Unearthing the Links between Urban Development, Natural Disasters and its Impacts on Urban Sustainability

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1.0 Introduction

Grenada's urban centre, St. George's is not only known for its rich historical architecture, coastal location, natural deep harbour and dynamic population but also its extreme vulnerability to the threats of natural hazards. The city's complex interdependent system forms part of the parish of St. George which houses approximately one third (37,057) of Grenada's population that spreads over an area of 26 sq mi (67 km^2); a population density of 1,416.7/sq mi (547/km^2), (Grenada Statistical Office, 2010). The city itself has a resident population of approximately 4,500 and this together with its working population houses just about 30,000 persons on a daily basis - an approximate population density of 2000 km^2. This population density seen today in St. George's is a reflection of the continued concentration and centralization of commerce and other administrative activities since the city was built in 1650 by the French. As a result, the spatial development pattern, the process of development and the inability of land-use planning to cope with the growth of the city and its functioning land and property markets created complex relationships between the city's risk to natural hazards, its level of vulnerability and its incapacity to sustain itself in the event of a natural disaster. This relationship manifested itself in the devastation of St. George's during [1]hurricane Ivan in 2004 where much of the city's infrastructure and development initiatives were crippled.

Historical axioms have proven that natural hazards have been an integral part of Grenada's physical and human landscape and will continue to have a significant impact on the development of the island; because not only has traditional settlement planning and management of natural hazards have been ad hoc and nonresponsive to the problems experienced but the current planning model (identify & study the problem, develop alternatives, choose one and monitor, then deal with the next problem) is relatively static and only sees hazard mitigation as a linear trend (Melti, 1999). Therefore, after having witnessed such immense destruction in 2004, it is only fitting that the city's robust and most desirable features are preserved and sustained through the incorporation and implementation of disaster reduction measures in the city's spatial development plans. The aim of these measures is to ensure that St. George's becomes a resilient city while at the same time ensuring that its future spatial development efforts do not increase the city's vulnerability to natural hazards. Accordingly, this paper will seek to investigate the pattern of urbanization and land-use that have intensified the city's vulnerability to natural hazards, its levels of risk and ultimately its inherent level of sustainability.

2.0 Pattern of Urbanization, Land-use and Vulnerability

The general development pattern of the island of Grenada is characterised by the concentration of the population, community facilities, business activities and employment opportunities in the Greater St. George's Urban Area (Grenada's National Development Plan, 2003). St. George's, the major town due to its population size, development form and services, functions as the administrative district for the entire island of Grenada. The primary land use activities have been a mixture of residential, commercial and tourism. Because of

the development disparities between the city of St. George's and the other parts of Grenada, there has been the pattern of urbanization that is propelled by rural to urban migration. It is the concentration of human activities and settlements around the downtown area or the peripheralization of the core, thus transforming the city's structure, as well as, the radius which increased relentlessly.

Since the 17th century, the city has grown from a population of approximately 250 to 4000 persons to date. This, together with the limited land space of the capital city lends itself to a high population density. A spin of from the increased density was the growth in spatial development activities that weren't adequately planned giving rise to an amalgam of issues that went beyond the capacities of the existing regulatory, land use and disaster management systems of the city.

During hurricane Ivan, it became abundantly clear that the land use and development objectives of St. George's did not take into account the effects of a hurricane disaster on the community and their various vulnerabilities. So then, what made St. George's so vulnerable to the impacts of hurricane Ivan? First, it must be understood that vulnerability is a dynamic factor (continuously modified by social changes) that is socially constructed (Morrow, Betty Hearn, 1999); not only has it resulted from social processes, but also from a combination of [2]socio-economic factors that influences the intensities and effects of hurricanes on the population. Certainly, human misconceptions of disasters add to their level of vulnerability. In some cases, it is out of ignorance and in order instances persons believe that disasters are unique and exceptional cases.

According to Blaikie et al, 1994, human activities as in the case of hurricane Ivan, exacerbate the population's vulnerability by increasing the sequence of events whilst minimizing the ability of individuals or society to respond. Some of the factors that contributed to the vulnerability of the population of St. George's were:

- Increased population density
- Ad hoc settlement pattern on hill slopes which inevitably resulted from the spiralling effect of the land and property markets, in which case there were either informal settlements and/or the poor was forced to settle or build in areas susceptible to the effects of hurricanes without adequately constructed buildings. This further lead to the structural vulnerability of the building stock.
- No diversity in the economy
- It's a coastal settlement
- Inappropriate location of lifeline infrastructure especially the telecommunication and electrical lines which are located overhead rather underground. In the case of the water mains, disruption was due to silt build-up in the dams and broken water lines.
- Inadequate protection of the economic activities (marina, fishing, tourism) developed and located in the coastal zone.
- Sociophysiochological

From looking at the various aspects of vulnerability, what is evident is that the city's spatial development pattern, its location and the existing density are some of the underlying causes of the injuries and destruction caused by this single cataclysmic event. Concomitantly, this increased stress on the city's ecosystem exposed its resources to a higher risk of environmental and socio-economic deterioration. What was even clearer is that the condition of the people made it possible for the hazard to become a disaster, not solely the hazard per se, a concept purported by Cannon in1994.

This hurricane disaster problem has many dimensions (physical, environmental, social, psychological and political implications) and substantial complexities. The task therefore, is not only to determine the impacts of the natural hazard on the settlement, but an attempt

must be made to manage these impacts through the integration of land use/spatial development planning.

The point is, this natural phenomenon is unstoppable, but once the hazard intersects with a vulnerable population and adversely affects that population due to forces extraneous to them, it is a natural disaster (UNDHA, 2001). In cannon's (1994) view, this perspective is pragmatic because disasters are not natural, it is hazards that are natural, but in order for a hazard to become a disaster, it has to affect a vulnerable population (Burton and Kates, 1994). Therefore, the term "natural hazards" according to Koffi Annan (1999) may be on the verge of passé, as well as, "natural disaster" has become:

> **An increasingly anachronistic misnomer, in reality, it is human behaviour that transforms natural hazards into what should be called unnatural disasters**.

Because of this intricacy, and the delicate balance that exists between the various related component parts of spatial development and disaster management, the vulnerability reduction process should be continuative and adaptable, with the aim of optimizing and producing superlative decisions at all times; it should not present a final definitive panacea. As such, the Planner/Disaster Manager who is the artist of rationality with reference to human activity should pursue the reduction of the city's vulnerabilities with reason and logic. Accordingly, the role of land use planning/disaster management will be two-fold; where on the one hand, the practice of spatial development planning will consider the complex demands of disaster management and prevention of disasters by prohibiting (so far as possible), development on fragile and vulnerable sites from the socio-economic, environmental and physical epistemologies; and on the other hand, the spatial development planning systems will have a focus on place and space that can resolve these demands. The essential point here is, in planning for a resilient city, spatial development planning together with disaster management has the ability to consider a wide spectrum of factors including growth management, development densities, and the allocation of lifeline infrastructure, among others.

3.0 Levels of Risk

In order to assess the levels of risk experienced in St. George's after Hurricane Ivan, one must first have an appreciation and understanding of risk. According to the International Strategy for Disaster Reduction (ISDR) 2009, risk is referred to as:

> **"the probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions."**

It is expressed as: Risk = Hazards x Vulnerability. However, one has to be mindful that risk can be inherent, created or can exist within the city's social systems. It's an integral part of vulnerability because during hurricane Ivan, those persons who were most vulnerable were the ones proven to be most at risk from the extraneous forces of the hurricane. Therefore, the socio-economic context in which risk occur and the population's perception of risk and its underlying causes are the components that greatly determine the level of risk experienced during the hurricane.

Clearly, defining the acceptable level of risk for the urban area and its population can be difficult as risk means different things to different people because each person holds a unique view of the environment and environmental risk (Smith, 1992). The underlying question is how then do we assess the risk levels in order to determine the level of risk experienced by the resident population of St. George's during Hurricane Ivan? Overtly, there is no unequivocal answer to this but the symbiotic correlation that exist between hazard severity and the inherent conditions of vulnerability alluded to in section 2 of this paper will

ultimately provide a framework to calculate the risk levels for St. George's. The risk levels to be calculated will be done using the following tabulation obtained from OSHA, which is:
Risk level = Hazard Severity x Likelihood of Hazard Occurrence.

The hazard under investigation is hurricane Ivan and the various risk levels to be assessed are mortality risk, economic risk, structural/infrastructural risk, environmental sensitivity level risk, and sociophysiochological risk. The table below gives the parameters that were used in determining the levels of risk exposure, 5 being the highest level of risk.

Risk Level	Effect of Hazard	Likelihood of Occurrence
5	Catastrophic/Fatality	Certain
4	Extreme/Permanent Injury	Near Certain
3	Extensive/Disabling Injury	Very Likely
2	Moderate/Minor Injury	Frequent
1	Minimal/No Injury	Seldom

[3]Based on endnote 1 and 2, there was a vast unnaturalness of hurricane Ivan as the impacts experienced and per capita loss exceeded the capacity of the local urban and national economy to manage the adverse effects thus requiring emergency assistance from the International community. This ineluctable circumstance made it even more prudent for the urban population of St. George's to understand their various risk levels in order to ameliorate the living/development standards through sustainable policies and plans. These were the outcome of the risk levels calculated:

1. Mortality Risk Level: 4 x 4 = 16
2. Economic Risk Level: 5 x 4 = 20
3. Structural/Infrastructural Risk Level: 5 x 4 = 20
4. Environmental Sensitivity Risk Level: 5 x 4= 20
5. Sociophysiochological Risk Level: This risk level is very difficult to measure because the level of stress experienced by each person during the hurricane varied. It is a risk that is indicative of the socio-economic condition of the persons affected. From initial analysis, the Government of Grenada estimated that a minor percentage of the population were either affected or died a month after the hurricane from post traumatic stress disorder, most of which were over the age of 50. An approximation of this risk level can be 9.

From the various risk levels previously determined, the average risk level for St. George's for a category 3 hurricane is 17. This translates into a risk rank of medium to high medium. The table below outlines the action to be taken in response to the corresponding categories of risk.

Risk Ranking	Category of Risk	Action to be Taken
20-25	High – Very High	Swift Action
10-19	Medium – High Medium	Immediate Action
1-9	Low	Contingent Action

This risk analysis concurs with the outcome of the risk profile assessment conducted by PreventionWeb for Grenada and in particular St. George's, which falls in the category of medium to high medium.

The management of the varying risk levels experienced during hurricane Ivan ought to be considered in Government's long-term spatial development plans and measure in which case, appropriate management of the conditions of vulnerability (socio-economic, environmental, etc.) must be done through the implementation of mitigation polices and

activities to include aspects of structural, infrastructural and non-structural. This will inevitable lend itself to reducing the risks of the disaster by avoiding (preventing) and limiting (preparedness and mitigation) the adverse impacts of the hurricane within the context of sustainability.

4.0 Inherent Level of Sustainability

Based on the overall risk level of medium to high medium for St. George's, it can be inferred that the inherent level of sustainability for the city is low. This is simply because the city could not withstand the extremity of hurricane Ivan and as such, there was vast devastation of the local economy, lifeline infrastructure, the social and institutional components of the city, environment and ultimately the quality of life. Therefore, St. George's was not a resilient city lacking in every aspect that would make it sustainable.

Being sustainable or meeting the desired principles of sustainability is no easy task. The theoretical concept of sustainability is typically defined as meeting today's needs while preserving/conserving for future generations. But then how do we know what and how much to preserve/conserve for the future generations? The answer to this question will vary from generation to generation but one thing is certain that even without a precise definition of sustainable development, the urban city design and developmental goals should be geared at developing a sustainable St. George's within the context of the current generation's parameters while at the same time incorporating disaster mitigation tools aimed at reducing the city's losses from disasters.

One thing is certain, there is definitely a need for a resilient St. George's, a city that will make choices to ensure that human development (or lack thereof) does not undermine the quality of its environment but instead expand the level of the city's sustainability and resiliency. In so doing, the city's decision makers (Planners, Engineers, Politicians, Civic Society, etc.) must have as the cornerstone of their plans and policies the root causes of disasters, one of which is, human beings, not nature. There the city's level of vulnerability will be critically assessed in the hope that future development decisions will not be done in isolation but rather through an integrated approach, a shift in paradigm from relief and recovery, because of the inextricable link between development and disasters. This means that there ought to be an evolutionary shift in the way development goals are pursued in St. George's in relation to its fragile socio-economic and environmental systems.

Since the onslaught of Hurricane Ivan in 2004, Grenada through various international & regional donor agencies has embarked on various immediate, short-term measures such as debt restructuring, revision of national disaster plan and improved contingency plan, retraining of persons to meet the needs of the skilled sectors (e.g. maritime), retrofitting of buildings, just to name a few. [4]Even the 2010 Budget statement presented by the Honourable Nazim Burke alluded only to the fact that disaster management continues to be of high priority but did not purport the overarching view of an integrated approach to development that will incorporate long-term goals of sustainability, land use planning, disaster management, vulnerability reduction and resiliency. If this approach is taken then the city's physical systems and human communities (social and institutional components) would become robust and able to survive and function under the extremities of a hurricane. With this being said, it is important to recognize and include the following in the city's disaster management strategies and land use decision making process:

- [5]The six principles of sustainable development as outlined by Melti (1999); and
- [6]The two fundamental reasons of the importance of resiliency as stated by David R. Godschalk (2003).

In that way, there would be benchmarks to monitor the city's vulnerability reduction, risk levels and its attainment in reaching its goal of being sustainable and resilient.

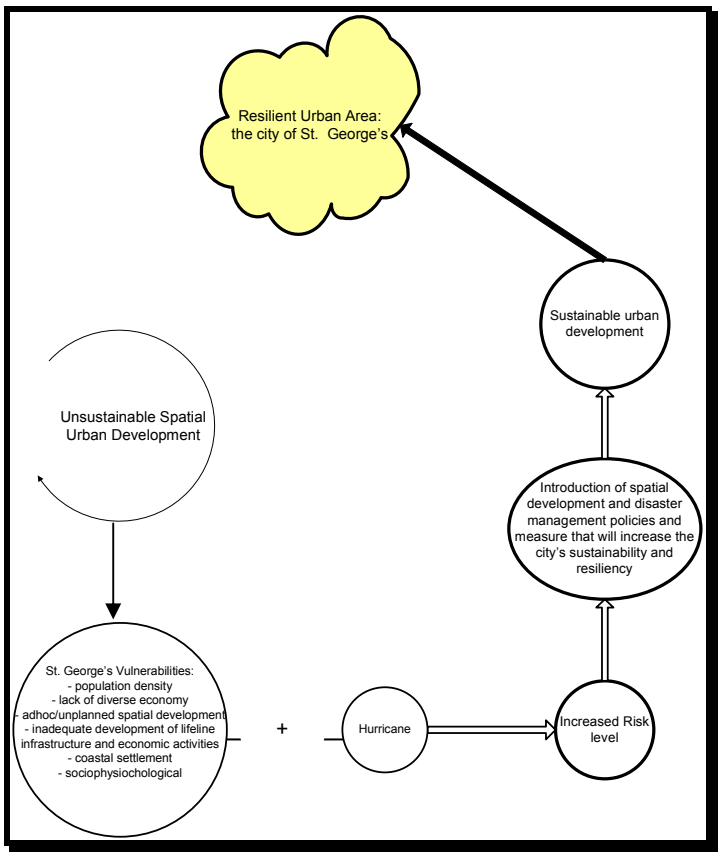
Overtly there exists a symbiotic correlation between the environment and development that must be explored to understand that planning and management of the natural and built environment are of particular importance to the mitigation of natural disasters.

5.0 Conclusion

Man cannot stop the winds from blowing or the sea from rising. These natural events although unstoppable, reducing their impacts remains one of the greatest challenges of our times, but will not happen overnight. Hurricane Ivan was no aberrant phenomena, it was a reflection of the way the city of St. George's structured itself and allocated its resources. As such, a better understanding of the nature, magnitude and potential risks is a prerequisite to policymaking, risk reduction and management. Therefore, we, the change managers have a golden opportunity to rise to the present challenges of this fragile community by reducing its level of vulnerability and risk through the development of a resilient city while at the same time protecting various urban strata and cultural heritage that matured over the centuries.

What is clear from the evaluation is that St. George's risk level to a Category 3 hurricane is medium to high medium meaning that approximately 70 to 85% of the city's lifeline infrastructure, social institutions and economic base were destroyed. Accordingly, it can be inferred that if St. George's was hit by a category 4 or higher hurricane under the existing vulnerability conditions then the risk level will be high, in which case, there will be total destruction. The city's smallness and compactness was fundamental to this disaster dilemma, as well as, the lazzafairre attitude adopted by the population of not having a hurricane within the last 50 years, therefore, the culture of 'do nothing' became a norm among the population allowing [7] *'misfortune to come in by the door that was left open for it'*.

Highlighted below is the link between urban development, natural disasters and sustainable development.



The question is how do we achieve the level of sustainability and resiliency required? This question is currently asked by many even when we are lost. As in the case with Alice in wonderland, she asked:

> **…which way I ought to go from here?...that depends a good deal on where you want to get to, said the cat.**

The lesson here is what are the desired goals for disaster management? With that in mind, we must remember that hurricanes are an inexorable part of developments, especially coastal developments, and its reality cannot be changed but what is certain is carving that holistic approach to achieve the desired goal, that is, a sustainable urban area.

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Endnotes

[1] Ivan was a category 3 hurricane when the center passed about 7 miles south of Grenada, a path that took the northern eyewall of Ivan directly over the island. In the Caribbean, Ivan became a category 5 hurricane, with winds of 160 m.p.h., on the 9th when it was south of the Dominican Republic, and on two occasions the minimum pressure fell to 910 mb. The center of Ivan passed within about 20 miles of Jamaica on the 11th and a similar distance from Grand Cayman on the 12th , with Grand Cayman likely experiencing sustained winds of category 4 strength. Ivan then turned to the northwest and passed through the Yucatan channel on the 14th , bringing hurricane conditions to extreme western Cuba. Ivan moved across the east-central Gulf of Mexico, making landfall as a major hurricane with sustained winds of near 120 m.p.h. on the 16th just west of Gulf Shores, Alabama.

The death toll from Ivan stands at 92 - 39 in Grenada, 25 in the United States, 17 in Jamaica, 4 in Dominican Republic, 3 in Venezuela, 2 in the Cayman Islands, and 1 each in Tobago and Barbados. U.S. damage is estimated to be near $14.2 billion, the third largest total on record. (cited on *http://www.nhc.noaa.gov/HAW2/english/history.shtml*)

[2] One of the socio-economic indicators is the GDP per capita which was US$$4,135.32 for Grenada in 2004. In comparison with to the USA's GDP per capita of $39,771.79 for the same year, Grenada's GDP per capita was only a drop in the bucket. Both countries were affected by hurricane Ivan.

[3] Until 2004, Grenada's economic performance was considered among the most favourable in the Eastern Caribbean. Grenada was battered by hurricane Ivan on 7 September 2004, which caused widespread devastation on the island. Around 90% of buildings were either harmed or destroyed and roads were severely damaged. 39 people died and the economy was virtually destroyed. Prior to Hurricane Ivan, the economy was recovering rapidly from the 2001-2002 downturn. Having grown by nearly 4% in the first half of 2004, due to Hurricane Ivan the economy is estimated to have contracted between 1.4 and 3.2% in 2004, the tourism sector (Hotels and restaurants) being the worst affected (-25% growth in 2004). In the nutmeg sector, Hurricane Ivan uprooted some 550,000 trees, thereby affecting approximately 30,700 persons directly or indirectly, and reducing their household incomes. Following Ivan, the near-term outlook is very difficult, as the extensive damage inflicted on the economy is estimated at over 200% of 2003 GDP and a growth of only 1 percent is projected in 2005 (DPADM, 2006).

[4] Mr. Speaker, disaster management continues to be a major priority for our government given our vulnerabilities. NADMA has made considerable progress during the last year with a major focus on public information and building community disaster management capacity. However, there is much more work to be done. We will continue our community capacity building effort, the upgrading of our national emergency centre and the development of our staff. Furthermore, we have begun discussions with the World Bank on another Disaster Risk Reduction Project that may include retrofitting of more hurricane shelters and disaster management training (Extracted from Grenada's Budget Statement, 2010).

[5] Six principles of sustainable development accordingly to Melti (1999) are:

1. Maintain and if possible enhance environmental quality
2. Maintain and if possible enhance people's quality of life

3. Foster local resilience to the responsibility for disasters – the first step toward responsibility and resiliency is public awareness of local environmental problems, disasters, environmental sustainability and how they all affect each person's safety and security.
4. Recognize that sustainable, vital local economies are essential – A sustainable economy is diversifies and thus less easily disrupted by disasters.
5. identify and ensure inter- and intragenerational equity
6. adopt a consensus building approach, starting at the local level.

[6] The importance of resiliency accordingly to David R. Godschalk, 2003 are:

1. The vulnerability of the technological and social systems cannot be predicted completely, resilience therefore creates the ability to accommodate change gracefully without catastrophic failure during critical in times of disaster.
2. People and property tend to fare better in resilient cities struck by disasters than in city's that is less flexible and adaptive when faced with uncommon stress.

[7] Czech proverb