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ABSTRACT

The Caribbean's susceptibility to natural disasters was reinforced after the multi-hazard impact of the 2017 hurricane season. Multiple disasters have caused severe physical, social, and economic loss in the region since the Caribbean's disaster susceptibility encompasses more than physical exposure. These susceptibilities, however, have not translated into heightened disaster data collection or risk assessments. The fact is that the region currently lacks a standardized methodology to assess risk. In response to this absence, the 'Caribbean Risk Information Tool' (CRIT) was developed by the International Federation of Red Cross and Red Crescent Societies. Since assessing risk is a key aspect to increase resilience, this study seeks to investigate the usefulness of this community-based risk information tool, within the Caribbean context. The paper accordingly aims to examine the role of community-based and local-level approaches using a small island developing state case study. The present results are significant in at least three major respects. From the information collected through the CRIT in the Sangre Grande regional corporation, it was possible to identify the peak months of disasters, the hazards with the highest impact in the regional corporation, the most susceptible communities, the communities that are in immediate danger or crisis, as well as the natural and man-made triggers of the most impactful disasters. The continuous collection of this qualitative data hopes to, therefore, consistently inform mitigation and resilience strategies in the Caribbean

Keywords: Community-Based, Risk Assessment, Disaster Risk Perceptions, Small Island Developing State.

1.0 INTRODUCTION

The Caribbean is subjected to multiple hazards including hurricanes, floods, landslides, earthquakes, storm surges, coastal erosion and volcanoes which possess the potential to significantly stunt growth and development in the region on a social, economic, physical, and environmental level **[14]**. After the 2017 hurricane season where Hurricane Irma and Maria caused severe physical, social, and economic damage to Dominica, the British Virgin Islands, and Barbuda, the need for further enhancement of disaster resilience in the built environment was reinforced. Islands in the Caribbean are highly susceptible due to their exposure to a wide variety of hazards as well as other socio-geographical factors that dampen their ability to mitigate against and recover from disasters **[19]**.

For instance, these islands are typically small in size with mountainous terrain, which results in a significant percentage of the population settling in highly vulnerable coastal areas or building settlements on

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hazardous steep hillsides. Their spatial location and the warm waters in the Atlantic Basin also create a favourable environment for the formation of tropical cyclones. With the ever-present threat of climate change causing rising sea levels and temperatures, there is evidence to support that there will be an increase in frequency, duration, and variability of the islands' weather events **[27]**. In addition to weather events, the region is subjected to tectonic activity such as subduction occurring at the boundaries of the Caribbean and North American plates, which makes the region also vulnerable to volcanic and earthquake activity **[10]**.

In addition, to these physical and environmental shortcomings, there are also social and economic issues that increase vulnerability within the region **[31, 27]**. The volatile economies, large public debts, little to no cohesiveness amongst institutions, and inadequate disaster resilience legal frameworks of Caribbean countries, pose major problems within the region that have the potential to significantly impact pre and post-disaster recovery operations **[30]**. Therefore, to reduce the level of risk in the region, a holistic approach to disaster management that combines the main tenets of preparedness, mitigation, response, and recovery, while strengthening the region's capacity is critical to increasing resilience and coping capacity **[17]**.

For effective disaster management, the first step in the process is risk identification, which is undertaken through Disaster Risk Assessments and Risk Analysis **[21]**. Risk is a function of exposure and vulnerability consequences, and therefore these risk assessments use suitable and relevant indicators as a means of assessing existing levels of risk **[5]**. Identification of risks allows for the implementation of suitable mitigation and response strategies that can aid in the prevention and reduction of the impacts of natural disasters **[5]**.

Throughout the Caribbean, there is evidence to support that there is an absence of a standard methodology to assess risk within the region **[31]**. Therefore, to overcome this absence the Office of Disaster Preparedness and Management (ODPM) of Trinidad and Tobago, in conjunction with the Caribbean Disaster Emergency Management Agency (CDEMA), has considered using the Caribbean Risk Information Tool (CRIT) assess risk. For this reason, the CRIT, a Semi-Quantitative Risk Assessment tool, was designed and developed by the International Federation of Red Cross and Red Crescent Societies and the CDEMA Caribbean Disaster Emergency Management Agency. Previous iterations of the tool encompassed a smaller number of data collection components. These were tested in Jamaica, Mexico, and India. However, it was deemed necessary to include additional components to facilitate the collection of more robust data for local disaster resilience decision-makers.

The CRIT, a Semi-Quantitative Risk Assessment tool, aims to utilize local communities' perceptions and experiences on disasters, vulnerability, and risk to identify local disaster susceptibilities; to identify community-based social vulnerabilities that require immediate intervention and development; and finally, to have an information-based decision-making process that will prioritize local disaster preparedness, mitigation, and response strategies in order to reduce disaster risk.

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This study, therefore, seeks to examine the suitability and application of CRIT using a Caribbean case study. The paper accordingly aims to determine if the previously listed aims and approaches can be achieved in the Caribbean context. This is needed due to the increased intensity, frequency, and types of disasters being faced by local communities in the Caribbean. Most studies analysing the Caribbean tend to focus on the region's heightened fragilities and vulnerabilities. Few studies mention the Caribbean's lack of disaster data. The absence of regional and national risk assessment methods and disaster loss databases that are standardised, sustainable, continuous, publicly accessible, and quality assured supports the need for more disaster risk assessments grounded in a Caribbean lens. While existing Caribbean databases satisfy one or more of these characteristics, very few achieve all. As articulated by De Groeve **[9]**, disaster data collection coupled with national disaster loss databases, establish a historical baseline from which disaster impacts can be measured **[9]**. Therefore, the collection of disaster impact data has a critical role in measuring the success or failure of existing disaster risk reduction initiatives in the Caribbean.

In the absence of such quantitative data collection efforts, the collection of local qualitative data becomes a meaningful and necessary initiative in every data deficient disaster vulnerable society. The collection of local qualitative data also represents the shift from the former myopic routine of disaster response to proactive risk identification and mitigation strategies **[1]**. Moreover, the involvement of communities in qualitative data collection realigns risk resilience strategies from the top-down approach, where communities solely seek the provision of risk resilience strategies and disaster rescue, to the bottom-up approach where communities are made aware of their own risk. They, consequently, drive, implement, and maintain their disaster resilience initiatives **[34]**. The collection of community-based disaster data will also assist in the transparent allocation of resources as well as reduce the duplication of efforts by multiple DRR stakeholders. Thus, for disaster risk resilience to be effective, it is critical to involve locals in the initial stages since their involvement not only affords substantial forms of disaster information that is otherwise absent, but also, the involvement of locals encourages the fulfilment and continuation of the risk resilience efforts **[33]**.

2.0 DEVELOPING COMMUNITY DISASTER RESILIENCE

One common factor that keeps resurfacing in international and regional frameworks for disaster management is the necessity of incorporating the community into each stage of the planning process **[28, 29]**. Community-Based Disaster Risk Management (CBDRM) sometimes used interchangeably with Local Level Disaster Risk Management (LLDRM), is a method of incorporating grassroots or localised knowledge of the existing social, economic, and environmental circumstances in the community, regarding vulnerability and risk **[16]**. It is a humanistic approach to the disaster management process that includes the layperson in the entire risk management cycle from preparation to recovery and rehabilitation. CBDRM has become necessary as risk, hazard, and vulnerability are space and place dependent. Additionally, there is significant spatial and temporal variation in the impact of

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disasters. Consequently, for disaster response and recovery to be successful, it is critical to involve locals in the assessment stage. They provide the most substantial forms of qualitative information as these are the persons that live in and experience hazardous conditions and are well aware of the existing shortcomings **[2, 18]**. This information can be applied to tailor and create suitable and sustainable disaster management strategies while building the capacity within the area of concern **[30]**.

The concept of CBDRM gained traction mobility internationally during the 1990 International Decade for Natural Disaster Reduction, and further emphasis was placed on the concept via the use of the 2005-2015 Hyogo Framework for Action. The Hyogo Framework placed special emphasis on building the resilience of nations and communities through the incorporation of stakeholders at all levels, as well as the promotion of a culture of disaster resilience **[27]**. This concept was used with a Caribbean focus and on a regional scale, in the comprehensive disaster management (CDM) strategy contributed by CDEMA. As such their fourth CDM strategy outcome states, "Strengthened and sustained capacity for a culture of safety and community resilience in Participating States" **[7]**.

The initial step in CBDRM requires accurate disaster risk and vulnerability assessments. These types of assessments are one of the components that can be used to help improve the coping capacity of the area of concern **[7]**. When carrying out these disaster risk assessments there must be suitable and relevant indicators present that can provide a comprehensive overview of the level of vulnerability and risk present in a community **[4]**. These indicators can typically be divided into broad groups, which are Ecological, Economical, Social, Institutional, Infrastructural, and Community Competence **[8]**. Beccari **[3]** provided a more in-depth list of indicators that included but were not limited to Governance, Education, Health, Information and Communication, and Coping Capacity. Persons' response to these indicators would be dependent upon their perception of current risks. The collection of risk perception data, a qualitative form of data collection, typically depends upon individual awareness, social status, economic standing, and levels of immunity.

In Thailand, CBDRM qualitative data collection methods, such as focus groups and participatory observation techniques, were used to study existing flood risk in flood-prone communities, as well as to collect community-risk management solutions **[23]**. Similarly, Chinese case studies also employ a qualitative scoring system in their CBDRM assessments **[34]**. Their scoring system assessment methodology was used to increase public awareness of disaster prevention and to implement the standardization of disaster development strategies. Thus far, these Chinese CBDRM methodologies have produced policies that document standards on national comprehensive disaster reduction demonstration communities. This has resulted in improved overall disaster development processes in risk mitigation, emergency preparedness, response, and recovery. The CBDRM data collection process, therefore, facilitated significant improvements in China's coping capacity **[33]**.

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3.0 RATIONALE OF RESEARCH AND STUDY AREAS

In comparison to the Thailand and Chinese case studies, Trinidad also requires improved disaster risk resilience development processes at the community level [25]. In Trinidad, regional corporations are first-level administrative boundaries that encompass multiple relatively high-density urban areas and low-density communities. For this reason, CRIT was applied and tested in a regional corporation of Trinidad and Tobago. Moving forward, it expected that the disaster management units of each regional corporation will have the responsibility to implement the use of the CRIT in Trinidad. Due to the community-based nature of the tool, and the existing community networks and relationships between the disaster management units of the regional corporations and the communities, resources are readily available to implement the tool at this level.

The Sangre Grande regional corporation was selected for this study. Four main factors governed the study area selection process. The most critical of these was the availability and willingness of local community participants and the local disaster unit of the regional corporation. Also, as the hazard profile will support, this regional corporation experiences a high frequency and a wide variety of hazards.

Despite Trinidad's high disaster susceptibility, declaring disaster zones are rare occurrences that are reserved for the most severe disasters. In the past ten years, only two regional corporations have declared their regions as disaster zones. Sangre Grande is one of these two regional corporations. Its high exposure to a broad range of high intensity and frequent hazards such as floods, landslides, earthquakes, coastal erosion, high winds, storm surge, and forest fire emphasises the need for disaster risk resilience efforts in this regional corporation.

Furthermore, the Sangre Grande regional corporation currently lacks high-resolution hazard, vulnerability, or risk maps that delineate the areas susceptible to hazards. Hazard and risk map aid in spatially demarcating the intensity, scope, and probability of hazard events. More than ten years ago, national-level flood and landslide hazards, as well as landslide risk maps, were designed and developed. Since then, the urban landscape, road densities, drainage density, and rainfall patterns have altered. Therefore, more updates are required to support decision making.

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4.0 HAZARD PROFILE OF STUDY AREA

The regional corporation of Sangre Grande is situated to the north-east of Trinidad. Figure 1 displays this municipality. It is 927 square kilometres (km^2) in area, represents 18% of Trinidad's total land space. Its relatively large landscape, with 41 communities and 5.7% of the national population lends to the rural and semi-rural character of the municipality. The population is evenly distributed with a female population of 49% and a corresponding male population of 51% (CSO 2013). There is generally a youthful population since 57% of the municipality's populace is under the age of 35 years, of which 25% are under the age of 15years **[6]**.

Within the last two census periods, the area has experienced a 36.6% increase in the number of households, and by extension the numbers of persons in the area **[6]**. The youthful population explains this recent growth in the Sangre Grande municipality. Despite these increases, the 41 communities are rural and semi-rural. The municipality, however, has the third-lowest household income per capita per annum in the country. The local fisheries are the main source of livelihood for the Sangre Grande municipality.

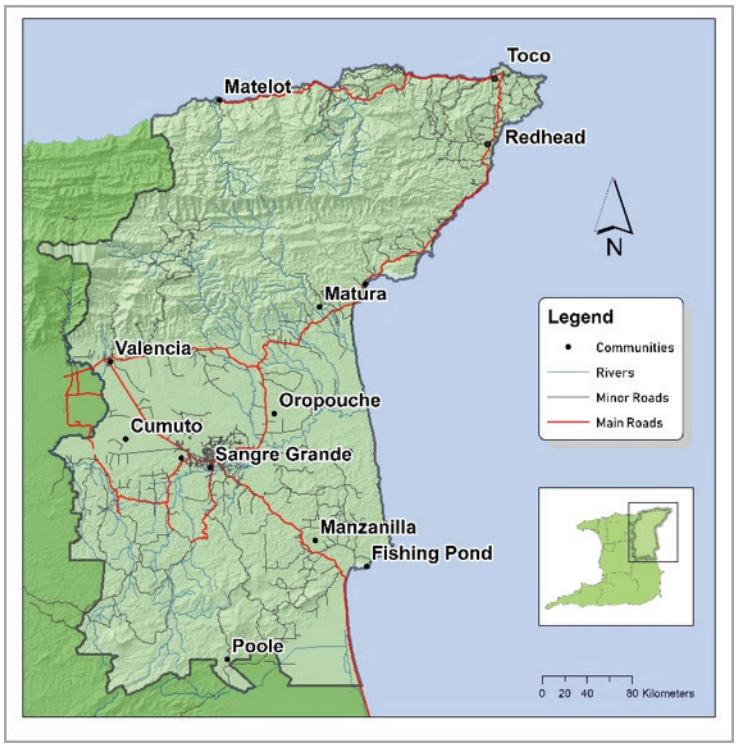

Figure. 1 *Map of Study Area, Sangre Grande Corporation, Trinidad.*

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As shown in Figure 1, the 927 km^2 of the municipality includes 101 km^2 of coastline, which is 24% of Trinidad's coastline. It follows that geographically, it is the largest administrative region in Trinidad and Tobago. This geography of the municipality also highlights the region's hazards susceptibility.

Sangre Grande Regional Corporation is subjected to a variety of hazards, which include but are not limited to floods, landslides, coastal erosion, and strong winds. However, these hazards vary spatially and temporally throughout the municipality due to factors such as seasonal changes, topography, proximity to the coast, infrastructure, and population density.

The Oropuche community of the Sangre Grande Regional Corporation has a history of being impacted by flooding. These floods typically occur during the period October to December such as, the flood of October 2017 that affected over 80 families and resulted in the loss of livestock, when the Oropuche River burst its banks. According to an article published in the local newspapers, the Chairman of the Sangre Grande Regional Corporation identified unplanned settlements via squatters and developers who constructed buildings in natural drainage networks and as a result, became some of the main contributors to the flooding event **[24]**.

The Toco Fishing Pond, another community located within the Sangre Grande regional corporation is impacted by a multitude of hazards including, mainly flooding, landslides, and strong winds. These hazards also typically occur from October to December. In November of 2010, 2013, 2014, and 2016 residents of the region were frequently impacted by the flooding that resulted in persons being trapped and displaced from their residences. In November of 2013 in particular, homes were not only flooded but also, housing material, livestock, and appliances were lost and damaged after two days of flooding **[25]**.

Landslides in the region typically result in erosion and blockage of roadways, with homes and bridges being destroyed. As a result, these landslides also result in communities being marooned due to impassable roadways. In December of 2011, a 67-year-old man lost his life when debris fell on his home resulting in it caving in and trapping him. During the same hazard event, a 68-year-old woman was also displaced as her home was affected by mud and debris **[22]**. Strong winds have also caused roofs to be blown off and trees being blown over. **[26]**.

Participants of the exercise indicated that the Sangre Grande community, which is located within the boundaries of Sangre Grande municipality, has also been subjected to flooding, fires, and crime. Flooding, similar to the rest of the region, occurs mostly during October, November, and December. This flooding is typically a result of heavy rainfall, poor drainage, and the river overflowing its banks. This leads to devastation, as residents' homes and the surrounding areas are flooded, endangering residents and livestock. Sangre Grande is also vulnerable to storms and hurricanes that cause severe damage even without direct impact. This occurred during the passage of outer bands from Tropical Storm Bret, which resulted in a roof being blown off and trees being torn down in the region.

The Manzanilla coastal community of the Sangre Grande Regional Corporation is mainly subjected to coastal flooding, however, due to its proximity to the coast, it is also highly vulnerable to strong winds and the passing of tropical disturbances. This coastal flooding typically makes roadways impassable and cuts off access to communities within the area. During intense weather events such as in November 2014, flooding and storm surges can and did cause significant erosion of the roadway, the collapse of homes, and significant agricultural losses that cost approximately $20 million TT dollars **[11]**.

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5.0 THE CRIT

Group interviews have evolved into a well-known, and widely used technique for the collection of qualitative data **[15]**. They are used to examine people's perceptions, experiences, feelings, and ideas about a topic. Through in-depth group discussions, the goal is to reach a consensus for each question among all the participants. When the group dynamics are successful, participants work with the researcher to explore and clarify pertinent issues that are familiar to them. The volunteer sampling was used in this research. Thereby encouraging participation from a wide range of contributors, particularly those who are usually reluctant to conduct one-on-one interviews **[15]**.

It should, however, be noted that it is not possible to implement the CRIT within any study area without the buy-in from local disaster managers or community members. At times, it is difficult to obtain community as well as technocrat buy-in to undertake such data collection exercises. Though wider communities stand to gain from the assessment of local hazards and risk, more often than not, it is difficult to translate the importance of such studies to persons who do not foresee a tangible economic, social or environmental benefit to enhance their everyday lives.

For the application of CRIT in Sangre Grande, there was the buy-in from local disaster managers who encouraged residents of this community to partake in this exercise. Due to these advantages, a focus group was used to obtain qualitative risk information for the CRIT. The focus group consisted of 26 persons who volunteered to partake in the research. 21 persons were residents of the Sangre Grande region, 5 persons were technical staff working with the Sangre Grande Regional Corporation. The technical staff, who were predominantly male, included the Chief Executive Officer Chairman of the corporation, the Senior Disaster Management Coordinator, and the Disaster Management Coordinator. In total there were 10 males present at the focus group. Also, 70% of the focus group was over the age of 40 years old. Although it was not an ideal situation for both technocrats and community members to partake in exercise at the same time, both parties indicated that there was a level of comfort between the two parties that facilitated the completion of this task.

All the employees of the Sangre Grande regional corporation that participated in the CRIT exercise have held their position at that regional corporation for at least five years, and for some, more than ten years. These employees have traversed the study area for many years, observing the geographical landscape and the people who live there while the regional corporation was at the peak of disasters as well as days that preceded and followed the disasters. Additionally, the residents who participated in the exercise resided in that regional corporation for more than thirty years. Each of the participants has seen the Sangre Grande regional corporation evolve into Trinidad's largest geographical regional corporation with 41 communities. As expressed by the participants, some of them are older than a few of the communities that currently exist in the Sangre Grande regional corporation. As a result, they possess in-depth knowledge and experience on the following:

- The magnitude and impact of past disasters in the study area.
- The physical, social, and environmental impacts of past disasters in the study area.
- Existing mitigation, preparedness, and risk reduction strategies in the study area and surrounding areas.

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It is therefore assumed that the data to be collected is a true spatial representation of the current geographic and social environment.

The CRIT guided the exercise through a combination of open-ended and scaled close-ended questions, which the participants answered. Consensus between the technical staff and residents of the study area was necessary before the respective answers were inserted into the CRIT workbook. It should be noted that, in most instances, a consensus was easily attained between both parties.

The CRIT worksheet is divided into four main sections. These four sections are Hazards, Vulnerability, Child-Centered Vulnerability, and Capacity under which there were a series of sub-sections. For example, as shown in Table 1, the Hazards section was further subdivided into Natural and Man-Made Hazards sub-sections.

Table 1: *Showing the Sub-Sections of the Natural and Man-Made Hazards Categories of CRIT*

Type of Hazard	Component	Subcomponent
Natural	Hydro-meteorlogical	Hurricanes
		Floods
		Droughts
		Severe Storms
		Extreme Temperatures
		Hailstorms
	Geological	Strong Winds
		Earthquake
		Landslides
		Tsunamis
		Volcanic Eruption
Man-made	CBRNE	Explosions
		HAZMAT Spills
		Fires
		Gas Leaks
		Radioactive Emissions
	Health/ Ecological	Intoxication
		Poisoning
		Epidemics
		Plagues
		Air Pollution
		Water Pollution
		Soil Contamination
		Extinction of Flora and Fauana
	Other	Civil Unrest
		Crime/Homicidal Rates

Under Natural Hazards, the first component assessed was Hydro-meteorological hazards with the subcomponents Hurricanes, Floods, Droughts, Severe Storms, Extreme Temperatures, and Hail Storms. Under the Geological component of Natural Hazards, the subcomponents addressed were Earthquakes, Landslides, Tsunamis, Strong Winds, and Volcanic Eruptions. Under the Man-Made section, the first component was the Chemical, Biological, Radiological, Nuclear and Explosives (CBRNE), under which the subcomponents were Explosions, HAZMAT Spills, Fires, Gas Leaks, and Radioactive Emissions. The second component was Health/Ecological under which the subcomponents were Intoxication, Poisoning, Epidemics, Plagues, Air

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Pollution, Water Pollution, Soil Contamination, and Extinction of Flora and Fauna. The last component under Man-Made was Other, and the subcomponents under this were Civil Unrest and Crime/Homicidal Rates. In each of these components, participants were asked to provide a rating of frequency, severity, and scale. The ranked range of frequency, scale, and severity responses are listed in Table 2.

These scaled close-ended questions aid in qualitatively identifying and ranking the relevant hazards, the frequency of hazards, and the scale of the impacts. When the responses are combined, they are quantified and calibrated into one statistical risk score for each hazard. To demonstrate how this was all incorporated for a flood hazard, suppose the participants provide the responses of "occurs every year" with regards to the frequency subcomponent, "affects less than half the population" with regards to scale subcomponent, and "some deaths, injury, or major public health" with

Table 2: *Showing the Predefined Response Options for the Frequency, Scale, and Severity Categories*

Frequency	Scale	Severity	Respective Score
Occurs every year	Affects all of the population	Catastrophic death, injury, or public health	10
Occurs most years	Affects most of the population	Some deaths, injury, or public health	8
Occurs once or twice a year	Affects less than half of the population	Few deaths, injury or public health	6
Has occured but a long time ago	Affects small groups of houses	Minor injuries only; OR minor damage/losses	4
Has never occurred but could occur	Affects individual houses	No impact on humans OR damage to infrastructure	2
Not applicable	Nothing affected	Not applicable	0

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regards to the severity subcomponent, the respective individual scores will be 10, 6, and 8. Since each score has the same weighting, the overall risk score for flood would be 7.83. Conversely, if for the drought hazard, the participants provide the responses of "occurs most years" with regards to the frequency subcomponent, "affects all of the population" with regards to scale subcomponent, and "minor injuries only or minor damages" with regards to the severity subcomponent, the respective individual scores will be 8, 10, and 4. The overall risk score for drought would then be 6.84. From these scores, it can be concluded that in the Sangre Grande regional corporation, floods hazards are more severe than droughts.

The second section in the CRIT, displayed in Table 3, was Vulnerability, where there were six sub-sections. These were Ecological, Economic, Functional, Non-Structural, Structural, and Social. Under these sections, a variety of components were assessed through various indicators that were listed in the tool. For example, the ecological vulnerability component sought to assess the existence of municipal land-use policy or plan. Participants were asked to indicate whether the plans or policies were "enforced", "enacted only existed in draft form", or "did not exist". Once again, the response from this scaled close-ended question was quantified into a numerical score for this vulnerability indicator. The "no laws or policy" response resulted in an ecological vulnerability score of 10 whereas the "enforced policy" resulted in a score of 1.

Table 3: *Showing the Sub-Sections of the Vulnerability Categories of the CRIT*

Type of Vulnerability	Vulnerability Component
Ecological	Land Use
Economic	Employment Levels
Functional	Planning Arrangements
	Availability of Resources
Non-Structural	Legal Instruments
	Protection for Properties and Livelihoods
Structural	Infrastructure
Social	Gender Ratio
	Social Services
	Education
	Health
	Water and Sanitation
	Security
Child Centred Vulnerability	Education
	Health

The last section of the tool was Capacity. This section assessed how effective existing disaster management strategies are in this study area. It was divided into Institutional and Operational capacities, and then further subdivided into Governance, Comprehensive Disaster Management, Operational Resources, Operational Personnel, and Early Warning Systems. For example, the early warning system component is a subcomponent of the operational capacity component. The EWS has one question. This scaled open-ended question provides the participant with five different levels of existing comprehensive early warning systems, from which one should be chosen. The first option, "the existence of a multi-hazard early warning system" yields a risk score of 1, whereas, the absence of an early warning system yields a score of 10. Thus, the more comprehensive the EWS, the lower the risk score. As with the previous sections, the response of each participant is converted to a quantifiable score.

Table 4: *Showing the Sub-Sections of the Vulnerability Categories of the CRIT*

Type of Capacity	Vulnerability Capacity
Institutional	Governance
	Comprehensive Disaster Management
Operational	Operational Resources
	Operational Personnel
	Early Warning System (EWS)

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The introduction of the quantifiable scores for each of the Hazard, Vulnerability, and Capacity components, as well as the various sub-components, facilitates the identification of the most frequent hazards, the intensities of the hazards, and the most severe hazards. Moreover, the CRIT classifies and singles out the most socially and economically vulnerable in the community. Finally, yet importantly, deficiencies in operational and institutional capacities are also individually pinpointed. The tool also details the strengths and effective approaches used in the community.

The presence of this information, if undertaken for multiple communities, aids in the identification of the most at-risk communities, the selection of disaster risk reduction initiatives, in assessing the efficacy of existing disaster management systems, and in the reduction of redundant risk reduction efforts.

6.0 THE APPLICATION OF CRIT

The participants were asked to identify which hazards impacted the study area along with the frequency, scale, and severity of each hazard. The scores shared by local participants were inputted into the CRIT worksheet.

The Risk was ranked on a scale from 1 to 10 for each section of the tool, where the higher the score highlighted, the higher the level of risk. Thus, a score of 9 or more corresponds to a 'very high' risk, scores between 6 and 8 correspond to a 'high' risk, scores between 4 and 6 correspond to a 'moderate' risk, scores between 2 and 4 correspond to a 'low' risk, and scores between 0 and 2 correspond to a 'very low' risk. The scores, outputs, and information collected were then utilised to determine the level of risk that exists within the Sangre Grande Regional Corporation.

7.0 CRIT RESULTS

The data collected using the CRIT from the focus group participants in the Sangre Grande municipality is presented and discussed in the following sections.

7.1 NATURAL HAZARDS

The first component assessed using the CRIT was Natural Hazards. This was subdivided into hydro-meteorological and geological hazards. Under this section, for the hazards identified, frequency, score, and severity were assessed on a combined risk scale of 1 to 10. As shown in Figure 2, based upon the response of the members of the focus group the consensus for this component was that the Sangre Grande Regional Corporation was most at-risk for landslides, with a total score of 8, a high-risk rating. This was as a result of the landslides that were certain to occur every year, affecting the entire region of Sangre Grande, and thus having the potential to result in injury and death. Floods, extreme temperatures, and earthquakes all tied with a risk factor score of 7, a relatively high-risk rating. Flooding was believed to have a high frequency as it occurs annually, and has the potential to result in structural damage.

Other high ranked hazards included climatic hazards such as hurricanes, strong winds, and severe storms. Hurricanes and strong winds obtained a risk score of 4.58 and 6.84 respectively. Residents expressed that strong winds typically impacted the Toco area, in that they typically broke tree branches, which in turn dismantled electricity lines. Overall the natural hazard section generated a score of 6. Thus, despite the very-high and high-risk ratings of landslides, floods, and earthquakes, the low-risk ratings of the other natural hazards, reduced the overall risk ratings of Natural Hazards to a moderate score.

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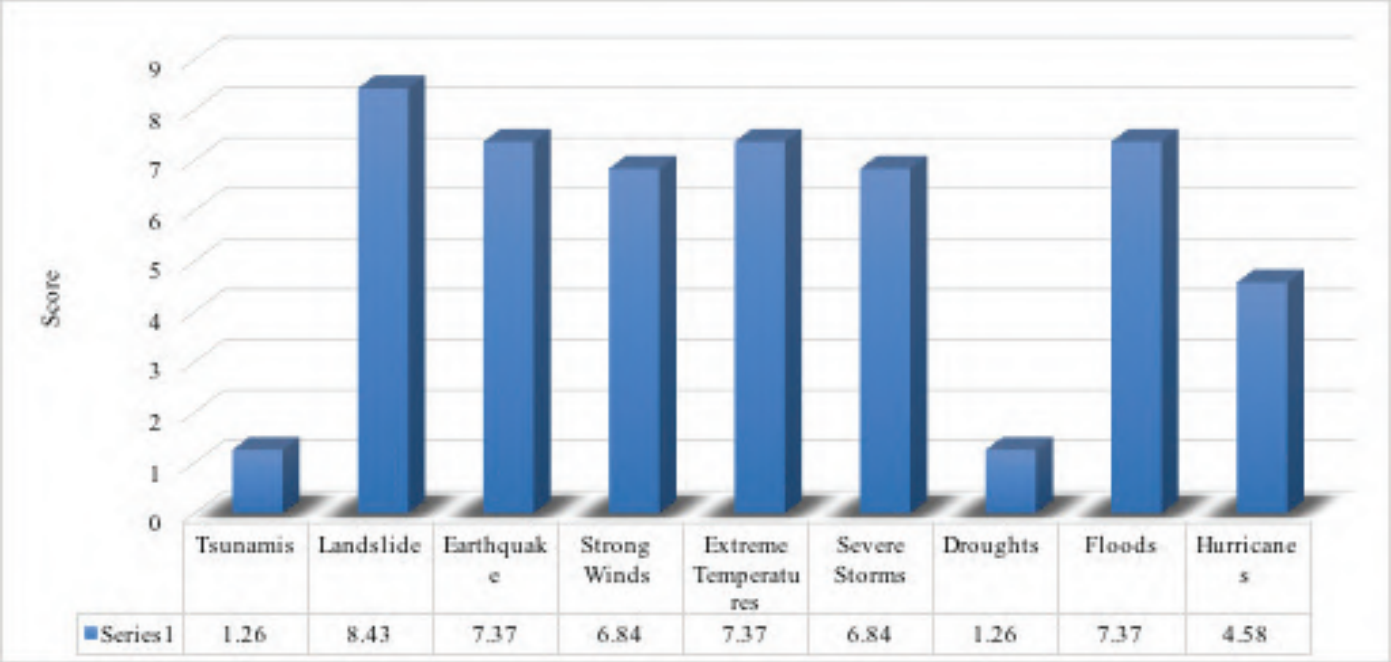

Figure 2: *Illustrating the Natural Hazards Risk Perception Scores in Sangre Grande*

One of the key areas of concern identified by the participants, as being highly vulnerable to flooding, was Vega de Oropuche, an agricultural-based community in the Sangre Grande Regional Corporation. Focus group participants also stated that the agriculture sector was impacted as crops displayed signs of wilting and animals suffered heat strokes during the drier months of the year.

For the earthquakes and their related impact, the members agreed that they occurred annually, affecting the entire region and that they could result in minor injury and loss. Additionally, the subcomponents that fell within the category of minimal risk were tsunamis and droughts with scores of 2, because although they have never occurred, the possibility of them occurring and producing a devastating impact still existed. Hailstorms and volcanic eruptions did not apply to the region of Sangre Grande and they were therefore given a score of zero.

7.2 MAN MADE HAZARD

This second component was divided into two sub-sections, which were CBRNE (Chemical, Biological, Radiological, Nuclear, and Explosives) and Health/Ecological. Under CBRNE the region was most vulnerable to Forest Fires, which received a score of 7, that is, a moderate risk rating. The members of the focus group stated that these fires occurred regularly, affecting most of the population and were typically set by homeless persons.

The most vulnerable areas to forest fires were the Vega de Oropuche and Tamana communities in the Sangre Grande Regional Corporation. Explosions and

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HAZMAT Spills, which obtained scores of 4.00 and 4.58 respectively, two low-risk ratings, have occurred in the past where a small portion of the population was impacted, and which resulted in minor injuries and damages to infrastructure.

Radioactive Emission attained a score of 1.26, a low-risk rating. This was because this hazard has never occurred, but there is the potential of it occurring in the future. Under the Health/Ecological Components based upon the responses, Intoxication, Poisoning, Epidemics, and Air and Water Pollution regularly occurred in the region, however Poisoning gained the highest score with 8.0, a high-risk rating. This was because there was a high potential for death via poisoning with animals such as fishes and dogs being particularly vulnerable. For Intoxication the residents stated that the population frequently indulges in drinking and smoking as a form of recreation, giving it a score of 7. Epidemics possessed the second-highest score with 7.83, a high-risk rating, as the residents believed that it was a major health issue especially with the occurrence of viruses such as Zika and Dengue. It was believed that they typically occurred as a result of the lack of maintenance of the environment.

Water Pollution possessed a score of 7, as it was certain to occur annually, affecting most of the population of the regional corporation and resulting in minor injuries. The participants stated that this pollution typically results in the eutrophication of ponds and the pollution of the river course due to the dumping of waste and silt from quarrying.

Air Pollution and Soil Contamination were also certain to occur and possessed scores of 7, a high-risk rating, and 4.31, a low-risk rating respectively. For the Extinction of Flora and Fauna, the members were not aware of this occurring however they did believe that fires had the potential to result in a loss of biodiversity along with the death and displacement of animals.

Regarding Crime and Unrest, the members became very enthusiastic to express their opinions about criminal activities in the region as well as potential solutions. It gained a score of 9 with the corresponding very high-risk rating because it was a regular occurrence and had the potential to result in major injury and death. The overall risk score for the Man-Made Hazard Section was 5.

7.3 VULNERABILITY

The Vulnerability section of the CRIT was divided into six components, namely, Ecological, Economic, Functional, Non-Structural, Structural, and Social.

Based upon the responses for the Ecological component, there are no known municipal and land-use policies in the Sangre Grande region and this resulted in a risk score of 10. Employment levels within the region were estimated to be at approximately 30% - 50% and this was given a score of 5. It was suggested that employment opportunities did exist however persons in the region were not interested in the available types of employment.

Under the Functional component, the residents stated that there are no known emergency plans or traffic plans for the Sangre Grande region. When asked about the availability of resources the members became very passionate and stated that there is limited access to resources for the community if a disaster is to occur. They also stated that there were issues of delivery and distribution, as these resources tend to arrive days after the event and not to those truly in need. These sub-components were given risk scores of 10 and 3 respectively.

For the Non-Structural component of the vulnerability section, the residents stated that they are unsure of laws related to planning in the community, while some

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highlighted the fact that there was government planning but no enforcement of the laws in the area. The members became passionate as well about this topic as they believed that there is no cohesion amongst state institutions. Also, because of financial cuts, institutions are not capable of funding enforcement. Furthermore, less than 25% of the residents possessed property insurance thereby resulting in a risk score of 5.

Social was the last component assessed under Vulnerability. When asked about the ratio of the employed person in the community, the members stated that the ratio was approximately greater than1:5 and this gained a score of 10. Laughingly, the participants responded to the question of social services, to which they stated that there were no existing social safety nets in the community. When discussing the percentage of the population that possessed a secondary level education, the participants all agreed that it was greater than or equal to 50%. They also stated that there are 15 functional clinics in the entire Sangre Grande Regional Corporation.

Under the subcomponent Water and Sanitation, when asked about the percentage of households that have access to potable water, those that rely on river water as the main source of potable water, those with available drinking water within a 30-minute walk, and the percentage of households that have basic sanitation facilities; the results were >50%, >20%, >50%, and >75%, respectively, with an overall score of 3. They stated that there were functional methods in place to dispose of waste from sanitation facilities in the community. However, they became very passionate as they expressed that the only dumping site in the region was Guanapo. When this dumping site is at maximum capacity, they are forced to take their refuse to the Beetham landfill, which is located 37 km away. Sometimes instead of doing this, they admitted to disposing of unwanted materials in nearby rivers, which in turn exacerbates the flooding hazards in the study area. Lastly, in this section under Security, the members rated the crime ratio as a medium. Overall this vulnerability section gained a score of 6.

7.4 CAPACITY

This section was divided into broad categories of Institutional and Operational Capacity. Under Institutional for the Governance component, the Level of Organisation possessed the highest level of risk with a score of 10. The question on Legal Framework was given a score of 10, due to the lack of existing natural hazard, and risk laws, and policies. Under the CDM component, the members stated that awareness was integrated into the work plan however the number of existing plans was unknown. The total risk score for Institutional Capacity was 6. For the Operational component, members were asked various questions based upon Information and communications technology (ICT) in the region. Based on the responses of the members, the proportion of individuals that use mobile telephones was approximately greater than 75%. It was also stated that approximately 50% of households have access to the Internet. The participants were asked their opinion on the proportion of households that possessed electricity, radio, and TV. The results obtained were >75%, 50%, and >75% respectively. The score obtained for this section of the CRIT was 8.36.

7.5 DISTRICT RISK SCORES

As seen in Figure 3, based on the results obtained from the participants of this assessment and the CRIT, the district Hazard profile score was 5.53, the District Vulnerability score was 5.59, and the District Capacity score was 6.93. Utilising the scores generated, based upon the responses for the various indicators, the tool calculated the overall District Risk Score for the Sangre Grande Region to be 5.98.

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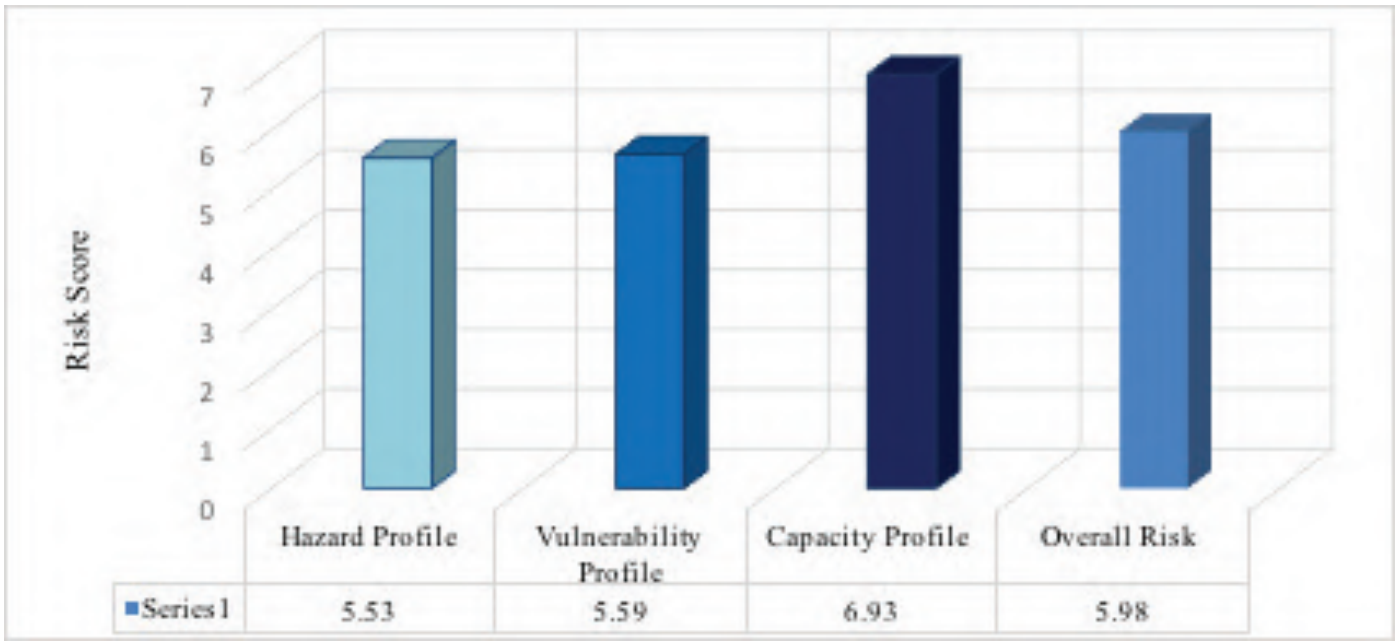

Figure 3: *District Risk Score for the Sangre Grande Regional Corporation*

8.0 DISCUSSION

Through the production of the hazard profile, correlated with the statements of the residents and results of the CRIT, it was observed that some areas within the Sangre Grande Region are repeatedly subjected to specific hydroclimatic and geo-hazards. October, November, and December were observed to be peak times for flooding and landslides. The hazard with the highest risk score was landslides and based upon the responses of the residents and assessment of the hazard profile, Toco was identified as the most vulnerable area.

There is also an abundance of landslide occurrences in Sangre Grande and Valencia. Overall landslides in this region typically occur due to heavy rainfall which results in saturated soil, combined with faulty drainage and unstable slopes. However, they may also be the result of man-made activities such as quarrying, debris littering, cutting into the hillside to create roads, and other urban land uses. Therefore, particularly in the Toco region, where the main route is one road in and out, the vulnerability of these persons was heavily highlighted through the use of the CRIT.

The CRIT also showed the devastating impacts associated with flooding in the study area. Moreover, the CRIT identified the most flood-prone communities in the Sangre Grande Regional Corporation. This acute level of susceptibility was attributed to poor drainage, and the presence of the Vega de Oropuche

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River, and its tributaries that run through the region. Based on information obtained from residents, severe storms and strong winds occur every year and affect the population in the study. Winds typically come as a result of tropical waves and cyclones. Cumana, Grand Riviere, Salybia Village, Matura, and Matelot have been identified as the areas most affected by strong winds. Storms are not a regular occurrence, however, there are numerous tropical disturbances and due to their proximity to the coast, the region is subjected to the out-lying storm bands passing near Trinidad.

The next major component assessed was Vulnerability; this can be influenced by several factors inclusive of, but not limited to, prior experiences, education, and perception of development. Within the assessment, Vulnerability was categorised into ecological, economic, functional, non-structural, structural, and social for analysis purposes. Currently, there are no implemented, well-known or publicized municipal plans or policies for the municipality of Sangre Grande. In contrast, there is a Sangre Grande Regional Municipality Draft Development Plan proposed for 2010-2020. There is also a National Spatial Development Strategy for Trinidad and Tobago. These plans, however, are only frameworks and their level of use is unknown. The lack of planning and policies dedicated specifically to the current issues in the region hinders future development in the region.

Contingency planning is a management tool that requires the input of the ODPM, CDEMA, government bodies, the Sangre Grande Regional Corporation, and the participation of civilians. This type of planning aims to, prepare an organization to respond to a disaster and its potential social impact. It is hoped that this information will be used to prepare, analyse, develop, implement, and review potential plans for the area. The absence of an endorsed contingency plan resulted in a risk score of 10, which poses a significant risk for the study area.

Another aspect of social vulnerability is the availability of local social safety nets. Social safety nets act as a means of promoting equitable development outcomes, by improving the country's social safety net programs through institutional reforms, capacity building, and improved monitoring and evaluation **[13]**. Based upon the response of the residents there are currently no existing social safety nets in the region; thereby, decreasing population resilience, and increasing population vulnerability, for the study area. In determining the nets needed for the municipality, factors such as community data, the competence of disaster management bodies, and previous policies and programs should be taken into consideration. The social safety net aims to offer a smooth transition from hazard to relief and recovery in the most vulnerable areas. It was recommended that the social safety nets be incorporated into the municipality plan and contingency plans because they are more effective when they are reinforced through planning systems.

The present results are significant in at least three major respects. From the information collected through the CRIT in the Sangre Grande Regional Corporation, it was possible to identify the peak months of disasters, the hazards with the highest impacts in the regional corporation, the most susceptible communities, the communities that are in immediate danger or crisis, as well as the natural and man-made triggers of the most impactful disasters. Moreover, the tools aided in qualitatively ascertaining the current disaster operational and disaster institutional capacity of this regional corporation. CRIT highlighted and documented the absence of social safety nets, disaster risk resilient policies, multi-hazard early warning systems, and the ad-hoc access to some operational pieces of equipment.

These findings, while preliminary, are critical to determining the most effective course of action, where several alternative disaster risk reduction possibilities exist. Therefore, the information collected and collated

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by CRIT assists in efficiently channelling risk reduction efforts to the most vulnerable communities. The qualitative ranking in the CRIT can help in communicating the basis on which resources are allocated to stakeholders, including communities, the reasons for selection or non-selection for support. It also supports the resolution of intervention type and length.

Finally, as previously mentioned, there was the participation of respondents that is, a combination of local residents and technical personnel of the Sangre Grande Regional Corporation provides. This implies the application of the bottom-up or community-based research which takes into account local people's perceptions and beliefs that are less visible through a top-down quantitative approach. This type of application creates an environment where stronger interpersonal ties between the regional corporation and the community are encouraged. The intra-personal ties in the community are also ripe with opportunities. Thus, having strong implications for both disaster research and policies since it may stimulate community-based protection measures that empower self-protective behaviour in that community.

9.0 LIMITATIONS OF CRIT

Despite these promising results, to develop a more comprehensive picture of disasters in study areas, it is important to address specific elements of the CRIT that require further development. One limitation of the CRIT is the absence of the disasters' spatial information. For example, a spatial aspect that facilities the mapping of hazards and past disasters by residents will aid in enhancing the quality of data acquired. Moreover, given that the data is collected from the members of the community, it follows that the collated data should be returned to the community. It is hoped that the awareness of disasters and vulnerabilities within the communities would support self-mitigating and community-based disaster resilience in the study area. The communities would now be aware of the limited institutional and operational capacities faced by local disaster management agencies. Therefore, encouraging self-protective and self-mitigating behaviour that is rooted in community-based disaster resilience.

Another possible element of development that will prove to be a fruitful area for future studies is the inclusion of questions that will stimulate mitigation, preparedness, response, and recovery strategies from residents. For this case study, technical experts led the CRIT exercise. In the future, the CRIT exercises should be community-led where yearly comparisons of the results will assist in evaluating the value and sustainability of implemented resilience strategies.

10.0 CONCLUSION

This study set out to examine the usefulness of CRIT within the Caribbean context. The paper accordingly aimed to analyse the role of community-based and local-level approaches using a Caribbean small island developing a state case study. The study found that the utilization of the community as the initial source of information for the Semi-Quantitative Risk Assessment provided a variety of useful results relating to levels of disaster risk, vulnerability, and resilience of the Sangre Grande Region. This information along with the compilation of secondary information on past hazards facilitated the provision of a holistic overview of the current relative disaster

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exposure, vulnerability, and resilience of the study area.

The hazard profile served to reinforce the results of the tool and the information gained from the participants of the focus group. Undertaking a risk analysis based on the information obtained would aid the development of interventions that would strengthen communities and in that way build resilience if the measures were successful.

The CRIT tool facilitated the identification and ranking of potential hazards that can affect the study area, as well as assisted in ascertaining the causative factors of disasters in the study area. Additionally, the tool, with the guidance of the participants aided in establishing the most vulnerable regional corporation in the country along with pinpointing the weaknesses in the existing mitigation and preparedness strategies.

The continuous collection of this qualitative data serves to inform consistent risk assessment, and mitigation strategies, which should be developed. It is hoped that the CRIT data collection process is iterative. This suggested since informed disaster risk decision-making is especially necessary in the changing global environment due to climate change. Overall the CRIT is capable of providing a useful comparison amongst study areas across different regions. Thus, allowing the allocation of scores with relative identification of risk, disaster susceptibility, and social vulnerability that is, at that time, already grounded in local knowledge and experience.

The information gathered can also be used to manage available disaster management resources within the community. Not only will resources be channelled away from the low-risk communities to the more vulnerable who are severely impacted by disasters but the required resources to mitigate and respond to disasters in the community would also be determined. This is suggested since the tool identifies their relative strengths and weakness. These strengths and address weaknesses can be used to develop assistance measures within the community. This will also improve the deployment, access, and use of resources throughout the different phases of any disaster.

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