Institutional Capacity to Manage the Risk of Flood Disaster: A Case Study of the Tunapuna/Piarco Regional Corporation in Trinidad and Tobago

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Year of Submission: 2019

This dissertation is submitted as part of a MA degree in Disasters, Adaptation and Development at King's College London.

Declaration

KING'S COLLEGE LONDON

DEPARTMENT OF GEOGRAPHY

MA/MSc DISSERTATION

I, ……Christal Benjamin…… hereby declare (a) that this Dissertation is my own original work and that all source material used is acknowledged therein; (b) that it has been specially prepared for a degree of King's College London; and (c) that it does not contain any material that has been or will be submitted to the Examiners of this or any other university, or any material that has been or will be submitted for any other examination.

This Dissertation is ……11976……words.

Date: ……...…13/09/2019…….

Dedication

This thesis is dedicated to my parents, Gerard and Bernadette Benjamin and my sister, Jasmine Benjamin for their unwavering support during my academic journey. It is also dedicated to my aunt, Christine Fortune for her invaluable support during my time at King's College London.

Abstract

This paper explores the causal relationship between institutional capacity and flood disaster risk within the Tunapuna/Piarco Municipality. It employs the institutional capacity framework after Lebel *et al*. (2013) to examine the institutional design, capacities and practices of the Tunapuna/Piarco Regional Corporation. The research employs a case study design. Data collection involved a review of policy documents and interviews with officials of the corporation and residents of the municipality. The findings of this study reveal that weaknesses in institutional design, resource constraints and knowledge gaps limit the Tunapuna/ Piarco Regional Corporation's capacity to effectively manage flood risk. However, the ongoing process of local government reform presents opportunities for critical reflection and institutional capacity building. The study also finds that the institutional capacity framework cannot be used to adequately reflect the complexities of risk management within the municipality. It proposes a revised conceptual model for institutional capacity assessment.

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List of Abbreviations

APN-Asia-Pacific Network for Global Change Research

CARILED-Caribbean Local Economic Development Project

CDEMA -Caribbean Disaster Emergency Management Agency

CEPEP- Community-Based Environmental Protection and Enhancement Programme

CCRIF SPC-Caribbean Catastrophe Risk Insurance Facility Segregated Portfolio Company

DMU- Disaster Management Unit

EOC-Emergency Operations Centre

ESRI-Environmental Systems Research Institute

GORTT- Government of the Republic of Trinidad and Tobago

HDC-Housing Development Corporation

IDNDR- International Decade for Natural Disaster Reduction

IPCC-Intergovernmental Panel on Climate Change

ITCZ- Intertropical Convergence Zone

MORDLG - The Ministry of Rural Development and Local Government

MOWT-Ministry of Works and Transport

NEMO-National Emergency Management Office

NODS-National Office of Disaster Service

NGOs-Non-governmental Organsiations

OCHA-United Nations Office for the Coordination of Humanitarian Affairs

ODPM- Office for Disaster Preparedness and Management

ODEPM-Office of Disaster Preparedness and Emergency Management

TTDF- Trinidad and Tobago Defence Force

TTMS-Trinidad and Tobago Meteorological Service

TTFS-Trinidad and Tobago Fire Service

TTPS-Trinidad and Tobago Police Service

TPRC- Tunapuna/Piarco Regional Corporation

UNDRR/UNISDR- United Nations Office for Disaster Risk Reduction

MOCDCA- Ministry of Community Development Culture and the Arts

MOHUD - Ministry of Housing and Urban Development

MOE- Ministry of Education

MOWT -Ministry of Works and Transport

MOSDFS- Ministry of Social Development and Family Services

TTP- Trinidad and Tobago Parliament

Acknowledgements

I am grateful to God for His guidance and provision during my thesis journey. I would also like to thank my supervisor, Professor Sarah Bracking for her critical commentary and feedback during the research design. I acknowledge all the research participants who willingly took part in the study. I wish to thank them for their valuable insight. Thank you also to Beth Goins for proofreading my dissertation and to all my friends and family members who encouraged and supported me during the thesis journey

1. Introduction

This paper explores the causal relationship between institutional capacity and flood risk at the local government level in Trinidad and Tobago. It conducts a case study of the Tunapuna/Piarco Regional Corporation (TPRC) and examines its capacities for deliberation, coordination, implementation and evaluation with respect to flood risk management measures. Specific focus is placed on examining how these capacities influenced social risk to a major flood disaster that took place in 2018.

In October 2018, Trinidad experienced the worst flood disaster in its recent history (Baig, 2018). As estimated 150,000 persons were affected and total damages amounted to approximately US$ 3,700,000 (Fontes de Meira and Phillips, 2018). Within the Tunapuna/Piarco municipality 1500 households were impacted by the disaster (OCHA, 2018). The residents suffered extensive material losses and experienced psychological and physical distress. The severity of flood disasters and concomitant losses in Trinidad and Tobago and the wider Caribbean are expected to increase as a result of climate change (OPPM, 2013a). This has created an urgent need to build capacity for managing flood risks at local, national and regional scales (CDEMA, 2014).

An understanding of the root causes of disaster risk is essential for capacity building at the municipal level (Wisner *et al*., 2004). Much emphasis has been placed on the application of decentralised frameworks to strengthen the disaster risk management capacities of municipal authorities (Ahrens and Rudolph, 2006). However, in many cases this approach has been viewed as a panacea for good governance. It has been applied without a critical understanding of how the capacities and incapacities of local authorities influence social risk to disaster (Blackburn, 2014). These capacities and incapacities are often modified by cross-scalar interactions between central governments and local authorities. They may also be influenced by the interplay between formal and informal actors at the municipal level.

The research applies the institutional capacity framework after Lebel *et al.* (2013) to investigate the flood risk management capacities of the TPRC. The overall aim of the research is to explore the impact of institutional capacities on social risk to flood disasters in the Tunapuna/Piarco municipality. This is useful for capacity building and strategic risk management. More specifically the research aims to:

1. Analyse the Tunapuna/Piarco Regional Corporation's institutional design, capacities and practices for flood risk reduction.
2. Assess the extent to which the institutional incapacities of the Tunapuna/Piarco Regional Corporation generated risk to the 2018 floods in the region.
3. Discuss constraints and opportunities for institutional capacity building within the Tunapuna/Piarco Regional Corporation
4. Assess the applicability of the institutional capacity framework to the Tunapuna/Piarco context.

The findings of the study reveal that the TPRC places most emphasis on disaster response. Its capacities to address the underlying causes of flood disaster are limited and this modifies social risk to floods (Wisner *et al*., 2004). Inefficiencies in institutional design, resource management challenges and knowledge gaps limit the TPRC's ability to employ a comprehensive approach to flood risk management. However, the process of local government reform provides opportunities for addressing these challenges. Furthermore, the study elucidates that the institutional capacity is a useful tool for understanding flood risk management within the Tunapuna/Piarco context. However, it cannot be used to fully reflect the complexities of the corporation's risk management approach. The paper proposes a revised framework which is considered to be applicable to the research context.

The paper reviews the literature on disaster risk, institutional capacity and the use of frameworks in disaster risk research in section 2. Section 3 provides insight on the research context, while Section 4 details the research methodology. Section 5 presents the findings on the TPRC's institutional design. Section 6 analyses the TPRC's capacities for flood risk management. Section 7 assesses the extent to which these capacities influenced risk vis-à-vis the 2018 flood disaster. Sections 8 discusses constraints and opportunities for capacity building within the TPRC. Section 9 assesses the applicability of the institutional capacity framework to the Tunapuna/Piarco context, and it presents a revised framework for assessing the impact of institutional capacity on flood risk. Section 10 draws a conclusion on the lessons learnt on institutional capacity and flood risk management and considers opportunities for future research.

2. Literature Review

2.1 Conceptualising Disasters and Disaster Risk

There has been much debate over what causes some persons to be more at risk to disaster than others (Lemons, 1957; Sheets and Grayson, 1979; Cannon, 2008; Twigg, 2015). Prior to the mid-20th century, a fatalistic view of disasters dominated human societies, and catastrophic events were associated with misfortune. However, advancements in science and technology during the second half of the 20th century gave birth to the hazard paradigm. Within this paradigm, natural hazards such as floods were referred to as "extreme geophysical events" and their impact on society was termed "natural disasters" (Burton *et al*., 1968: 36). Risk management approaches were predominantly technocratic in nature; research and policy on flood risk management placed emphasis on engineering interventions such as levees, channel diversions and dams (White, 1973).

However, in the 1970s a paradigm shift took place. Disaster research within the social sciences elucidated the causal relationship between hazard impact and human vulnerability (Baird, 1975; O'Keefe *et al.*, 1976; Wisner *et al.*, 1977). Phil O'Keefe *et al.* (1976) made a significant contribution to the discursive change in their landmark article entitled, "Taking the Naturalness out of Natural Disasters". They argued that, "disaster marks the interface between an extreme physical phenomenon and a vulnerable human population" (O'Keefe *et al*., 1976: 566). Further, they posited that vulnerability is caused by underdevelopment and unequal power relations and that precautionary planning is critical to risk reduction. On similar lines, Hewitt, (1983, viii) challenged the parochial focus on the accidentalism of hazards and emphasised the need for risks to be understood within the wider context of the "'normal' socioeconomic order".

These writings spurred changes in the international approach to disaster risk reduction. For example, in its 'Yokohama Message', the United Nation's International Decade for *Natural* Disaster Reduction (IDNDR) [italics added] underscored the importance of implementing policies and building capacity for risk reduction at national scales (IDNDR, 1994). While the misnomer 'natural disaster' persisted, the message conveyed a more comprehensive understanding of disaster risk. Today, disaster risk is commonly defined as the probable loss of life and property, harm or damage to resources which could be sustained by a population at a given time, expressed as a

function of hazard, exposure and vulnerability (UNDRR, 2015). The disaster risk formula that is derived from this definition is a useful tool for assessing disaster risk (see Box 1).

Disaster Risk = Hazard × Vulnerability × Exposure

Box 1. Disaster Risk Formula
Adapted from: UNDRR (2015)

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2.2 Understanding Flood Disaster: The Risk Factors

i. The Flood Hazard

A hazard is a natural, socio-natural or human induced physical event which may cause injury or loss (Birkmann, 2013). Natural hazards such as volcanoes cannot be modified by human action; however, physical, social and technological factors may intersect to make a flood a "hybrid hazard" (Mustafa, 2005: 566). Rainstorm-generated riverine floods are caused by a combination of natural and anthropic factors. The hydraulic characteristics of a rainstorm-generated flood wave are influenced by the meteorological characteristics of a rainstorm, the physical characteristics of a watershed and anthropogenic alterations to watercourses and flood plains (Shrivastava, 2003). Characteristics such as duration, cloud structure and areal extent determine the measure of precipitation generated by a rainstorm (*ibid.*). Furthermore, the relief, soil characteristics, vegetation and areal extent of a watershed influences its response to precipitation input. Dredging, widening and pollution of watercourses alter peak discharge, and land use changes on flood plains may increase the propagation of a flood wave (Wisner *et al*., 2004).

Historically, a poor understanding of these factors have led to the dominance of technical methods to reduce flood risk (APN, 2005). In many cases these interventions have failed or have led to a redistribution of risks to the poor and marginalised in society (Mustafa, 2005). The inadequacy of these methods is more apparent due to the climate-driven changes in flood regimes which have modified flood risks (Lebel *et al*., 2010). This has led to a greater focus on sustainable approaches to managing exposure to floods (Bangalore *et al.*, 2019).

ii. Exposure

There has been much debate in the literature over the definition of exposure in respect to disaster risk. Exposure refers to the presence of people, livelihoods, assets and infrastructure in areas which could be adversely affected by a hazard event (UNDRR, 2017). While some authors define exposure as a component of risk, (Bollin *et al*., 2003; UNDRR, 2015) others consider it to be a factor of vulnerability (Bohle, 2001; Wisner *et al*., 2004). These differences have been represented in conceptual risk assessment models.

In the Conceptual Framework for measuring disaster risk after Bollin *et al*. (2003), exposure is situated as a risk factor alongside hazard, vulnerability and capacity. It comprises three key characteristics: structures, population and economy. Disaster risk is the sum of hazard, exposure, vulnerability and capacity measures (see Figure 1).

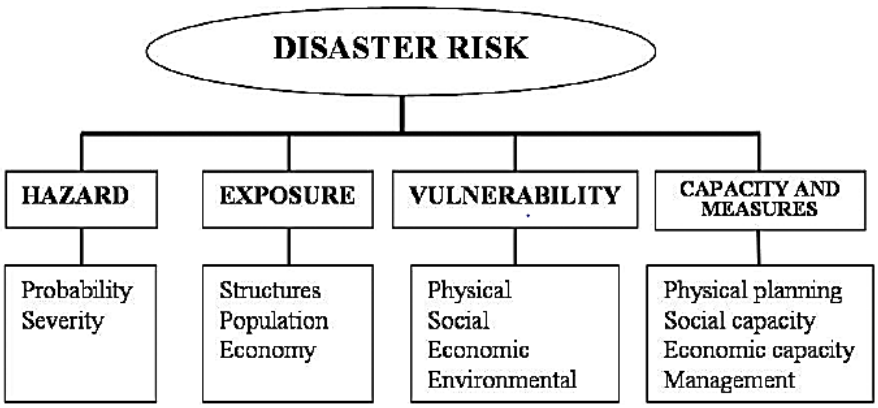


Figure 1. The Conceptual Framework
Source: Bollin *et al*. (2003)

In contrast, in the Pressure and Release Model after Wisner *et al*. (2004) exposure is classified as a component of vulnerability (see Figure 2). Vulnerability is conceptualised as a progression towards risk which originates from roots causes such as entitlement relations and social constructs. These are modified by social, economic, environmental and institutional dynamic pressures. These dynamic pressures are then manifest in lack of resources and unsafe conditions such as dangerous locations.

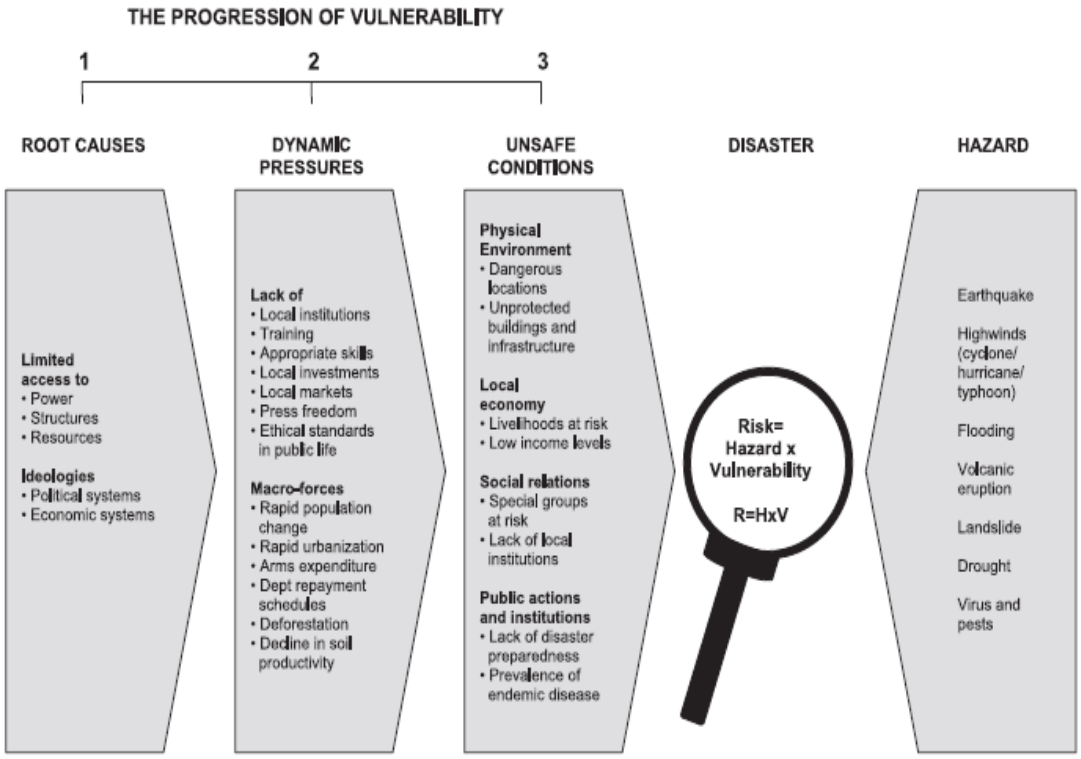


Figure 2: The Pressure and Release Model
Source: Wisner *et al*. (2004)

In relation to a flood, a flood plain may be considered a dangerous location. Factors such as economic growth, urbanisation, population growth and concomitant competition for land use drive exposure to flood hazards (UNDRR, 2015; Manuta *et al*., 2006). However, an individual may be exposed to a flood risk, but may not be impacted due to their specific characteristics (Birkmann, 2013). The distinction between exposure and vulnerability in flood assessment is useful for a more in-depth understanding of these characteristics and their impact on differential risk (*ibid.*).

iii. Vulnerability

The notion of vulnerability has been widely contested in the literature. Wisner *et al*. (2004:11) defines vulnerability as "the characteristics of a person or group and their situation that influences their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard". Characteristics such as socioeconomic class, caste, ethnicity, gender, social networks, social protection, disability and health status influence social vulnerability to hazards (Cannon, 2008;

Birkmann, 2013; Koks *et al*., 2015). Vulnerability studies have established causal links between disaster susceptibility and disempowerment in hegemonic socio-political contexts. In his discourse on flooding, Cannon (1990) elucidated differential vulnerability among classes on the Gangetic plain of North India. In this society, affluent groups lived on elevated land within the town centre. However, the "untouchables" who were poor and marginalised lived on the low-lying peripheries which were more prone to flooding (Cannon, 1990: 22). Both groups were exposed to flood hazards; however, those of a lower social class were vulnerable to disaster because of their social status (*ibid.*).

Vulnerability analyses such as these have influenced more strategic approaches to vulnerability reduction; however, they have also been criticised for their portrayal of people as passive victims of risk (Hewitt, 1997). This critique led to a greater focus on the capacities of persons to resist and cope with disasters (Anderson and Woodrow, 1998). Capacities are all the resources and relationships which are required by a society or organisation to reduce risk to disaster (UNDRR, 2017). Within the literature there is a theoretical tension regarding the distinction between vulnerability and capacity. Davis *et al.* (2004) suggest that vulnerability and capacity are not on opposite ends of a single spectrum as vulnerabilities and capacities can co-exist at various scales within societies. However, Birkmann (2013) argues that vulnerability has a multiple structure which encompasses both susceptibility and capacity. He also suggests that vulnerability has an institutional dimension which refers to the capacities and incapacities of governmental authorities to manage risks. are essential for disaster risk reduction. An assessment of these factors can serve as a starting point improving disaster risk governance, and thus, reducing social risk (*ibid.*).

2.3 Institutional Capacity: An Indicator of Social Vulnerability

The causal relationship between institutions and social vulnerability to flood disasters is increasingly well understood (Cannon, 2000; Lebel *et al.*, 2013; Ran and Nedovic-Budic, 2016). Institutions are the rules, decision-making procedures and norms that define social practices, and the roles and responsibilities of various stakeholders (Young, 2002). They may be formal or informal. While a governance structure is an example of a formal institution (Beer and Lester, 2014), a family's flood response plan is an example of an informal institution. The interactions between formal and informal actors for the purpose of flood risk management can be better

understood by assessing the capacities of flood risk management authorities (Manuta *et al*., 2006; Lebel *et al*., 2013).

ii. Institutionalised Capacities

Lebel *et al*. (2013) propose a framework for assessing institutional capacities for flood risk management (see Table 1).

Table 1. Framework for Assessing Institutionalised Functions and Capacities with Regard to Flood Related Disaster

	Phase of disaster cycle (Timing)			
Functions	Mitigation (Well before)	Preparedness (Before)	Emergency (During)	Rehabilitation (After)
Deliberation *What should be done?*	How were decisions made about what and who would be at risk? Whose knowledge was considered, whose interests were represented?	Was the public consulted about disaster preparations? How were decisions to give special powers to particular authorities made?	How were decisions made about what and who should be saved or protected first? What special directives or resolutions were invoked?	How were decisions made about what is to be on the rehabilitation agenda? Whose knowledge was considered, whose interests were represented?
Coordination *Who was responsible?*	What national and basin-level policies, strategies or legislation were in place to reduce risks of disaster?	How were responsibilities divided among authorities and public? Was an appropriate early warning system implemented?	How were specific policies targeting emergency operations implemented? Were there gaps between stated responsibilities and performance of key actors? Who was in charge?	Were the resources mobilized for recovery adequate? Were they allocated and deployed effectively? How was rehabilitation integrated into community, basin or national development?
Implementation *How was it done?*	What structural measures were undertaken to reduce likelihood of severe flood events? To what extent were laws and regulations regarding land-use in flood prone areas implemented? What measures were taken to improve coping and adaptive capacities of vulnerable groups?	Were public authorities well prepared? Was the public well informed? How were specific national or basin-level policies targeting disaster preparedness implemented?	How were emergency rescue and evacuation operations performed? Were special efforts made to assist socially vulnerable groups? Were any measures taken to prevent looting?	Did the groups who most needed public assistance get it? Who benefited from reconstruction projects? Was insurance available and used and if so how were claims processed? Was the compensation process equitable and transparent?
Evaluation *Was it done well?*	How is the effectiveness of risk reduction measures assessed?	How is the adequacy of preparedness monitored?	How is the quality of emergency relief operations evaluated?	How is the effectiveness of the rehabilitation programs evaluated?
	To whom and how are authorities accountable? Were institutional changes made to address capacity and practice issues learnt about in the previous disaster cycle?			

According to the framework there are four capacities and practices of formal risk management institutions which may be assessed to understand the causal relationships between institutional capacity and social vulnerability. These are capacities for deliberation, coordination, implementation and evaluation.

Deliberation could take the form of planning meetings and debates (Lebel *et al.*, 2013). It provides opportunities for authorities and the public to negotiate risk throughout the various stages of the

disaster cycle. Furthermore, assessment of coordination capacities raises the question, "Who is or should be responsible?" (Lebel *et al.,* 2013: 467). The framework suggests that authorities are responsible for mobilising actors and resources for flood risk management. However, responsibilities for disaster preparedness should be divided between authorities and the public.

Implementation involves the judicious use of resources and the execution of critical actions for flood risk management by formal and informal actors. Assessments of implementation capacity are used to evaluate structural and non-structural mitigation measures, preparedness policies, response efforts and the appropriateness of rehabilitation measures (*ibid*.). Lastly, evaluation involves the assessment of the effectiveness of flood risk management measures and social learning. It is used to hold authorities accountable and improve flood disaster interventions.

These capacities and practices have also been discussed in the literature. Anderson and Woodrow (1998) suggested that vulnerability and capacity assessments can be used by aid agencies to engage local people and collaborate with them to devise sustainable measures for reducing disaster risk. Manuta *et al*. (2006) posit that critical reflection throughout this process can preclude a narrow definition of deliberation which relegates it to the transfer of knowledge from technocrats to locals. The process should be equitable providing a space for various groups within a locality to share their perspectives, so that their specific needs can be addressed where possible (Alexander, 2015). Furthermore, it should not be viewed as a panacea for risk reduction, but should form part of a holistic approach to disaster risk management (Titz *et al*., 2018).

Furthermore, in regard to coordination, Manuta *et al*. (2006) notes that cross-scalar interactions among land use planning, social welfare and disaster response agencies among other actors are important for efficient flood risk management. Collaborations between these institutions and the public are equally important (Ahrens and Rudolph, 2006; Lebel *et al*., 2010). Disaster risk can be effectively reduced when authorities work closely with the public throughout the various stages of the disaster management cycle (Takeuchi, 2009).

Additionally, Manuta *et al*. (2006) suggest that the poor institutional design and management of resources give rise to gaps in the implementation of flood risk management measures. Wisner *et al.* (2012) add that critical analysis of these risk factors are imperative for effective implementation. The absence of such analysis may lend to the perpetuation of disaster (UNISDR, 2015).

Lastly, Krausmann and Mushtaq (2006) propound that the cyclic occurrence of disasters may reflect deficiencies in systematic learning and documentation of lessons from past experiences. Evaluation and monitoring of risk measures are critical especially in contexts where flood regimes are being altered due to climate change (Lebel *et al*., 2010). In such contexts institutional capacity building is required to manage modified risks (*ibid*.). However, establishing causal links between disaster risk measures and risk reduction is challenging; these challenges may be addressed by collecting baseline data which can be used as reference points for evaluating progress (Twigg, 2015).

2.4 Framing in Flood Disaster Risk Management

Theoretical frameworks such as the institutional capacity framework after Lebel *et al*., (2013) are widely used in the disaster literature to gain a better understanding of disaster risks in various contexts. They are lenses through which social phenomenon can be explored and understood (Anfara and Mertz, 2014). They are also used to validate theories which have been established from observations of causal relationships in the real world (Wisner *et al*., 2012). The literature contains diverse perspectives on how theoretical frameworks should be used to assess social phenomenon.

Walsham (1993:71; cited in Dobson, 1999) suggested that "a good framework should not be regarded as a rigid structure, but as a valuable guide to empirical research". Walsham also compares theory to a building scaffold which should be removed once its purpose has been served (Walsham, 1995). Wisner *et al*. (2012) expound on the usefulness of theoretical frameworks suggesting that they can be used as a tool to remind researchers of the pertinent questions which they need to ask while conducting fieldwork. However, Gaillard (2019) notes that the uncritical application of theoretical frameworks to given contexts can result in the perpetuation of hegemonic ideas.

The institutional capacity framework is based on the assumption that capacities for deliberation, coordination, implementation and evaluation can be institutionalised as suggested in the literature, and by empirical research in the Asian context (Lebel *et al*., 2013). It also developed around the concept of a disaster cycle as proposed by Alexander (2002) [see Figure 3].

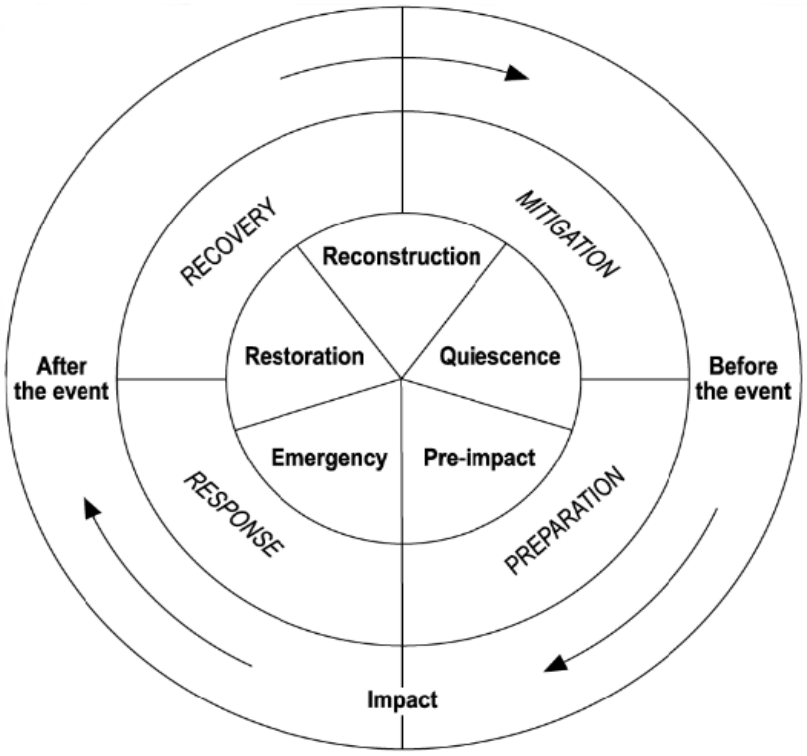


Figure 3: The Disaster Management Cycle

Source: (Alexander, 2002)

According to Alexander (2002), disasters are repetitive events which can be classed into four management categories: mitigation, preparedness, response and recovery. He suggests that mitigation involves structural and non-structural measures to reduce the impact of disasters. Preparedness measures such as evacuation are undertaken when the disaster is imminent. Response is executed during the disaster impact or in its aftermath. Lastly recovery involves repairing damaged structures and restoring essential services in the short-term and long-term. This approach was proposed as a corrective to the emergency centric models used by many countries within the dominant hazard paradigm (UNISDR, 2015).

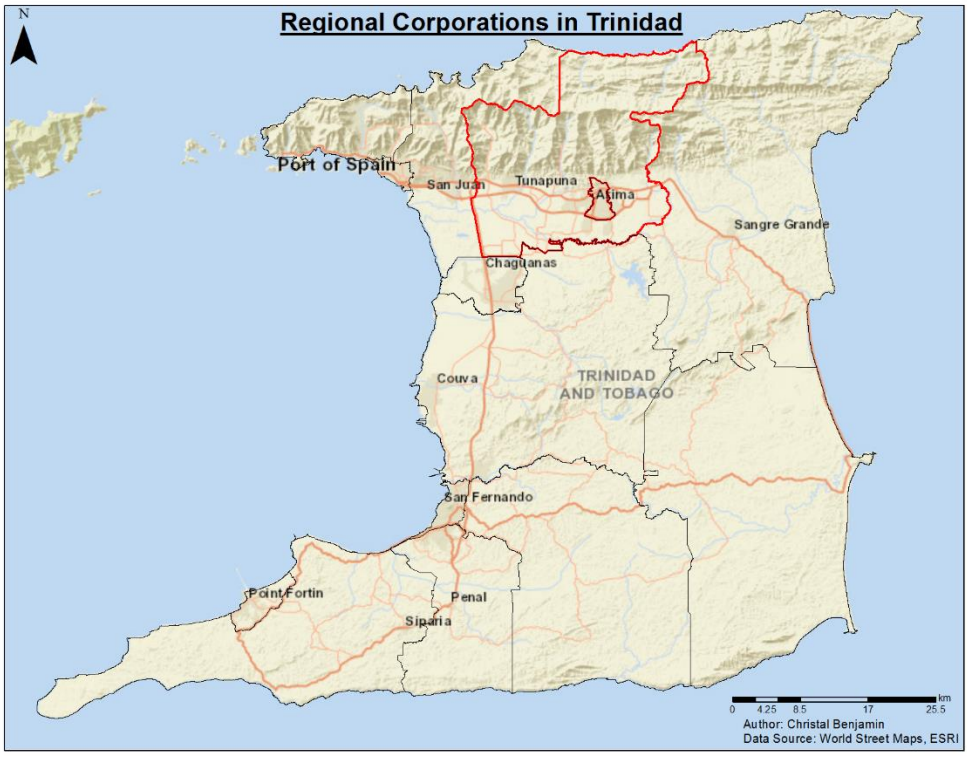
However, there has been critique of the disaster management cycle in the literature. Wisner *et al*. (2004: 20) posits that terms such as "disaster management cycle" are technical constructs which are imposed on societies and they may not reflect the lived reality of disaster. The disaster management cycle "revolves around disasters as events" and implies that they are external shocks

to development (UNISDR, 2015:37). According to Lavell and Maskrey (2014), the concept does not reflect the complexity of disaster risks which are inherent to development.

Notwithstanding this critique, disaster risk management in several Caribbean countries including Saint Lucia, Antigua, Jamaica and Trinidad and Tobago is based on the concept of the disaster management cycle (NEMO, 2019; NODS, 2019; ODEPM, 2019; TPRC, 2019). The study applies the institutional capacity framework to disaster risk management at the local government level in Trinidad and assesses its relevance to the context. While Lebel *et al*. (2013) used the framework to assess the impact of institutional capacity on social vulnerability, this study applies the framework to assess the causal relationship between institutional capacity and the three risk factors: hazard, exposure and vulnerability. The study is relevant in light of the ongoing process of local government reform in Trinidad and Tobago which has brought the issue of institutional capacity for disaster risk management to the fore. It contributes to the discussion. Furthermore, the study is also important given the need for capacity building to address the flood risks that are associated with climate change in Trinidad and Tobago and the wider Caribbean region.

3. Research Context

Trinidad and Tobago is a twin-island state in the southern Caribbean region. Trinidad is divided into 14 local government corporations, including the Tunapuna/Piarco municipality, which is located in north-central Trinidad (see Map 1). It comprises two regions: the Tunapuna region and the Piarco region. According to the last national census report, it is the most populous municipality with a population of 215,119 (CSO, 2012). This represents 16.2 percent of the national population of 1,328,019 persons (*ibid.*). Over the last two decades, there has been significant growth in population, commerce and industrial activities within the corporation, accompanied by competition for land space and environmental degradation (MORDLG, 2016b).



Map 1. Regional Corporations in Trinidad
Source: Author's Own (Created in ArcMap using data from
World Street Maps and the Environmental Systems Research Institute [ESRI])

The TPRC is the local government authority for this municipality. The corporation is made up of a council that consists of 15 councillors and four aldermen and an administrative branch (MORDLG, 2016b). The council has primary responsibility for policy-making; the administrative branch receives orders from the elected branch and executes the day-to-day operations of the corporation. The TPRC is responsible for managing the political, economic, environmental and social affairs of the municipality. One of its key functions is disaster risk management. Flood disasters are among the most common disasters experienced by the municipality.

The Tunapuna/ Piarco municipality experiences annual floods. Trinidad has a tropical climate and two distinct seasons: a dry season from January to May and a rainy season from June to December, which is marked by increased rainfall. Furthermore, the municipality is located within the Caroni River Basin. This is one of the largest river basins on the island with a total area of 883.4 square kilometres (Juman and Ramsewak, 2013). During the rainy seasons localities on the Caroni flood plain experience floods. However, the 2018 floods were the worst floods to occur in the

municipality in its recent history. The disaster experience has brought the issue of institutional capacity for flood risk management to the fore (Neaves, 2019).

4. Methodology

4.1 Research Approach

This research uses an interpretive case study methodology to provide insight into how institutional capacity influences flood risk management in the Tunapuna/Piarco municipality. Case study research facilitates intensive qualitative engagement when investigating complex phenomena within their contexts (Baxter and Jack, 2008). This case is based on an interpretive paradigm as it draws upon "the full spectrum of factual material and social construction" to elicit an understanding of social phenomena (Thorne, 2016:11). It employs a framework as a theoretical basis for explaining causal relationships in everyday lives (Yin, 2017).These relationships are best explained by the people who live them (Pile, 1991).

4.2 Case Selection and Sampling

i. Case Selection

The TPRC is of particular interest to the research topic as it was the most severely affected municipality in the 2018 flood disaster (OCHA, 2018). The research also focused on four localities within the purview of the TPRC which were disproportionately impacted by the floods: Greenvale, Ascort Gardens, Saint Helena and Kelly Village. Greenvale is a housing settlement which is partially managed by the Housing Development Corporation, an agency of the Ministry of Housing and Urban Development; in contrast, Ascort Gardens is a gated community. Gated communities have been found to appeal to upper-income and middle-income citizens in Trinidad and Tobago (Mycoo, 2006). Unlike the other localities, Saint Helena and Kelly Village experience annual floods. Participant engagement in these diverse localities provides alternative perspectives on institutional capacity and enhances the quality of the case study (Yin, 2017).

ii. Sampling

Research participants were selected using a non-probability purposive sampling technique. This involves the deliberate selection of research participants who are willing and able to share their knowledge and experiences (Tongco, 2007). Officials of the TPRC and the Office of Disaster Preparedness and Management (ODPM) who fulfil various functions in flood risk management were invited to participate in the study via telephone or email contact. With the exception of one individual who was unavailable during the time of the study, all the contacted officials were interviewed (see Appendix A).

Within the localities, disaster relief volunteers provided access to key research participants. Thus, they played the role of gatekeepers in this research (Cloke *et al*., 2004). A snowballing technique was then used to make subsequent contact with research participants of interest. The use of gatekeepers and snowballing can result in the narrow selection of like-minded participants (*ibid.*). However, participants shared diverse perspectives on their unique experiences, thus enriching the study. Specific attempts were made to interview persons with disabilities as there is a paucity of information on the experiences of persons with disabilities in the Caribbean region (Huggins, 2009) and in the wider disaster literature (Alexander, 2012).

4.3 Data Collection and Analysis

Data collection took place between May to July, 2019. Data sources and methods were triangulated to enhance the credibility of the research (Baxter *et al*., 1997). Semi-structured interviews were used to collect primary data from officials of the TPRC and residents of the municipality. Secondary data sources were also analysed.

A total number of seventeen residents and nine officials were interviewed. These interviews were approximately one hour in length and facilitated "close encounters" with participants (Davies *et al.,* 2002:351). The resident interviews elicited deep emotion as residents recounted their experiences during the flood disasters; some residents expressed fear and frustration, while others were moved to tears. The interviews allowed for a level of flexibility which would not have been possible with quantitative methods (Berg *et al*., 2004).

Four residents were interviewed via mobile phone due to their unavailability to be interviewed during the day. Telephone interviews may restrict interview length and rapport as researchers depend solely on verbal cues to pace interviews (Berg, 2001). In this case, residents were pleased to have the interviews conducted at their convenience and they willingly engaged in in-depth interviews.

All interviews, with the exception of one official interview were recorded, transcribed and coded to elicit new themes and ideas from the data (Cloke *et al.,* 2004). One official expressed her preference not to be recorded. While data may have been lost in this interview, extensive notes were taken and were found to be valuable to the research analysis.

Legislation, policies, plans, reports and newspaper articles pertaining to flood risk management in the Tunapuna/Piarco municipality were also analysed. They provided insight on the research context and useful background information which was corroborated and refuted during the interviews (Yanow, 1999).

4.4 Ethics, Limitations and Possible Bias

i. Ethics

The research followed the guidelines for low-risk research as outlined by the King's College London Research Ethics Committee. The consent of participants was sought and received prior to the interviews. In some cases, verbal consent was given as written consent was not feasible. For example, the consent of participants with visual and mobility impairments were recorded by audio. Research participants were also anonymised and quoted using field codes to protect their identities (see Appendix A).

ii. Limitations

Limitations with data collection were encountered in this research. One-on-one interviews were scheduled with the officials of the TPRC and residents. However, O3, O4, O5 and O6 expressed their preference to be interviewed simultaneously. Furthermore, R2 assisted his wife, R1 with recounting their family's flood experiences. In both cases, the interview dynamics were unplanned and the capacity to go in-depth with participants was commensurately less than in the one-on-one interviews (Cloke *et al*., 2004). Notwithstanding this, respondents appeared to be comfortable with

the interview structure; thus, they were candid and expressive throughout the discourse (Ritchie *et al*., 2013).

iii. Possible Bias

Scott (1990; cited in Cloke *et al*., 2004) suggests that accounts of social phenomenon are distorted by the standpoint of the researcher. Standpoint is nested in one's knowledge and experiences, which impact data interpretation (Madge *et al*., 1997). Attempts were made to reduce researcher bias which may have been formed through residency in Trinidad and volunteer work in flood disaster management. This was achieved by active listening, reflection and clarification of participants' contributions to the production of knowledge in this study (Davies *et al*., 2002).

5. Institutional design for Flood Risk Management

5.1 Governance Structure

The Ministry of Rural Development and Local Government (MORDLG) is responsible for disaster risk management at the regional level in Trinidad. There is a disaster management unit (DMU) within each regional corporation. This unit is headed by a Disaster Management Coordinator whose role is to mobilise resources for disaster preparedness and response (GORTT, 2008). He supervises one Communication Technician and two Field Officers who are attached to the unit. The Communication Technician is responsible for managing all radio communications within the municipality. The Field Officers are responsible for conducting outreach programmes, supporting preparedness and response activities and conducting damage assessments after flood events.

Within the MORDLG, there is a Chief Disaster Management Coordinator whose role is to support and coordinate the functions of the DMUs and all other stakeholders involved in disaster risk management at the local government level. He is assisted by a Communications Technician. The Chief Disaster Management Coordinator reports to the Minister of the MORDLG through the Deputy Permanent Secretary and Permanent Secretary.

The Disaster Management Coordinator reports both to the Chief Disaster Management Coordinator and the Chief Executive Officer of the Corporation. This is because the DMUs are

attached to the corporations, but are not part of their organisational structures. Rather, they are part of the MORDLG's organisational structure (see figure 4).

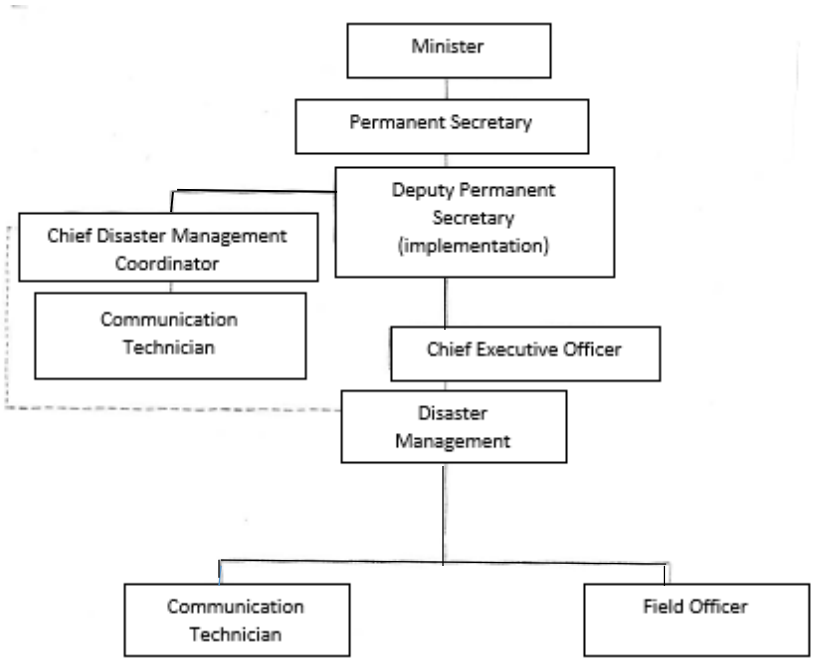


Figure 4. Governance Structure for Flood Risk Reduction at the Regional Level in Trinidad
Source: GORTT, 2008

5.2 Flood Risk Management Approach

There is a dissonance between the governance structure and the approach to flood risk management at the local government level in Trinidad. The TPRC follows an All Agencies approach to flood risk management (O2, O7). This mirrors the ODPM's All-Hazards, All-of-Government strategy which is used at the national level (ODPM, 2014). The staff of the TPRC DMU play a prominent role in disaster mitigation, preparedness, response and recovery. However, there are multiple actors within and external to the corporation who also play a role in flood risk management within the municipality. These actors belong to various agencies and they are governed by both the corporation and the central government. Table 2 (below) shows the various agencies involved in flood risk management with the Tunapuna/Piarco municipality.

Table 2. Agencies Involved in Flood Risk Management within The Tunapuna/ Piarco Municipality

Actors Involved in Flood Risk Management within The Tunapuna/ Piarco Municipality	
Mitigation	
Function	
Development and maintenance of infrastructure	Technical Department, TPRC; Ministry of Works and Transport (MOWT)
Building Inspection	Building Inspectorate Department, TPRC
Litter Law Enforcement	Public Health Department, TPRC
Drain Cleaning, Grass Cutting	Public Health Department, TPRC; Community-Based Environmental Protection and Enhancement Programme (CEPEP)
Selection and Maintenance of Shelters	ODPM, MORDLG, Ministry of Education (MOE), Ministry of Community Development Culture and the Arts (MOCDCA), Ministry of Housing and Urban Development (MOHUD), Ministry of Social Development and Family Services (MOSDFS), Non-governmental organisations (NGOs) Private Sector, MOWT
Dredging of Rivers	MOWT
Creation and Enforcement of Land Use Laws	Ministry of Planning and Development (MOPD)
Education and Community Outreach	TPRC DMU
Economic Development	TPRC (Economic Development Officer)
Preparedness	
Development and Implementation of Early Warning Systems	TPRC DMU, ODPM, Trinidad and Tobago Meteorological Service (TTMS)
Mobilisation of Vehicles for response	Transport Yard, TPRC
Evacuation	TPRC Council, DMU, Municipal Police, Trinidad and Tobago Police Service (TTPS), Trinidad and Tobago Fire Service (TTFS)
Designation of Shelters	TPRC DMU
Response	
Activation of Emergency Operations Centre	TPRC DMU
Rescue	TTFS, Municipal Police, TTPS, Trinidad and Tobago Defence Force (TTDF)
Shelter Management	Shelter Managers
Recovery	
Damage Assessment	TPRC DMU
Compensation	Ministry of Social Development and Family Services (MOSDFS)
Reconstruction	MOTW

Source: Author's Compilation (Data compiled from interviews; ODPM, 2013b; TPRC 2019)

5.3 Legal and Regulatory Framework

The Disaster Measures Act Chapter 16:50 (Act 47 of 1978), the Municipal Corporations Act Chapter 25:04 (Act 21 of 1990) and Cabinet Minute Number 1347 of May 23, 2008 are the primary legal authorities governing flood risk management at the local government level in Trinidad and Tobago. However, flood risk management is considered to be spread across several pieces of subsidiary legislation since these laws define the roles of various disaster risk management actors (ODPM, 2014). The Tunapuna Regional Corporation Plan for Disaster Preparedness (2018-2019) is designed to implement these laws within the region.

5.3.1. Primary Legislative framework

i. The Disaster Measures Act (1978)

This act authorises the President of Trinidad and Tobago to proclaim that an area adversely impacted by a given hazard is a disaster area (Disaster Measures Act, 1978). It also outlines his power to take action and make orders to mitigate disaster risk with the disaster area.

ii. The Municipal Corporations Act (1990)

The Municipal Corporations Act outlines the responsibilities of the officers within the regional corporations. This plan makes no specific reference to disaster risk management. However, it authorises the functions of the corporation's officers which encompass disaster mitigation, preparedness, response and recovery.

iii. Cabinet Minute Number 1347

Cabinet Minute Number 1347 of May 23, 2008 is the legal authority for the overall disaster management structure within the MORDLG (GORTT, 2008). The Cabinet agreed by this minute to establish Disaster Management Units to correct the informal, "unstructured and haphazard" execution of disaster management at the local government level (GORTT, 2008: 2).

5.3.2 Subsidiary legislation

Subsidiary legislation outlines the functions of a wide range of actors who are involved in flood management at the regional level. These include the TTDF, Litter Wardens, and MOPD (see table 3).

Table 3. Subsidiary Legislation for Flood Risk Management within the Tunapuna/Piarco Municipality

Legislation	**Description**
Defence Act, Chapter 14:01, Act 7 of 1962	This act governs the functions of the TTDF and outlines its responsibility to provide protective services during a public emergency.
Litter Act, Chapter 30:52, Act 27 of 1973	Section 16B of this act authorises Litter Prevention wardens to take action to prevent littering in public places
Town and Country Planning Act of 1960	This act authorises the Town and Country Planning Division of the MOPD to approve land use development within regional corporations.

Sources: Author's Compilation from Defence Act (1962); Litter Act (1973); Town and Country Planning Act (1960)

5.3.3 The TPRC Plan for Disaster Preparedness (2018-2019)

The TPRC Plan for Disaster Preparedness states that the corporation is responsible for all phases of disaster risk management. However, the plan provides little details about the corporation's initiatives for disaster mitigation, preparedness and recovery. It provides the most details for response activities.

According to the TPRC plan, disaster mitigation and preparedness consist of "routine mitigation and preparedness activities conducted by the corporation staff and its Mitigation Planning Team" (TPRC, 2019: 17). It states that the Disaster Management Coordinator of the DMU is responsible

for coordinating early warning, shelter and evacuation. Early warning may include the use of loud hailers or door-to- door visits to warn residents of an impending disaster event.

Furthermore, the Disaster Management Coordinator is responsible for managing the corporation's emergency operations centre (EOC) during a disaster. Resources and personnel are mobilised for response from this location. According to the plan "there is no absolute standard" for coordinating disaster response (TPRC, 2019: 12). The Disaster Management Coordinator's role is to make suitable adjustments as the event unfolds. This may include requests for assistance from voluntary groups and other municipalities.

Lastly, a list of activities for recovery are outlined in the plan. The TPRC recovery activities are live-saving operations, restoration of essential services, completion of detailed damage assessments, identification and management of recovery and reconstruction projects and submission of damage assessment reports to the Ministry of Social Development and Family Services (TPRC, 2019).

The local government legislative framework situates flood risk management within both the MORDLG and the TPRC. Disaster management units have been established to execute mitigation, preparedness, response and recovery measures. However, due to the All Agencies approach, flood risk management is carried out by multiple regional and national actors and is regulated by several pieces of legislation. The TPRC plan for disaster preparedness exists to implement these laws throughout the four stages of the disaster management cycle. However, it places primary focus on measures for responding to disasters, which are considered to be emergencies.

6.Capacities and Practices for Flood Risk Management

Capacities and practices for flood risk management are influenced by societal characteristics. This section elucidates the TPRC's capacities and practices for deliberation, coordination, implementation and evaluation within the Tunapuna/Piarco municipality.

6.1 Deliberation

The TPRC engages in deliberation at the mitigation stage of the disaster management cycle. This is facilitated by stakeholder meetings and public outreach programmes. Representatives of the

agencies that are involved in flood risk management meet regularly to review and discuss their respective roles; however, there is no public representation at these meetings (O7, O2). When asked about how the public is engaged, O7 noted that Field Officers use tools such as PowerPoint presentations to sensitise the public on flood risks. These presentations are done at schools and at locations that the wider community can access (O7). He further expressed that outreach is done with the hope that residents will work together to implement what they have been taught in the event of a disaster (O7).

Residents of the study areas were asked about their participation in the TPRC's outreach programmes. None of the participants were aware of these programmes. When asked about her interaction with the Field Officer for her area R1 of St. Helena stated, "I dunno [don't know] we have one; this is information". Residents were also asked about resident-led initiatives in their localities. At the time of the interviews there were no ongoing initiatives in any of the study areas.

6.2 Coordination

The four stages of flood risk management are not coordinated at the macro-scale within the TPRC or MORDLG. Each agency, department and unit coordinates their activities and liaises with other actors when necessary. Cross-scalar coordination between national and regional authorities involved in structural risk management measures, land use planning and rehabilitation measures is limited as there is no mechanism in place for such interactions. However, the TPRC's disaster preparedness plan provides a framework for the Disaster Management Coordinator within the DMU to mobilise resources for preparedness and response.

The TPRC's Disaster Management Coordinator rarely manages warning, evacuation and shelter and response as outlined in the preparedness plan (O2). Residents of Kelly Village and Saint Helena experience floods on an annual basis and have developed preparation and response capacities of their own. For example, R1 stated that she expects her home in Saint Helena to be flooded during the rainy season. As such, after days of inclement weather she and her husband usually act like "water police" who check the ravine behind their house on an hourly basis (R1). Once the water in the ravine reaches a certain level the house is flooded to a height of approximately five inches. In anticipation of this, they usually safeguard household items by placing them on concrete blocks and they remain indoors until the flood waters recede. The TPRC

depends on capacities such as these for flood disaster preparedness and response within the municipality.

However, the 2018 flood disaster exceeded the preparation and response capacities of the Saint Helena and Kelly Village participants. In both study areas, residents described their efforts to place items at higher levels within their houses. However, they eventually abandoned these activities and their homes as the flood waters rose to heights of approximately six to eight feet (R1, R3, R5, R6). In contrast, in Ascort Gardens and Greenvale there were little or no coordination activities for preparedness or response as floods were rare in these areas. For example, R9 of Greenvale stated that he was aware of the national weather forecast and flood alerts, but he took no pre-emptive measures as he did not expect his home to flood. This flood event required the full coordination capacities of both authorities and the residents of the region. However, the TPRC did not anticipate a flood disaster of such magnitude; they depended on usual public capacity and this proved to be insufficient. The lack of coordination during the preparedness phase impacted negatively upon the implementation of response measures.

6.3 Implementation

The TPRC places the greatest emphasis on implementing flood response as there is an urgent need to safeguard life and property at this stage of the disaster cycle (O9). The TPRC staff believes that their greatest capacity for flood risk management lies in rescue and other critical activities executed during a flood event and in its aftermath (O2, O5, O9). This is measured by the fact that no lives were lost in the 2018 flood disaster and few lives have been lost in previous disasters (O9). Notwithstanding this, the 2018 floods elucidated significant shortfalls in the implementation of response measures.

Multiple actors implemented disaster response. Officers of the Municipal Police Service, TTPS, Regional Health Services, TTFS, TTDF and the Air Guard worked alongside the Disaster Coordinator at the TPRC's EOC (O7). Representatives of these organisations assessed the situation in the impacted areas and relayed information back to the EOC. As a result, these actors were able to execute rescue operations and provide resources for recovery in areas where there was urgent need (O7, O1).

However, response was delayed for over twenty-four hours in some areas as the TPRC did not have appropriate and adequate resources to rescue flood victims (R1, R4, O6). Fire trucks were dispatched for rescue, but were forced to turn back en route as the roads were impassable. The corporation did not have the dinghies which were essential for search and rescue; these were only obtained after the floods (O1, O2, O6). Informal actors filled the gaps created by the corporation's lack of resources. While residents formed a "human chain" to assist each other with getting to safer locations in Greenvale, (R9, R10); in Kelly Village and Ascort Gardens residents were rescued by private boat owners (R7, R14).

6.4 Evaluation

At present there is no overall mechanism for evaluating flood risk management within the Tunapuna and Piarco regions (O2, O9). Evaluations are carried out at various scales and they may not necessarily include an assessment of how operations influence flood risk reduction (O2, O9). The DMU places the greatest emphasis on evaluating flood disaster response. According to O7, after each disaster event debriefings are held to assess the corporation's strengths and weaknesses with regard to response. However, the debriefings facilitate general learning and may not engender strategic changes (O2).

In contrast, there are no mechanisms for measuring outreach programmes. During the discussion on evaluation of outreach programmes, O7 noted:

> I don't think we have any yardstick to measure, we just hope…we may go to an environment where we have a number of people, either you do PowerPoint presentations or you verbalise your presentation …we can only share, at the end of the day it comes down to the endeavours of the community.

While, the TPRC staff highlighted some evaluation measures, discussions elucidated the fact that the TPRC's capacity for transformative evaluation is weak as there are no institutional mechanisms in place for evaluation.

The TPRC's does not have institutional mechanisms in place for extensive deliberation, coordination of mitigation and recovery measures and evaluation. Its policies outline measures for mobilising resources to prepare and respond to disasters. Furthermore, the TPRC officials believe

that their strongest capacity is found in disaster response. However, informal capacities for preparedness and response within the municipality have been institutionalised and they have been critical to effective flood risk reduction over the years. The 2018 flood overwhelmed informal coordination capacities and elucidated the incapacities of the TPRC. These incapacities influenced population risk to the 2018 floods.

7. Influence of Institutionalised Incapacities on Flood Disaster Risks

Institutional incapacities generate and modify flood risks. They exist not because of an absence of institutions, but rather, due to poor design and inefficient practices which preclude the achievement of substantive goals (Manuta *et al*., 2006). This study assessed the extent to which the TPRC's institutional incapacities caused or increased social risk to the 2018 flood disaster in the Tunapuna /Piarco region of Trinidad. This section presents an analysis of the causal relationships between institutional incapacity and the three risk factors: hazard, exposure and vulnerability.

7.1 The Flood Hazard

The flood hazard was a significant determinant of social loss and distress due to its magnitude and intensity. In its report on the hazard, the Trinidad and Tobago Meteorological Organisation (TTMS) described the deluge as the "Mother of All Floods" (Baig, 2018). This is because its hydraulic characteristics and concomitant destructive impacts surpassed all modern day floods in Trinidad and Tobago (*ibid*.). The flood was a rainstorm-generated flood which was caused by an active intertropical convergence zone[1] (ITCZ); this resulted in prolonged periods of rain and thunderstorm activity over the island from October 17 to 19, 2018 (CCRIF, 2018; Baig, 2018). The Piarco weather station recorded its highest three-day rainfall total of 250.2 mm since the commencement of record keeping in 1946 (Baig, 2018). This exceeded the average monthly rainfall of 234 mm during the wet season in Trinidad (TTMS, 2018).

Some research participants believed that the 2018 flood disaster was inevitable due to the hazard characteristics. O1 opined that all agencies had played their roles in disaster mitigation and preparedness, and it was the magnitude of rainfall which caused the floods. R17 of Ascort Gardens

[1] The ITCZ is a zone in the equatorial region where the trade winds of the northern and southern hemispheres converge. This convergence causes intense convective activity which generates thunderstorms.

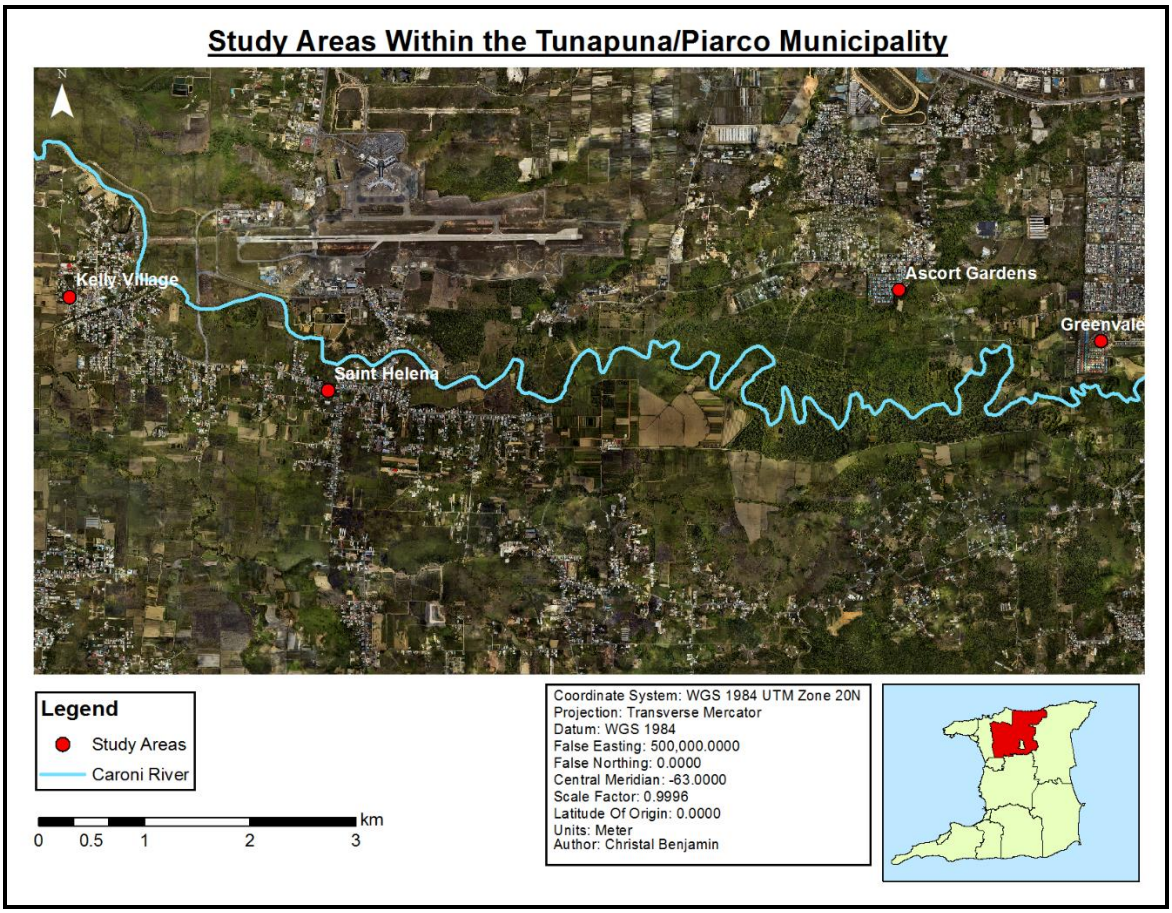
also expressed that there was nothing that anyone could have done to prevent this disaster as it was a "natural disaster". These views reflect the hazard paradigm which situates disaster risk in nature and is uncritical of the anthropic factors which generate risk (O'Keefe *et al.*, 1976).

The flood hazard was generated by both natural and anthropic factors. The rainfall event may have been reflective of changing rainstorm characteristics in Trinidad and Tobago due to climate change (ODPM, 2013a; TTMS, 2019). These events are expected to cause more extensive flooding on the islands as seen in 2018 (TTMS, 2019). However, the construction of houses along the Caroni flood plains has increased surface run-off and peak discharge in the river basin (Brookhuis and Hein, 2016; TTMS, 2019). This has resulted in more extensive flooding in the Tunapuna/Piarco municipality (*ibid.*).

The TPRC's incapacity to enforce land use planning laws in the region results in unsustainable land development on the Caroni flood plains. According to O2, there are several private developers within the municipality who have infilled plots of land which previously served as catchment areas for flood waters. He explained that this results in a greater concentration of water flowing into the Caroni, thus contributing to flooding in areas such as Greenvale (O2). When asked about the TPRC's power to intercept these developers, he stated that they were given "high authority" (O2). While the TPRC had no control over the rainfall characteristics, deficiencies in land use planning led to the modification of the flood hazard. This also increased the risks associated with population exposure.

7.2 Population Exposure

Research participants of the Tunapuna and Piarco regions were exposed to the 2018 floods as they all live on the Caroni flood plains (see Map 2).



Map 2. Study Areas
Source: Author's Own (created within ArcMap using data from Open Street Maps and ESRI)

In every study area, residents expressed that their housing location was a primary factor which contributed to their flood risk (R1, R2, R7, R12, R14). Residents of Saint Helena, Kelly Village and Ascort Gardens were all aware of this risk factor prior to the floods; most of them had experienced floods of lesser magnitudes during their tenure in these areas. They opined that they had chosen to live in these locations as they had confidence in national and regional risk measures, and their own coping and adaptive capacities. On the contrary most research participants in Greenvale stated that they were not aware that they were exposed to flood risks. For example, R9 articulated that he had no idea that the area was flood-prone. He had placed his full trust in the government to provide him with safe housing. This was reiterated by R10.

Although the Greenvale housing settlement is located in the Tunapuna/Piarco region, the TPRC had no control over its development. This settlement was developed by the Housing Development

Corporation (HDC). The HDC applied to the Town and Country Planning Division of the MOPD for approval to construct houses in Greenvale in 2000 and 2009 (La Vende, 2019). In both instances approval was denied as the land was allocated for agricultural purposes and was subject to flooding (Alexander, 2019; Neaves, 2019; La Vende, 2019). However, prior to its application in 2009, the HDC had already begun construction of the houses which were completed by the time the Town and Country Division granted final permission in 2014 (*ibid*.). The vast expenditure of national resources on the land settlement was a critical factor which influenced the TCPD's decision to grant the HDC post-construction approval (Neaves, 2019). Residents of the settlement were incited when this was revealed in parliamentary discussions which took place after flood. They are currently seeking recompense from the HDC for their material losses, psychological distress and medical costs (La Vende, 2019).

The TPRC has limited capacity to enforce land use planning laws which can preclude the modification of flood hazards and population exposure. Land use planning is of paramount importance to hazard mitigation and policy-makers; planners have a duty to ensure that new disaster risks are avoided in the development of home settlements (Highfield *et al*., 2014). The TPRC is responsible for land development in the region; however, private developers can receive direct authority from central government for land development in the Caroni basin. In the case of the HDC, a public authority displayed patent disregard for land use legislation and operated in silos. These cases are evidence of poor cross-scalar interaction among agencies which is essential for managing flood risks (Manuta *et al*., 2006; Lebel *et al.*, 2010, Scolobig *et al.*, 2015). Inter-agency coordination can improve the efficiency of the TPRC's All Agencies approach to flood risk management.

7.3 Social Vulnerability

Vulnerability assessment is an essential part of holistic risk management (Cardona, 2013). In this study, interviews were used to elicit participants' perceptions of their vulnerabilities. This differs from other studies which use socio-demographic variables as proxies for vulnerability (Highfield *et al.,* 2014; Koks *et al*., 2015). Across all study areas, participants believed that a lack of social protection contributed significantly to their material losses in the 2018 floods. Differences in vulnerability and capacities were highlighted among study areas and individuals.

Most research participants believed that poor maintenance of drains and green spaces and the inconsistent dredging of rivers by authorities increased their susceptibility to the floods (R1, R7, R13). Greenvale was unique among the localities in that residents also thought that their lack of awareness, experience and preparedness contributed significantly to their vulnerability (R10, R9, R12).

Residents also believed that their lives were placed at risk due to the incapacity of the authorities to respond to their requests for rescue. However, none of these participants lost their lives as they were able to make precarious journeys through the flood waters to get to safer locations. Unlike these participants, R11 has a nerve disorder which limits his mobility. He contacted the coastguard but was told that their journey to his house would take three hours. He feared for his life when he recognised that the flood waters were rising rapidly; however, his neighbours came to his aid and saved his life (R11).

The elucidation of these vulnerabilities and capacities raises the question, "who is responsible?" (Lebel *et al*., 2013). During the interviews it became evident that many residents did not know who was responsible for flood mitigation and response in their localities. Many persons blamed the TPRC for inconsistent dredging of the rivers; however, this falls within the remit of the MOWT (MOWT, 2018). Furthermore, residents of Greenvale held the government responsible for their lack of awareness of flood risks. While government through the HDC was responsible for informing the residents about their risks to floods, this settlement also falls under the remit of the TPRC in regard to disaster educational awareness (O5). Participants also criticised the ODPM for poor flood response measures. However, the TPRC Disaster Management Coordinator has the primary responsibility for coordinating flood response within the region.

In contrast, several officials of the TPRC blamed the public for flood disasters. They opined that the public was largely responsible for their vulnerability to disaster due to lawless activity such as littering (O1, O7, O8). According, to O7:

> We clean, but as we turn our backs, the public continues to litter…a lot of what we experience in terms of disaster, in terms of flooding...is a result of our bad living…the government does not come to throw stuff in your watercourses, [it's] the people living in the area [who] do that.

The issue of culpability in disaster causation has been widely debated in the literature and in praxis. The public's limited understanding of the roles and responsibilities of risk managers, and the officials' assignment of blame to the public is reflective of "narrow deliberation", (Manuta *et al*., 2006) poor coordination and ineffective evaluation. Narrow deliberation occurs when risk managers view flood-hazards as natural events which require technical fixes; public participation is limited to the dissemination of information so that persons will be prepared and can adhere to emergency instructions when given (Manuta *et al*., 2006; Lavell and Maskrey, 2014). The interviews elicited these views within the corporation. Officials repeatedly mentioned that they use their outreach programmes to inform the public about risk so that they can take appropriate action; O6 lamented that the public rarely follows their instructions. Notwithstanding this, most residents in the study areas stated that they were not aware of any disaster outreach by the TPRC. As such, they had limited knowledge on the institutional measures for disaster risk management within the region.

Furthermore, the various actors who are involved in disaster mitigation, preparedness, response and recovery within the Tunapuna/Piarco region operate based on their departmental or organisational objectives as outlined in various legislative frameworks. There is little public accountability since each agency carries out internal evaluations. The TPRC's incapacity to coordinate and evaluate the functions of these agencies leads to gaps in the implementation of flood management measures. In the absence of public action, these gaps may have led to the loss of human life during the 2018 flood disaster. Coordination and evaluation of both formal and informal capacities can reduce social vulnerability to flood disaster in the Tunapuna/Piarco region.

Flood disaster risk is a function of hazard, exposure and vulnerability. In many circumstances it is impossible to modify a hazard; as such, risk managers place focus on managing exposure and vulnerability (Cardona, 2013). In the case of the 2018 flood disaster in Trinidad, the institutional incapacities of the TPRC modified the three risk factors.

8. Constraints and Opportunities for Institutional Capacity Building

Institutional capacity building is essential for managing hazards, exposure, vulnerability, and thus risk to disaster (Collymore, 2011; Scolobig *et al*., 2015; Christensen *et al*., 2016). Institutional inefficiencies, resource constraints and knowledge gaps present the TPRC with constraints for

capacity building. However, the process of local government reform present opportunities for addressing deficiencies. Critical reflection on these causal factors and concomitant praxis can build the corporation's capacities for deliberation, coordination, implementation and evaluation.

8.1 Constraints for Capacity Building

Officials of the TPRC believe that inefficient institutional design precludes effective coordination and implementation with regard to land use planning laws (O3, O4, O5, O9). The TPRC has overall responsibility for land development with the Tunapuna/Piarco municipality. However, the Town and County Planning Division (TCPD) of the MOPD receives and approves all land development applications. Applicants are then required to submit their approved documents to the TPRC for final approval. The Building Inspectorate of the TPRC must then ensure that applicants construct and maintain buildings according to the building codes. The process is complex and fragmented and provides little incentive for authorities to enforce laws (O9). Lebel *et al.* (2010: 48) refers to this as "bureaucratic separatism" and suggests that it produces gaps in implementation. In the case of the TPRC these gaps are exploited by both governmental authorities and the public, and there are unregulated state and private developments in the Tunapuna/Piarco municipality (O2).

Furthermore, limited human and financial resources limits the TPRC's ability to mitigate and respond to flood disaster. According to the TPRC DMU staff, it is challenging for the two field officers to fully implement public outreach programmes and execute damage assessment after floods due to the size and diversity of the municipality's population (O5, O6, O7, O2). The MORDLG is responsible for staffing of the DMU and this is standardised across all municipalities irrespective of their geographical area or population (O4). Thus, it is beyond the TPRC's capacity to address the issue of staffing constraints.

Additionally, the TPRC depends mainly on funding from the central government to execute its operations; it receives meagre income from rental fees and other miscellaneous services (MORDLG, 2016a). However, this is mostly insufficient and is manifest in constraints such as the TPRC's inability to purchase diesel for transportation and materials such as mattresses to assist residents with the recovery process (O6). Resource constraints have been identified as a major challenge for institutional capacity building (Manuta, 2006; Lebel *et al*., 2013). It impacts

negatively upon the ability of risk managers to provide security for citizens and thus, to reduce social vulnerability (Birkmann, 2013).

Lastly, insufficient analysis of the underlying causes of flood disaster limits the corporation's ability to build formal and informal capacities for flood risk management. O9 noted that the corporation directs most of its efforts to response where there is an urgent need to safeguard life and property. This is because there has been insufficient research on the root causes of flood risk within the municipality which could validate the use of funds in other areas (O9). However, there is a broad consensus in the disaster literature that expenditure on disaster response greatly exceeds investments in (Walker *et al.*, 2005; Altay *et al.*, 2013; Shreve and Kelman, 2014). There may be a need for more contextual research; however, much has been written about the causal relationship between unsustainable development practices such as poor land use planning and flood risk in Trinidad and Tobago (Shrivastava, 2003; Brookhuis and Hein, 2016). While these studies are acknowledged in theory, there is a lack of political will to execute the "forensic analysis" which is required to address these issues (Lavell and Maskrey 2014:19). This is because there is more political reward for responding to disaster than for reducing intangible risks (O2).

8.2 Opportunities for Capacity Building

The process of local government reform presents the TPRC with opportunities for reducing institutional deficiencies, improving resource management and addressing knowledge gaps. The Miscellaneous Provisions (Local Government Reform Bill), 2019, an act to amend the Municipal Corporation's Act (1990) is currently being reviewed by a Joint Select Committee of the Trinidad and Tobago Parliament (TTP, 2019). This bill proposes greater devolution of power from the central government to the local government. Municipal corporations will have greater control over land use planning and resource management and structures will be established for public engagement (MORDLG, 2016a). These changes can facilitate the strengthening of the TPRC's deliberation, coordination implementation and evaluation capacities.

The local government reform draft policy proposes the establishment of a Spatial and Planning Building Inspectorate within the regional corporations. It would be responsible for developing spatial plans, undertaking land use planning and enforcing land use laws within the municipality. A key function would also be to collaborate with various stakeholders involved in land use

decisions including government authorities, private developers and local organisations (MORDLG, 2016a). The establishment of a Spatial and Building Inspectorate can increase the TPRC's capacity for cross-scalar coordination and reduce institutional inefficiencies. This can lead to greater effectiveness in the implementation of land use laws and a reduction in the risks associated with flood hazard and exposure (Scolobig *et al*., 2015). However, the success of this structural adjustment is contingent upon changes in the value systems of risk managers, state authorities and the public to reflect "equity and sustainability" (Lavell and Maskrey, 2014: 8). In the absence of this, the lawless approach to land use may remain unchanged and flood risks could continue to increase.

Furthermore, the local government reform draft policy proposes a restructuring of the corporation's staffing and financial structures (MORDLG, 2016a). Disaster management units will be transferred from the MORDLG to the corporations. This will give them more control over staff allocations for this unit. The enactment of legislation will also authorise corporations to collect property tax; and thus, increase their income. Additionally, a newly established internal audit committee will be responsible for collaborating with the audit department of the Ministry of Finance to review local government expenditure. More control over human and financial resources can increase the TPRC's capacity to implement risk reduction measures such as public outreach programmes. Evaluation can also promote greater transparency and more strategic use of resources (Lebel *et al*., 2013).

Notwithstanding these possibilities, a critical approach to decentralisation is essential (Blackburn, 2014). Questions should be raised about the central government's decision to maintain low staff numbers at the corporations; furthermore, an interrogation of the TPRC's decision to prioritise funding in some areas, whilst neglecting others is important. Greater devolution of power to local authorities may not result in more effective implementation if national and local actors place little value on mitigating flood risks. Greater dialogue between local authorities and the public can provide opportunities for this type of reflection.

The local government reform draft policy proposes that corporations should host forums to engage the public in decision-making apropos spatial planning, land use developments and budgetary expenditures. Deliberation can provide opportunities for authorities and the public to discuss the underlying causes of disaster risk and explore formal and informal capacities for addressing these

risks. Lebel *et al*. (2010) posit that deliberation is critical in light of alterations to flood regimes, which are projected to take place due to climate change. Wider engagement which is inclusive of vulnerable groups is important for monitoring flood regimes, negotiating protection and compensation and sharing strategies for adaptation where it becomes necessary (*ibid.*). Participation should be pursued with a critical lens which allow methods to be tailored to the municipality's context (Titz *et al*., 2018). Evaluation of this process is also essential so that it does not result in a shift of the flood risk management burdens to the public (Manuta *et al*., 2006; Lebel *et al*., 2010).

Effective flood risk management is contingent upon capacity building to address the dynamic factors which generate risk. Institutional design, resource management and knowledge gaps present the TPRC with constraints for capacity building. However, the process of local government reform provides opportunities for the TPRC to address deficiencies and build formal and informal capacities. While changes in institutional design provide the frameworks for capacity building, changes in value systems and an in-depth understanding of the root causes of flood disaster are essential for transformative change.

9. Applicability of the Institutional Capacity Framework to the Tunapuna/Piarco Context

This study employed the institutional capacity framework after Lebel *et al* (2013) as a scaffold for exploring capacities for deliberation, implementation, coordination and evaluation within the Tunapuna/Piarco municipality. It was applied with a critical understanding of the fact that frameworks may be used to elucidate key issues in a social context while concealing others (Anfara and Mertz, 2014). The framework served as a valuable tool for understanding institutional capacity and highlighting deficiencies in institutional design and practices within the TPRC. However, it could not be used to fully account for the complexities of flood risk management within the municipality. The study proposes a framework which is considered to be more applicable to the Tunapuna/Piarco context.

To some extent, the institutional capacity framework is applicable to flood risk management at the regional level in Trinidad and Tobago. Legislation, policies and plans of the TPRC highlight the importance of coordination and implementation capacities in flood risk management (TPRC,

2019). Mechanisms for public dialogue and evaluation are not explicit in the current institutional design of the TPRC. However, the draft local government reform policy proposes mechanisms for enhancing these capacities, thus validating their importance. Furthermore, disaster risk management at the regional level in Trinidad is built around the conceptual model of a disaster risk cycle as proposed by the institutional capacity framework. Thus, the framework was a useful guide for conducting document analysis.

The framework was also a useful tool for initiating conversation with the research participants. During the interviews, the TPRC officials highlighted the extant gaps between their legislative frameworks and practices. They also expounded on the institutional incapacities which produced these gaps and modified social risks. This was useful not only for meeting the research objective, but also for prompting critical reflection by the officials (O6). The explanations, questions and anecdotes of the research participants also generated new ideas on the interplay between formal and informal capacities at the regional level in Trinidad. The framework was a valuable instrument for meeting the research objectives and for the co-production of knowledge in the research context (Walsham, 1995; Davies *et al*., 2002; Wisner *et al*., 2012).

While the framework was used to elucidate the TPRC's capacities and incapacities, it could not be used to account for amorphous nature of floods and flood risk management within the municipality. The framework is oriented towards the view that authorities initiate disaster risk management by employing a structured approach from one stage of the disaster cycle to the next. In contrast there are multiple formal and informal actors involved in disaster risk management at the regional level. The 2018 floods revealed that informal actors play a significant role in initiating response and directing the interventions of the authorities. Furthermore, the various stages of disaster risk management are not well defined as portrayed in the framework. For example, activities such as the cleaning of roads and dredging of rivers are carried out by both regional and national actors. They may be executed to mitigate disasters, accelerate the recovery process or at times they are considered to be the normal operations of the relevant agencies (O2, O6). As such they may not be clearly delineated and evaluated as a mitigation or recovery measure as suggested by the framework.

Furthermore, while the capacities of authorities are critical during a flood disaster, it is important to note that its chaotic nature may not facilitate a linear approach to deliberation, coordination, implementation and evaluation as suggested by the framework. Constant iteration of these functions may be required for success in disaster response. The framework could not be used to fully capture these dynamics in flood risk response.

The Conceptual Model for Flood Risk Assessment (see figure 8) proposes a revised conceptual model for assessing institutional capacities for comprehensive risk management in the Tunapuna/Piarco context.

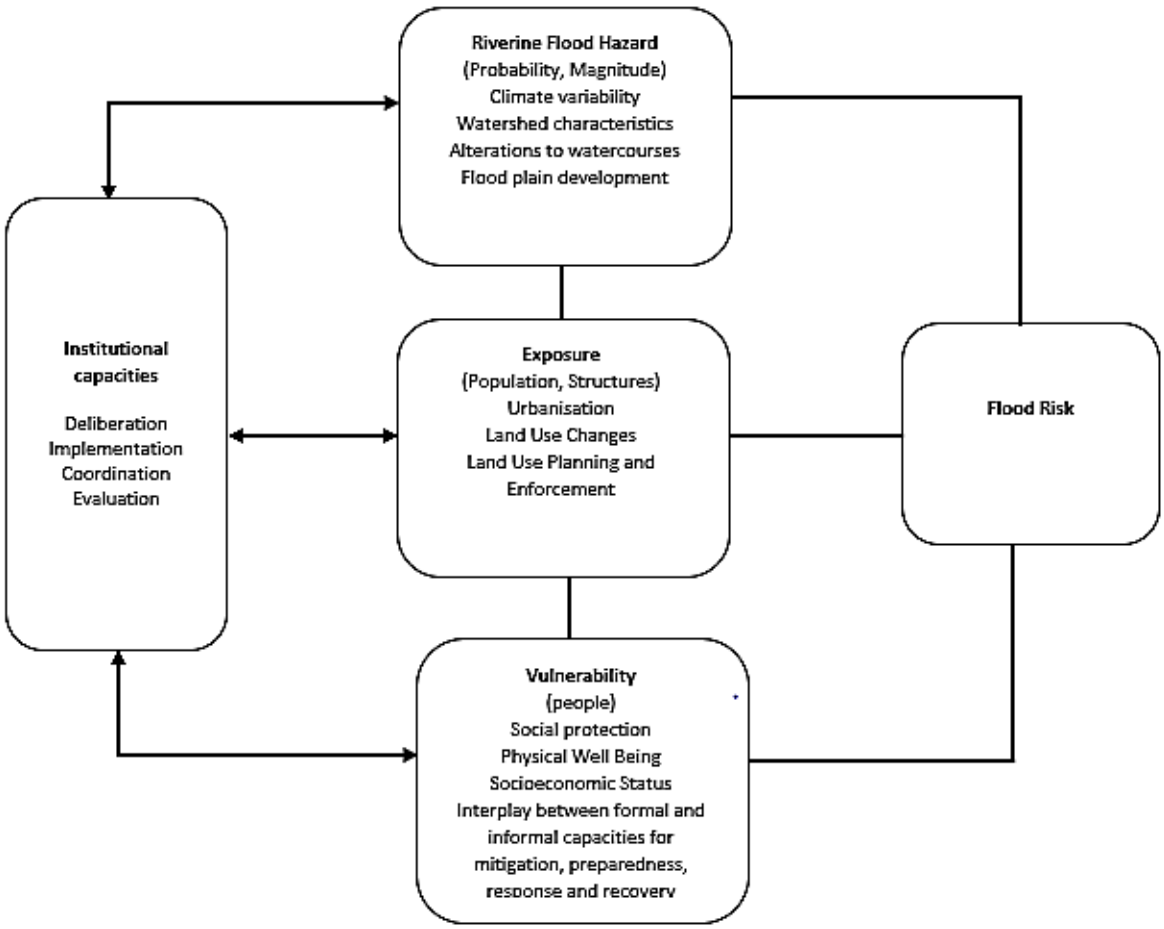


Figure 5. Conceptual Model for Assessing Institutional Capacity to Mange Flood Risk

Source: Author's Own

The model suggests that institutional capacity for deliberation, implementation, coordination and evaluation modify the three risk factors: riverine flood hazard, exposure and vulnerability. This

can be better understood by examining the causal relationship between institutional capacities and the drivers of risk such as climate variability, land use changes and physical wellbeing. Institutional capacity modifies these factors; however, these factors also influence institutional capacity. For example, institutional capacities can lead to vulnerability reduction if there in an effective interplay between formal and informal capacities. This in turn, strengthens institutional capacities for flood risk management.

The conceptual model is not built around the disaster management cycle. Rather, it encompasses the underlying factors in everyday living which give rise to disaster risk (Wisner *et al.*, 2004; Cardona, 2013; Lavell and Maskrey, 2014). Notwithstanding this, the framework incorporates these four stages into vulnerability assessment. The Tunapuna/Piarco municipality faces annual floods, which may increase in magnitude due to climate change (ODPM, 2013a). Addressing the underlying causes of disaster is imperative. To some extent, this is contingent upon transformative change in the TPRC's institutional design and in the values of both formal and informal actors within the municipality. A more integrative approach to disaster risk management must be juxtaposed with capacity building for disaster mitigation, preparedness, response and recovery. This will facilitate the management of extant and future risks to floods.

10. Conclusion

The study employed the institutional capacity framework after Lebel *et al*. (2013) to investigate the causal relationship between institutional capacity and flood risk within the Tunapuna/Piarco municipality in Trinidad. The findings reveal that the TPRC has the strongest capacity to implement flood response measures. The interplay between the TPRC's capacities and informal capacities of residents within and external to the municipality precluded the loss of life in the 2018 floods. This confirms Ahrens and Rudolph's (2006) claim that formal and informal capacities are interdependent and critical for disaster risk reduction. The study also assessed the extent to which the incapacities of the TPRC modified risk to social vulnerability. This is necessary for improving the quality of formal risk governance measures, and thus reducing risk (Birkmann, 2013).

The institutional incapacities of the TPRC are reflective of weaknesses in its institutional design. The TPRC's disaster preparedness plan promulgates an All Agencies approach to flood mitigation, preparedness, coordination and response. However, the plan focuses mostly on measures for

disaster response which are regarded as emergencies. This reflects the hazard paradigm advanced by Burton *et al*., (1968) among others and has resulted in an underdevelopment of capacities for comprehensive flood risk management.

While the TPRC engages in deliberation, this is "narrow", limited to the transfer of information to the public (Manuta, *et al*., 2006: 20). It is also incomplete due to the TPRC's inability to engage the entire municipality. This modified social vulnerability in the 2018 floods evident by the Greenvale residents' lack of awareness of their flood risk. Furthermore, coordination among the multiple actors involved in flood risk management such as those involved in land use planning has not been institutionalised. This foments poor enforcement of land use planning laws and land use development in hazard-prone areas which modify flood hazards and generate population exposure to flood hazards. Poor coordination also leads to gaps in implementation of structural mitigation measures and response measures. In the absence of informal capacities these deficiencies in social protection could have resulted in mortalities, particularly of those who were less able to manage their risks to floods. The absence of evaluative measures presents challenges for measuring social learning and reducing social risk to flood disasters (Krausmann and Mushtaq, 2006).

The study also found that bureaucratic structures, limits in resources and knowledge gaps are key constraints for capacity building. However, the process of local government reform provides opportunities for addressing the corporation's deficiencies. Greater effectiveness in flood risk management is contingent upon a critical approach to this process. It must not be seen as a panacea for managing flood risk (Titz *et al*., 2018). Rather, the links between institutional deficiencies, unlawful practices and underlying values and morals of key actors must be understood to achieve transformational change (Lavell and Maskrey, 2014). The institutional capacity framework was a useful tool for prompting such reflection.

The institutional capacity framework was a useful guide for exploring the institutional capacities and incapacities of the TPRC through document analysis and interviews. However, it could not be used to fully reflect the complexities of disaster risk management within the Tunapuna/Piarco municipality. The Conceptual Model for Assessing Institutional Capacity to Manage Flood Risk proposed in this research is considered to be applicable to the research context.

The literature proposes a move away from the response centric approach to flood response and a greater focus on integrating risk management with development (Lavell and Maskrey, 2014; UNISDR, 2015). While this is necessary for achieving sustainable development, the study notes that this process may prove to be challenging for developing countries such as Trinidad and Tobago due to present social, economic and institutional constraints which present challenges for addressing the risks which are inherent to development. At present, flood disaster seems to be inevitable due to the geographical construction of risk. Takeuchi (2009) suggests that in contexts such as these building capacity for early forecasting and preparedness is essential. The study suggests that an integrative approach to flood risk management should be juxtaposed with measures for disaster preparedness, response and recovery. It is important to strengthen institutional capacities to manage both current and future flood risks.

The revised framework which is proposed in this study can be used to assess the impact of institutional capacity at the national government level in Trinidad and Tobago. It may also be applicable to Caribbean countries such as Saint Lucia, Antigua and Jamaica given the similarities in the underlying causes of risks, similarities in risk management approaches and the urgent need for institutional capacity building (CDEMA, 2014). The Conceptual Model for Assessing Institutional Capacity to Manage Flood Risk can be used as a scaffold to investigate capacities and generate new ideas for flood risk management in these contexts.

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Appendix A: List of Respondents

Resident Interviews		
Respondent Code	**Specific Characteristics**	**Study Area**
R1	Female	Saint Helena
R2	Male	Saint Helena
R3	Female	Saint Helena
R4	Female	Saint Helena
R5	Male	Saint Helena
R6	Male	Kelly Village
R7	Female-Visual Impairment	Kelly Village
R8	Male	Kelly Village
R9	Male	Greenvale
R10	Female	Greenvale
R11	Male-Mobility Impairment	Greenvale
R12	Female	Greenvale
R13	Male	Ascort Gardens
R14	Female	Ascort Gardens
R15	Female	Ascort Gardens
R16	Male	Ascort Gardens
R17	Female	Ascort Gardens

Official Interviews	
Code	**Organisation**
O1	Office of Disaster Preparedness and Management
O2	Tunapuna/Piarco Regional Corporation-Disaster Management Unit
O3	Tunapuna/Piarco Regional Corporation-Disaster Management Unit
O4	Tunapuna/Piarco Regional Corporation-Disaster Management Unit
O5	Tunapuna/Piarco Regional Corporation-Disaster Management Unit
O6	Tunapuna/Piarco Regional Corporation-Disaster Management Unit
O7	Tunapuna/Piarco Regional Corporation-Disaster Management Unit
O8	Tunapuna/Piarco Regional Corporation-Administration
O9	Tunapuna/Piarco Regional Corporation-Economic Development