



**Quantifying Climate Impacts on
Sustainable Livelihoods in Coastal
Caribbean Communities:
The Development of a Vulnerability Index**

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Outline

- Climate Change
- The C-Change Project
- Developing a Vulnerability Index
- Methodological and Data Challenges
- Conclusions
- Further Work

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
- ◆ Small Island States recognised as “vulnerable” to climate change impacts by the IPCC

IPCC 4th Assessment: Climate Change and Water

- Higher water temperatures and changes in extremes, including floods and droughts, are projected to affect water quality and exacerbate many forms of water pollution (*high confidence*).
- *In addition, sea-level rise is projected to extend areas of salinisation of groundwater and estuaries, resulting in a decrease of freshwater availability for humans and ecosystems in coastal areas.”*

The C-Change Project

- Sponsored 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
- 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 impending 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

Program Objectives of C-Change

1. Community objectives

- 1. Establish formal Community-University alliances***
- 2. Strengthen community institutional arrangements***
- 3. Establish long-term linkages***
- 4. Prepare community action plans***

2. University objectives

- 1. Develop academic alliances***
- 2. Collaborate on global research***
- 3. Develop new curricula***

3. Joint Community-University Alliances objectives

- 1. Identify the short and long term vulnerabilities***
- 2. Mobilize knowledge and innovation***
- 3. Build capacity***
- 4. Develop impact scenarios, and prepare adaptation action plans***

General Methodology

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

Expected Project Outcomes

- Creation and Communication of Knowledge
- Co-Learning
- Creation of Decision Support Tools
- Development, Monitoring and Evaluation of Indicators
- Provision of Training
- Development and Implementation of Community Adaptation Action Plans (CAAPs)
- Provision of Governance and Institutional Advice

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

Caribbean Research Activities

- Baseline socio-economic report and compilation of secondary data
- Administration of surveys and primary data collection
- Developing a methodology of Vulnerability Indices
- Index calculations and Scenario Analyses
- GIS land-use mapping and spatial analyses
- Adaptation Recommendations at Community and National Levels

Some Recent Measures of Vulnerability

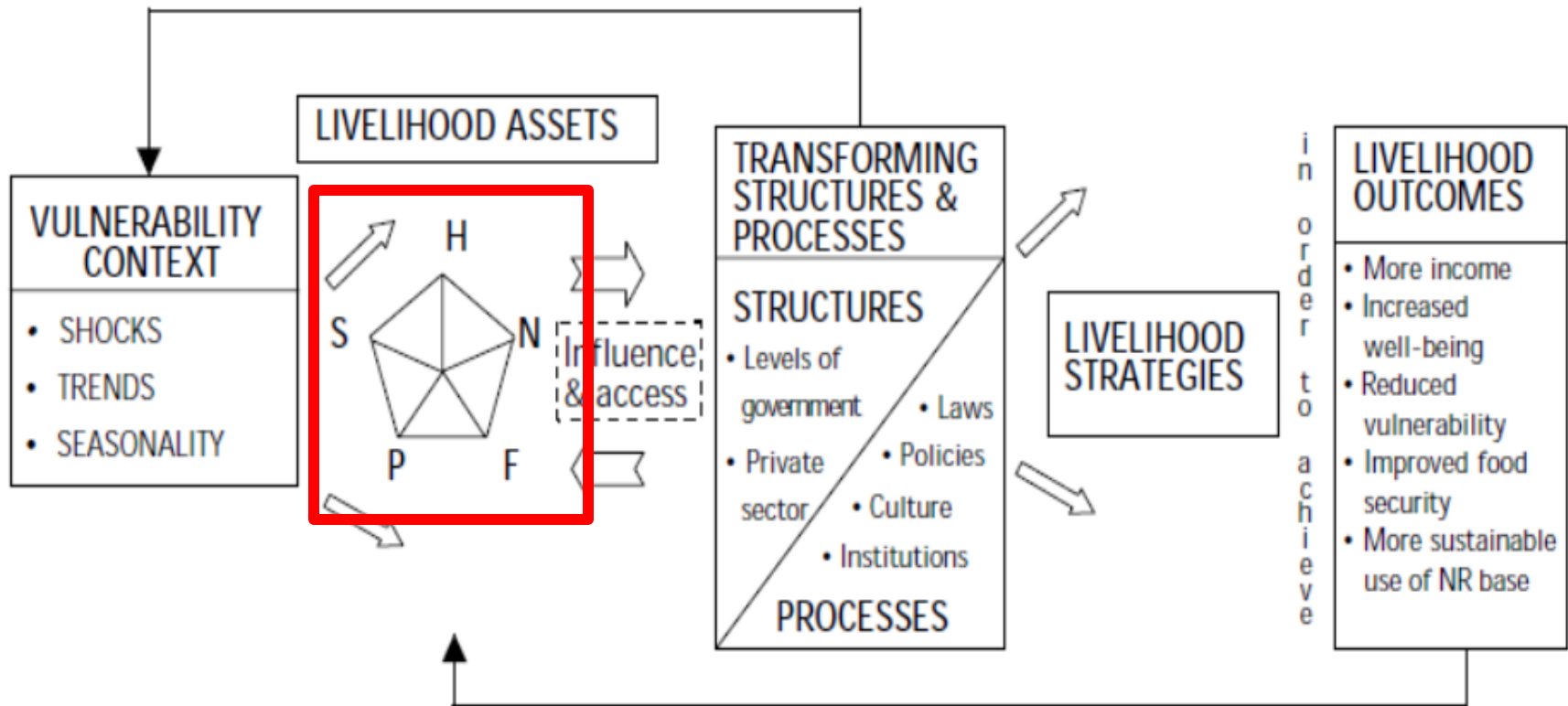
Reference	Geographic Focus	Vulnerability Index/ Focus	Scale	Categories Chosen	Type of Data
Skondras et al (2011)	Greece	Environmental Vulnerability	Country	Hazards, resistance, and damage	Secondary data
Hahn et al (2009)	Mozambique	Livelihood Vulnerability	Community	Socio-demographic, profile, livelihood 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

The Sustainable Livelihoods Framework

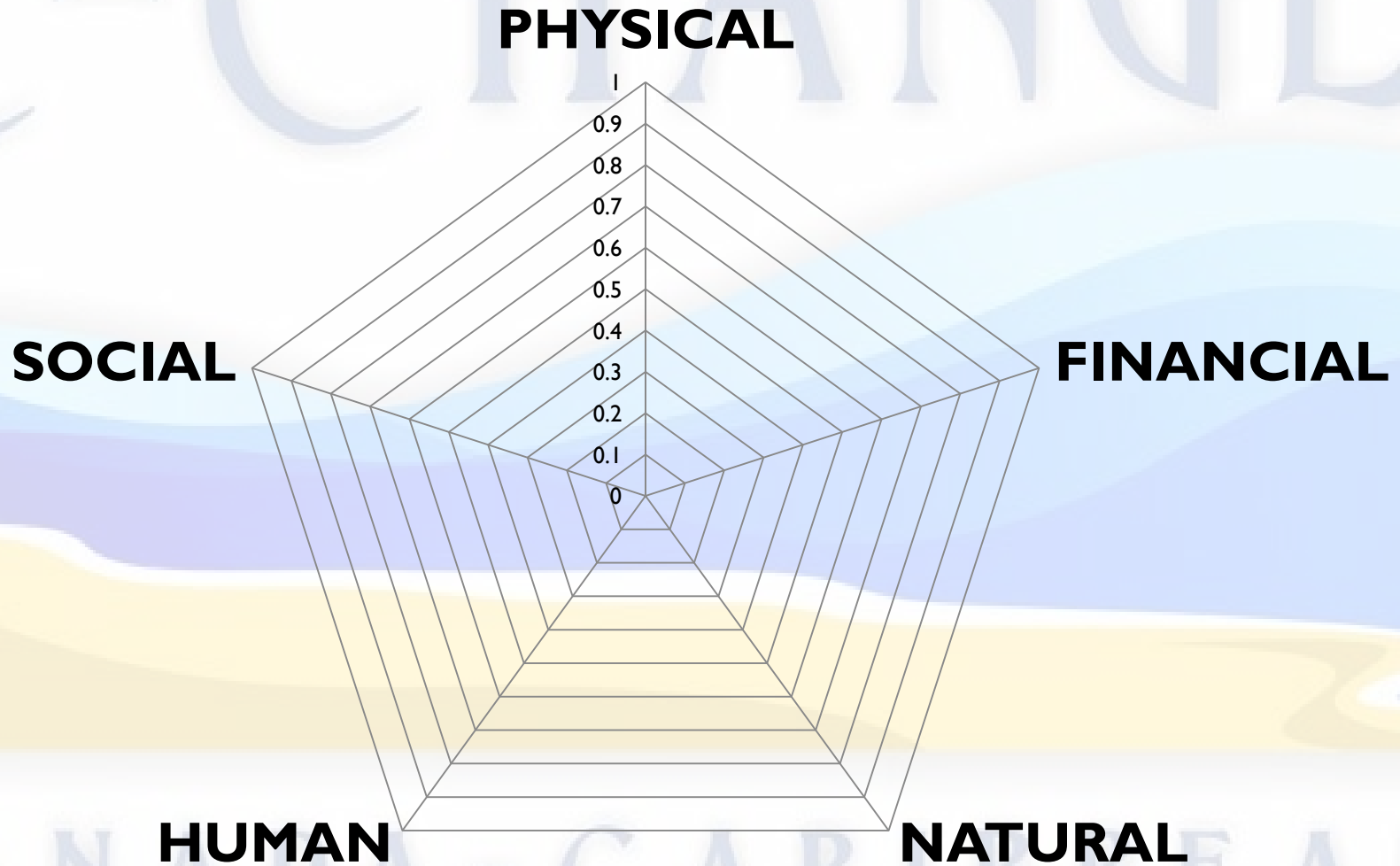
Sustainable Livelihoods Framework

Key

H = Human Capital S = Social Capital
 N = Natural Capital P = Physical Capital
 F = Financial Capital



The Capital Pentagon Approach



CANADA - CARIBBEAN

Natural Capital

- The resource stocks from which resource flows and services useful for livelihoods are derived.
- Divided into 6 sub-indices:
 - ❖ Biodiversity
 - ❖ Freshwater
 - ❖ Agriculture
 - ❖ Forestry
 - ❖ Marine Resources
 - ❖ Natural Hazards

Physical Capital

- The physical infrastructure necessary for the pursuit of livelihood strategies
- Divided into 5 sub-indices:
 - ❖ Transport
 - ❖ Shelter
 - ❖ Sanitation
 - ❖ Energy
 - ❖ Communications

Social Capital

- “an instantiated informal norm that promotes co-operation between individuals”. Fukuyama (2001)
- “the norms and networks that enable people to act collectively”. Woolcock and Narayn (2000)
- Used in vulnerability analyses by Adger (2003), Pelling and High (2005), Hahn et al. (2009), Hinkel (2010)
- Divided into five sub-indices
 - ❖ groups and networks
 - ❖ trust and solidarity
 - ❖ collective action and cooperation
 - ❖ social cohesion and inclusion
 - ❖ empowerment and political action

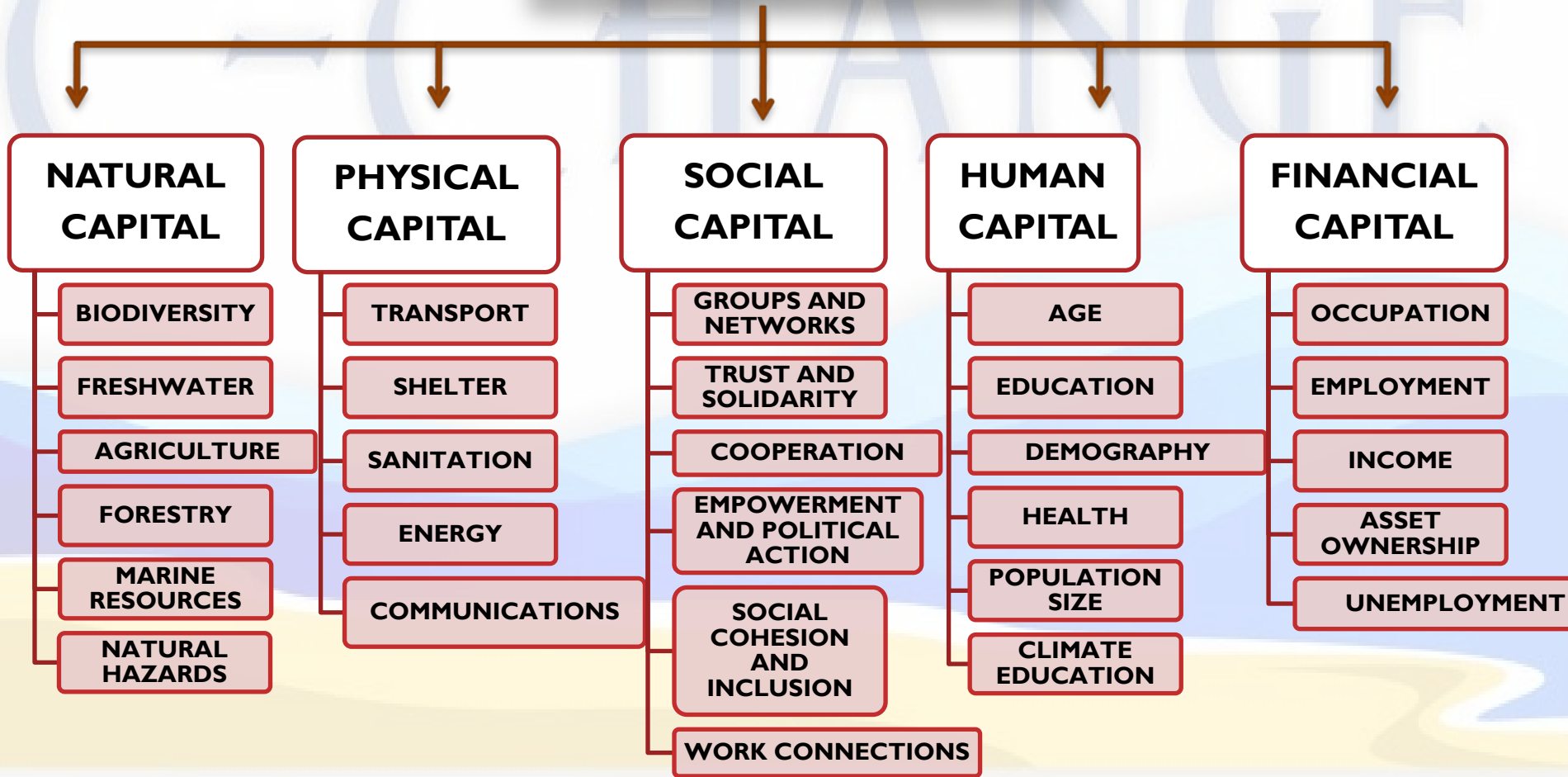
Financial Capital

- Financial capital has a straightforward association with vulnerability to climate change
- The lower the level of financial resources accessible by a household the higher the level of vulnerability
- Divided into 4 sub-indices
 - ❖ occupation of members of household
 - ❖ ownership of assets by household
 - ❖ % of community workforce working within the community
 - ❖ % of workforce unemployed

Human Capital

- the skills, knowledge, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives.
- Divided into 6 sub-indices:
 - ❖ Population size of community
 - ❖ Diseases common to area
 - ❖ Educational level of household members
 - ❖ Age composition of household
 - ❖ Demographic composition of household
 - ❖ Health status of household members

Vulnerability Index



Quantifying the Vulnerability Index

Survey Questions

- Emphasis on primary data collection
- Survey template built along the segments previously identified

Sub-Indices

- Survey questions input into calculation of sub-indices

Capital Pillars

- Sub-index calculations input into quantification of the vulnerability of the individual capital pillars

Vulnerability Index

- Capital pillar calculations input into an overall calculation of the Vulnerability Index

Calculating the Index

- Likert-scale responses: higher values equate higher vulnerability
- Relative frequency calculations: higher percentages equate higher vulnerability
- Standardisation of all responses = $\text{Value} - \text{Minimum} / \text{Maximum} - \text{Minimum}$
- Calculation of sub-indices
- Aggregating to calculations of capital pillars
- Aggregation to calculation of Vulnerability Index
- Scores assume standard format with Minimum of 0 and Maximum of 1 (least and most vulnerable respectively)

Challenges

- Defining the sub-indices of the capital pillars - a certain subjectivity in choosing variables
- Problems of measurement due to the absence of data for certain components
- Averaging and weighting procedure - equal versus unequal weights within sub-indices and among pillars
- How to model trade-offs among sub-indices, and among capital pillars
- Reliability of primary data collection and survey-based methods

Next Steps

- Empirical applications to all 4 Caribbean case study sites
- Scenario analyses and policy prescriptions for all 4 sites
- Poster presentation by Ganase represents a preliminary application to Grande Riviere
- Integration of spatial data with vulnerability calculations in all sites

Conclusions

- It is accepted that coastal communities in developing countries are particularly “vulnerable” to the impacts of climate change
- We need to measure this vulnerability and disaggregate into relevant component areas
- We need to conduct scenario analyses to measure impacts of internal shocks, external shocks and relevant policies
- We need to highlight appropriate policies with an aim to reducing vulnerabilities
- This Vulnerability Index is being developed and applied in this context

Thank You!

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