Linking Vulnerability, Adaptation and Mitigation in SIDS: Climate Change and the Community of Grande Riviere, Trinidad

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Outline

- Introduction
- C-Change Project
- Literature Review
- Methodology
- Case Study and Data Collection
- Empirical Results
- Scenarios and Policy Simulations
- Further Work in Progress
- Conclusions

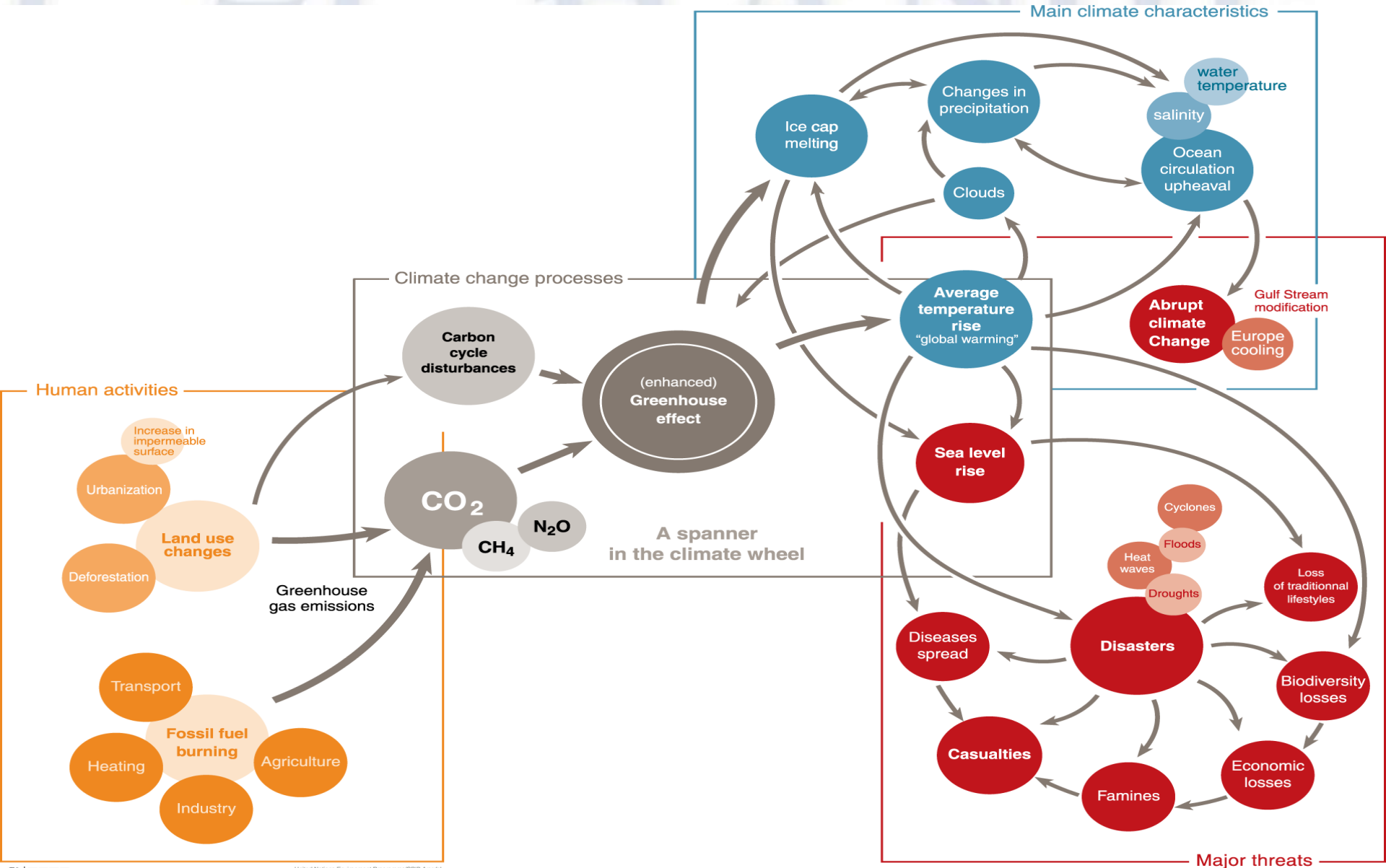
INTRODUCTION

Climate Change

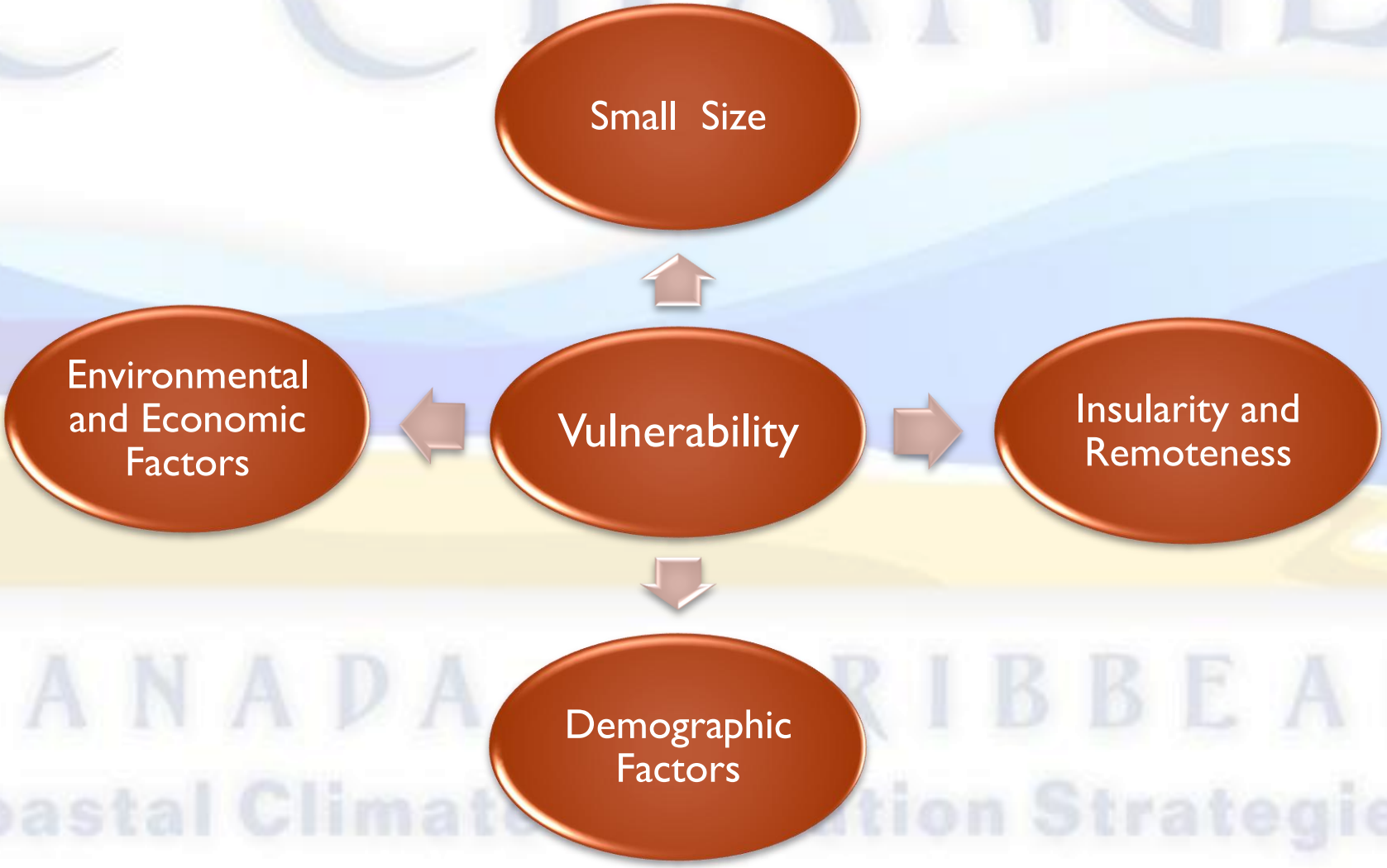
- Refers to "*any changes over climate over time, whether due to natural variability or as a result of human activity*" (IPCC 2007).

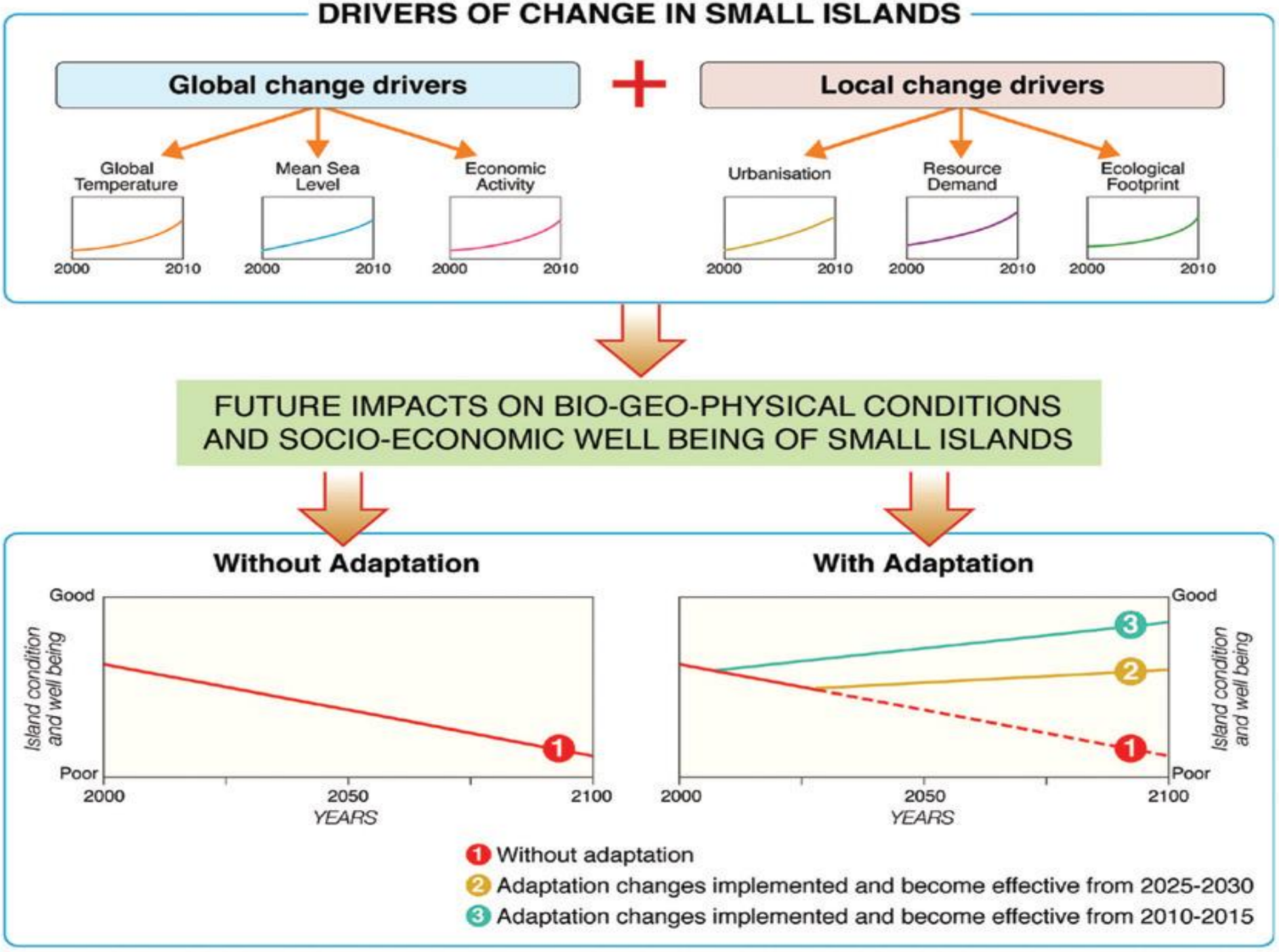
- Increasingly being accepted as the single major threat facing the socio-ecological systems in the 21st century

Climate Change Processes



Who are Most Vulnerable? A Focus on SIDS




DRIVERS OF CHANGE IN SMALL ISLANDS
Global change drivers
Global Temperature
Mean Sea Level
Economic Activity
2000
2010
Local change drivers
Urbanisation
Resource Demand
Ecological Footprint
FUTURE IMPACTS ON BIO-GEO-PHYSICAL CONDITIONS AND SOCIO-ECONOMIC WELL BEING OF SMALL ISLANDS
Without Adaptation
With Adaptation
Good
Poor
Island condition and well being
2000
2050
2100
YEARS
1 Without adaptation
2 Adaptation changes implemented and become effective from 2025-2030
3 Adaptation changes implemented and become effective from 2010-2015

THE C-CHANGE PROJECT

C-CHANGE GALLERY

About the C-Change Project

Managing Adaptation to Environmental Change in Coastal Communities: Canada & the Caribbean

The global climate is changing. Impacts are increasingly visible, and the trends are undeniable. Rising temperatures are melting polar ice and together with thermal expansion of water are contributing to: sea level rise, changing precipitation patterns, more frequent intense weather events, storm surges and flooding, coastal erosion, increased sedimentation of coastal waters, and, especially worrisome, pollution from flooded or destroyed infrastructure and [illegible] are that "all countries" will be affected, especially small island states and [illegible]ations in low-lying and coastal regions being most at risk from sea-level rises, increased ave[illegible]ures affecting the normal seasonal cycles, increased incidences and intensity of storms and hurricanes along with the consequent increased risks of storm surges, and increased incidences of droughts and floods.


Princess Margaret Beach, Bequia © C-Change Caribbean

Vulnerable coastal communities can increase their adaptive capacity to climate change by linking national and regional institutional resources and services with local community knowledge, know-how, and response networks. Together, they can better anticipate and cope with potential impacts, and strategically apply limited resources to priority areas. Mitigation and adaptation strategies for the impending climate change threats to vulnerable coastal communities in developing countries are therefore socially significant research pursuits.

This project examines coastal communities in the Caribbean region and coastal communities in Canada's Atlantic, Pacific and Arctic regions whose livelihoods will be most

SEARCH

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C-CHANGE SUPPORTERS

IDRC CRDI Social Sciences and Humanities Research Council of Canada
The University of the West Indies at St. Augustine, Trinidad and Tobago
Telfer School of Management
C-FOAM

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C-Change: Managing Adaptation to Environmental Change — C-Change: Managing Adaptation to Environmental Change created an event.

The C-Change Project

- Sponsored by the IDRC under the "ICURA" Framework (International Community-University Research Alliance)
- 5 year collaborative project between The University of the West Indies and the University of Ottawa (2009-2014)
- Harnesses a multidisciplinary approach to the challenge of climate change, incorporating aspects of sociology, economics, land-use planning and geomatics engineering
- Project Website : http://www.coastalchange.ca

Research Objectives of C-Change

- The creation and maintenance of mitigation and adaptation strategies for the impeding threats to coastal communities from sea-level rise and storm surges

- To develop community awareness, infrastructure and decision support tools for preparing for adaptation and mitigation strategies for the impacts of climate change on selected regional coastal communities in Canada and the Caribbean

Case Study Sites: Canada and the Caribbean

Canada	Caribbean	Characteristics
Charlottetown, Prince Edward Island	Georgetown, Guyana	Capital Cities
Iqaluit, Nunavut	Belize Barrier Reef, Belize	Native Homeland / Indigenous Communities
Gibsons, British Columbia	Grande Riviere, Trinidad and Tobago	Mainland Coastal Communities
Isle Madam, Cape Bretton, Nova Scotia	Bequia, St. Vincent and the Grenadines	Offshore Coastal Communities

Caribbean Case Study Sites

- ***Grande Riviere***: small coastal village in Trinidad that is host to a major spawning site for leatherback turtles, around which a burgeoning **eco-tourism** industry is developing

- ***Georgetown***: the capital of Guyana, an **urban centre** that is below sea level

- ***Bequia:*** small island in the St. Vincent and the Grenadine chain that is sustained by **tourism and fishing** activities

- ***The Belize Barrier Reef***: reef ecosystem that is vital to the livelihoods of a **multiple indigenous coastal communities** through its support of **tourism and fishing** activities

Methodology and Research Activities

1. Problem definition
2. Data collection and database development
3. Visual modelling (GIS tools)
4. Vulnerability Index development and calculations
5. Scenario analyses
6. Adaptive capacity and resilience modelling
7. Development and assessment of policy options
8. Implementation of local adaptation planning and action frameworks

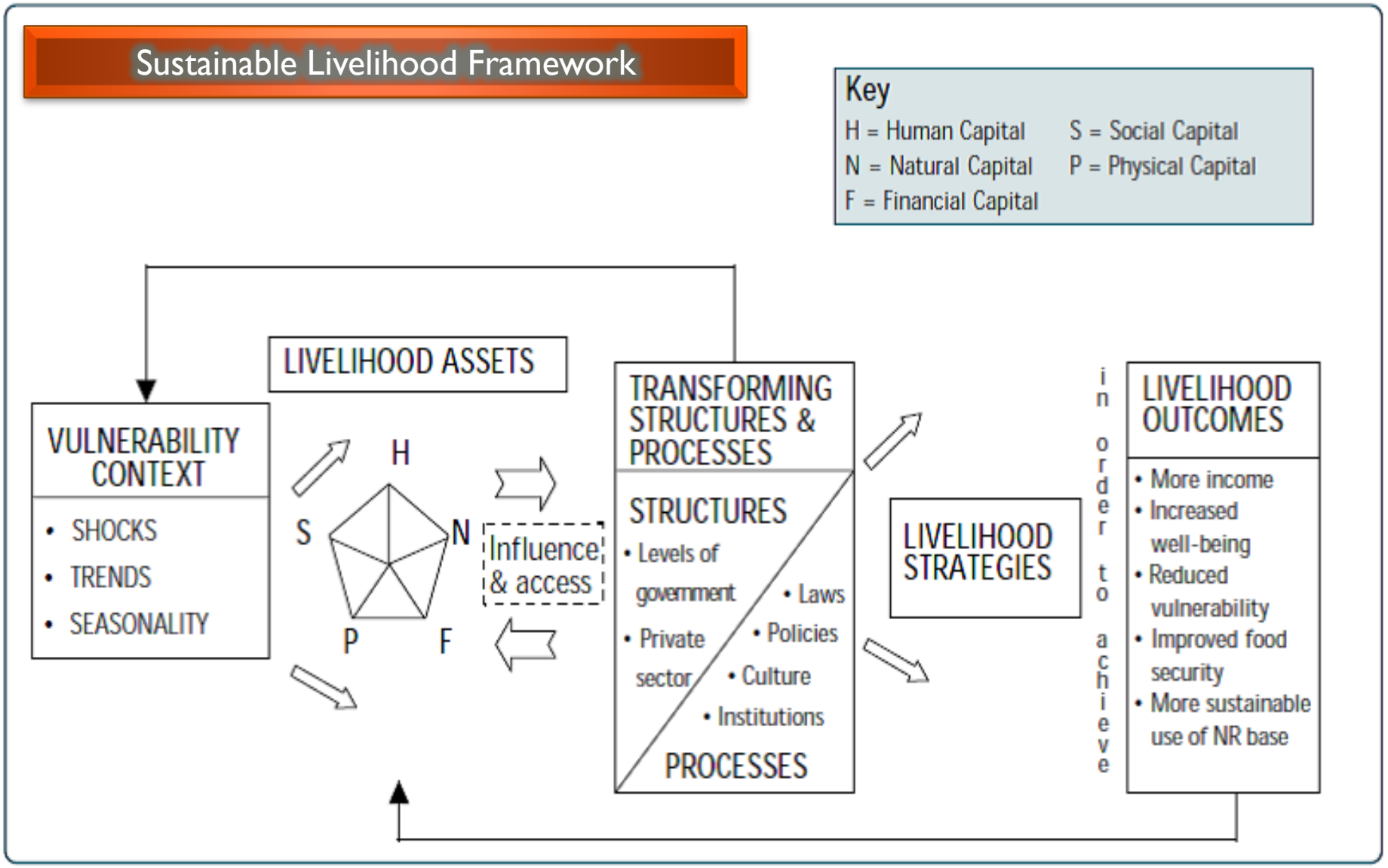
LITERATURE REVIEW

Some Recent Measures of Vulnerability

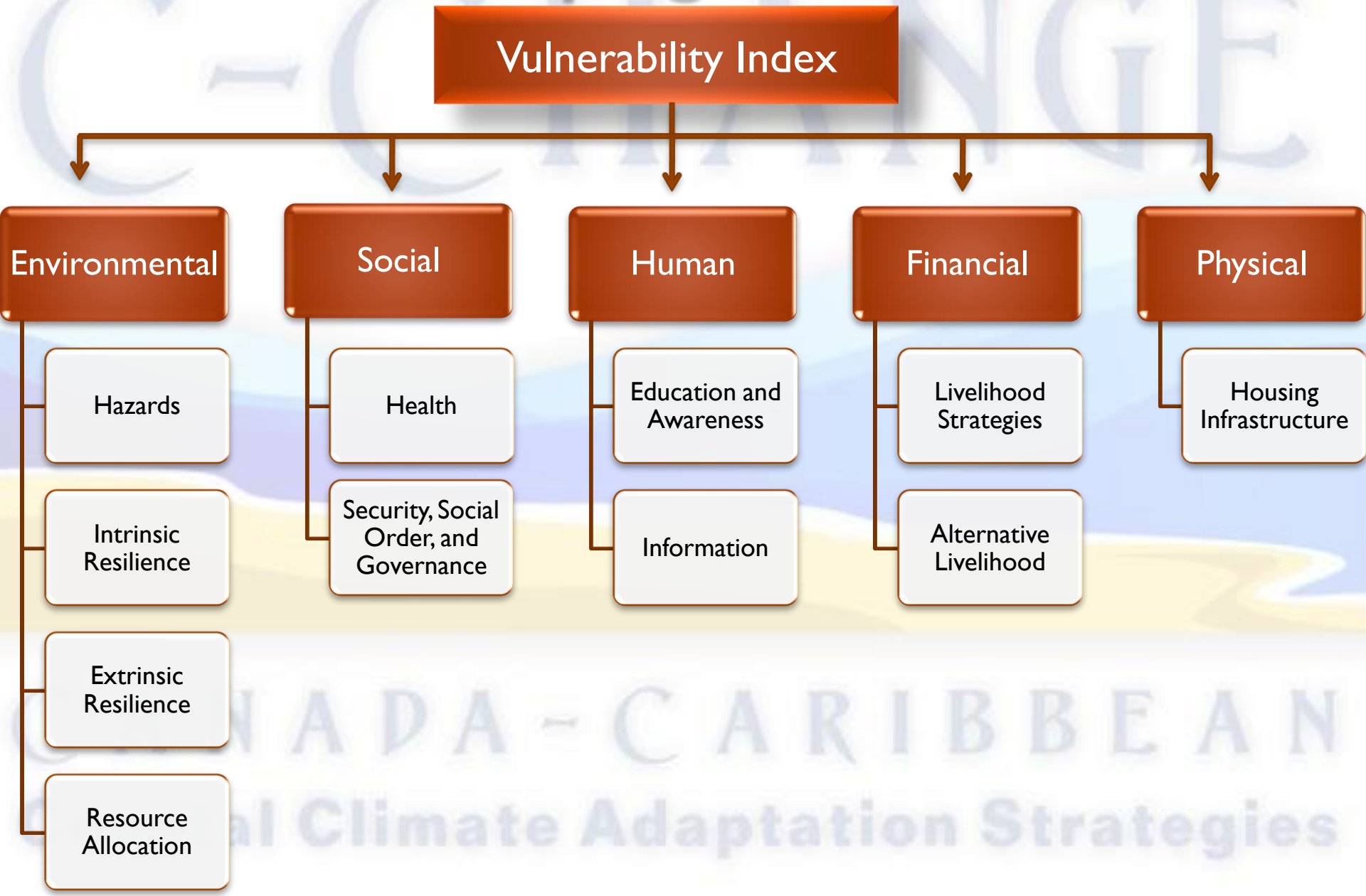
Reference	Geographic Focus	Vulnerability Index/ Focus	Scale	Categories Chosen	Type of Data
Skondras et al (2011)	Greece	Environmental Vulnerability	Country	Hazards, resistance, and damage	Secondary data
Hahn et al (2009)	Mozambique	Livelihood Vulnerability	Community	Socio-demographic, profile, livelihood strategies, health, food, water, and natural disasters	Primary data-survey
St Bernard (2007)	The Caribbean	Social Vulnerability	Country	Education, health, security, social order and governance, resource allocation, and communication architecture	Primary and Secondary data
SOPAC (2004)	SIDS	Environmental	Country	Hazards, resistance, and damage	Secondary data
Vincent (2004)	Africa	Social Vulnerability	Country	Economic well being and stability, demographic structure, global interconnectivity, natural resource dependence	Secondary data
Briguglio and Galea (2003)	SIDS	Economic Vulnerability	Country	Economic openness, export concentration, peripherality, and dependence on strategic imports	Secondary data
Gowrie (2003)	Tobago	Environmental	Country	Environmental risk, Intrinsic Resilience, and Environmental degradation	Secondary data

METHODOLOGY

Sustainable Livelihoods Approach



Developing the Index



Calculating the Index

- Standardisation = Value – Minimum / Maximum – Minimum
- $M_c = \sum^{n}_{i=1}$ index $s_c i$ / n
- Where Mc is one of the major 11 components, $s_c i$ is the sub component
- $VI = \sum^{11}_{i=1} w_{Mi} M_{ci} / \sum^{11}_{i=1} W_{mi}$
- Scores assumes standard format with Minimum of 0 and Maximum of 1 (least and most vulnerable respectively)

CASE STUDY AND DATA COLLECTION

Grande Riviere

Some Basic Facts

- Small Community: 298 individuals, 147 households
- Low Income: over 68% earn less than $999 per month
- Environmental assets: rich in biodiversity and natural fauna; major nesting site for the critically endangered leatherback turtle
- Environmental threats: Hillside Deforestation, Hunting of Turtles and Wildlife, Reduction in Fish Stocks, Oil Spills, Waste Disposal from Beach Hotels, Climate Change

Data Collection

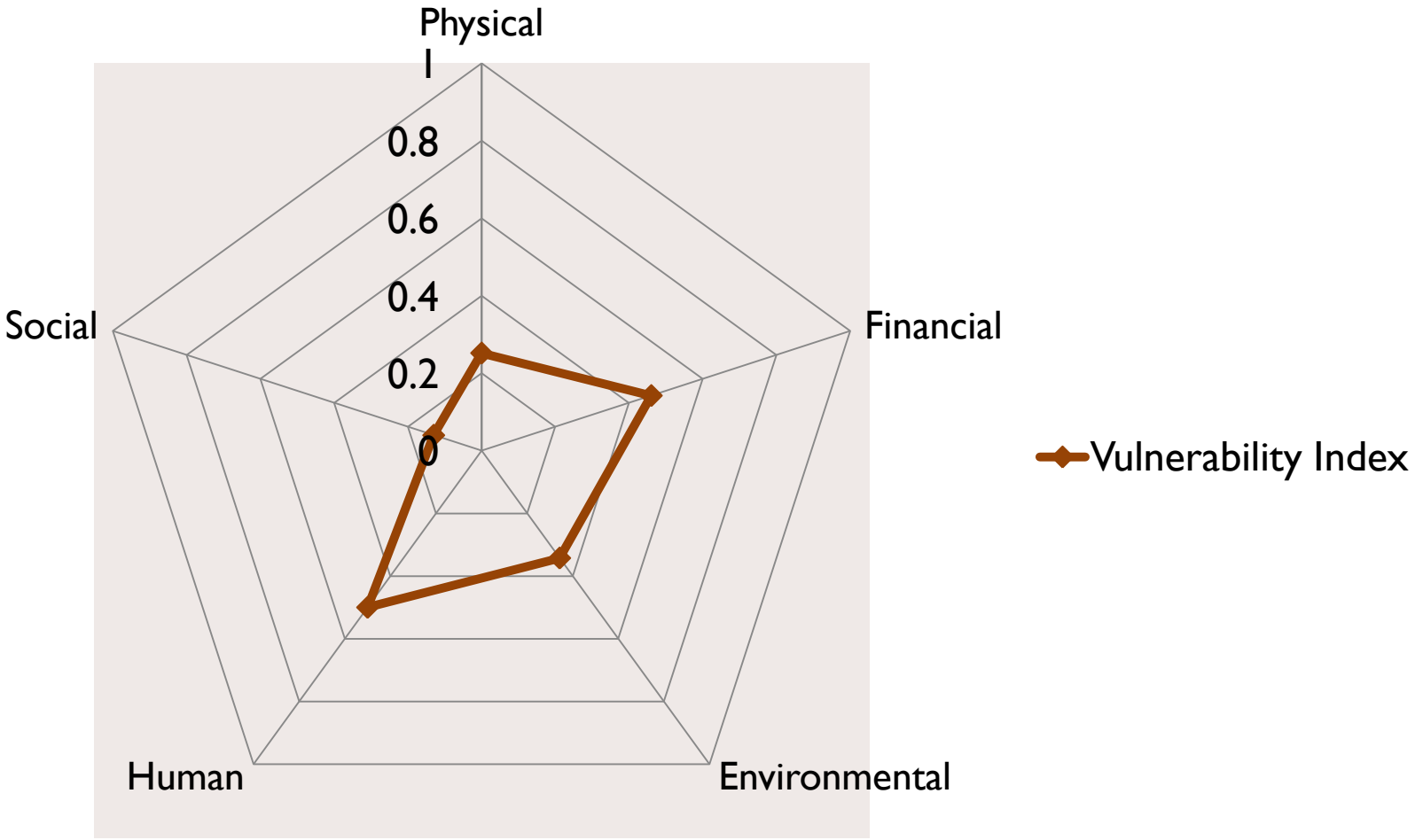
- Secondary Data from CSO
- Primary Data: community survey
- Required information was grouped into capital pillars: Environmental, Social, Human, Financial and Physical

EMPIRICAL RESULTS

Vulnerability Index Results

Pillars	Major Component values for Grande Riviere
Human	0.4997
Financial	0.4604
Environmental	0.34288
Physical	0.2521
Social	0.1302
VULNERABILITY INDEX	**0.3371**

Spider Diagram showing Vulnerability Index



Example Calculation

Indicator	Sub-components for Physical	Sub-component values	Maximum	Minimum	Index value	Component value
Housing Infrastructure	Average number of households that uses wood, brick or some other construction material as their outer wall (H_1)	1.35	3	1	0.1768	**0.2521**
	Average number of households that own the land in which they farm (H_3)	1.56	2	1	0.558	
	• • •	• • •	• • •	• • •	• • •	
	Average frequency of water supply for the households (H_5)	1.05	3	1	0.025	

SCENARIOS AND POLICY SIMULATIONS

Policy Simulations

Policy	Government	Community	Household
Enhance education and awareness	•Implement climate change into school syllabus	•Frequent meetings with community groups •Organise lectures or workshops •Publicise the information via posters and pamphlets	•Ensure school attendance •Read, listen to, and watch more stories on climate change
Conservation of Ecosystem Services	•Promote greater measures for recycling, and reducing pollution	•Community groups can communicate the need for ecosystem services	•Support the conservation & protection of species
Reduce emission on GHG	•Set limits on the number of land use for farming •Implement carbon caps	•Reduce slash and burn •Reduce number of land reclaimed from forest, and land under cultivation •Avoid deforestation and promote re-forestation	•Same as the community level
Adopt No-Regret Options	•Enforce approval for sites	•Community building, hotels or health facilities should not be built too close to coastal zone	Home owners should not build too close to coastal zone
Ensure proper Infrastructural material	• Have policies, standards and procedures that deal with climate change	•Use stronger material for outer wall and roofing	•Same as the community level
Improve Health and Sanitation	•Set minimum standards •Ensure frequent inspection	•Community members can form clean up groups	•Containers, and tyres are properly secure •Cut grass/bushes •Ensure proper water flows, and toilet linkages

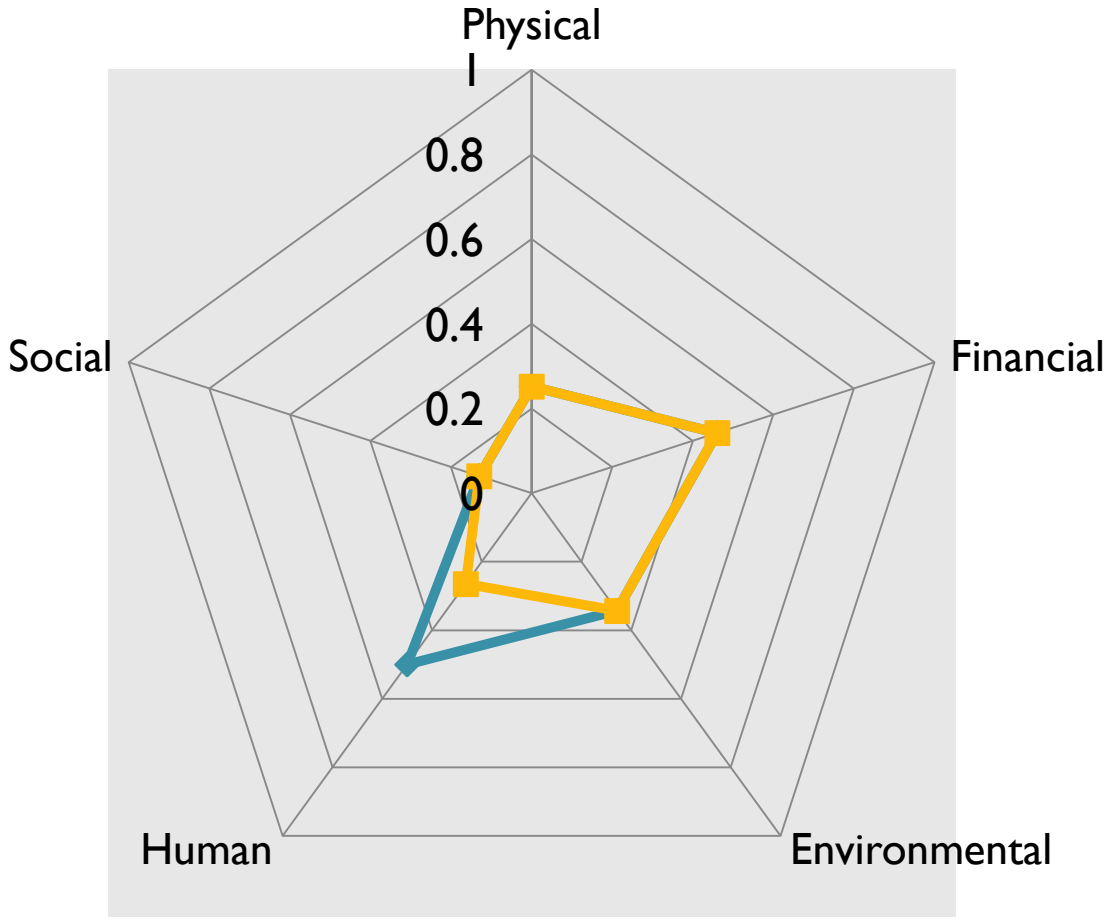
Simulation Example

Indicator	Sub-components for Human	Sub-component values	Maximum	Minimum	Index value	Component value
Education & Awareness	Average number of households that know about climate change (EA_1)	2.63	4	1	0.5433	**0.2648**
	Average number of households that are concerned about climate change (EA_2)	1.55	4	1	0.183	
	• • •	• • •	• • •	• • •	• • •	
	Average number of households that believe Grande Riviere is at risk to climate change (EA_3)	1.80	4	1	0.2667	

Results of Simulation

Pillars	Major Component Value for Grande Riviere		Vulnerability Index
	Without Policy	With Policy	
Physical	0.2521	0.2521	***0.2901*** (lower than 0.3371)
Financial	0.4604	0.4604	
Environmental	0.34288	0.34288	
Human	**0.4997**	**0.2648**	
Social	0.1302	0.1302	

Spider Diagram showing Pillars With and Without the Policy



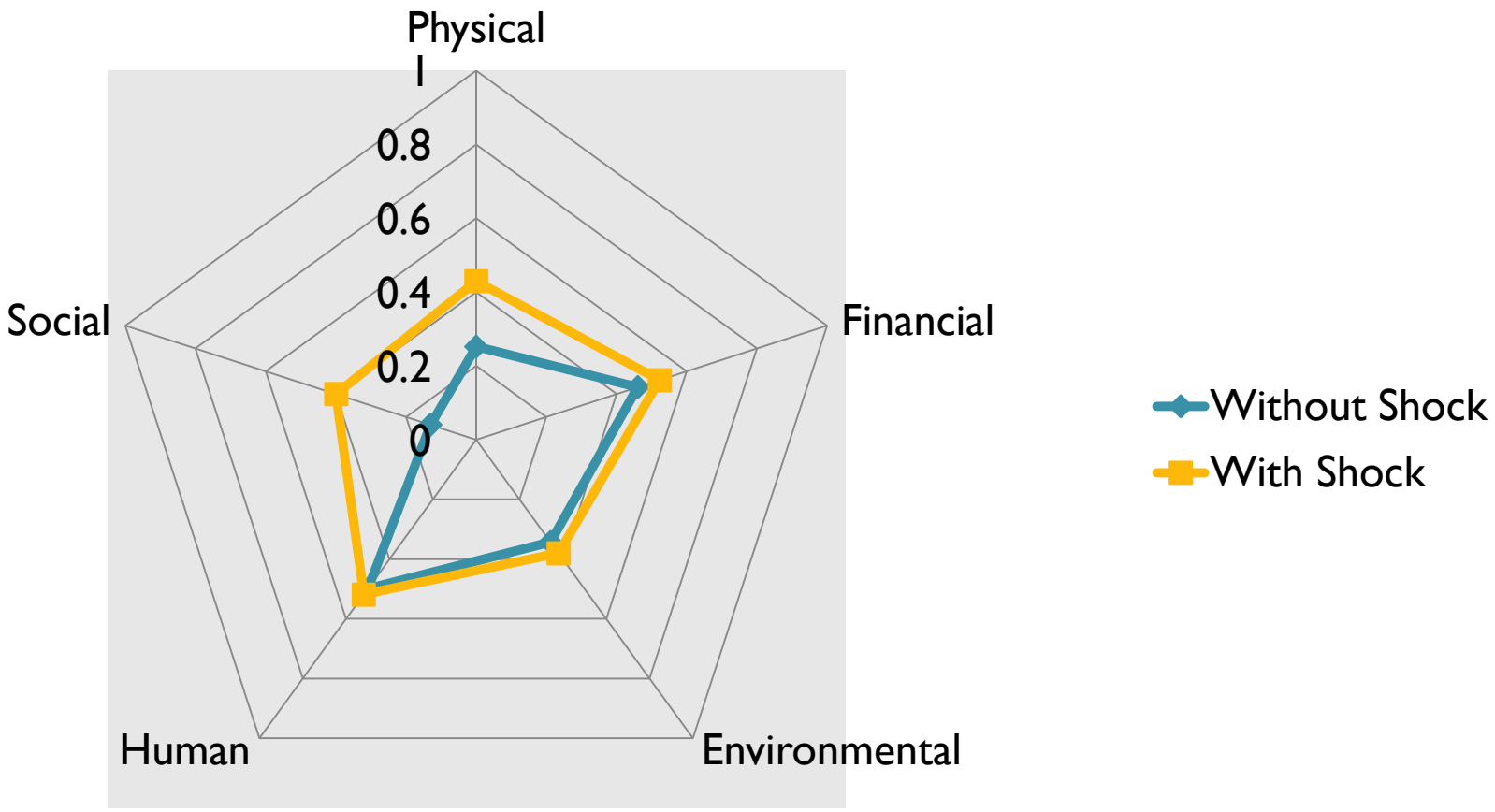
Exogenous Shock: Hurricane

Indicator	Sub-component for Physical	Sub-component values	Maximum	Minimum	Index value	Component values
Housing Infrastructure	Average number of households that uses wood, brick or some other construction material as their outer wall (H_1)	**1.85**	3	1	**0.4250**	***0.4046***
	Average number of households that uses sheet metal, concrete or other material for roofing (H_2)	**3.48**	6	1	**0.496**	
	• • •	• • •	• • •	• • •	• • •	
	Average number of households that have their toilet facility linked (H_9)	**3.07**	3	1	**0.810**	

Results Of Exogenous Shock on All Capital Pillars

Pillars	Major component values for Grande Riviere		Vulnerability Index	
	Without Shock	With Shock	Without Shock	With Shock
Physical	0.2521	*0.4296*	***0.3371***	***0.4501***
Financial	0.4604	*0.5227*		
Environmental	0.34288	*0.38005*		
Human	0.4997	*0.5186*		
Social	0.1302	*0.3996*		

Spider Diagram showing Pillars With and Without an Exogenous Shock



FURTHER WORK IN PROGRESS:

VULNERABILITY INDEX CALCULATIONS FOR GEORGETOWN, GUYANA

Georgetown Guyana

Some Basic Facts

- Georgetown is the capital and largest city of Guyana

- Divided into three regions:
  - Central Georgetown
  - Greater Georgetown
  - South Georgetown

- Businesses include: international trade in sugar, timber, bauxite, gold, and diamonds

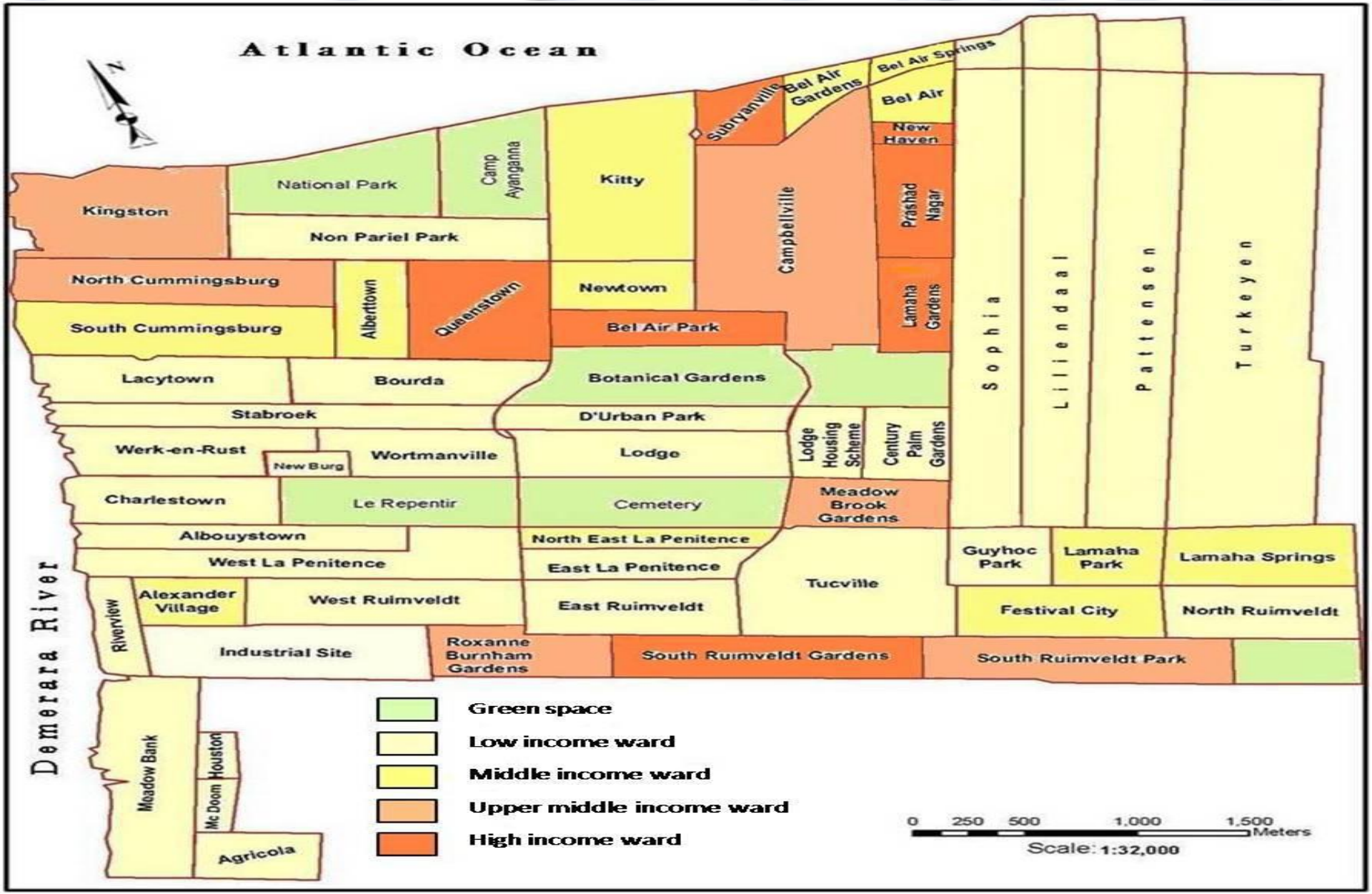
- Rich in natural resources such as timber, bauxite, gold, and diamonds

- Faces the threat of climate change especially sea level rise

Georgetown

- About 90% of the Guyana's population lives on a coastal belt that is 1.4 meters below sea level
- Rising sea-levels are likely to increase the frequency and intensity of flooding in Georgetown
- In the last decade, extreme weather conditions more frequent
- Most of the potable water provided by artesian wells whose water tables are susceptible to saltwater intrusion
- Specific areas suffer from saltwater intrusion mainly due to the many drainage canals and water outlets, overtopping, and flooding resulting from heavy rainfall
- Since the coast is critical to the economic development of the entire economy, the ripple effects are expected to be felt further than the coastal regions of Guyana.

Georgetown Guyana



Sampled Communities

Sampled Community	Income Category
Bel Air Park Subryanville	High Income
Roxanne Burnham Gardens Kingston	Upper Middle Income
South Cummingsburg Kitty	Middle Income
Werk-en-rust Tucville	Lower Middle Income
Sophia Riverview	Low Income

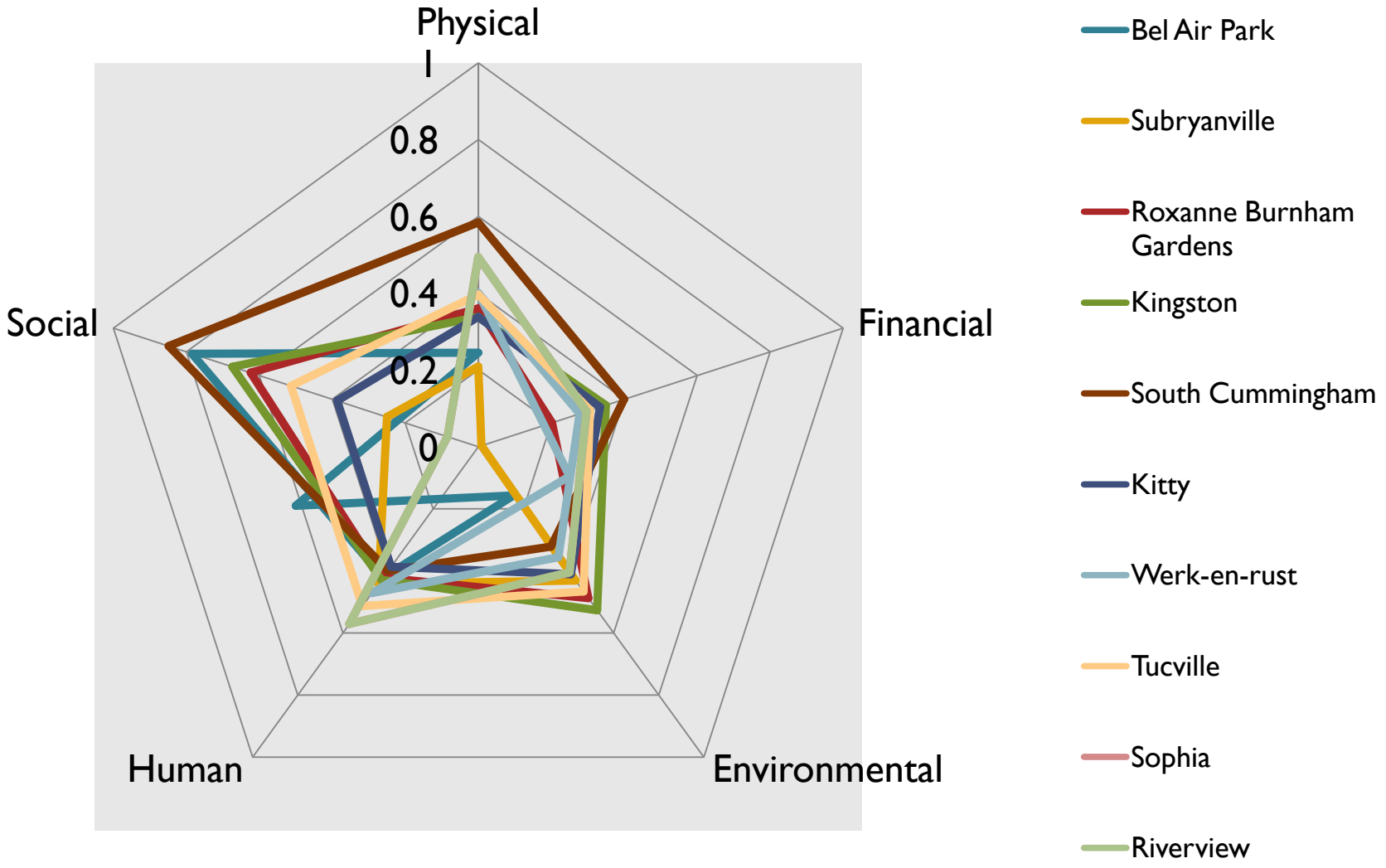
Vulnerability Indices by Community

Wards	Index Value
South Cummingsburg	0.511
Kingston	0.443
Tucville	0.436
Roxanne Burnham Gardens	0.422
Riverview	0.370
Kitty	0.294
Subryanville	0.284
Werk-en-Rust	0.251
Sophia	0.243
Bel Air Park	0.222

Vulnerability Indices by Pillars for Selected Communities

Wards	Env'al	Financial	Physical	Human	Social
South Cummingsburg	0.322	0.4	0.584	0.4	***0.848***
Kingston	0.527	0.35	0.338	0.429	***0.674***
Tucville	0.467	0.306	0.396	***0.513***	***0.513***
Kitty	***0.411***	0.334	0.338	0.387	0.387

Spider Diagram showing Vulnerability Index



CONCLUSIONS

In Summary

- Climate change is a global problem
- SIDS (and coastal communities of developing countries in general) have high levels of vulnerability and low adaptive capacity
- They need to adopt a climate smart policy where they *Act Now, Act Together, and Act Differently*
- Action and impacts of Action must be measurable
- To that end, this Index can be used to
  - measure vulnerabilities
  - Disaggregate vulnerabilities into component areas
  - Compare vulnerabilities across other communities and countries
  - Highlight appropriate policies with an aim to reducing vulnerabilities
  - Measure the impact and efficacy of such policies

Limitations and Further Work

- *Some Limitations and Constraints:*
  - A certain subjectivity in choosing variables
  - Problems of measurement due to the absence of data for certain components (social capital was particularly challenging)
  - Averaging and weighting procedure (equal weights?)
  - Reliability of primary data collection
  - Trade offs among pillars not yet captured

- *Further Work currently in progress within the C-Change project:*
  - Disaggregation of capital pillars
  - Empirical applications to communities of Bequia, Belize, and Georgetown
  - Integration of Spatial Data with Vulnerability Calculations in all sites

Thank You

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