgaged land? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

110. Has your household or anyone in your household received any monetary or non-monetary assistance in the past 30 days? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

111. ***If respondent selected 1 for question 110***, What assistance has your household received? (Select all answers that apply for this question.)

Code	***Label***
1	Food (for how many people and how many days?)
2	Water (for how many people and how many days?)

3	Other non-food household items
4	Cash vouchers
5	Loans
6	Food for work programme
7	Agricultural inputs (seeds, tools, etc.)
8	Tent or plastic sheets
9	Building materials for house repair or construction
10	Other (please specify)_____
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

112. ***If respondent selected 1 for question 110***, Is the assistance provided enough to meet the needs of everyone in the household/family? (Select only one answer for this question.)

Code	***Label***
1	Yes
2	No
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

113. What are the most important or priority needs to recover from the disaster? (Select all answers that apply for this question.)

Code	***Label***
1	Housing
2	Health care
3	Access to water
4	Schools for children
5	Food and/or water
6	Seeds and tools to resume farming
7	Cash vouchers
8	Loans to resume business operations
9	Restoring basic infrastructure (roads, bridges, etc.)
10	Protection against insecurity, violence, etc.
11	Restoring electricity
12	Other (please specify)_____
97	Refused to answer (DO NOT READ OUT LOUD)
98	Do not know (DO NOT READ OUT LOUD)
99	Missing (DO NOT READ OUT LOUD)

114. Are there any difficulties that you face or experiences you have had since Cyclone Idai that we have not talked about? (Read the question aloud and allow the respondent to answer freely. Record all responses. Input 97 for refused to answer, 98 for do not know, and 99 for missing.)

Additional experiences:

Survey Ending

Note: *Thank you very much for your time. Your time and answers are very valuable to us. If you are interested in learning more about the findings from this survey, please feel free to contact the project principle investigator, Dr. Cameron McCordic at the University of Waterloo in Canada (c2mccord@uwaterloo.ca). This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board (ORE application number 43049). Now that the survey is completed, do you have any questions?*

We may need to follow up with you in order to check that we have accurately inputted the answers you have given. Would you be willing to provide a way of contacting you? (If the respondent is willing to provide this information, record the respondent's phone number, email, and/or business address location. Please record this information in a separate physical notebook (recording the Household Identification Number and Contact Details provided) and please hand that notebook to your field supervisor at the end of each day of fieldwork. If the respondent is not willing to provide this information, please move on to the remaining questions in the survey.)

We would like to learn more about your experience of Cyclone Idai. Would you be interested in participating in a 1-2 hour focus group session in the coming year? If you are interested in attending any potential follow up focus groups, we will use the contact information you have provided to contact you with the information about the focus group session and a request for your consent to participate. You may then decide to accept or decline the invitation to join the focus group and it will have no impact on your current participation in this survey.

Code	***Label***
1	Yes
2	No

Enumerator Pledge: By writing my name here, I am hereby swearing that this survey was filled out in accordance with the training I received during the enumerator training workshop and that the content of this survey accurately represents the true statements of the respondent I have been assigned to interview according the sampling strategy outlined by my supervisor.

Enumerator Name:

What is the Household Identification Number for this Survey? (Format Tablet Number.Month.Date.Time in 24 hour format. For example: 03.07.25.1435).

Household Identification Number:

What is the status of this interview?

Code	***Label***
1	Complete
2	Incomplete
3	Terminated

Was this survey form checked by a supervisor for input errors?

Code	***Label***
1	Yes
2	No

Was this survey form back-checked to confirm any survey answers?

Code	***Label***
1	Yes
2	No