Small and Medium Enterprises as indicators of resilience to climate change in the Caribbean

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ABSTRACT

The Caribbean's contribution to climate change is negligible but the projected impacts of global climate change on the region may be devastating given the limited adaptive capacity of CARICOM small island and low lying coastal states. Understanding a community's vulnerability to potential impacts of extreme weather events, resilience and adaptive capacity to recover post disaster is important as it can guide appropriate interventions.

Based upon a previous assessment of two large scale water and sanitation projects in Trinidad and Jamaica, the paper proposes a series of practical indicators to measure the vulnerability, resilience and adaptive capacity of Small and Medium Enterprises (SMEs) from which inferences can be made about their host communities. SMEs may engage in the development/ adaption/ adoption of "green" technologies or through lobbying efforts can improve their own, their community's and/or the country's resilience to climate hazards. As indicators, SMEs are discrete enumerable entities whose numbers may change over time due to a range of factors, including suitability of location. Management of risk is a normal part of their operation and they have a range of measurable attributes relating to their operational process. The following indicators are discussed: SMEs per area, Type of industry, Registration status of business, Tenure status, Topography and environmental conditions, Insurance, Type and location of data storage and Organisation membership.

INTRODUCTION[1]

Climate is naturally variable and it is often difficult to separate "natural" climate hazards from those induced by climate change. The Caribbean's contribution to climate change is negligible but the projected impacts of global climate change on the region is predicted to be devastating given the limited adaptive capacity of CARICOM[2] small island and low lying coastal states (CCCCC 2009). Global climate change and the potential increase in extreme climatic events, will determine the vulnerable position of the countries in the region (IPCC 2007; Ramlal and Baban 2008; Shenk et al. 2011). Caribbean populations are at particular

[1] This paper is based on a report *Mohammed et al. Small and Medium Enterprises as Indicators of Resilience to Climate Change in the Water Sector of the Caribbean* submitted to the Inter-American Development Bank (IDB) (to be published in 2015).

[2] CARICOM is an acronym for the Caribbean Community which includes the thirteen independent English speaking countries in the region along with Haiti and Suriname.

risk to the impacts of climate change as urban development is generally concentrated in one dominant port city and along a coastal strip (Jaffe 2008). It is estimated that more than half the region's population lives within 1.5 kilometres of the shoreline and there is much critical infrastructure along the coast (Mimura et al. 2007; UNHabitat 2012; Thomas et al. 2013).

Coping with natural disaster is common place for most of the Caribbean region, but the impacts of climate change on the estimated 40 million residents will be exacerbated by local social and economic conditions (Bueno et al. 2008). Post disaster recovery is likely to be slow as Caribbean residents are poor by world standards (Bueno et al. 2008). Caribbean countries also have significant international debts and hard adaptation measures such as dikes, seawalls and insulating shorelines may not be affordable (Bueno et al. 2008). Caribbean governments therefore need to have a better understanding of the vulnerability of areas and the extent to which interventions will improve resilience and adaptive capacity to justify investments.

While research has examined the broad impact of natural hazards on national economies, there is growing interest in the understanding of vulnerability to climate change at the level of the local community and socio-ecological system (Adger et al. 2005). Considerable research has been conducted on vulnerability to climate change at the national and household level in the Caribbean (Barnett 2001; Pelling and Uitto 2001), however, there seems to be an information gap in vulnerability research regarding the private sector (Zhang et al. 2009), in particular, Small and Medium Enterprises (SMEs[3]) and implications for their host communities.

The established definition of vulnerability is described by the Third Assessment Report of the Inter-Governmental Panel on Climate Change (IPCC) as:

> "*the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variations to which a system is exposed, its sensitivity, and its adaptive capacity*" (Hinkel 2011).

[3] Some literature refers to Micro, Small and Medium Enterprises (MSMEs). This paper uses SMEs to include micro, small and medium enterprises.

The concepts of vulnerability, resilience and adaptive capacity are discussed further by several authors such as Adger (2006), Gallopin (2006), and Smith and Wandel (2006). Hinkel (2011) sees vulnerability as "a measure of possible future harm", not its current state but a theoretical concept about a future, which may or may not happen. As such, he argues that vulnerability, in itself, is not an observable phenomenon and to make the concept operational there is need for a methodology to allow for it to be mapped from observable variables. Indicators, Hinkel (2011) argues, are a function of observable variables which can achieve this goal. Indicators also reduce the complexity of systems to allow communication and are useful to inform policy-making and assess the progress of policy measures.

SMEs are practical for the development of an indicator system. SMEs: are discrete enumerable entities, have a range of internal processes which are also measurable, normally conduct risk management as part of their daily operations, are impacted by small and large scale external interventions, such as the water projects being reviewed in this paper, and the survival of some are linked to the wellbeing of their host community. The private sector in the Caribbean, although dominated by a small number of multinational companies, is largely comprised of SMEs. Data on SMEs is often collected by national agencies and may be accessible to researchers. Assessments of the parameters associated with SMEs may be possible pre-intervention, during the life cycle and post intervention hence the impact of an intervention can be assessed.

This paper proposes a methodology to assess the vulnerability and adaptive capacity of a geographic area based on indicators associated with the SMEs within the area. This proposition is based on preliminary research on water and sanitation projects in Jamaica and Trinidad and Tobago funded by the IDB, i.e. the Kingston Metropolitan Area (KMA) Water Supply project (JA-L1035) and the Wastewater Infrastructure Improvement Project (TT-L1018), respectively. The paper poses the following questions:

1. What are the nature of the threats posed by Extreme Weather Events (EWE) and other events associated with climate change to the Caribbean, in particular to the water and sanitation sector?
2. Can SMEs influence the vulnerability and adaptive capacity of its host communities?
3. Can parameters associated with SMEs be useful in developing an indicator system to measure vulnerability and adaptive capacity in their host communities?

THE IMPACTS OF EXTREME WEATHER EVENTS AND OTHER CLIMATE CHANGE EVENTS ON THE CARIBBEAN

The IPCC estimated that the Caribbean region experienced an increase in temperature between 0.0 and 0.5 degrees over the last two decades (IPCC 2007). Temperature was predicted to rise from the baseline of 26^{o}C by 2.3^{o}C, 3.4 ^{o}C and 2.9 ^{o}C respectively under the A2[4], B2[5] and BAU[6] scenarios between 2007 -2099 (ECLAC 2010).[7] Hotter temperatures may warm oceans and fuel stronger hurricanes (Bueno et al. 2008; Howard 2009). Much of the coastal infrastructure in the region may not be able to withstand significantly stronger winds, deeper incursions of forceful ocean surges, and heavier rains. This will impact the lives of persons who live and work there and particularly the urban poor who live in sub-standard structures (Bueno et al 2008; Verrest et al. 2013).

Warmer oceans may also lead to sea level rise. The IPCC (2007) estimated that sea levels rose, on average, 1 mm yr during the 20th century. A sea level rise of 0.35 meters on average may lead to an 8% loss of land, impacting critical infrastructure and habitats (mangroves, turtle nesting sites, etc.) (Toba 2007). Given that much of the Caribbean is highly dependent on tourism, which contributes up to 15% of the region's income, beach erosion and coral bleaching due to warmer waters may significantly reduce the desirability of the Caribbean as a destination and also impact the fishing industry (Bueno et al. 2008). Salt water intrusion into aquifers could also reduce the supply of potable water (McGranahan et al 2007; Bueno et al. 2008).

[4] Scenarios are based on IPPC Special Report on Emissions Scenario (SRES). The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility pattern across the region converge very slowly which results in continuously increasing populations. Economic development is primarily regional oriented and per capita economic growth and technology change is more fragmented and slower than other story lines.

[5]The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social and environmental sustainability. It is a world with continuously increasing global population, at a rate lower than A2 and intermediate levels of economic development. While the scenario is also oriented towards environmental protection and social equity, it focuses on local and regional levels.

[6] Business As Usual (BAU) represents a situation where greenhouse gasses continue unabated, and the socio-economic parameters in the baseline period remain unchanged.

[7] ECLAC (2010) examined the economics of climate change on the water sector in nine Caribbean SIDS (Aruba, Barbados, Dominican Republic, Guyana, Jamaica, Montserrat, Netherlands Antilles, St. Lucia, Trinidad & Tobago) using three scenarios (A2, B2 and BAU) from 2007 -2099 based on the IPPC SRES.

Climate change impacts are not restricted to low lying coastal areas in the Caribbean. Rainfall in most countries is characterised by pronounced wet and dry seasons while year-to-year variability is influenced by the El Niño-Southern Oscillation (ENSO) (ECLAC 2010). Climate change may cause greater precipitation during storms and other peak periods which can contribute to flooding (Bueno et al. 2008). Nurse (2009) suggested that inland flooding, not related to sea level rise, but to the increased intensity of weather events and changes in weather patterns may cause infrastructural damage. As disposal and treatment of sewage in the Caribbean is largely on-lot in latrines, cesspits and soak-aways, inundation may cause overflowing on-lot treatment facilities which can promote waterborne disease. Increased turbidity and siltation can also affect the collection, treatment and distribution of water and sewage treatment. This situation is accentuated by the high degrees of unplanned and informal settlements with poor infrastructure and services as well as the sprawling nature of urbanization in general.

Climate change may also cause more frequent and longer droughts while the limited fresh water supply of many islands may be further reduced by contamination from flooding (Bueno et al. 2008). Limited water supply and other factors can contribute to worsening sanitation conditions that can favour the spread of water and vector-borne diseases, such as dengue fever, malaria, and diarrhoea and further strain the region's public health systems (Bueno et al. 2008).

It is difficult to predict the long-term impacts of climate change on the Caribbean. CCCCC (2009) estimated the economic impact of the 2004 hurricane season on The Bahamas, Cayman Islands, Dominican Republic, Grenada, Haiti and Jamaica to be US$4.247 billion. However, CCCCC (2009) makes the point that estimating economic consequences of the impacts of climate change in the Caribbean is difficult due to varying global climate change scenarios, limited geographical projections for the region and an inadequate inventory of vulnerable assets and resources. Toba (2007) estimated the annual impacts of climate change on the 20 CARICOM countries ca. 2080 to be US$11.2 billion which equates to 11.3% of their total GDP. However, ECLAC (2010) suggests that the economic consequences of climate change may be offset by growth in the GDP in the region.

THE ROLE OF SMES IN BUILDING ADAPTIVE CAPACITY AND RESILIENCE

Defining SMEs

The private sector can be divided into three components: the corporate enterprises component (including multinationals), the informal enterprises component, and the SMEs (Knorringa and Helmsing 2008). However, in the Caribbean, the lines between the two latter categories may be blurred. There is no standard global definition for SMEs and even within a country different agencies may have their own definition (Kushnir 2010). Based upon a survey of 132 countries, Kushnir et al. (2010) suggests that SMEs are most commonly classified by the number of employees with variations in the lower and upper limit between countries. Many countries define SMEs as having up to 250 employees while in others variables other than total employment are used or a SME definition is not available. Other variables often used in association with number of employees in the definition are: type of Industry, annual turnover and investments size (Kushnir 2010; Kushnir et al. 2010).

The majority of formal SMEs globally are micro-enterprises (83%). Outside of the Organisation for Economic Co-operation and Development (OECD), Latin America and Caribbean region has the highest number of SMEs, approximately 30 per 1000 persons (Kushnir et al 2010). Within Trinidad and Tobago, micro enterprises are classified as employing 1 to 5 persons, small enterprise 6 to 25 persons and medium enterprise 26 to 50 persons, along with assets and/ or sales (Wignaraja et al. 2004; Kushnir 2010). Trinidad and Tobago even recognises mini-micro where only the owner or manager is employed (MOLSME 2013). In Jamaica, micro enterprises are considered as owner operated employing less than 3 persons, small enterprises as those employing 4-10 persons with medium enterprises employing 26-49 persons (Kushnir 2010). In other countries of Latin America, less than 250 employees is the normal classification for SMEs.

The difference in classification of SMEs between Trinidad and Tobago and Jamaica means that comparison is difficult within the categories that comprise SMEs. In both cases, however, SMEs are considered as less than 50 persons which makes international comparison

challenging. The Caribbean classification of SMEs is more reflective of micro and small enterprises from an international perspective.

SMEs as Proxy Indicators of the Private Sector

Numerically, the majority of the private sector in the Caribbean is accounted for by SMEs and hence, monitoring the performance of SMEs can give an indication of private sector performance. A *World Bank Enterprise Survey of Latin America and the Caribbean* determined that 94% of enterprises were SMEs in countries classified as Small (i.e. Antigua & Barbuda, The Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Suriname, St. Kitts & Nevis, St. Lucia and St. Vincent & the Grenadines). Trinidad and Tobago and Jamaica were considered as Medium size countries and not included in the figures. However, based on the information obtained from the website associated with the publication[8], Trinidad and Tobago was reported to have 73% SMEs (2011 data on 370 businesses surveyed) and Jamaica, 82 % (2011 data based on 376 businesses surveyed). Using Trinidad and Tobago and Jamaica as case studies for the wider Caribbean, it thus appears that SMEs are generally good surrogates for the private sector.

Recognising the distinction between the informal sector and SMEs in the definition of Knorringa and Helmsing (2008), the informal sector in the Caribbean is large and requires mention. Non-registered informal enterprises outnumber formal ones many times over, for example, this can be as high as 17 unregistered to 1 registered (Kushnir et al. 2010). It is found that countries with higher income per capita tend to have more formal SMEs per capita (Kushnir 2010).

The Impact of and Response to Climate Change on the Private Sector

Biagini and Miller (2013) suggested that research on the private sector can facilitate a better understanding of climate risk and can provide the technologies and business models that will make current and future investments more climate resilient. Successful private sector engagement in adaptation can also encourage greater and more frequent investments which could lower the costs and accelerate the development and/or replication of climate–resilient

[8] www.enterprisesurveys.org

technologies; mobilise financial resources and technical capacity; engage civil society including community efforts and influence government decision making particularly regarding infrastructure investment. In industrialised countries, awareness of climate change is increasing and EWEs are already considered a business risk, however, this is less so in developing countries and there is a need to prioritise the engagement of the business community in climate change risk awareness, response, and adaptation (Biagini and Miller 2013).

Bynoe (2013) identified technologies/actions adapting to climate change already existing in the water sector in the Caribbean which could have potential transferability to other Caribbean countries, while Mans et al. (2013) identified and classified similar technologies available in the water sector in The Netherlands with potential transferability to the Caribbean. Use of such technologies and actions can potentially be facilitated by the private sector.

Wedawatta et al. (2008) suggested that SMEs can be considered the most vulnerable among the business community to climate change as they are not prepared to cope with the effects of EWEs or natural hazards. They are also less buffered than the corporate sector, which may have more access to resources (Runyan 2006). Asgary et al. (2012) noted that while reestablishment of SMEs may occur after disaster, complete recovery is a challenge. Further, since a majority of SMEs are local in their operations and rooted in local communities, their owners are often additionally vulnerable as they are doubly hit by EWEs; first as local citizens and then as business owners, because their personal assets are interlinked with their business assets (Runyan 2006; Wedawatta et al. 2008).

SMEs as Indicators of Building Resilience in Communities

SMEs play an important role in the functioning of a community and will support communities to better prepare for, adapt to and mitigate climate hazards (including those stemming from climate change) (Zhang et al. 2009). Acs and Kallas (2008) identified job creation, innovation and economic growth as three indicators of the main interaction of SMEs and local communities. Runyan (2006) acknowledged the ripple effects of SMEs, which can

either create problems or create opportunities for persons and organisations which are not directly associated with the SME.

Impact of Large Infrastructural projects on SMEs.

Large infrastructural projects can lead to physical improvement in an area, which not only impacts households but can have a profound impact on the business potential of an area. Improving access to water and sanitation, for example, can reduce the number of occasions businesses may be forced to close, which increases income generation. Such improvements can influence the decision of businesses to either permanently establish themselves in the area or relocate and would be reflected by indicators which measure SMEs.

DEVELOPMENT OF INDICATORS FOR DATA GATHERING

Basis of Methodology

These recommendations are based on preliminary work conducted in December 2013 in Jamaica and Trinidad as part of a study to develop a project specific methodology that can characterise, analyse and assess vulnerability to climate change in IDB projects. JA-L1035 and TT-L1018. An overview of these projects is provided in Box 1 and 2. The purpose of that assessment was to determine (a) the ease to which data could be collected from primary and secondary sources to populate a comprehensive set of 34 indicators developed around an asset-based adaptation and vulnerability approach in a context of climate change related disasters and (b) if the data could allow for the comparison of the vulnerability and adaptive capacity of SMEs and their host communities. Using the appraisal techniques of the asset adaptation operational framework of Moser (2011), the researchers used the following approaches: secondary data review, structured/semi-structured interviews, focused interviews, and general observations. The use of the comprehensive list of indicators was thought to be too data and resource intensive and not easily replicable by either the community or many state agencies in the Caribbean. An attempt was made to narrow this list to a more realistic list of indicators that met much of if not all the desired understanding of the relationship between the resilience of a community and its resident SMEs.

Box 1: Overview of the Kingston Metropolitan Area (KMA) Water Supply project

The Kingston Metropolitan Area (KMA) Water Supply project (JA-L1035) is a water supply infrastructure upgrading project with activities geographically spread across the KMA which comprises part of the parish of Kingston, including the city of Kingston, and the parish of St. Andrews as well as in parishes outside of the KMA such as St. Catherine, Manchester and Clarendon. Project areas are numerous and include Innswood, Red Hills, Forest Hill, Hope, Mona, Mandeville, Old Harbour and May Pen (Smith 2011).

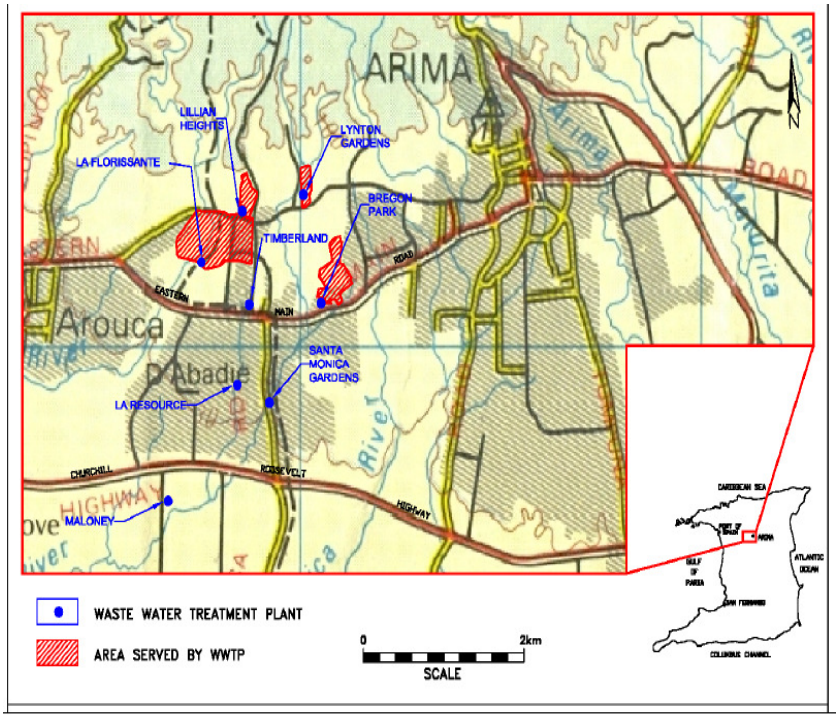
Figure 1: Project areas in the Kingston Metropolitan Area Water Supply Project

The main objectives of JA-L1035 are to improve efficiency, quality and sustainability of the potable water services provided in the KMA and to increase the access in selected urban centers of Jamaica (IDB n.d.**a**). Four project components support achievement of these objectives: (a) Rehabilitation of the potable water supply for Kingston and St. Andrew Area (KSA); (b) Rehabilitation of the potable water supply for KMA; (c) Energy Efficiency Improvements; and (d) Institutional Strengthening of NWC. Construction of a wastewater treatment plant is a small component of the project.

Box 2: Wastewater Infrastructure Improvement Project (TT-L1018)

The Wastewater Infrastructure Improvement Project (TT-L1018) in Trinidad is a sewage infrastructure upgrading project in Maloney/Malabar, a limited geographic area in eastern part of the major capital city conurbation around Port of Spain commonly referred to as the "East -West Corridor". The WWTPs are located in housing developments: Bregon Park, Lynton Gardens, Lilian Heights, La Florissante, Santa Monica Gardens, La Resource, and Timberland (Sammy 2011).

Location of Waste Water Treatment Plant (WWTP) the Maloney Area (Source: Sammy 2011)



The country has an estimated 560 km of sewers and 243 wastewater facilities which serves only 20% -30% of the population (400,000 persons) with the remainder serviced by septic tanks and pit latrines. The expansion of the sewer system has not kept pace with population growth and housing developments. Government's policy required new housing developments, larger than 40 houses, to establish a sewerage and wastewater treatment plant (WWTP) which would later be integrated into an expanded sewer system. However, the majority of the approximately 200 package type WWTPs implemented to serve housing subdivisions has not been integrated into the sewer system and are either abandoned or malfunctioning. Below quality standards discharge from these facilities enter directly into water courses or is released upstream of water courses, posing health and environmental risks and increases the cost of potable water treatment.

Short List of Indicators

The critical indicators selected are:

1. SMEs per area
2. Type of industry
3. Registration status of business
4. Tenure status
5. Insurance
6. Data storage
7. Organization membership, and
8. Topography and environmental conditions

The proposed methodology categorised vulnerability as: Very high vulnerability (5), High vulnerability (4), Moderate vulnerability (3), Low vulnerability (2) and Very low vulnerability (1). It is proposed that there can be a pre project assessment of the vulnerability of the SMEs in a project area and these scores can be compared to post project assessment scores to determine the changes in vulnerability of the SMEs/area due to project implementation.

Data from indicators will be used to calculate a mean score which would contribute to the determination of vulnerability and a composite value based on the sum of means will be calculated to give an estimated vulnerability score. Areas with 'Very High Vulnerability' and 'High Vulnerability' should be prioritised for interventions to reduce their vulnerability. Areas with 'Moderate', 'Low Vulnerability' or 'Very Low Vulnerability' should be monitored for changes. Given the importance of the informal sector in communities in the Caribbean and the paucity of data on informal enterprises, information on both formal and informal enterprises can be collected.

(1) SMEs per area: This methodology proposes that the density indicator of SMEs in a project area will be a good indicator of relationship between the SME population and the general population of the area. The higher the density of SMEs the stronger the relationship to the host community.

Since SMEs are responsive to risk as part of their normal operations they are likely to employ asset adaptation strategies which make their businesses and area of operation more resilient to negative impacts of climate change. Areas, which have large numbers of businesses, are also more likely to be able to collectively lobby for infrastructural improvements which can improve resilience. Generally, the larger the number of SMEs per area, the greater the possibility of improved resilience to climate change.

SMEs will be classified according to number of employees based on the national classifications for SME (i.e. < 50 employees for Trinidad and Tobago and Jamaica). The number of SMEs in each sample area will be determined and divided by the area (km^2) which corresponds to the geographic area of activities of the IDB project. Data on informal enterprises including HBEA will also be collected and cumulative and disaggregated totals presented in the analysis.

Given that number of SMEs and land masses will vary between countries, an average SMEs/ area will be calculated for each country as a reference point although it is recognized that is not a uniform distribution across the country. For example, in Trinidad and Tobago, the Companies Registrar[9] states that there are 81,922 businesses in Trinidad and Tobago, and with a land area of 5128 km^2, the average number of businesses is 16 per km^2. Based on 2008 data from Trading Economics website[10] Jamaica had 54,116 businesses, and with a land area of 10,991 km^2 the average is 5 businesses per km^2.

As urban areas, will generally have high concentrations of SMEs while rural areas will generally have low concentrations, the density indicator could be highly skewed. Hence, the appropriate ranges to correlate SME per area (i.e. km^2) to vulnerability may have to be non-symmetrical. Density will be classified based on variations from the national average using a square root scale and this will contribute to its understanding of the vulnerability of the host community. For example:

- 0 to national average for Trinidad and Tobago, the range will be 0-16 = Very high vulnerability (5)

[9] rgd.legalaffairs.gov.tt/faq/html
[10] http://www.tradingeconomics.com/jamaica/total-businesses-registered-number-wb-data.html

- *National average +1 to (√ national average)* ^{3} (e.g. the range will be 17-64 for Trinidad and Tobago,) = *High vulnerability (4)*
- *(√ national average)* ^{3} *+1 to (√ national average)* ^{4} (e.g. the range will be 65-256 for Trinidad and Tobago) = *Moderate vulnerability (3)*
- *(√ national average)* ^{4} *+1 to (√ national average)* ^{5} (e.g. the range will be 257-1024 for Trinidad and Tobago) = *Low vulnerability (2)*
- > *(√ national average)* ^{5} (e.g. the range will be >258 for Trinidad and Tobago) = *Very low vulnerability (1)*

(2) Type of Industry: In the case of localised disasters, businesses which are highly dependent on the local community are more vulnerable than businesses which service a wider geographical range. Thus, if the adaptive capacity of the community is high the business are likely to survive disaster and conversely if the community has low adaptive capacity the businesses will suffer.

The classification of industries by the Central Statistical Office (CSO) in Trinidad and Tobago is not very useful to the understanding the nature of SME activities nor an understanding of linkages with the community.[11] Based upon our field assessments, interviews and the focus group discussion we will adapt this classification and create a typology of vulnerability based on type of activity:

- *Very high linkage (Retailing of food and other personal products)* – Items which are purchased in day-to-day operations due to proximity to community (small shops, vendors etc.) = *Very high vulnerability (5)*
- *High linkage* (Services) –Services which are utilized due to proximity to community (hair dressers, car repair garages etc.) = *High vulnerability (4)*
- *Moderate linkage* (Large retail and Light manufacturing)– Business which may be established in a community but service a wider market (e.g. supermarkets, large clothing shops etc.) = *Moderate vulnerability (3)*

[11] The CSO classifies industries in the following categories: Sugar; Petroleum industries; Food Processers and Drink; Textiles, Garments, Footwear and Headwear; Printing Publishing and paper converters; Wood and Related Products; Chemical and Non-Metallic Minerals; Assembly type and related industries; Miscellaneous Manufacturing; Construction; Distribution; Hotels and Guesthouses; Transportation, Communication and Storage; Finance, Insurance, Real Estate and Business Services; Educational and Cultural Community Services; Personal Services.

- *Linked (Construction)*- SMEs involved in construction can repair other business premises after a climate change induced disaster hence their presence builds adaptive capacity (Wedawatta and Jones 2008) = *Low vulnerability (2)*
- *Low linkage (Other)* -SMEs which are connected to the national economic sector such as those in Sugar; Petroleum industries; Chemical and Non-Metallic Minerals; manufacturing etc. have larger markets are aware of international adaptation practices and are less likely to be affected by localized disasters affecting the community = *Very low vulnerability (1)*

The percentages of each type of industry in a project area will be calculated and an average vulnerability rating calculated as shown in the example given in Table 1. This approach is applicable to the other indicators.

Table 1: Dependency Index of Type of Industries

Type of Industry	Rating	Percentage expressed as decimal	Value
Food and personal items	5	0.30	1.5
Services	4	0.20	0.8
Large retail/ Manufacturing	3	0.20	0.6
Construction	2	0.10	0.2
Other	1	0.20	0.2
TOTAL			**3.3**

(3) Registration status of business: Registration is an effective way of separating formal and informal enterprises with the latter normally outnumbering the former. Registered SMEs pay taxes and legally access other services (electricity, water etc.) have filing systems, access to credit and insurance coverage and as such are likely to be more established and hence more resilient than informal enterprises. An increasing proportion of registered businesses to informal businesses will give an indication of formal growth in the area and increasing resilience.

Formal SMEs are registered with State through a legal mechanism such as the Companies Act in Jamaica and Trinidad and Tobago; however, a challenge is that businesses may be

registered with the Companies Registrar but not currently operational. Although the Board of Inland Revenue (BIR) may be a more suitable source of secondary data there is a challenge with accessibility. Formal businesses are required to display Value Added Tax (VAT) certificates or Articles of Incorporation, which will assist in verification in a primary data gathering process.

The percentage of registered SMEs relative to informal SMEs in a project area will be calculated using the formula (Registered SMEs/ Informal SMEs) X 100. Businesses will be classified as:

- *Very low registration (0-20%) = Very high vulnerability (5)*
- *Low registration (21-40%) = High vulnerability (4)*
- *Moderate registration (41-60%) = Moderate vulnerability (3)*
- *High registration (61-80%) = Low vulnerability (2)*
- *Very high registration (81-100%) = Very low vulnerability (1)*

(4) Tenure Status: In the Caribbean, tenure status for SMEs can generally be classified in a continuum from informal to formal development with a range of intermediate tenure types and perceptions of security. SMEs may be established on land with tenure status other than freehold or leasehold (which are the most formal and secure tenure types), such as squatting, family land, traditional land and rented land (Griffith-Charles and Opadeyi 2009). Documentation of tenure status is also a challenge, which may limit control over legal infrastructural improvements. Generally, there tends to be correlation between increasing levels of tenure security and the level of formal planning of settlements. This factor, more than the actual tenure status, would affect the vulnerability of SMEs to climate change. Given the limited enforcement abilities of national agencies, SMEs on informal tenure will often operate with the confidence of those with formal tenure and make adaptation strategies.

The assessment of this indicator is partly paradoxical. If there is ownership of the premises, the vulnerability level can be higher if both the premises and business is affected. Nevertheless, when the premises are owned the vulnerability level decreases as there is a higher probability the property would be improved to reduce hazards (e.g. presence of a solid building structure, drainage etc.). SMEs which rent have less control over infrastructural

improvements. Data may not be up to date from secondary sources as property may change hands. Even though data is becoming available from agencies dealing with regularisation of informal settlements this data will most likely need to be collected from primary sources.

The tenure status of SMEs will be classified according to:

- *Informal tenure (squatting) = Very high vulnerability (5)*
- *Traditional holdings/ family lands = High vulnerability (4)*
- *Rented premises = Moderate vulnerability (3)*
- *Formal tenure without documentation = Low vulnerability (2)*
- *Formal tenure with documentation = Very low vulnerability (1)*

(5) Insurance: The existence of personal (e.g. life, health etc.) or business insurance (e.g. fire, public liability, business interruption, goods in transit, workmen's compensation etc.) can allow for financial resources to be available post disaster if the business was damaged or there was injury or loss of life by the owner or employees.

The Insurance status will be classified according to:

- No personal or business insurance = Very high vulnerability (5)
- Personal but no business insurance = High vulnerability (4)
- Single protection business insurance = Moderate vulnerability (3)
- Multiple protection business insurance = Low vulnerability (2)
- Both personal and multiple protection business insurance = Very low vulnerability (1)

(6) Type and location of data storage: Business information (e.g. accounts, employee information, supplier information, contracts etc.) are useful for the proper functioning of business and for taxation purposes and will necessary for recovery post disaster. Information stored on premises without backup are at greater risk than information stored off site. Paper files may be more a risk than electronic files if not copied. A trend where persons utilized their mobile phone to store business information was noted in Jamaica.

The type and location of data storage status will be classified according to:

- No data storage = Very high vulnerability (5)
- Data on mobile device = High vulnerability (4)
- Single copy paper and electronic files on premises only = Moderate vulnerability (3)
- Paper and electronic files off premises = Low vulnerability (2)
- Paper and/or electronic files backed up in multiple locations = Very low vulnerability (1)

(7) Organisation membership: Some businesses are part of larger business organizations. Businesses in internationally linked Business Associations (e.g. American Chamber of Commerce of Trinidad and Tobago) are more likely to conform to environmental standards than locally formed Associations (e.g. Chamber of Commerce) (Shah and Rivera 2013). The former is likely treat environmental issues alongside financial issues while the latter may deal with it as a "special' topic. SMEs are more likely to be linked to locally formed associations which offer business support (financing and training) rather than those focusing on networking.

The organisation membership status will be classified according to:

- No organisation membership or links to training and networking opportunities = Very high vulnerability (5)
- No organisation membership but access to training and networking opportunities = High vulnerability (4)
- Membership in a locally formed Associations = Moderate vulnerability (3)
- Membership in a internationally linked Association = Low vulnerability (2)
- Membership in internationally linked and local Associations = Very low vulnerability (1)

(8) Topography and environmental conditions: The topographical and environmental conditions determine the internal bio-vulnerability of SMEs. This generally would not change drastically with projects unless they involve unless hard engineering adaptation solutions, for example associated with large infrastructural projects. Based on multi-hazard datasets and datasets on location of businesses, an internal biophysical vulnerability score can be

calculated for SMEs. The data from Bailey (2014) can be used as an example. It spatially represents informal communities in relation to their multiple hazards in Jamaica (Figure 1) and the KMA (Figure 2) and rather than squatter settlements, this can be done for SMEs.

Figure 1: The location of squatter settlement in relation to multi-hazards in Jamaica (Source: Bailey (2014))

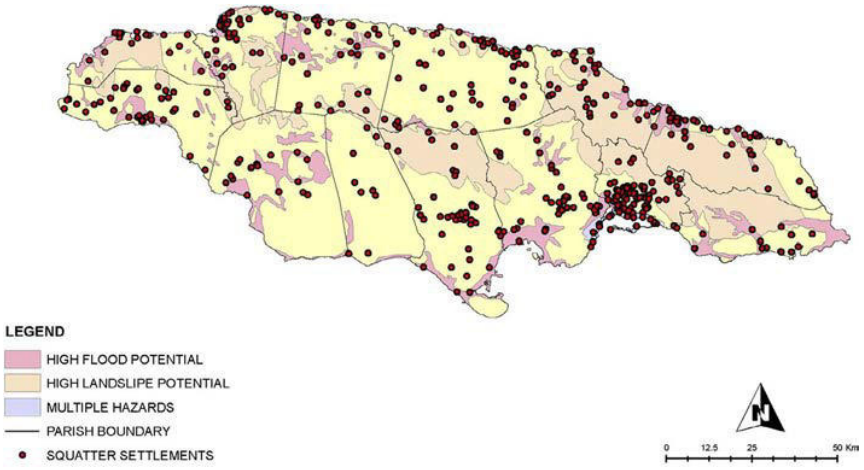
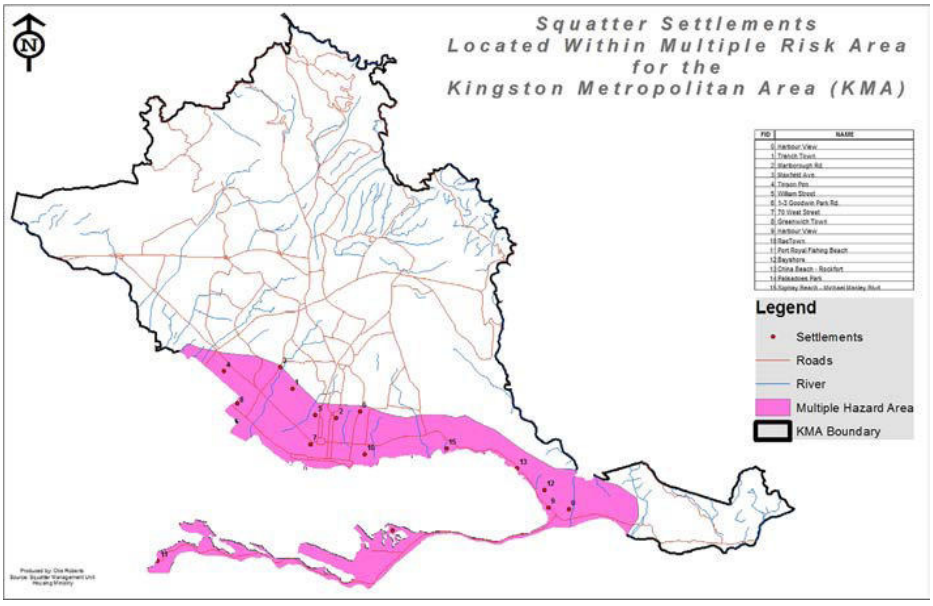


Figure 2: The location of squatter settlement in relation to multi-hazards in the KMA, Jamaica (Source: Bailey (2014))



The values for risk will be assigned as follows: 'Very High Vulnerability' (5), 'High Vulnerability' (4),'Moderate Vulnerability' (3),'Low Vulnerability' (2), and 'Very Low Vulnerability' (1). A mean score will be calculated based on aggregate scores for SMEs for each hazard examined in the sample.

Composite Index of vulnerability

Table 2 summarises the vulnerability rating system based on the eight indicators which all range from 1-5.

Table 2 : Parameters for Composite Index of SME vulnerability

	Very Low vulnerability (1)	Low vulnerability (2)	Medium vulnerability (3)	High vulnerability (4)	Very High vulnerability (5)	Weighting
SMEs per area	> (√ national average)^5	(√ national average)^4 +1 to (√ national average)^5	(√ national average)^3 +1 to (√ national average)^4	national average +1 to (√ national average)^3	0 to national average	0.15
Type of Enterprise	Other	Construction	Large retail/ manufacturing	Services	Food and personal items	0.2
Registration status of business	81-100 % Formal SMEs /Informal SMEs	61-80 % Formal SMEs /Informal SMEs	41-60 % Formal SMEs /Informal SMEs	21-40 % Formal SMEs /Informal SMEs	0-20% Formal SMEs /Informal SMEs	0.1
Tenure Status	Formal tenure with documentation	Formal tenure without documentation	Rented premises	Traditional holdings/ family lands	Informal	0.1
Insurance status	No personal or business insurance	Personal but no business insurance	Single protection business insurance	Multiple protection business insurance	Both personal and multiple protection business insurance	0.1
Type and location of data storage	No data storage	Data on mobile device	Single copy paper and electronic files on premises only	Paper and electronic files off premises	Electronic files backed up in multiple locations	0.05
Organisational membership	No organisation membership or links to training and networking opportunities	No organisation membership but access to training and networking opportunities	Membership in a locally formed Associations	Membership in an internationally linked Association	Membership in an internationally linked and local Associations	0.05
Topographical and Environmental conditions	Composite score	Composite score	Composite score	Composite score	Composite score	0.25

Given that Topographical and Environmental conditions have a heavy influence on total vulnerability, this indicator was given a weighting of 0.25. Type of Industry was given a weighting of 0.2 and SMEs per area, 0.15. Registration, Tenure status and insurance status were given a weighting of 0.1. Type and location of data storage and organisation membership was given a weighting of 0.05 each. A final composite score will be calculated based on the sum of the means, pre and post project.

Identifying Target SMEs

There were two types of SMEs indentified in the research, Final and Associated, which may have implication on the type of information that can be collected.

Final SME Beneficiaries, i.e. SMEs in the geographic area of the project and likely to benefit directly from infrastructural improvements, are the most appropriate targets for targeted questionnaires. They can be identified from visual inspection in the sampling area identified from project documents and assesses pre-intervention, during the project life and post the project life. Their presence can be contextualized in terms of socio-economic data on the area.

Associated SME beneficiaries, i.e. those benefiting financially from the projects through providing goods and services, are not practical for targeting as they can only be identified well into the project life from procurement lists. As some successful companies may subcontract other companies, the number of Associated SME beneficiaries may be large. They may be useful to interview post project to determine if their association with the project resulted in the use of "greener" technologies or higher standards of operation and if these were translated to other local projects which could reduce community and/or national vulnerability.

Collection of Secondary Data

Identifying secondary data which can be valuable for pre and post project assessment in a limited geographic area will be a challenge in the Caribbean. Based on experiences in

Jamaica and Trinidad, some sources of data on SMEs include the Central Statistical Offices, Board of Inland Revenue Division, Central Bank and Companies Registrar. Environmental and socio-economic data can be obtained from sources in Box 3.

BOX 3 Secondary Data Sources

Environmental & Socio-Economic Data Sources (Jamaica)

- National Environment & Planning Agency (NEPA)
- Forestry Department
- Planning Institute of Jamaica (PIOJ)
- Statistical Institute of Jamaica (STATIN)
- National Land Agency (NLA)
- National Water Commission (NWC)
- Water Resource Authority (WRA)
- Land Information Council of Jamaica (LICJ) / National Spatial Data Management Division (NSDMD)
- Office of Disaster Preparedness & Emergency Management (ODPEM)
- Meteorological Service of Jamaica (Met Service)
- Mines & Geology Division (MGD)
- Mona Geomatics Institute

Environmental and Socio-Economic Geographical Data Sources (Trinidad)

- Office of Disaster Preparedness and Management (ODPM)
- Everglow (private GIS company)
- University of the West Indies in St. Augustine (UWI)
- Meteorological Service of Trinidad and Tobago (MET Service)
- Central Statistical Office of Trinidad and Tobago (CSO)
- Ministry of the Environment and Water Resources
- Ministry of Works and Infrastructure

It was noted that agencies in Jamaica and Trinidad and Tobago involved with climate change were generally not involved with SMEs and *vice versa* which meant that these agencies may not be able to fully understand the vulnerability of SMEs. As such, the issue of data sharing between organisations needs to be addressed for it to have any practical use in accessing vulnerability. Statistical agencies which are likely to be a repository of both sets of information may not utilize the information for this purpose unless the importance is recognised and there is the technical expertise to understand the implications of the data.

As can be seen from the environmental and social impact assessments of the project areas (Smith 2011; Sammy 2001), data within municipal boundaries may be available, however, these do not correspond well with project impact areas making available data of limited use. Published information on SMEs available from the World Bank Group's Enterprise Survey and other sources may provide timely (e.g. annual) information, however, it may be reported at a national level and not sufficiently disaggregated to provide information at the community level. While census data is collected at the enumeration district level, the ten-year cycle for collection of census data also makes before and after project data analysis difficult. These challenges indicate that data management systems regarding SMEs need to be more robust.

Sampling

In limited project areas such as TT-L1018 a census (100 % survey) could be attempted at reasonable costs. In JA-L1035, because of the much larger project area and likely larger SME population, a structured sample survey would be needed.

CONCLUSIONS

The predicted negative impacts of climate change (sea level rise, extreme weather events, drought etc.) are likely to be exacerbated by the nature and geographic location of urbanisation in Caribbean Small Island Developing States (SIDS) while recovery is likely to be hampered by factors such as international debt (Thomas et al. 2013; Bueno et al. 2008). Climate change may impact national economies but some events will be directly felt by communities and individual households. As such, there is a growing need to build the adaptive capacity/resilience of communities and information that helps to understand such capacity is required for short, medium and long term planning.

Although international agencies, governments and national agencies tackle climate change issues from a global and national level, often the risks associated with climate change are not perceived at the local level. Hence, there are limited community efforts which goes into building adaptive capacity in the community. This is ironic as it is the households and businesses in the community which are most likely to be impacted if disaster occurs given the limited enforcement of planning regulations, weak municipal management, and high levels of informality in the Caribbean (Mohammed and Howard 2013).

SMEs make a relevant and bottom-up unit of analysis which will provide us with information and data which supports a more complete understanding of the climate change issue on a more local level (Runyan 2006; Wedawatta et al. 2008). Due to the heterogeneous nature of the functions of SMEs, they can give a broader understanding of adaptive capacity in communities than aggregated household data alone. SMEs are an economic and socially important subset of communities. By providing jobs, products and services, they act as nuclei, which hold communities together and allows for settlements to grow from neighbourhoods to towns and cities. Through regulatory requirements or on their own accord, often engage in disaster management or contingency planning and build in adaptive strategies (e.g. insurance, savings, resilient structures etc.) into their day to day operations which can mitigate in cases of (climate change) related disasters. They also play a critical role in the functioning of the country's economy which provides the resources to implement mitigation measures in communities and can create or transfer useful technologies which can improve resilience in communities. Despite the importance of SMEs, there remains a gap between how the private sector prepares for and is vulnerable to climate change (Zhang et al. 2009).

The methodology proposed is robust but simple enough to allow for urban practitioners, Non-Governmental Organisations (NGOs), business associations, communities and individuals to participate in the data gathering and understand the results. This mirrors monitoring and evaluation procedures being developed by the IDB in their Emerging and Sustainable Cities Initiative (ESCI) where a platform for citizens led monitoring of programmes is developed very much in the form of the Bogota *Como Vamos* programme.[12] This indicator system, and monitoring and evaluation systems in general, are concerned with the importance of issues to citizens and their potential cost to the city if not addressed.

In the identification of eight indicators, there was balance between factors intrinsic to the resilience and adaptive capacity of the SMEs and the impact of SMEs as a collective on an area. Along with a better understanding of the role SMEs play in the community and a means to determine a vulnerability score for external shocks and stresses based on multi-hazard risk, the proposed methodology should be able to allow comparison of the resilience of

[12] The ESCI programme actually utilises a complex set of indicators, but the citizens monitoring system is much simpler and utilises a combination of qualitative and quantitative indictors. See *Annex 2 Indicators of the Emerging and Sustainable cities Initiative: Methodological Guide*, IDB, Washington, 2013. and http:/www.bogotacomovamos.org/scripts/home.pnp

communities. Testing in the field would allow for further refinement of both the classification system and weighting of the indicators.

In order for these indicators to be of use to measure the change in adaptive capacity, brought on by interventions such as large infrastructural projects, the practicality of these indicators in terms of data collection needed to be determined. Primary data collection can provide valuable up to date information however it can consume both time and resources and only be done on a limited geographic and time scale by persons monitoring the progress of projects. However, identifying and accessing secondary data on SMEs or data related to vulnerability indicators is also challenging. Data management capacity for planning purposes has improved across the Caribbean region over the past 15 years, but remains generally limited, unevenly distributed at the national scale, and extremely limited at the municipal level (Frojmovic and Ramlal, unpublished). Key challenges include weak institutions, lack of data, limited storage in GIS format, lack of access to data via internet, unwillingness to share data, multiple or incompatible administrative boundaries (Frojmovic and Ramlal, unpublished; Mohammed and Howard 2013).

The limited spatial understanding of risk factors, more so in Trinidad than Jamaica, makes determination of the vulnerability difficult which will impact both national response capacity and understanding by owners of the SMEs. The Mona Geomatics Institute of Jamaica has the capacity to produce such mapping but requires upgrading of the data on businesses. In Trinidad, only hazard maps for flooding and landslides exists and a similar system can identify the geographic position of each SME in the sample area and calculating their risk likelihood will be required.

The lack of a standard national definition used by all agencies within the country and standard global definition for SMEs also limits the usefulness of data and limits the ability to compare between countries and hence translation of best practices. Consideration should be given to the alignment of IDB project boundaries with established national administrative boundaries to allow for data from national agencies to be used in impact assessment.

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