Developing Design Concepts for Climate Change Resilient Building

Interim Report
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List of Acronyms

5Cs	Caribbean Community Climate Change Centre
ACCCRN	Asian Cities Climate Change Resilience Network
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CDB	Caribbean Development Bank
CDEMA	Caribbean Disaster Emergency Management Agency
CUBIC	Caribbean Uniform Building Code
DAC	Development Assistance Centre
DBJ	Development Bank of Jamaica
DOs	Development Orders
EIAs	Environmental Impact Assessments
ERA	Environmental Regulatory Authority
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GHG	Green House Gas
GIS	Geographic Information System
IPCC	Intergovernmental Panel on Climate Change
LAC	Latin America and Caribbean
LBAs	Local Building Authorities
LDUC	Land Development and Utilization Commission
LPA	Local Planning Authority
NEPA	Natural Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
PIOJ	Planning Institute of Jamaica
PPCR	World Bank Pilot Program for Climate Resilience
PSEECP	Public Sector Energy Efficiency and Conservation Programme
SIDS	Small Island Developing States
SME	Small and Medium Enterprises
TCPD	Town and Country Planning Department
TPD	Town Planning Department
UDC	Urban Development Commission
UNFCCC	United Nations Framework Convention on Climate Change

Overview of Project

The documentation sub-component of the Developing Design Concept for Climate Change Resilient Buildings Project is geared at providing a comprehensive project document that discusses the possibilities and limitations to creating effective design concepts that address the impact of climate change on the Jamaican landscape. The expected outcome is to produce a document that can be used by development practitioners to understand the benefits of climate change resilient buildings and projects and support the policy and regulation framework to implement these initiatives at the national and regional level. In light of this stated objective, the documentation of the project will consolidate analyses carried out in the project's key components, which include the Planning Analysis and Technical Assessment and the Geographic Information System (GIS) Mapping.

The Planning Analysis and Technical Assessment component of the project employs a 5 tier approach to review the policies of developing design concepts for climate change resilient buildings in Jamaica. Specialised consultants were contracted to examine this issue from legislative, economic, and technical perspectives, with emphasis being attached to conducting a review of building codes (contracted to a professional consulting firm specialising in engineering and architecture) and the Green Paper on the proposed Environmental Regulatory Authority. The focus of the second component, GIS Mapping, is the compilation of relevant planning and legislative data on climate change into hazard maps that will inform the national spatial plan. The third component will contract the services of a public relations, marketing and communications firm to disseminate the project outputs in order to foster public awareness on climate change resilient building in Jamaica and the Caribbean.

In light of the above, the first interim report will highlight the work carried out thus far by the consultants working on components 1 and 2, and will consolidate the preliminary assessments of each component.

The project team was comprised of the following consultants:

Component 1: Policy and Technical Assessment
Sub Component 1.1: Technical Assessment – Kwame Emmanuel
Sub Component 1.2: Legislative Review – Akilah Anderson

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Component 2: GIS Mapping - Mona GeoInformatics Institute

Component 3: Dissemination and Awareness Building Program - Focal Point Consulting Ltd.

Introduction

Climate change is considered one of the most damaging threats to the growth and sustainability of developing nations, particularly small island developing states (SIDS). The impact of climate change on the global community "is likely to be inherently unequal and tilted against many of the world's poorest regions, which have the least economic, institutional, scientific, and technical capacity to cope and adapt." (World Bank, 2012a: p. xii). The impact of climate change on these nations has resulted in rising temperatures, sea level rise, increased rainfall, coastal flooding, drought and an increase in extreme weather systems such as hurricanes and tropical storms. The occurrence of these severe weather conditions are particularly damaging to SIDS with large coastal populations and fragile economies that are heavily dependent on tourism and agriculture. Therefore, climate change resilience discourse plays an integral role in determining the ability of SIDS to ensure continued development. Similarly, a nation's ability to combat climate change effectively will have further implications on its capability to achieve the Millennium Development Goals by 2015 (UN 2007).

The concept of resilience, in this discourse refers to the ability to:

> survive, recover from, and even thrive in changing climatic conditions. It includes the ability to understand potential impacts and to take appropriate action before, during, and after a particular event, such as a typhoon, major flooding or prolonged drought, to minimize negative effects and maintain the ability to respond to changing conditions, even unpredictable conditions (ACCCRN).

Additionally, developing a climate change resilient infrastructure involves "ensuring the preservation, restoration, or improvement of [the state's] essential basic structures and functions" (IPCC 2012: p. 3).

Developing an infrastructural framework to combat the damaging impact of climate change on SIDS requires a strategic approach that encompasses institutional change, economic and policy review, and adjustment in regulations regarding environmental protection and development. States have the added responsibility of improving its risk analysis capacities and its capabilities to respond to a plethora of climate change related risks such as diseases, flash floods, storm surges, and environmental hazards etc. (USAID 2012). Additionally, urban development

planning based on hazard mapping, implementing the use of greenhouse gas emission inventories, promoting the benefits of investing in climate change resilient development, and policy reviews that support the utilization of clean and resilient development all play a pivotal role in effectively addressing climate change (USAID 2012: p. 9). Central to this discourse is the concept of utilising building stock that is resilient to the long term effects of climate change. This process involves:

1. Investing in construction ideas that support the efficient use of water, energy and resource-efficient materials;
2. Enhancing public awareness of construction concepts that are designed to safeguard homes and businesses from the damaging effects of severe weather conditions and other natural hazards created as a result of climate change, and;
3. Improving public awareness of the benefits of supporting climate change resilience construction initiatives.

In so doing, states adopting these strategies will essentially safeguard its social, economic, political and physical infrastructure from decline while improving its ability to compete equally within the global political economy.

The goal of this study is to therefore examine the feasibility of employing design concepts for climate change resilience building as a tool to combat the consequences of climate change in SIDS. Primary focus is placed on assessing building stock in Jamaica with reference made to other Caribbean states.

Technical Assessment

Infrastructural development, especially in developing countries, plays a pivotal role in realizing sustainable development. Despite its importance, however, significant work needs to be carried out in the areas of housing, transport, water, energy and essential services and therefore infrastructure will continue to be an important area of investment. Taking into consideration the impacts of climate change along with the cost and life span of infrastructure, the present focus should be to invest in climate resilient initiatives that can withstand climatic extremes.

The technical review of developing design concepts for climate change resilience buildings seeks to provide an assessment of current and proposed planning, zoning and development standards, and regulations at the regional and international level. The assessment examines climate related policies and provides a review of best practices related to climate change in Jamaica and other CARICOM states. The framework of this assessment is therefore based on addressing the implications of climate change hazards on CARICOM states.

1.1 Climate Change: Hazards and Impact

Caribbean territories are particularly vulnerable to the hazards associated with climate change. This vulnerability is due to the region's geographical location (within the "Hurricane Alley"), geology, topography, limited size, the concentration of development in high risk areas (e.g. coastal zone and river banks) and limited financial capacity at the national and local levels. This vulnerability is further enhanced by the poor construction of the state's infrastructure and environmental degradation which results in the deterioration of the natural buffers to extreme events such as wetlands and coral reefs. In addition, the Caribbean depends on climate sensitive, economic sectors such as tourism and agriculture. As a consequence, frequency of events will erode the economic base of CARICOM states as their foreign exchange earning capacity will be diminished at a time when increased expenditure will be necessary to address costs associated with recovery plus normal operating expenses. The Policy Development Committee (2005) states:

> Over the last two decades Jamaica's economic growth and development has been persistently hampered by the impact of natural hazards. For example, between May and September 2002, flood rains in Jamaica caused cumulative damage of about $6 billion. Over 90 percent of this

> damage was accounted for by infrastructure and agriculture. Placed in perspective, that $6 billion was approximately 26.3 per cent of the total budget for education in 2003 and could have built 12,000 low income houses to shelter the poor. Were these monies not spent on disaster recovery, they could have reduced fiscal deficit and advance growth. (p.3)

Of particular concern to SIDS is sea level rise. According to Kelman and West (2009), "sea level rise is arguably the most certain and potentially devastating climate change impact" (p. 3). The south Pacific nation of Kiribati, for example, has already experienced the impacts of sea level rise with two uninhabited atolls being submerged in 1999. The resulting coastal inundation in SIDS will lead to reduction in land area and negative impacts on tourism infrastructure, cities, and ports. There will also be saline intrusion of groundwater resources and a reduction of freshwater available for the potable water supply. Saline intrusion coupled with reduced rainfall will particularly impact countries like Barbados and Antigua and Barbuda, which are already characterized as "water scarce".

The Caribbean will also be impacted by tropical cyclones, possibly with greater intensity (Category 4 and 5 storms) while the duration of the hurricane season is likely to increase. These cyclones have the potential to cause severe devastation as was the case with Hurricane Ivan impacting Grenada in 2004 (See Box 1). In approximately four hours the country's economic machinery, which took decades to develop, was in ruins with damages valued at twice the gross domestic product (GDP) at the time. Climate change therefore is not just an environmental issue; it is also a developmental issue.

Box 1: Hurricane Ivan and Grenada

Hurricane Ivan struck Grenada on 7 September 2004, as a category 4 system on the Saffir-Simpson scale. Sustained winds reached 140 mph, with gusts exceeding 160 mph. An official OECS/UN-ECLAC Assessment reported the following:

- 28 people killed
- Overall damages calculated at twice the current GDP
- 90% of housing stock damaged,
- 90% of guest rooms in the tourism sector damaged or destroyed, equivalent to approximately 29% GDP
- Losses in telecommunications equivalent to 13% GDP
- Damage to schools and education infrastructure equivalent to 20% GDP
- Losses in agricultural sector equivalent to 10% GDP. The two main crops, nutmeg and cocoa, which have long gestation periods, will not contribute to GDP or earn foreign exchange for the next 10 years
- Damage to electricity installations totaling 9% GDP
- Heavy damage to eco-tourism and cultural heritage sites, resulting in 60% job losses in the sub-sector
- Prior to Hurricane Ivan, Grenada was on course to experience an economic growth rate of approximately 5.7% *per annum* but negative growth of around -1.4% *per annum* is now forecast.

Source: Mimura et al 2007

Climate change hazards and impacts with infrastructural implications are summarized in Table 1. It should be noted, however, that a clear understanding of the impact on the Caribbean is difficult to ascertain because of a lack of downscaled information, limited understanding of the midsummer drought process, limited agreement on the relationship between sea surface temperature and frequency and intensity of hurricanes, sea level rise uncertainty and insufficient modelling of storm surge (IISD 2011).

Table 1: Hazards, Impacts and Infrastructure Implications

Hazard	Impact	Infrastructure Implications
Sea level rise	Coastal flooding and erosion, land lost, seawater intrusion	Damage to coastal infrastructure and pollution of underground water resources
Category 4 and 5 hurricanes	Storm surge, inland flooding, wind related damage	Damage to infrastructure including electricity and water
Torrential rainfall events	Inland flooding	Damage to infrastructure including electricity and water
Prolonged drought	Limited water resources	Water supply restrictions

Hazard	Impact	Infrastructure Implications
Increased temperatures	Heat stress Coral bleaching Increased emergence of vector borne diseases	Increased energy and water use. Coastal erosion (damage to coastal infrastructure). Vector habitats

The Caribbean Catastrophe Risk Insurance Facility (2010) noted for the Caribbean that:

- Expected losses related to current climate risk is equivalent to 6% of GDP under current climatic and economic conditions in some countries.
- Expected losses related to climate change risk is equivalent to an additional 1-3% of GDP in the worst case scenario.
- As much as 90% of damages for some countries can be avoided by implementing adaptation strategies such as risk mitigation (adaptation measures) and risk transfer (e.g., insurance). Risk transfer is most effective in cases where the hazard is low probability but high impact.

1.2 Resilience

Ecological resilience is related to the capacity of the natural environment to provide regulatory services effectively. For example, a wetland facilitates flood control, storm and surge protection, groundwater replenishment, shoreline stabilization, carbon sequestration, and limits the impacts of sea level rise and droughts. Forests and coral reefs also play an important regulatory role. Degradation will therefore exacerbate the impacts of climate change and cause geographical areas and infrastructure to be vulnerable, which were not previously at risk. Issues such as deforestation and coastal pollution have seriously compromised ecological resilience. In particular, infrastructure development in the Caribbean is usually pursued at the demise of the natural environment, for example, hotels and roads are constructed in wetland areas. Protecting the environment should therefore be the priority in enhancing resilience to climate change as it would help to minimize the negative impacts on infrastructure and costs associated with damage. Protecting the environment is also the most cost effective adaptation option.

The Caribbean has commenced work (policy development, research and projects) in the area of climate change resilience which incorporates a social dimension to resilience discourse. The Caribbean Community Climate Change Centre (5Cs) in Belize manages the region's response to climate change and has been instrumental in guiding the adaptation program. There are also

other regional institutions such as UWI (Disaster Management Unit, Climate Studies Group) and Caribbean Disaster Emergency Management Agency (CDEMA) doing work in this area.

The World Bank Pilot Program for Climate Resilience (PPCR) Coordination Unit is also conducting work in the region. The World Bank's interest is to ensure that investments in infrastructure are sustainable. The World Bank PPCR Coordination Unit (2011) notes that "Infrastructure represents nearly half (46%) of the World Bank's overall portfolio, with net commitments of $44 billion" (p.2). Jamaica is participating in the PPCR initiative and the focus is on capacity building, knowledge communication and policy formation and integration (IISD 2011). Other current or recently concluded Jamaican projects are:

- The Impact of Climate Change on Tourism and Economic Growth in Jamaica (funded by The International Institute of Environment and Development and Oxfam)
- Community-based Adaptation (CBA) Programme (funded by the Global Environment Facility)
- Global Climate Change Alliance (Funded by European Commission, Czech Republic, Sweden, European Development Fund)
- The Economics of Climate Adaptation Initiative (funded by CCRIF Technical Assistance Programme)
- CARIBSAVE Climate Change Risk Atlas: Phase 1 (Funded by DFID and AusAID)

The International Institute for Sustainable Development (2011) notes that gaps in the regional adaptation program include:

- Limited national level projects responding to individual needs
- Limited implementation of adaption actions on the ground
- Limited action related to various sectors including tourism, forestry, biodiversity and gender dimensions of climate change.
- Limited attention paid to freshwater and marine resources and human health concerns

There are also resilience initiatives being conducted outside of the region, from which the Caribbean can learn. One of the Asian Cities Climate Change Resilience Network's (ACCCRN) city projects is based in Da Nang Vietnam and focuses on storm and flood resistant credit and housing schemes. The key issues are high vulnerability to exposure, limited socioeconomic ability to respond and poorly constructed and maintained homes. The expected project impact is 376 homes in six years will be modified or reconstructed to withstand storms. In addition, the

resilience characteristics of resourcefulness, responsiveness and learning will be enhanced (ACCCRN 2012).

1.3 Physical Planning and the Institutions

Physical planning seeks to achieve optimal spatial coordination of human activities. Vulnerability to climate change in the Caribbean has been exacerbated by weak planning systems, which have influenced environmental degradation and allowed developments in high risk areas. In the case of Jamaica, for example, development along the Hope River in Kintyre, St. Andrew, as well as the approval of Caribbean Terrace along the coast of St. Andrew is the result of a dysfunctional physical planning system. There has also been extensive deforestation and destruction of wetlands due to the proliferation of informal and formal developments. The Green Paper for the establishment of an Environmental Regulatory Authority (ERA) for Jamaica notes that the physical planning model is obsolete and dysfunctional with no effective mechanism for integrated planning. Several noted examples of the planning weaknesses in Jamaica include:

1. Institutional fragmentation and overlaps
2. Lack of integrated planning
3. Inadequate monitoring and enforcement
4. Insufficient leadership in planning
5. Tedious development approval process
6. Ability of some institutions to disregard regulations
7. Inadequate infusion of planning at all levels of the decision- making process
8. Limited use of technology to increase efficiency and reduce transaction cost to the public

The impacts of climate change speak to the urgent need to reassess planning and development (Platt 2007). The role of planning should be to facilitate mitigation and adaptation. Platt (2007) states:

> Planning is like preventative medicine, whereas we have spent the last generation focusing on curative medicine. So, we have had social upheaval, the diseconomies of retrofitting infrastructure, and the avoidable costs of rehabilitating settlements after natural disasters, when instead we should have been planning for new sustainable urban settlement and hazard mitigation. (p. 6)

The Planning Institute of Jamaica (PIOJ) (2009a) notes that the institutional framework for planning in Jamaica is fragmented with over twenty agencies directly or indirectly involved in the

process. This issue is further compounded by inadequate institutional capacity. In Jamaica, the main planning agencies are the Local Government Authorities (Parish or Municipal Councils) under the Ministry of Local Government and Community Development as well as the National Environment and Planning Agency (NEPA). NEPA reports to the Minister responsible for Water, Land, Environment and Climate Change and it represents a merger of:

1. The Natural Resources Conservation Authority (NRCA)
2. Town and Country Planning Department (TCPD)
3. Land Development and Utilization Commission (LDUC)

There is also the Development Assistance Centre (DAC), a unit within NEPA, which provides a pre-consultation and facilitation service to developers who are in the process of preparing development applications. Referral agencies for development control include:

1. Water Resources Authority (WRA),
2. Rural Physical Planning Division (RPPD),
3. National Works Agency (NWA),
4. National Water Commission (NWC),
5. Mines and Geology Department (MGD),
6. Fire Department
7. Office Disaster Preparedness and Emergency Management (ODPEM)
8. Ministry of Health
9. The Planning Institute of Jamaica (which provides policy direction)

Agencies such as the Ministry responsible for Housing and the Urban Development Commission (UDC) conduct their own planning exercise. This autonomy is outlined in the UDC and Housing Acts, which allow for the designation and declaration of development and housing areas, respectively. These agencies only collaborate with NEPA for environmental permitting purposes but not for planning permission. Due to limited staff and application overload, NEPA focuses more on development control and less on planning and environmental management. There is also limited enforcement capacity within NEPA and the Local Authorities, a lack of support on the part of the police and judiciary as well as political interference, which undermines enforcement. NEPA has a number of additional challenges including conflicting roles (operation and regulation, development facilitation and environmental protection) and a complex regulatory framework (Office of the Cabinet 2010).

In the case of British Virgin Islands (BVI), the Planning Authority, through the Town and Country Planning Department, is responsible for ensuring proper land use and orderly and sustainable development throughout the Territory. Agencies across the various Ministries of Government are involved in the physical planning process and participation depends on the type of development plan that has been submitted for approval or the national or area specific plan that is being created by the Planning Authority. In terms of a formal process, a technical review board called the Pre Planning Authority reviews all development plans before they go to the Planning Authority in order to identify all the issues and give recommendations. This Board consists of representation from all Ministries including:

1. Public Works
2. Conservation and Fisheries
3. Fire and Rescue
4. Police
5. Environmental Health
6. Survey Department
7. Tourist Board
8. Water and Sewerage
9. Social Development
10. Disaster Management
11. Land Registry
12. Inland Revenue
13. Town and Country Planning

1.4 Physical Planning Policies

In the case of Jamaica, there are a number of policies which guide physical planning. These include:

1. The National Physical Plan 1978-1998 which includes the National Settlement strategy
2. Development Plans and Orders (discussed in the legislative assessment)
3. Development and Investment Manual
4. Vision 2030
5. National Land Policy of Jamaica
6. National Housing Policy and Implementation Plan (Draft) 2009

The National Physical Plan, which is not recognized in law, attempts to integrate social, economic and physical development plans and define the spatial relationships. The issue of hazard-risk reduction and its relevance to development was considered during the conceptualization stage in the 1970s (Policy Development Committee 2005). Therefore, some attention was paid to flood prone areas, for example, but not within the context of a changing climate and extreme events specifically. As it relates to the National Settlement Strategy, it is clear that there has been little success in meeting its objectives which seek to minimize rural-urban drift, improve rural centres, and control urban sprawl. Rural areas have experienced limited infrastructural development while urban boundaries continue to encroach incrementally into the upper reaches of watersheds impacting the regulatory ecosystem services and ecological resilience. NEPA (2011) highlights a number of weaknesses associated with the National Physical Plan and the Settlement Strategy. These include:

- Short-term planning horizons
- Inadequate implementation support
- Poor linkages between objectives, strategies and budgets
- No targets, indicators, and monitoring and evaluation framework
- Coastal zone development focus
- Inadequate rationalization of competing land uses
- No recognition of climate change impacts and adaptation
- Use of modern tools for rationalizing land use is not encouraged
- No modern framework for integrated spatial planning and decision making
- No mechanism for linking land use planning and economic development (p.9)

The Development and Investment Manual in Section 3, Volume 1, acknowledges that the "The planning process is an excellent method of promoting the incorporation of mitigation measures into developments and this is essential for mitigation success"(ODPEM 2006: p. 2). The Manual notes that the ODPEM makes recommendations on subdivisions in high risk areas. These areas are categorized as having high population density, frequent disaster history, high dependency ratio, large impact area, high damage magnitude and poor construction. The Manual highlights the importance of hazard maps and other tools to help indentify geographical areas, which require special standards for development. The purpose of the guidelines is:

> …to assist in the planning and design of development proposals by setting out key factors which need to be considered in assessing the degree of risk, and

> the management of the risk through appropriate mitigation, planning and design measures (ODPEM 2006: p.2).

The manual presents broad construction guidelines related to flooding, hurricanes, storm surge and landslides but needs updating as it relates to current climatic trends and the degree of vulnerability in specific geographical locations. Section 1, Volume 2 also includes hazard identification and mitigation considerations. It states that "hazard identification must be taken into consideration during the planning and construction stages of development with the aim of devising appropriate mitigation measures" (NEPA 2006: p.18). Consideration of measures for strong winds and high levels of precipitation is stipulated. Measures identified include proper drainage and adherence to minimum standards of the building code.

The Vision 2030 seeks to create an efficient planning system by adopting mechanisms for improved integration of spatial models in decision making; rationalizing roles and responsibilities of planning agencies; and strengthening the capacity for monitoring and enforcement. There is also a strategy focusing on sustainability planning which entails physical development in harmony with the natural environment; development being guided by spatial planning; and the review of regulations, codes and standards for housing and urban development.

The National Housing Policy for Jamaica has a number of objectives including developing mechanisms to minimize impacts associated with natural disasters on settlements using appropriate planning instruments.

The 1997 National Land Policy defines a framework for planning, management, development and use of land. The policy notes that:

> The decision to develop or not to develop an area will be based on the extent, severity, and frequency of the natural hazard event (probability) and the availability of current technology to mitigate negative impacts of the hazard. Total rejection to develop land will be a last resort and will only occur in extreme cases of danger (Government of Jamaica 1997: p. 78).

The policy recognizes the importance of land information systems and up to date geographic data to physical and environmental planning. However, related issues include non-standardized systems across agencies, inadequate data sharing mechanisms, sub-optimal decision making due to inadequate datasets and shortage of specialist personnel. Several policies have been identified to address these issues. The land use policy also has a disaster management component with policy initiatives which include:

- Vulnerability analysis as part of environmental impact assessments (EIAs) and incorporation of mitigation measures
- Government acquisition of land in high risk areas and subsequent leasing based on special standards
- Incorporation of disaster mitigation and hazard risk zoning in physical development plans
- The construction of critical facilities (hospitals, electricity plants, water distribution systems) using special standards
- Relocation of households in flood prone areas which rely on Government assistance after each flood event
- Preparation of emergency plans as part of development plans for vulnerable areas
- Disclosure of hazard risks by developers to purchasers of land or development
- Provision of information on vulnerable locations to developers by Government agencies
- Incorporation of risk mapping into work plan by technical agencies within Government

For Barbados, the main policy is the Physical Development Plan (Amended 2003). Although climate change is not explicitly addressed, the plan provides the basis for consideration by defining natural hazard areas, which include gullies, soil slip areas, areas of coastal erosion and flood prone areas. There is also a provision for land use management taking into consideration risks associated with natural hazards. The Plan also includes an integrated coastal zone management plan which is a key policy instrument that will provide guidance for climate change adaptation.

In the case of St. Lucia, the Physical Planning and Development Act (PPDA), the draft Building Code and the draft Environmental Impact Assessment Regulations make no specific reference to climate change resilience. Policy issues include, but are not limited to, zoning of areas appropriate for housing and other development; coastal zone management; and fiscal policies to encourage resilience building, for example, related to insurance, rainwater harvesting, and retrofitting of buildings to better withstand hurricanes.

1.5 Hazard Mapping

The GIS Mapping component of the project will be discussed in more detail in the next project report. For the purposes of the technical assessment of this project the objective of the GIS mapping is to generate a comprehensive hazard map that outlines key areas of vulnerability in

Jamaica. Specifically, the data collected from this component is expected to complement existing results that will support the development of a national spatial plan.

Twenty areas in Jamaica have been identified as being at risk/vulnerable to the damaging effects of climate change will be studied. These communities are grouped into four key quadrants and examined based on their susceptibility to specific climate change hazards which include river flooding, coastal flooding (10m zone), landslides, mean wind and annual precipitation (based on 30 year mean). The vulnerability areas identified on the map is generated based on the relationship between population density, the number of buildings and poverty levels with the above stated hazards for each community. This information is expected to further guide more specific discussion on developing climate change resilient buildings tailored to the environmental/climatic conditions of Jamaica, which in turn is hoped to influence discourse on design concepts, guidelines, policies standards and practices in the development of climate change resilient buildings throughout the Caribbean community.

1.6 Planning Process

The physical planning system in most CARICOM states has three main components:

1. A physical development plan system - attempts to spatially identify and quantify future land use requirements based on demographic and economic projections within the context of a natural resource base and a specified time horizon
2. A development control system - works in tandem with the development plan, seeks to ensure orderly and progressive development. It is the process whereby planning permission may be granted or refused for proposed development on a particular site.
3. An enforcement system - established to monitor development actions to ensure that the development has been undertaken in accordance with what was approved

In Jamaica, the main focus is on development controls for which there are three distinct processes for planning, building and subdivision permission. For planning permission, the applicant submits to the Local Planning Authority (LPA). Depending on the type of application it may further be requested by NEPA or submitted for its consideration. If not requested by NEPA, the Local Authority reviews the application and makes a decision. For building permission, the applicant submits to the LPA. The Authority assesses and informs the applicant of its decision. For subdivision permission, the LPA forwards the application to NEPA for comments after soliciting a site inspection report from the Fire Department and the Superintendent of Roads and Works. NEPA then solicits comments from relevant agencies such as NRCA, ODPEM, Ministry

of Agriculture, MGD and the Environmental Control Division of the Ministry of Health. The Local Authority is then informed of NEPA's recommendations based on the comments from the various agencies. For all three development control processes, the final ratification is done by the Physical Planning and Environment Committee.

1.7 Climate Related Policies

The Caribbean Catastrophe Risk Insurance Facility (CCRIF) is a noteworthy policy initiative that provides Caribbean countries with insurance for high risk, low probability hurricane events, enhancing the capacity to recover by providing immediate liquidity. It is the first regional risk pool in the world. The CCRIF also promotes adaptation measures including asset based responses and behavioural measures. For Jamaica, climate related policies include:

- Vision 2030
- Medium Term Socio-Economic Policy Framework 2009-2012
- Draft National Climate Change Policy and Action Plan (2012)
- Draft National Hazard-Risk Reduction Policy for Jamaica (2005)

The Vision 2030 policy has a number of goals one of which speaks to Jamaica having a "healthy, natural environment", for which there is an outcome "hazard risk reduction and adaptation to climate change". Strategies to improve resilience to all forms of hazards include:

- Hazard risk reduction through multi-stakeholder dialogue
- The use of predictive tools
- Modernization of the legal framework
- Integration of hazard risk reduction into educational programmes
- Adoption of a community based approach
- Expansion of early warning systems
- Incorporation of hazard risk reduction in environmental management
- Establishment of mechanisms for increased resilience of the poor and the most vulnerable
- Private sector involvement in hazard risk reduction and contingency planning
- Designing resilient housing settlements

There are also strategies focused on adaptation to climate change which include:

- Climate proofing policies and plans
- Identification of adaptation priorities
- Sector specific research

- Education and discussion through media
- Adoption of best practices
- Incorporation of climate change issues into physical planning
- Development of risk transfer instruments
- Integration of frameworks for disaster risk reduction and climate change mitigation

There are also environmental policies, which influence planning and contribute to climate resilience. Using an ecosystem approach, it is easy to identify the linkages between ecological resilience and social resilience to climate change. For Jamaica, the main policies include:

- National Forest Policy and Plan
- National Policy on Ocean and Coastal Zone Management and Action Plan
- Policy for Jamaica's System of Protected Areas

These policies seek to maintain the regulatory services of the natural environment. However, the successful implementation has been undermined by the lack of financial and human resources and, in some cases, conflict with other policies. In the case of Barbados, the Integrated Coastal Zone Management Policy is an important planning instrument.

The influence of national and regional policies on climate change legislation is further discussed in the legislative component of this study.

1.8 Best Practices

1.8.1 Planning

Examples of best practices in climate change resilience based planning throughout the international community include:

- The SMART Code – This is a land development template for planning and community development. The code was designed to create "walkable neighbourhoods" along a rural-urban transect. It takes into consideration zoning, subdivision regulations, urban design and architectural standards and can be calibrated for national and local circumstances based on its modular system, which includes hazard mitigation standards.

- The Pearl Rating System for Estidama (Sustainability) – This is used by the Abu Dhabi Urban Planning Council to grade communities, buildings and villas. The building rating system "encourages water, energy and waste minimization, local material use and aims

to improve supply chains for sustainable and recycled materials and products" (Abu Dhabi Urban Planning Council 2010). The system is organized into seven categories including: integrated development process, natural systems, liveable buildings, precious water, resourceful energy, stewarding materials and innovative practice. The rating stages include design, construction and operational.

- Leadership in Energy and Environmental Design (LEED) – This is a rating system for the planning, construction and operation of "green" buildings, homes and neighbourhoods. It provides a framework for environmentally friendly infrastructural development, operation and maintenance.

1.8.2 Adaptation

The construction of the 1.2 kilometre boardwalk in Barbados protects the coastal infrastructure from storm surge and sea level rise and provides access to the south coast of the island. The boardwalk also provides significant social and economic benefits to Barbados. Given the success achieved under the project the country has undertaken further investment through a project to expand its shoreline infrastructure designed to withstand climate change impacts.

The Richard Haynes Boardwalk, Barbados

Source: www.gov.bb

Rainwater harvesting is another best practice, which is already conducted in the region. Countries include but are not limited to the BVI and St. Thomas, where rainwater harvesting is mandated by law. Within the context of climate change, rainwater harvesting has also proven to be invaluable in disaster management. After the passage of Hurricane Ivan in 2004, the Tri-state islands of Carriacou and Petit Martinique fared better than the mainland, Grenada, as these islands rely on rainwater harvesting. In Grenada, the centralized water supply was interrupted by the passage of the storm.

1.9 Threats to Climate Change Resilience Initiatives

A major threat to developing climate change resilience is budgetary constraints at the national and local levels. In the case of Jamaica for example, policies have not been adequately financed, therefore impeding implementation. There is therefore a mismatch between capacity and measures to be implemented. This issue is also true for other cashed strapped territories such as Haiti, Dominican Republic and Guyana.

Another major risk for Jamaica relates to the economic policy, which seeks to secure employment at the expense of environmental conservation and resilience. For example, the construction and operation of large hotels on the north coast provides employment for Jamaicans but has a negative impact on coastal areas. These hotels will eventually be threatened by sea level rise and storm surge.

Similarly, the development control process is cumbersome and time consuming and is informed by outdated policies. In addition, there is a lack of planning and enforcement. This has resulted in formal and informal developments in high risk areas and the degradation of the natural environment. In Jamaica, a major issue is the autonomy of the UDC and the Ministry of Housing facilitated by their respective Acts. These Acts have influenced the inconsistency of development standards and the exploitation of loopholes in the regulatory framework by developers.

Inadequate datasets and data sharing amongst agencies negatively impact decision making relating to climate change resilience, as there is negligible use by planning agencies of data produced by research entities such as the Climate Studies Group, UWI, in the case of Jamaica. Furthermore, the development of some planning policies took into consideration climate related risks, for example, flooding and hazards related to coastal areas. However, these policies do not reflect current trends of climate related data. Climate risk consideration is therefore outdated and does not reflect current reality.

The inability/reluctance of the state to enhance and encourage public awareness of climate change and best practices and standards related to resilience further limits the region from successfully managing its vulnerability against effects of this global problem.

1.10 Areas for improvement

There are several initiatives that can be taken by the state to effectively and efficiently address climate change resilience. These include:

- Program financing at the national and local levels
- Research on risk appetite and economics of climate change
- Innovation in adaptation to climate change
- Mainstreaming specific adaptation measures into physical planning and development policies at the national and local levels
- Development and use of modern mechanisms for integrated planning
- Implementation of adaptation measures on the ground, which specifically address national and local needs.
- Generation and use of current scientific information by the region
- Enforcement of planning and environmental regulations
- Political will to develop and implement policies (e.g. no build zones and relocation) at the national and constituency levels.
- The employment of specialist personnel, for example, in the area of GIS.

Legislative Assessment

2.1 Policy Background

In response to the impact of climate change on sustainable development, several CARICOM states have employed mitigating strategies that incorporate resilience and adaptation frameworks into the regulatory infrastructure of the state. These strategies are executed through the introduction of revised or new legislation, policies and development/building standards. The Regional Framework for Achieving Development Resilient to Climate Change (2009-2015) is one such policy that provides CARICOM states with guidelines for incorporating climate change resilience concepts into physical and environmental planning and building standards. This framework is geared at reducing the vulnerability of the state's natural and human systems from the negative effects of climate change. Therefore, states abiding by this framework will seek to:

- Revise building codes, to include restricting construction in areas susceptible to coastal flooding, landslides, or tidal surges;
- Develop new standards for road construction to ensure adequate surface drainage;
- Implement integrated land-use planning;
- Develop new legal tools that make for a more responsive insurance industry.

In addition to the abovementioned framework, CARICOM states have adopted several other policies that focus on climate change adaptation in physical planning. These policies include:

- Liliendaal Declaration on Climate Change and Development (2009)
- Caribbean Risk Management Guidelines for Climate Change Adaptation Decision Making (2003)
- Draft Implementation Plan for A Regional Framework for Achieving Development Resilient to Climate Change (2011)
- The Caribbean Catastrophe Risk Insurance Facility (CCRIF)

The adoption of these regional polices has thus far influenced policy reviews at the national level that specifically addresses climate change resilience. For example, St. Lucia has created the National Climate Change Policy and Adaptation Plan (2001) that addresses physical planning; the Ministry of Natural Resources and Labour in the British Virgin Islands developed the Virgin Islands Climate Change Adaptation Policy 2012; and Grenada constructed the National Climate Change Policy and Action Plan 2007-2011. Jamaica has also drafted the National Climate

Change Policy and Action Plan 2012 which focuses on designing tools and mechanisms that will incorporate climate change into physical planning systems and vulnerable sectors so as to manage and improve the state's response to disasters and risks. These strategies will include establishing screening procedures for climate change impacts in EIAs; incorporation of environmental valuation methodologies for planning approval; review and enforcement of building standards and guidelines; and delineation of vulnerable areas in the National Spatial Plan; exploring opportunities for micro-insurance schemes; strengthening early warning systems; and relocation of persons living in disaster-prone areas and facilitation of climate resilient housing and infrastructures in these areas where appropriate. These policies provide a comprehensive framework for implementing improved and updated building codes, regulating physical planning and zoning while also ensuring environmental protection from the negative effects of development. In order to achieve the above stated goals effective climate change legislation must therefore be implemented that conforms to international and regional standards.

2.2 Legislative Background

Jamaica's current legislative background presents a somewhat limited and delayed response to legitimising climate change resilience regulation in the state's physical planning, zoning, and environmental protection frameworks. Nevertheless, there are several key legislations that are presently enacted that address environmental control and physical planning which will in turn provide the basis for the enactment of climate change resilience legislation that regulates building codes and standards. The Town and Country Planning Act 1958 (TCP Act) and the National Resources and Conservation Authority Act 1991 (NRCA Act) are the main pieces of legislations that regulate environmental and physical planning in Jamaica. Both entities were administratively but not legally merged to form NEPA. NEPA has no legal standing and issues decisions in the name of the 2 entities that comprise it.

The NRCA Act governs environmental control and acts as the singular authority that effectively manages the physical environment ensuring the "conservation, protection and proper use of its natural resources" (NRCA Act 1991: section 4.1a). The act provides codes and standards of practice that regulates:

1. the rehabilitation of the environment;
2. the quantity and type of substances that can be released into the environment;
3. the description and category of enterprises for which EIAs are required;

4. the management – handling and disposal of hazardous substances;
5. the establishment of ambient air quality standards, air pollution monitoring system and index, and the manufacturing, use and emission of air contaminants;
6. the discharge of waste and the associated fees;
7. the administration and management of waste;
8. the administration and management of national and marine parks, protected areas, public beaches and other public recreational facilities; and
9. the limits or prohibits the production or procurement of implements to kill, catch or destroy animals, any action that could make extinct prescribed species of flora or fauna, etc.

The NRCA's authority in the protection and conservation of the physical environment is vested in its Permit and Licensing System which plays an integral role in Jamaica's physical development. Individual's attempting to undertake any 'enterprise, construction or development of a prescribed description or category' in a 'prescribed area' must obtain a permit, called for our purposes 'an environmental permit' in order to carry out development". The NRCA's developmental remit is 'geographically unrestricted' as it defines the entire island and its surrounding territorial waters a prescribed area. The forms of development projects authorised under the permit include, "office complexes of 5,000 square feet or greater; watershed development and soil conservation projects; felling of trees and clearing of land of 10 hectares or more for agricultural development; and clear cutting of forested areas of 3 hectares or more on slopes greater than 25 degrees" (NRCA Act 1991). The types of buildings permitted in designated areas must be of general type that does not have far reaching implications to the environment which supports the notion that the NRCA Act is capable of promoting the construction of climate change resilient buildings throughout the island if the state was so inclined.

The zoning capabilities of the NRCA Act supports the assertion that it is capable of restricting development in areas that are vulnerable to the impact of climate change, such as rising sea levels and increased flooding, by declaring these areas protected or natural parks. According to the Natural Resources (Marine Parks) Regulations 1992 and the Natural Resources (National Parks) Regulations 1993 activities such as the removal of sand, coral and seaweed; dredging of sand or any excavation or mining activities; the discharge of liquid waste to lighting fires, disposing of solid waste in national and marine parks are strictly prohibited and punishable by law. The Watershed Protection Act, 1963 and the Beach Control Act operates similar legislation

to that of the NRCA Act in that they also promote the protection and conservation of protected areas from activities that would destroy the natural integrity of the area. It must be noted however that the declaration of protected areas under these acts is subject to the approval by the Minister who must approve the making of regulations by the Authority for "ensuring the proper, efficient and economic utilization of land in watershed areas with a view to promoting the conservation of water resources" (Watershed Protection Act 1963: section 8), thus limiting power of the acts.

The Town and Country Planning Act 1958 legislates the execution of physical planning in Jamaica. It does so through a centralized Town and Planning Authority that works in tandem with local planning authorities, which are in fact the parish councils. As a result, there is a local planning authority in each of the fourteen parishes of Jamaica, with the exception of the Kingston and St. Andrew authorities which are merged as one body, the Kingston and St. Andrew Corporation. The Minister responsible for planning appoints a person or persons to be the Town and Country Planning Authority. He can also, subject to the provisions of this Act, define the composition, powers and duties of such Authority (Town and Country Planning Act 1958: section 2.1). Application for planning permission for any development must be made to the local planning authority. In special circumstances the Town and Planning Authority may "call-in" an application for planning permission or such an application must be referred to it (Town and Country Planning Act 1958: section 12). The Act empowers the Authority to control the use of land in both rural and urban areas with the intention of "… securing proper sanitary conditions and conveniences and the coordination of roads and public services, protecting and extending the amenities and conserving and developing the resources of such area" (Town and Country Planning Act 1958: section 5.1).

The term 'development' in the TCP Act refers to "the carrying out of building, engineering, mining or other operations in, on, over or under land, or the making of material change in the use of any buildings or other land"(Town and Country Planning Act 1958: section 5.2). Development as defined by the TCP Act does not entail the:

1. Maintenance, improvement of other alteration on the interior of buildings;
2. Maintenance or improvement of road works;
3. Inspecting, repairing or renewing sewers, mains, pipes, cables, the breaking open of lands for that purpose;

4. The use of any enclosed area around a dwelling house for any purpose incidental to its enjoyment;
5. Use of land for agriculture or forestry and the use of buildings together with the land for any of those purposes;
6. Use of buildings or land for any purpose of any class specified in a development order.

In the case of certain types of developments requiring an environmental permit, planning permission cannot be granted until the NRCA has granted or indicates that it intends to grant a permit. The planning permission granted by the local authority can be subject to conditions for (a) regulating the development or land use or requiring works to be carried out on the land for purposes of or in connection with the authorized development (b) for requiring the removal of any buildings or works authorised by the permission or the discontinuance of any authorized land use at the expiration of a specified period and the carrying out of any works required for the reinstatement of land at the expiration of that period and any such permission granted subject to any such condition.

The TCP Act further provides for the preparation of interim, provisional and confirmed Development Orders (DOs) which are the main instruments for guiding and regulating the use of land. DOs specify what sort of development may take place within a certain geographical area, being all or a part of a parish. Their general object is developing the land – whether or not there are buildings on it – with a view to (i) preparing proper sanitary conditions and conveniences (ii) coordination of roads and public services (iii) protecting and expanding the amenities (iv) conserving and developing the resources of such an area (Town and Country Planning Act 1958). The majority of the DOs are outdated and were developed at a time when climate change was not a consideration and therefore they do not stipulate adaptation or risk reduction measures related to current climatic trends. The only recently prepared instrument is the St Ann Development Order, which was confirmed in 2000. While it has provisions for wastewater recycling, energy use, waste disposal and environmental conservation, it does not explicitly address climate change impacts. DOs consist of maps with zones focusing on built areas and are based on regional or parish development plans. Development plans (and the Development and Investment Manual) provide planning guidelines for areas without DOs. These plans are not recognized in law and the slow preparation process has resulted in many areas not having development orders (Office of the Cabinet 2010).

The Second Schedule to the TCP Act specifically addresses "Building and Other Structures" which is of particular importance to the purpose of this study on climate change resilience buildings. Under this section the Act manages the:

1) Regulating and controlling, either generally or in particular areas, all or any of the following matters, that is to say-
    a. the size and heights of buildings;
    b. building lines, coverage and the space about buildings;
    c. the objects which may be affixed to buildings;
    d. the purposes for and the manner in which buildings may be used and occupied including in the case of dwelling-houses, the letter thereof in separate tenements;
    e. the prohibition of building operations on any land, or regulating such operations.
2) Regulating and controlling the design, colour and materials of buildings and fences
3) Reserving or allocating any particular land, or all land in any particular area, for building of a specified class or classes, or prohibiting or restricting either permanently or temporarily, the making of any building or any particular class or classes of buildings on any specified land.
4) Limiting the number of buildings or the number of buildings of a specified class which may be constructed, erected or made on, in or under an area (Town and Country Planning Act 1958)

In addition to managing the built environment, the issue of zoning is also handled by the TCP Act under "Community Planning". This section provides the TCP with the Authority to manage the "control of land by zoning for specific uses; regulates the layout of housing areas including density, spacing, grouping and orientation of houses in relation to roads, open spaces and other buildings" (Town and Country Planning Act 1958); and determines the "provision and siting of community facilities including shops, schools, churches, meeting halls, play centres and recreation grounds in relation to the number and siting of houses" (Town and Country Planning Act 1958).

It is significant to note that some of the DOs relating to the parishes in which communities were mapped for this project were reviewed and none showed any particular specificity in terms of building design. They are the:

1. The Town and Country Planning (Kingston) Development Order 1966

2. The Town and Country Planning (St. Catherine Coast) Provisional Development Order 1964
3. The Town and Country Planning (St. Mary Coast) Provisional Development Order (Confirmation) Notification 1963.

2.3 Building Codes

Though Jamaica is known for having relatively good building practices, the devastations experienced during flood events, hurricanes and storms, as well as reports on areas vulnerable to earthquakes and other hazards, show that there are still major risks. Noel DaCosta, engineer, noted in 2010 that 40 to 70% of buildings in Kingston (the capital of Government and commerce) will collapse under a major seismic event; 30% of engineers in Jamaica do not know about Caribbean Uniform Building Code (CUBIC), while 24% knew of it but did not use it; outdated building codes were being used well beyond their useful life; while the tourism and other industries, on which the Jamaican economy heavily depends, now require that buildings are constructed and maintained according to international codes and standards. These risks (or shortcomings) have led to significant losses from infrastructural damage and destruction caused by weather events of the past.

In light of the above, the current building laws are said to be in an advanced state of review. They are primarily found in the Parish Councils Building Act 1908 and the Kingston and St. Andrew Building (KSB) Act 1883. Building applications made under the KSB Act must be accompanied by accurate plans and ground plans and there are requirements for spatial arrangements of buildings, parking spaces and so on. Aesthetic and safety aspects are also considered as is the character of the neighbourhood that the erection or re-erection is proposed to take place. Frontage, elevation and design are all referred to as material considerations for the grant of permission. Save for these types of considerations, there is no requirement or incentive given for the use or design of environmentally friendly material or structures respectively. Conversely, the Parish Councils Act mainly deals with provisions for the administrative running of parish councils such as procedures for election offices. However, it also confers parish councils with the power to compulsorily acquire land[1] for cemeteries or for any other public purpose. They may also define, for all or any specified purpose, the limits of any town or village in such parish[2], save that such resolutions do not come into effect until there is Ministerial approval. Parish councils may also make regulations regulating the construction of

[1] Acquisition under the Land Clauses Act; Section 109 Parish Councils Act
[2] Section 114 Parish Councils Act

buildings in towns and imposing suitable conditions and restrictions as to the elevation, size and design of houses to be built[3].

The Building Bill 2011, which if passed into law in substantially its current form, will represent the most explicit requirement in Jamaican law for buildings to reflect sound environmental principles in their construction and design. It expressly recognizes international building standards and has a stated object to promote the construction of environmentally and energy efficient buildings. It seeks to establish an effective and efficient system for issuing building permits and establishes Local Building Authorities (LBAs) which are the parish councils. In this way the Building Bill allows them to retain their control over planning and building activities. Particular powers of significance are that of the LBAs to make regulations for the enforcement of the Act and the National Building Code and to ensure that designs submitted in respect of building application are in compliance with the provisions of the relevant code and that works executed in respect of building permits are undertaken by competent individuals. The Bill does not seek to remove the primary jurisdiction for building permission from the local planning authorities (being the parish councils), but formally incorporate a National Building Code of Jamaica that would update and standardize building engineering and design requirements and formally harmonize them with current best practices. Significantly the Building Bill aims to facilitate the incorporation of design concepts for climate change resilient buildings. This should be a significant area of law reform that might help to encourage the incorporation and eventual proliferation of climate change resilient buildings. A perfect complement would be the revision of the relevant DOs, which could cause such buildings to be pre-approved for planning permission in specific geographical locations.

[3] Section 121 Parish Councils Act

Economic Review

The more climate change resilient the building, the more energy efficient and structurally sound it is likely to be. "Buildings are responsible for more than 40 percent of global energy use and one third of global greenhouse gas emissions, both in developed and developing countries. The building sector has the largest potential for delivering long-term significant and cost-effective greenhouse gas emissions (UNEP 2009). The construction sector and regulatory bodies can, therefore, play a significant role in the reduction of greenhouse gases, to reduce the potentially severe impacts of climate change.

Regulatory authorities have a responsibility to ensure that there is adherence to the provisions of the laws, through clearly communicated standards, consistent monitoring and the application of sanctions where there are breaches of the stipulated guidelines. These actions have significant implications for the economy. The Economics of Climate Change Adaptation Initiative explains that integrating:

> climate resilience measures with economic development strategies is also likely to help unlock the funding required both to address existing climate risk and adapt to climate change. The UNFCCC recently estimated that by 2030 the world will be spending an additional $36-$135bn each year to address impacts associated with climate change – and that $23-$55bn a year in additional investments and financial flows will be needed to fund adaptation in the developing world. Regardless of the size of the adaptation fund likely to be agreed upon in Copenhagen, the majority of this funding will need to come from the private sector. ... Indeed, well-targeted, early investment to improve climate resilience is likely to be cheaper and more effective for the world community than complex disaster relief efforts after the event (ECA 2009: p.56-57).

Caribbean countries must employ a combination of strategies that are appropriate to the levels and types of risks, in order to mitigate the impacts that climate change risks can have on the economy, life and property. The imperative is, therefore, to build climate resilience strategies – including building designs – into countries' economic development plans and strategies.

The PIOJs Urban and Regional Planner, Allison Richards estimated that losses from six major storm events, including hurricanes and floods between 2002 and 2007 totalled $73.19 billion. She also highlighted the fact that the most severe impacts of climate change are likely to take

place along Jamaica's coastal areas. This has significant economic implications, as most of Jamaica's population (~70%) live along the coastal areas (STATIN 2011); most tourism facilities, urban centres and industries are also located along the island's coastlines. Tourism is Jamaica's second largest provider of foreign exchange. Jamaica needs large inflows of foreign exchange to maintain the required reserves, meet payments for imports which make up a significant part of inputs for the productive sector, high consumer demand, and its external debt obligations, for a public debt that is higher than 140% of it national output/income (GDP). Climate change resilience is therefore, integral to the livelihood and very survival of the people of Jamaica and the Caribbean.

3.1 Climate Change and Energy Costs

The Latin America and Caribbean (LAC) region has been able to reduce greenhouse gas emission by 11% through improvements in land use and energy efficiency (IDB 2012). Land use policies and greater energy efficiency are therefore integral to developing design concepts for climate change resilient buildings in Jamaica. The country's cost of energy is exceedingly high, and has served as a deterrent to investment and growth. According to the Minister of Science, Technology, Energy and Mining Minister, the Hon. Phillip Paulwell,

> To date, Jamaica's heavy dependence on imported petroleum as its primary source of energy continues, as over 70 per cent of Jamaica's total energy mix is supplied by imported fuels. Over 90 per cent of Jamaica's electricity is produced from imported petroleum-based fuel. The sector is further shackled by aged and inefficient infrastructure. The average Jamaican household uses about 170 kWh of electricity per month. At current electricity prices of US$0.40/kWh, one of the highest in the region, the monthly electricity bill is already beyond the reach of thousands of Jamaican families and is making an increasing number of businesses uncompetitive (Paulwell 2012).

This statement clearly shows that there is an overdependence on energy from fossil fuels that is exacting a high cost on the economy. He further noted that the high cost of energy affects the inflation rate, exchange rate, disposable income and even the country's reserves at the central bank (Bank of Jamaica). He believed that economic growth could be significantly enhanced if electricity prices could be reduced to US$0.15 - $0.18 per kWh. Climate change resilient building which are recognizably energy-efficient by design, can contribute significantly to this goal/target, and improve Jamaica's global competitiveness. The Minister reported that US$4.6 million was channelled to the Development Bank of Jamaica (DBJ) for concessionary loans to assist Small and Medium Enterprises (SME) to retrofit and achieve greater levels of energy-

efficiency. As the impacts of climate change become more pronounced the required improvements to standards and adjustments (through retrofitting, relocation or removal) must be carried out expeditiously, to save lives, property and the economy from collapsing under the strain of reconstruction and recovery costs.

In examining design concepts for climate change resilient buildings one has to examine the high energy cost borne by the government, households and businesses in Jamaica. Between 2004 and 2007 the cost of energy in the public sector increased by approximately 4% per year; then peaked even further by 7% in 2008. Jamaica's Energy Policy 2009-2030 had indicated that the cost of imported energy was projected to increase to US$4.6 billion by 2020 (Ministry of Mining and Energy 2009). The US$90 million IDB financed Public Sector Energy Efficiency and Conservation Programme (PSEECP) is expected to help to reduce these costs (by 30%) and enhance energy efficiency. An overall expenditure of $7.8 billion was expected to lead to cost savings of $3.2 billion per year, if energy-efficiency standards are consistently implemented and observed.

Stern (2006) argued that for developing countries to invest in low-carbon, the incremental cost would have been US$20 to $30 billion per year. They felt that the process would be more effectively driven by national, regional and sectoral emission reduction objectives, through policies and programmes, more so than through projects. The Climate Works Foundation (Project Catalyst, 2009) noted that the cost to transition to a low-carbon economy is less than 1% of GDP per year, as long as the right policies and provisions are in place. They also highlighted the added benefits that can be gained, such as greater levels of employment and increased resource productivity, as persons provide goods and services for retrofitting building insulation and lighting. A point of concern for the ordinary citizen or business operator has been the cost of retrofitting. They have however, pointed out that "The costs of photovoltaic solar for example have declined 20 percent with every doubling of installed capacity. This means the decision to apply new climate change resilient design concepts is much more affordable than in the past decade. Rodgers (2012) noted that:

> Rooftop panels, which could last for 25 to 30 years, will now pay for themselves in just six or seven years, claim advocates. Until recently, the pay-back period was up to 20 years. The cost of solar cells has fallen by as much as 49.5 per cent since the start of 2011, according to the PVX spot market index, which tracks the monthly wholesale costs of the industry.

This dramatic cost reduction creates opportunities for businesses and household within the Caribbean to drive the process of energy efficiency and economic viability through these alternative energy sources.

Huge economic benefits can be gained and greater levels of economic growth stimulated by harnessing energy from sunlight and water in the Caribbean region. The island of Barbados, for example, has been lauded for successfully being able to get a large number of its citizens to harness the use of solar power. This was achieved through an initiative to reduce the cost of energy through incentives, as early as the 1970s, when 84 solar water heating units were installed in a housing development at Oxnard, St. James, Barbados (Epp et al 2009). They further reported that:

> 270,000 inhabitants already benefit from the 45,000 solar water heating systems for private, public and commercial buildings on Barbados. Two out of five households on the island use solar energy to heat their water.
> (Epp et al 2009).

Even as costs for solar panel and systems continue to fall, a 2009 example from Solar Dynamics in Barbados is instructive. The table below provides a comparison of the cost of electrical water heater vs. a solar water heater in Barbados in 2009.

Table 2: Comparative Cost of Switching to Solar Water Heater in Barbados – in 2009

Item	BBD$
Cost and Installation of an electric water heater in Barbados – 2009	1,000
Electricity Bill at 4000 kWh over 2 years	4,800
Total Cost in First 2 Year	**5,800**
Investment Cost of 80 gallon Solar Water Heater in 2009	4,900
Tax Deduction (incentive)	1,125
Net (Solar) Investment Cost	**3,775**

Source: Epp et al/Solar Dynamics (2009) table recreated from page 4 of their article

3.2 Cost of Climate Change Impact on the Caribbean

In August 2010 the CCRIF published a study on 'Enhancing Climate Risk and Adaptation Fact Base for the Caribbean'. The findings were based on Case Studies of eight Caribbean countries, namely: Anguilla, Cayman Islands, Antigua and Barbuda, Dominica, Barbados, Jamaica, Bermuda and St. Lucia. Their focus was to quantify the possible impact of climate change on

three hazards: (1) Hurricane-induced wind damage; (2) Coastal flooding/storm surge; and (3) Inland flooding from both hurricanes and tropical storms. The CCRIF (2010) noted that:

> Annual expected losses from wind, storm surge and inland flooding amount to up to 6% of GDP in some countries. Climate change has the potential to exacerbate these risks, and could increase expected losses by 1-3% of GDP by 2030. Climate change thus poses one of the most serious threats to development prospects in the Caribbean.

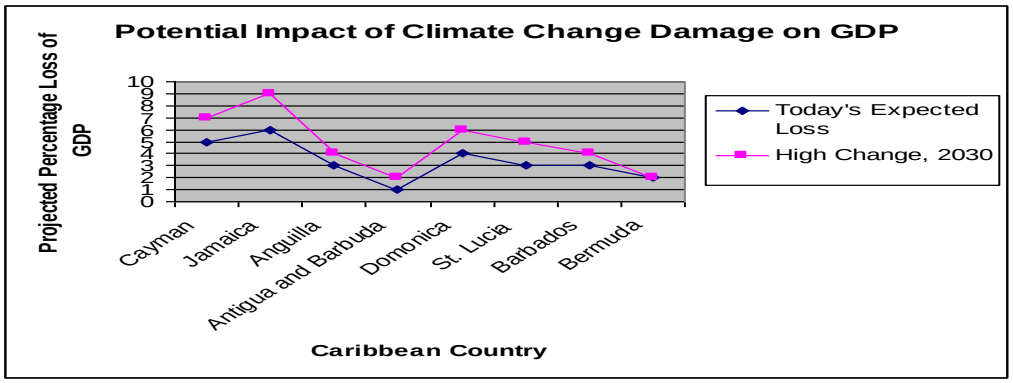
They highlighted that while climate change has historically been focused on mitigation, the Copenhagen Accord required that fast-start funds of US$30 billion be divided suitably between adaptation and mitigation, from 2010 through 2012. The findings are summarized below:

- Current climatic and economic conditions in the countries studied show that annual expected losses range between 1% and 6%; with significant variations across countries. For example, Jamaica' expected loss was 6% of GDP (with potential to increase by 1-3% with climate change effects), while that for Antigua & Barbuda was 1%. This means that with a 'high climate change scenario' the increase would be [(1-6%) + (1-3%] = 2% to 9% of GDP could be lost, in Jamaica's case, if the climate change outcomes are as predicted.

Table 3: Potential GDP % Loss from Climate Change

COUNTRY	Today's Expected GDP % Loss	High Change GDP % Loss 2030
Cayman	5	7
Jamaica	6	9
Anguilla	3	4
Antigua and Barbuda	1	2
Dominica	4	6
St. Lucia	3	5
Barbados	3	4
Bermuda	2	2

Source: CCRIF (2012)



As the table and graph above show, all of these Caribbean countries stand to lose a certain percentage of GDP if climate change continues unabated. Cayman, Jamaica, Dominica and St. Lucia, are expected to bear the highest percentage of losses. CCRIF reported further that the factors driving these risks, which affect the countries economically, are:

- Topography – landscape and geographical layout;
- Economic importance of special sectors;
- Location

3.3 Impact on the Macro-Economy and Analysis of Building Stock

In order to properly evaluate the economic impact of developing design concepts for climate change resilient buildings in Jamaica, one has to examine the quality and type of building stock in the island. The term 'building' is taken in this analysis to mean "a physical structure which is separate and independent from any other" (STATIN 2001). The current building stock in Jamaica is a combination of structures along a wide spectrum with regards to age, condition, building materials placed on different geological foundations, and along different elevations and slopes.

George (2009) conducted a study to compile a housing quality index for Jamaica's National Housing Trust, looking at: type of wall; use of toilet by type; method of water supply; use of kitchen; and persons per household. A low percentage suggests low quality. He noted that the overall index appeared low at 67% in 2006 which was eight percentage points (8%) above the 1994 score; and "Based on the Index, in 2006, roughly one in every three dwelling units in Jamaica was of substandard quality."(p. 37). In 2008 he also stated that "In Jamaica, builders do what they want outside the DO Areas. After Hurricane Ivan a variety of building professional bodies implored that the island's building code be revised and DOs be prepared to control

construction in vulnerable locations island-wide" (George 2008: p. 68) . As the World Bank (2011) noted:

> The private sector and development agencies often drive a large part of a city's economic and land use decisions, and can' thus, promote the city's resilience by making investment decisions that take climate impacts into consideration (for example appropriate building designs in flood prone zones, improved standards of waste and waste water treatment, and promotion of green building designs that can cool occupants naturally (p. 27)

The 2001 census data from the Statistical Institute of Jamaica (STATIN) shows that there was a total of 609,277 households in detached (599,806) units in Jamaica. Of this number 21,798 were listed as "Squatted". By the end of the 2011 Population and Housing census, this figure fell to 8,788. Even with the decrease, however, there are significant vulnerabilities, as the 8,788 units represented 31,439 households who dwellings are not sufficiently resilient to withstand the ravages of a heavy rain event, and worse a storm or hurricane.

Another useful measure of vulnerability or resilience in the building stock is the "Type of Roofing Material" and "Material of Outer Wall". This would be a relatively good proxy of building resilience. The two tables below focus on the areas that are frequently devastated during natural disasters. These areas represent approximately 70% of the total units reported on by STATIN.

Table 4: Number of Housing Units by Type of Roofing Material, by Parish - 2001

Parish	Total	Metal Sheeting	Wooden Shingle	Other Shingle	Tile	Concrete	Other	Not Reported
Jamaica	**599,806**	**489,939**	**7,467**	**5,894**	**2,059**	**82,231**	**3,479**	**8,737**
Kingston	13,850	11,704	183	15	5	1,657	92	194
St. Andrew	110,868	81,295	2,598	2,653	567	20,574	1,056	2,125
St. Thomas	24,758	22,593	515	96	16	1,217	66	255
Portland	21,545	20324	130	122	19	489	135	326
St. Mary	29,177	26,984	319	250	53	1,107	155	309
Manchester	45,386	40,934	408	148	362	2,637	327	570
Clarendon	57,558	52,957	113	130	104	3,254	251	749

St. Catherine	98,523	69,501	995	718	414	25,064	314	1,517

As was observed in Hurricane Gilbert and even the most recent Hurricane Sandy (October 2012) shingle roofs and those made of metal sheeting (especially if not strapped firmly to a strong ceiling foundation) have been damaged or destroyed during the disasters. The three most devastated areas after the passing of 'Sandy' in 2012 were St. Thomas, Portland, St. Mary and deep rural St. Andrew. According to the STATIN report of 2001, more than 90% of the roofs in the first three parishes and 73% of those in St. Andrew were made of metal sheeting (zinc). Those made of shingle (not decramastic) are even less resilient.

Another related data set that was only available for 2001, provided information on the material from which the outer walls of housing units have been built. While 399,665 or 67% of the housing units were reportedly constructed with concrete and blocks, the remaining 33% were made of stone, brick, 'nog', wattle and daub (clay), wood, bricks and other materials not stated. Several of the houses in St. Thomas, Portland and St. Mary demolished by the ravages hurricanes, appeared to have been built of these less resilient materials.

This lack of resilience has major cost implication for the Government of Jamaica, who is normally called upon to assist householders with repairs and recovery in the aftermath of a disaster. This information will, therefore, be useful to policy makers in the economic assessment of climate change resilient building, as well as budgeting for recovery, and making amendments to building codes and planning guidelines.

3.4 Cost Benefits Analysis

It is conceptually, ethically and empirically very difficult to quantify the total range of effects and place a monetary value on the impact of climate change on health and the environment (Stern 2006). However, according to the IPCC (2007):

> Implementing carbon mitigation options in buildings is associated with a wide range of co-benefits. While financial assessment has been limited, it is estimated that their overall value may be higher than those of the energy savings benefits *(medium agreement, limited evidence)*. Economic co-benefits include the creation of jobs and business opportunities, increased economic competitiveness and energy security. Other co-benefits include social welfare benefits for low-income households, increased access to energy services, improved indoor and

> outdoor air quality, as well as increased comfort, health and quality of life. In developing countries, safe and high-efficiency cooking devices and high-efficiency electric lighting would not only abate substantial GHG emissions, but would reduce mortality and morbidity due to indoor air pollution by millions of cases worldwide annually.

3.4.1Climate Change and Externality

Climate change is an externality that is caused by human action. Unlike externalities such as dust emission and second-hand smoke, that are localized, climate change is global in reach, and can be severe in its impact. Due to the long time that may elapse before the impacts of climate change are realized, one generation's action will impose the real costs of climate change on future generations. When people cannot see the immediate effect of their actions, they may be hesitant to take the urgent steps required to make amends, or change behaviour. This makes it difficult for governments and regulatory agencies to recoup the real costs of climate change from those contributing most significantly to it.

There is a cost, which is borne by society for every unit of greenhouse gas that is emitted into the atmosphere, and which can remain there for centuries. This makes it even more important for public policy to be used to provide the tools and sanctions required for effective regulation and remuneration to those affected. Two sets of policies need to be considered in this regards:

1. Policies to regulate the process of development, to ensure that relevant laws are current and enforced; with the requisite provisions to effectively monitor and control zoning, waste management, spatial planning and structuring of the built environment;
2. Policies and processes to maximize the benefits of carbon credit from countries that are contributing significantly to the emission of greenhouse gases and other pollutants that negatively impact all our lives and state of wellbeing (or lack thereof).

A financial analysis of climate change must include the actual, as well as the notional and social costs that are often missing from standard project proposals. As the IPCC (2007) noted:

> It is *very likely* that globally aggregated figures underestimate the damage costs because they cannot include many non-quantifiable impacts. It is *virtually certain* that aggregate estimates of costs mask significant differences in impacts across sectors, regions, countries and populations. In some locations and amongst some groups of people with high exposure, high sensitivity and/or low adaptive capacity, net costs will be significantly larger than the global average.

The challenge in this regard is to quantify these costs in a manner that will be understood and acceptable to the relevant stakeholders. The costing process cannot be delayed; neither can these elements of analysis be disregarded, due to the potential severity of the impact of climate change on buildings, and the importance of designing to strengthen resilience going forward.

The economic principle of scarcity does not apply to climate, and so very often producers (especially those in industrialized nations) do not factor in an input cost from its use. Industrial (and even some domestic and agricultural) activities contribute to the emission of greenhouse gases. Since the impact and costs are not readily discernible or measurable the cost may not be absorbed by the emitter. Consequently, policy makers must implement measures to address these anomalies. This analysis is suggesting that the impact of climate change must now be priced as a contingent cost in the national budgets; and the cost of emission must be borne by the imposition of fees, taxes or emission limits on producers, residents and other emitters, whose activities contribute to climate change. Stern (2006) identified four important points that must be noted in assessing the cost or benefit of reducing the impact of climate change:

> Climate change is an externality that is global in both its causes and consequences … The impacts of climate change are persistent and develop over time. Once in the atmosphere, some GHGs stay there for hundreds of years … The uncertainties are considerable, both about the potential size, type and timing of impacts, and about the costs of combating climate change; hence the framework used must be able to handle risk and uncertainty. The impacts are likely to have a significant effect on the global economy (p. 25.1)

The Commonwealth Foundation (2007) noted that there were three main elements that prove that the cost of taking effective and urgent action to build resilience to climate change will ultimately be less than the cost to remedy the impacts of climate change. They believed this could be done:

> First, by reviewing the physical science base on which any economic analysis must rest. Second, by considering the risks of damage from future climate change, and the human and economic costs associated with that damage. Third, by looking at the costs of action to mitigate climate change (p. 24).

3.4.2 Classification of Costs

There are social, environmental and economic costs associated with climate change and building resilience:

a) Social Costs

- Displacement and upheaval of community due to lack of climate change resilience during hazards and natural disasters; cohesiveness within communities is also undermined as residents may have to be dispersed or relocated to find shelter and sustenance after the disaster.
- Increased demand on health care facilities from water-borne diseases and injuries;
- Increased education related costs as a result of damage during disasters;
- Implicit costs of starting over – especially as a result of psychological impact on community and individual from the loss of cohesion built over several years;
- Losses, from underperformance and under-productivity in the Educational, and Legal systems – due to poor conditions and lack of maintenance of essential infrastructure such as schools, police stations and court houses;
- Fatalities and injuries that reduces the human capital available for productivity;
- Damage to social infrastructure such as community centres used for habitation, recreation or socialization;

b) Environmental Cost

- Externalities – spill over from inaction – dumping of garbage in gullies and drains, emissions from industrial activities, and public waste management (e.g. Riverton fires) – again health is affected from exposure to fumes and toxins from incinerated garbage
- Behavioural: Sensitization and Public Education – to generate a greater consciousness of the need to protect the environment and reduce carbon emission - via media ads, brochures etc; and to sustain the message to reinforce and modify behaviour over time.
- Forestry – the costs of environmental losses may be quantified; but the role played by the reinforcement and soil integrity when trees are intact and prevent soil erosion may be understated.
- Increasing carbon footprint through the burning of fossil fuels, and unsustainable waste management practices.

c) Economic Costs

- *Direct Costs* – This is a cost that can be immediately identified with an expense, an activity or financial obligation.

  Most Caribbean islands are heavily dependent on the agricultural, manufacturing and services sectors. Climate change can affect some or all of the structures associated with the provision of goods and services. For example, after a severe weather event, there

are usually prolonged power-outages. Loss of electricity and transportation services (due to inundated or damaged road surfaces) have repeatedly affected the provision of services in all sectors, as commerce and trade are often halted or delayed considerably, as a result.

The IDB (2000) estimated that adaptation could cost 1/10 of the cost of damage to the physical infrastructure of a country or region. The World Bank 2010 found that "the cost between 2010 and 2050 of adapting to an approximately 2°C warmer world by 2050 is in the range of $75 billion to $100 billion a year." (p. 1). Infrastructure accounted for the largest percentage (24%) of annual adaptation cost. Water supply, flood protection and coastal zone accounted for a significant part of the infrastructural cost in the Latin America and Caribbean region. Seal-level rise, tropical storms and cyclones were the main hazards expected to contribute to these costs.

Table 5: Comparison of Adaptation Cost estimated by the UNFCC and EACC in US$ Bn.

		EACC	EACC
Sector	United Nations Framework Convention on Climate Change	National Centre for Atmospheric Research (NCAR) "wettest scenario"	Commonwealth Scientific and Industrial Research Organization (CSIRO "driest scenario"
Infrastructure	2-41	29.5	13.5
Coastal Zones	5	30.1	29.6
Water supply & flood protection	9	13.7	19.2
Agriculture, forestry, fisheries	7	7.6	7.3
Human health	5	2	1.6
Extreme weather events	-	6.7	6.5
Total	**28 – 67**	**89.6**	**77.7**

Source: Table 2 - United Nations Framework Convention on Climate Change (UNFCCC) and the Economics of Adaptation to Climate Change (EACC) page 7

As the Caribbean Development Bank (CDB 2012) pointed out, it has been difficult to quantify the economic impact of climate change in the Caribbean, due to the fact that (1) global climate change projections change rapidly, while (2) climate model projections that are spatially relevant have been limited. They estimated the economic impact of climate change in the Caribbean to be between 5 and 30%. The CDB argued that due to the "loss of tourism revenue, and infrastructure damage, the total cost of global inaction

to the Caribbean is projected at USD22 billion (bn) annually by 2050 and USD46 bn by 2100."(CDB 2012: p. 4). CRED/EM-DAT data on cost of natural disasters to date is showing that this is highly likely, as costs had moved from an average of US$700 million per year, 20 years ago to US$3.3 billion annually as at 2005. This means that costs have increased by almost 19% annually. As the impacts of climate change become more severe and far reaching, the costs may even be higher than this CDB projection. For example, Haiti's lack of infrastructural resilience resulted in damages over a few days (quake and aftershocks), amounting to more than US$8 billion from the earthquake in 2010.

The damage to buildings from most natural disasters is undeniably exacerbated by the consequences of climate change. Therefore, in assessing the cost of climate change and the resilience of the country's infrastructure (especially buildings) to withstand the rages of these disasters, one must look at the available data on the estimated and actual costs to date. Damage to fixed assets, physical and human capital such as housing, equipment, machinery, commercial and other buildings, crops, dams and tributaries, loss of school hours/days, loss of productive time, loss of life, should all be considered by national authorities when evaluating the cost of disasters as climate change events.

It has been established that long term growth can be enhanced significantly through effectively developing and utilizing a country's natural resources, endowments and capabilities in the form of physical and human capital. When these are destroyed or damaged by a climate change event, the economic impact can be catastrophic. The IDB (2000) noted that:

> If lost capital is not replaced, because of an insufficient public policy or private sector response to the disaster, there might be longer-term negative effects on the supply side, whose magnitude depends primarily on the capital per output ratio of the affected economy… If reconstruction is fully financed by insurance payments, the cost for the economy amounts to disaster insurance premiums paid by economic agents… When massive international assistance finances the replacement of lost capital, the cost for the economy as a whole is limited or null depending on the share of grants or concessional funds in the assistance package. (p. 23)

If the international assistance comes in the form of loan funding, this will increase the country's indebtedness and curtail expenditure in other vital areas, and so curtail economic growth. Other key issues must be considered: It may be difficult to calculate estimates of damage for low or middle income householders and some small businesses, as assets may not be insured; and valuations may not be readily available or current. This has implications for government to find creative partnerships through policy and legislation to enable self-insurance wherever this is possible.

- *Indirect Costs* - Indirect costs refer to costs that may not be immediately quantifiable due to the impact of climate change. These include:
  - Time Related
- dislocation and immobility caused by flooding which may make some corridors impassable and slow down the productivity process significantly;
- lost man hours due to lack of electricity and water;
- loss of crops not yet ready for harvesting;
- loss of teaching time or reduced attendance rates in schools may lead to underperformance by students in external exams – resulting in their inability to attain personal and professional goals. These very students may have to spend an additional year (at a cost) repeating the courses in order to matriculate or qualify for their respective career path.
  - Income Distribution and Deterred Investment
- Loss of infrastructure and inability of small business operators to recover quickly, may skew income distribution and worsen inequities.
- Inertia or aversion to invest – Since an economy that has been (or may be likely to be) ravaged by a disaster may not be readily able to attract significant Foreign Direct Investment (FDI) due to the perceived risks loss that may be incurred.

While some of these costs (direct and indirect) can be quantified and/or estimated, they are not always included in national assessments; and if included they may be understated, due to inertia from persons who may not have insurance or any hope of compensation.

3.4.3 Further Impact/Cost on Macro-economy

Macro-economic performance is normally examined in terms of GDP, Balance of Payments, Debt to GDP (especially external debt), etc. These assessments are usually done to compare before and after disaster economic performance to examine changes over a two to three year

period. While one can ascribe some changes to the impact of the disaster(s) there are other mitigating or enhancing factors that affect economic performance which may not be accounted for in the analysis. Aid and support for reconstruction may boost construction activity, for example, leading to improvements in that sector and Gross Fixed Capital Formation (GFCF). Refurbishment of assets and reconstruction of infrastructure should yield future benefits which may also be missed in the analysis.

Table 6: Impact of Disaster on Economy

Macroeconomic Indicator	Expected Change After Disaster
Growth Rate of GDP	Decrease or negative in year of disaster; increase in years 1 & 2 after
Agricultural Sector	Decline in production; type of crop determines duration of impact
Manufacturing Sector	Reduction of output due to infrastructural damage and/or interruption in inputs, including utilities
Export Sector	Impact depends on sectors affected and type of production process. If the sector is service-oriented the impact may be subject to reinstatement of communication, hospitality and other infrastructure.
Gross Fixed Capital Formation	Increase expected if funds are readily available for recovery; otherwise process could be hampered by debt obligation and other national priorities.
Inflation rate	Generally will increase; but may also be managed if there are tight fiscal controls, and monitoring of consumer groups to prevent price gouging.
Public Finances	Widening fiscal deficit; expanding external debt obligation; increased expenditure for infrastructural repair and social intervention.
Trade Balance	May record deficits if exports decline; again this depends on the structure of the industries and types of exports; a communication company could e.g. have off-shore back up sites that enable speedy recovery and minimal losses or downtime
Current Account	Current Account deficits may increase due to decreased exports; Capital flows from ODA may offset this impact

Source: IDB (2000) page 16 – Reconstructed from IDB Table #1.2

The table below provides a snapshot of the extent of the impact of natural disasters on the region. Even with access to data on the severity of the impact of climate change events and the cost to their economic, several Caribbean governments have failed to reinforce their infrastructure to make them more resilient to climate change events. Data from CRED/EM-DAT was used to construct the following table for continuance of the assessment in the 2000s.

Table 7: Social and Economic Impact of Natural Disasters in the Caribbean 1970-1999

Country	Total Occurrence	Total Fatalities	Population	Economic Losses in (1998) USM	Economic Losses as % of GDP
Antigua & Barbuda	7	7	91,000	105.7	18.1
Bahamas	4	5	351,000	290.4	9.5
Barbados	5	3	275,000	148.4	6.3
Cuba	35	181	11,249,000	578	Not available
Dominica	7	43	68,000	133.4	55
Dominican Republic	17	1839	10,183,000	2,657.2	17.3
Grenada	4	0	108,419	30.1	9.5
Haiti	31	2031	10,256,000	288.7	7.3
Haiti		222,570	10,256,000	8,000	
Jamaica	19	271	2,761,000	1,988.1	29.3
St. Kitts & Nevis	7	6	54,000	312.5	116.5
St. Lucia	8	54	178,000	1,554.6	272.3
St. Vincent	9	5	109,000	47	16.5
Trinidad & Tobago	8	9	1,351,000	16.7	0.3
Montserrat	5	43	5164	323.7	899
Turks and Caicos					

Source: IDB (2000) – EM-DAT; World Bank – extracted from p. 38

It is likely that a piecemeal approach may be taken if there is no clearly outlined strategy to develop and the design concepts required to build and sustain climate change resilience. There are so many uncertainties involved in assessing climate change (Stern, 2006; IPCC, 2007; Weitzman, 2007 and others) that the strategy employed must be robust enough to adjust for the dynamisms involved and experienced through changing weather patterns and other environmental conditions. Without this, the actions may involve huge costs, with short-term benefits, and severe long-term consequences. The cost of lack of resilience to climate change events is seen annually in loss of GDP in one or many Caribbean islands. As the World Bank (2012b) noted, "On average, at least one major hurricane and numerous tropical storms cross

the Caribbean each year. From 1979 to 2005, aggregate economic losses due just to storms were estimated at US$16.6 billion – US$613 million annually." (p. 1)

Green Paper No. 2/2010 Review

Jamaica has been plagued by the inability to provide adequate regulation of the built and natural environment in terms of development planning and the protection of the environment against natural and man-made hazards. Though certain measures have been implemented to address these issues, such as the drafting of a new building bill, these corrective measures are usually slow to enforce or are treated as an addendum to outdated legislations and practices. The bureaucracy involved in the monitoring and protection of the environment further compounds the issue as many regulatory authorities share the same responsibilities, thus creating circumstances in which decisions confirmed by one agency is overturned by another based on different approval criteria. The intent of the Green Paper No. 2/2010 is to outline a framework of corrective measures that will ultimately streamline planning in Jamaica into one state body, the Environmental Regulatory Authority (ERA). The Green Paper provides an integrated approach to managing the natural assets and built up areas in the country. These all have implications for policy related to climate change resilience in the building stock of Jamaica. The purpose of this review therefore is to consider the viability and limitations of the recommendations put forth in the Green Paper that will ultimately act as the framework for the drafting of the White Paper.

Firstly, The Green Paper presents a clear depiction of the problems associated with the current arrangements for planning and the management of the environment in Jamaica. These include:

1. Inadequate protection for important ecological sensitive sites
2. Encroachment into wetland areas, damage to coral reefs, deforestation, land degradation and water pollution
3. Confusing and overlapping rules, regulations, procedures and agency remits for developers which can oblige them to deal with a number of separate government agencies with inconsistent demands and requirements
4. A significant number of illegal developments, where people have proceeded with construction without submitting any application, breaching planning laws and, in some cases, environmental laws as well
5. Inadequate environmental enforcement incurring substantial health, social and economic costs.

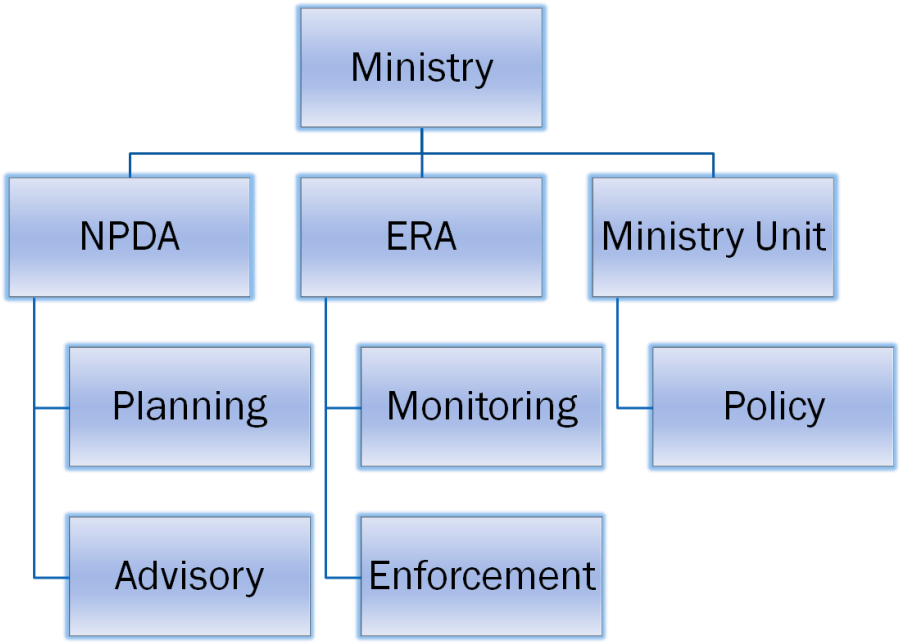
In order to correct these issues affecting the planning and regulatory system in Jamaica the Green Paper posits several key reforms to modernize and integrate the system:

1. To establish an ERA, and to transfer NEPA's responsibility for environmental monitoring and enforcement to this new agency.
2. To develop a National Spatial Plan, to include no-build zones and to give NEPA the primary responsibility for developing, maintaining and updating this plan.
3. To give NEPA the lead role in helping to solve environmental problems, via education, outreach, advisory assistance and training workshops (Office of the Cabinet 2010).

It is anticipated that these reforms will effectively lead to the implementation of robust protection for sensitive or vulnerable sites; clear delineation of no-built zones; prompt approval for developments in non-sensitive sites; and a more transparent and low-risk environment for developers more focused and efficient use of government resources. These reforms would ultimately improve the treatment of planning and environmental development in Jamaica with the possibility to encourage a better appreciation of the benefits of climate change resilience building concepts to improve the environmental and sustained developmental welfare of the state.

4.1 Strengths of the Green Paper

There are several key components of the Green Paper that make it an effective document that is integral to the reformation of the planning system. Firstly, the Green Paper advocates for substantive legislative reform to address and simplify the complex operations of NEPA (i.e. as it relates to the re-organisation/re-structuring of the body). NEPA was formed based on the merger of 3 agencies (NRCA, the Town Planning Department (TPD), and the Land Development and Utilization Commission (LDUC). These boards are not obliged to share information with each other, even though they belong to the same agency. This lack of integration can result in one arm of NEPA approving items that may not be approved by another. The Green Paper therefore supports integration/synchronization and addresses this issue, by setting up a structure/chain of command headed by the Ministry of Housing and Sustainable Development, as illustrated below, thus, eliminating the need for separate boards.



SOURCE: Heather Pinnock Power Point Presentation on the ERA

By separating the plethora of NEPA's current functions (i.e., regulator, planner, enforcer etc.) and, assigning the functions of enforcement and regulation to the ERA and planning and advice to NEPA, these agencies will essentially be carrying out its regulatory activities based on objectivity, fairness and efficiency. This allows NEPA the ability to cut down on its various functions and roles, narrowing its focus to planning, outreach and training, thus improving the efficiency of government resources and clarifying NEPA's mandate.

One benefit of narrowing the agency's focus relates to the reduction in the processing time for planning and sub-division applications as a majority of NEPA's current workload is focused on development permitting. At present, NEPA states that development approvals are granted in 90 days. However based on the McCalla Study (April 1, 2003 – March 31, 2005):

> In 2003 NEPA processed 40% of all planning and 31% of all subdivision applications within 90 days, so 60% of planning applications and 69% of subdivision applications took longer than 90 days. NEPA received 44 applications for environmental permits that year, and processed 24 of them, of which just 4 were processed within the stipulated 90 days. In 2004-5 NEPA received 2,257 applications and processed 1,819 (81%) of them, between April 2005 and March 2006 NEPA received 2,637 applications (a 17% increase) and processed 2,182

(83%) of them, but half of these took longer than 90 days. (NEPA Annual Report 2005)

At a public consultation session on the Green Paper, it was noted that there have been improvements in the approval time, resulting in 70-75% of cases being dealt with within the 90 days period. This paper however supports that further reductions can be made in processing time, with a reduction in NEPA's case load, ranging from 45 – 90 days (in light of the proposed spatial plan).

The Green Paper further addresses the inefficiencies in the planning and regulatory systems in Jamaica that are related to environment management/climate change resilience and physical development. Originally NEPA was intended to go through a 3 stage creation process: Stage 1 – Interim Merger; Stage 2 – Legislative Housekeeping; Stage 3 – Legislative Regularization (Office of the Cabinet 2010: p. 13). The most important stage, Legislative Regularization, has still not been completed and NEPA now currently operates under numerous Acts, with over 50 pieces of regulation relating to them. This of course has caused confusion, bureaucracy, conflict, duplication, overlaps and a general waste of government resources. Proposing an integrated approach to planning and regulation supports greater policy coherence and the replacement of outdated laws (it also encourages investment). As a result, the numerous pieces of legislations, governing the operations of NEPA and key agencies would be removed, adjusted and updated. This serves for greater transparency, as different stakeholders are part of the process, ranging from the highest to lowest levels of government.

This integration is operationalized by the establishment of a National Spatial Plan, the ERA and redefining NEPA as the National Planning and Development Agency. The establishment of a National Spatial Plan will allow different agencies/ ministries to place critical information on the same spatial plan especially as it relates to land use, so that all agencies are able to view each programme; they would be responsible for their respective layers and would know what other agencies are doing and responsible for. NEPA would manage this plan, and know how best to set primary zoning laws for various areas. Consequently, NEPA would maintain this map.

Using GIS as the tool to administer the spatial plan allows the user to continuously update the plan, especially in light of any changing priorities of the government. The changes can be tracked, stored, edited, analysed and contains real time data that can be used for critical decision-making purposes. The information is therefore not static, as in the case of a traditional

physical plan. The public would also have access to this information online and would know where development is and is not permitted. Access to information may help in reducing concerns related to inconsistencies/deviations as everyone would be privy to the same information.

The Green Paper further advocates for:

1. The reduction of political interferences that may be partisan, in the rulings of the Environmental Authority and pushes for an independent commission to address grievances (Section 5.4 and 5.11);
2. Legislative reform to take place before the ERA and NPDA are established and not vice versa;
3. The payment of fines for environmental offences in an effort to act as a deterrent for bad environmental practice. It supports the fact that fines should be aimed at full remediation/ restoration at the perpetrators expense. Hence the principle of the 'polluter pays'. Similarly it addresses the issue of compliance to environmental legislation;
4. Enforcement to be conducted by ERA agents in collaboration with the Jamaica Constabulary force and the Coast Guard;
5. The ERA to monitor both public and private entities, illustrating its impartiality

4.2 Limitations of the Green Paper

The Green Paper does not provide any specific details on the proposed legislative changes it identifies as essential to the restructuring of NEPA, the establishment of ERA or changing the overall complex planning system. The Paper has proposed the need for legislative reforms to have environmental planning controlled by one agency (NPDA), policy in the hand of the ministry, and enforcement and monitoring being controlled by the ERA. The paper is not clear on which Acts need to be adjusted/repealed, or absorbed into others from the existing Acts that governs the operations of NEPA. It also has not considered the changes to other Acts (and vice versa), that may be needed in light of the proposed reform e.g. Town and Country Act, Jamaica Energy Policy etc.

The enforcement capability of the agency is limited by the number of registered properties. The enforcement agency currently only focuses on the approximately 50% of properties that are registered. To have proper environmental regulation every property has to fall within its remit. This will have serious implications for the National Spatial Plan (primary land zoning, national

infrastructure) and enforcement and monitoring by the ERA. This is a major problem and the proposed solutions will not work in its fullness until properties are registered, with proper titles, and known owners.

Additionally, as it relates to the purposes of this study, the impact of climate change is not explicitly addressed in the Green Paper, even though its proposals are dependent on the ability of the country to bounce back in the event of an extreme climatic event. There are more references made to buildings in relation to environmental management, sustainable development, resource efficiency or good environmental practices, as opposed to climate change risks. The Paper discusses issues related to the location, height, and density required for buildings. However, there is little reference to the regulation of development in coastal areas, bearing in mind the risk of storm surge, sea level rise, beach erosion, saline intrusion, destruction to coral reefs or the removal of critical eco-systems that serve as natural barriers to hurricanes, flooding, landslides (coastal and inland).

4.3 Recommendations

If the ultimate aim of the ERA is to be a deterrent for bad environmental practices, and to impose sanctions and fines for breaches, then NEPA should encourage and partake in research and new technologies that will provide solutions to environmental problems. The creation of a research and development arm of NPDA/NEPA, which is also dedicated to the transfer of technologies in the country, would be a beneficial addition to the mandate of these agencies. As such, fines, penalties or enforcement orders put in place by the ERA, will need to factor in available technologies, resources, and alternative methods available to the public, when determining the sum to charge /remediation efforts.

In addition to having the ERA impose fines for persons who do not comply with environmental regulation, incentives should be put in place for those entities that do comply with the laws. Such 'rewards' may include tax breaks or reductions, reduction in import tax, tax holidays for investing in green projects, or projects with implications for reducing impacts and enabling the country to return to normal after an extreme climatic event. (This same principle is applied to companies that donate to charities etc.).

The Green paper N0.2/2010 is titled 'The Establishment of an Environmental Regulatory Authority'. Based on the content of this document, and the push for environment and development reforms, other proposed titles for this document are:

1. Proposed Planning Reforms for Sustainable Development in Jamaica
2. Streamlining Planning and Development in Jamaica, with the establishment of an ERA
3. Proposed regulations for Environmental Protection and Development in Jamaica
4. Proposed Integrated Planning System for Development in Jamaica
5. A Planning and Environment Framework for Jamaica
6. Environmental and Planning Permitting for Jamaica

Conclusion

Improving resilience to climate change will be at a cost but it will be much less in the long run when compared to the cost of inaction. Physical planning and innovation are considered excellent pathways to resilience building. Sharing international and regional experiences and best practices are also important. Physical planning policies have to be reviewed to address the present reality of climate change, processes have to be modernized to facilitate effective integrated planning and relevant institutions have to be adequately resourced. In addition, there needs to be more support for funding implementation of policies and adaptation measures on the ground, and enforcement of regulations. Paramount as well is the adoption of an ecosystem approach to resilience building in order to reduce adaptation costs.

The environmental legislation, although the beneficiary of more modern concepts, falls short of separating climate change as a standalone issue, notwithstanding Jamaica's accession to the United Nations Convention on Climate Change. International treaties do not enjoy a direct effect or translation into local law and so climate change specific legislation would have to be passed to give effect to the country's international obligations[4]. Notwithstanding, the NRCA's stated function to effectively manage the island's physical environment in order to achieve protection, management and proper use of its natural resources fits comfortably into a general framework for the promotion of climate change resilient buildings. The environmental regulatory system has a number of challenges. Insofar as these are reflected in the legislation, they can be characterized by:

i. overlapping powers and areas of responsibility;
ii. obsolete or underutilized laws;
iii. arguably, a disproportionate distribution of power that does not reflect available resources for the relevant entities;
iv. inadequate enforcement or enforcement mechanisms;
v. lack of incentive measures;
vi. subjugation of entities with technical expertise to their respective Ministers on technical matters;
vii. exemptions granted to key entities from the regulatory process which causes unevenness in application of the law.

[4] The Implementation of Three International Agreements in Jamaica – MSc Dissertation Akilah Anderson 2001

As illustrated in the above discussion, developing design concepts for climate change resilience buildings require a multi-faceted approach from all levels of society, ranging from the legislature to the financial sector. Successful implementation of this initiative must involve a comprehensive approach that examines:

i. the feasibility and necessary design concepts required for constructing climate change resilient buildings in areas vulnerable to climate change hazards.
ii. an in-depth understanding of the current building stock and the necessary requirements for upgrading existing infrastructures (which includes a review of current building codes)
iii. an overhaul of the legislative process that will provide the government with the necessary tools and power to effectively enforce and implement environment and planning policies safeguarding against further environmental degradation as a result of climate change
iv. finding cost effective mechanisms to implement and regulate climate change resilience strategies, particularly as it relates to construction and town and country planning

Without a full appreciation of these issues it will be considerably difficult for SIDS to develop design concepts for climate change resilience buildings especially in light of the potential constraints this may place on their economies, environment regulatory bodies and social infrastructure. Fortunately, several CARICOM states have indicated a commitment to combating climate change by committing to international treaties to reduce greenhouse gas emissions, policy review that contains language specific to climate change resilience and a reconceptualising of the environmental and regulatory authority's role in safeguarding the state against climate change.

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