

* Coastal Climate Change & Adaptation



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Co-Director - C-Change (Canada)

Professor Emeritus, Telfer School of Management,
University of Ottawa



*Presentation to the China- ASEAN Advanced Academy on
Oceans Law & Governance 2, NISCSS Haikou, Hainan*

PART 1 - Morning, November 12, 2016

* Knowledge & Lessons

- * Overall theme: *Climate Change Adaptation & Problem Solving*
 - ✓ *Accepting the need for action on climate change*
 - ✓ *Scientific method of problem solving*

- * How to identify issues and prepare for adapting to coastal climate issues?
 - ✓ Profiling community, region, nation and setting priorities
 - ✓ Assessing vulnerability

- * What are possible adaptation decisions?
 - ✓ Generalization of strategy options

- * How to make practical adaptation decisions in your local, regional, national coastal environments?
 - ✓ Application of decision preference tools, decision analysis
 - ✓ Course module assignments

* Coastal Climate Change & Adaptation - Outline

PART I - Morning

1. Introduction
2. Challenges for the 21st Century - Coastal Zones
3. Understanding Adaptation Needs - Profiling
4. Pillars of Sustainability - Reflecting Importance**

PART II - Afternoon

5. Vulnerability Assessment
6. Estimating Coastal Impacts
7. Adaptation Problem Solving and Strategy Options
8. Evaluating Decisions**
9. Climate Change Governance

**Class Assignment

* 1. Introduction

* Objective: Adaptation Problem Solving

1. Profile the Community (Problem Definition & Data)

- * GIS, local issues, key participants, identify community preferences, pairwise comparison (tradeoffs) - AHP

2. Assess Vulnerability “hotspots” (Data Analysis)

- * Determine potential impacts based on historical events, develop adaptation alternatives and options, costs
-

3. Simulate Strategic Systems (Modelling & Analysis)

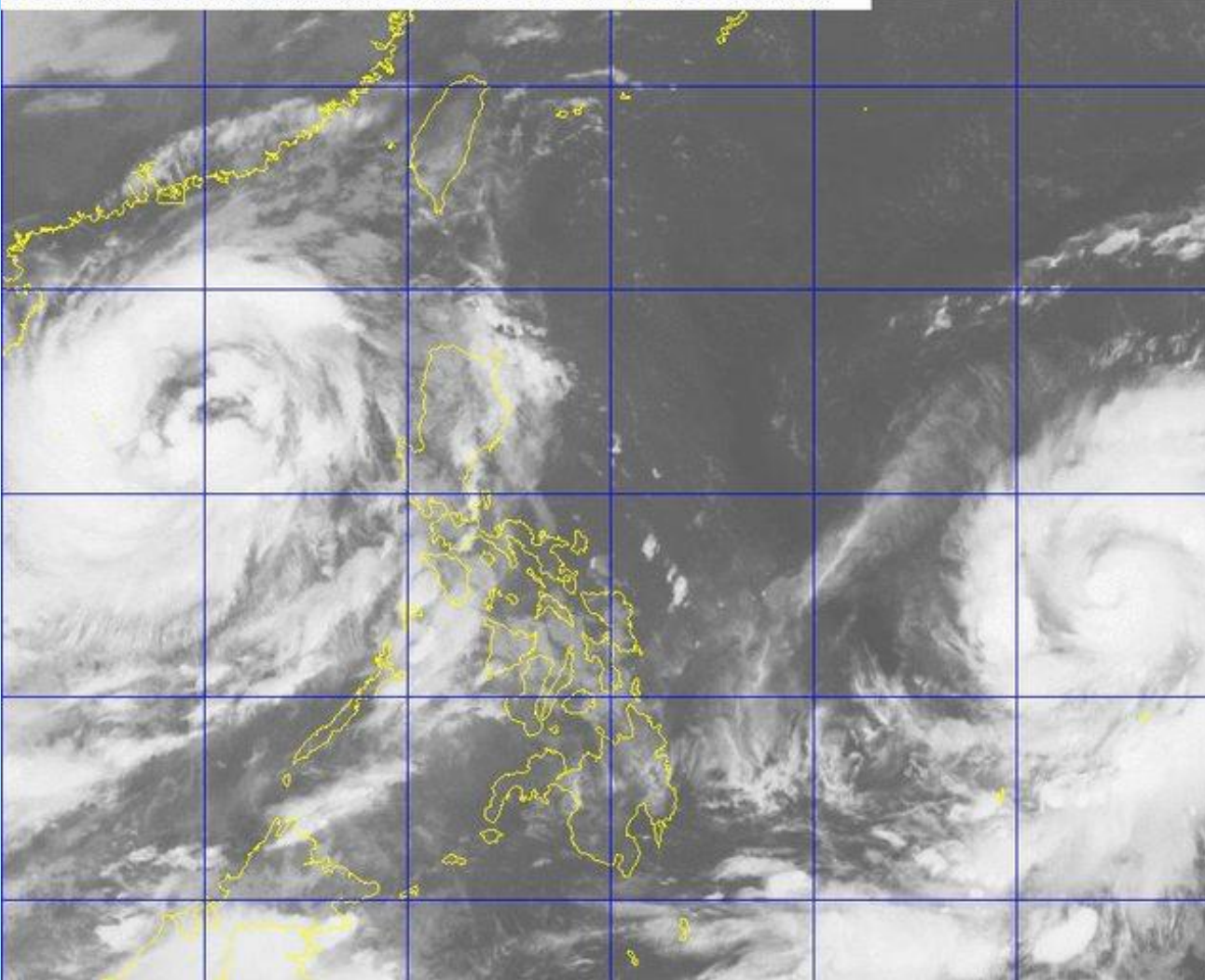
- * System dynamics modelling, strategic planning period

4. Evaluate Strategy Alternatives

- * Apply indices for Vulnerability, Resilience, Adaptive Capacity

5. Recommend, Implement & Monitor

DOST PAGASA HIMAWARI-8 IR1 2016-10-17 4:30:00 AM PHT



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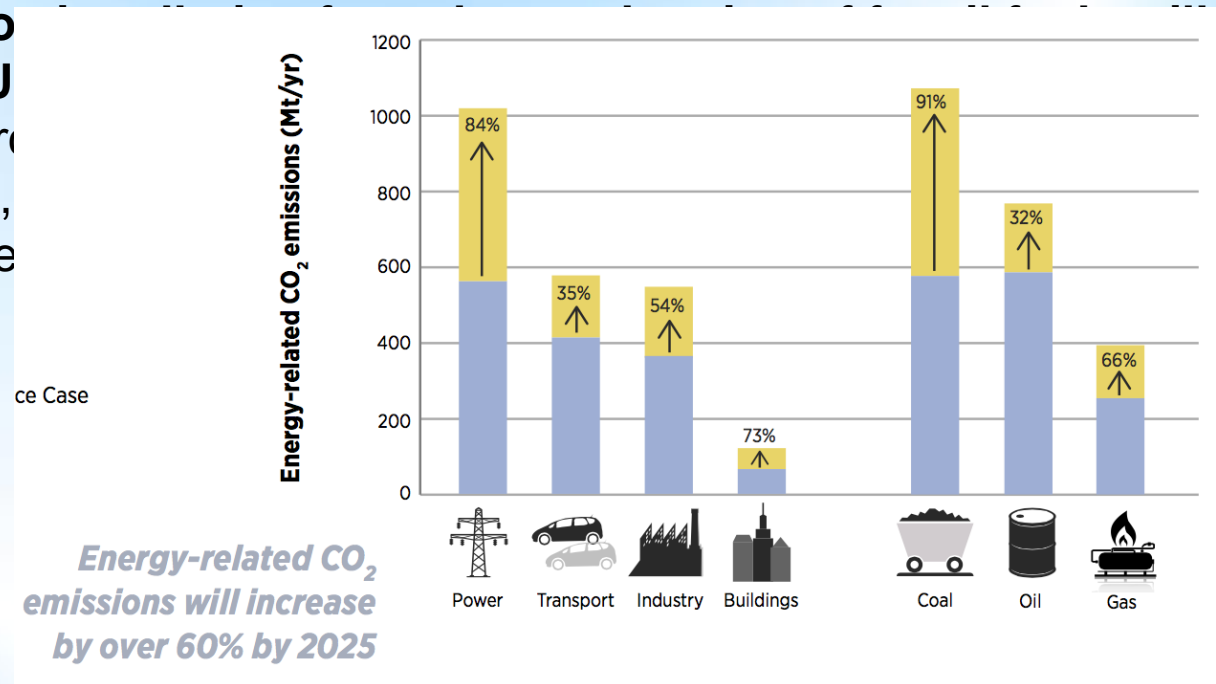
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* ASEAN and Climate Change

From the ASEAN Centre for Energy (ACE) Remap 2030 report (October 27, 2016):

External costs related to increase by 35%, from U 2025. This would equal and (GDP) in 2025. Therefore, as rising costs from the ne urban societies.



* China and Climate Change

* China's 13th five year plan (FYP)

released in March 2016 and covers the period up to 2020. The headline targets are to reduce energy intensity by 15 percent and carbon intensity by 18 percent compared to 2015 levels. In addition, energy consumption will be capped at 5 billion tons of coal equivalent, and the share of primary energy consumption from non-renewable sources will increase to 15 percent. The increased carbon intensity goal means that China would reach, or potentially exceed, its Copenhagen pledge to reduce carbon intensity 40-45 percent below 2005 levels.

(Source: Center for Climate and Energy Solutions <http://www.c2es.org/international/key-country-policies/china>)

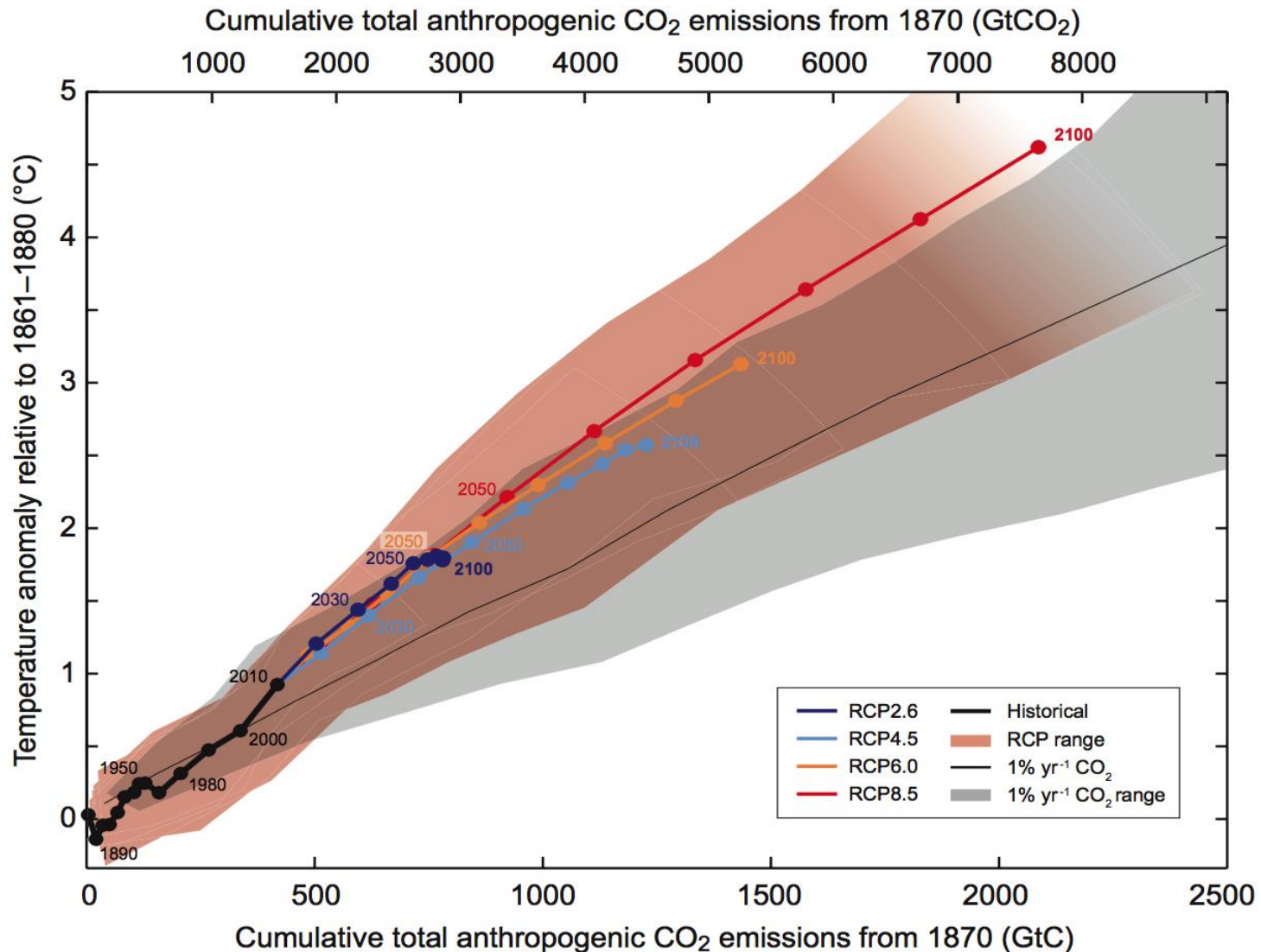
* China ratifies Paris climate change agreement ahead of G20

(Source: The Guardian, September 3, 2016 <https://www.theguardian.com/world/2016/sep/03/china-ratifies-paris-climate-change-agreement>)

* Donald Trump, China, ASEAN and Climate Change...:

“Donald Trump’s election could mean ‘planetary disaster’, environmentalists warn as UN climate summit begins” - The Independent, November 7, 2016

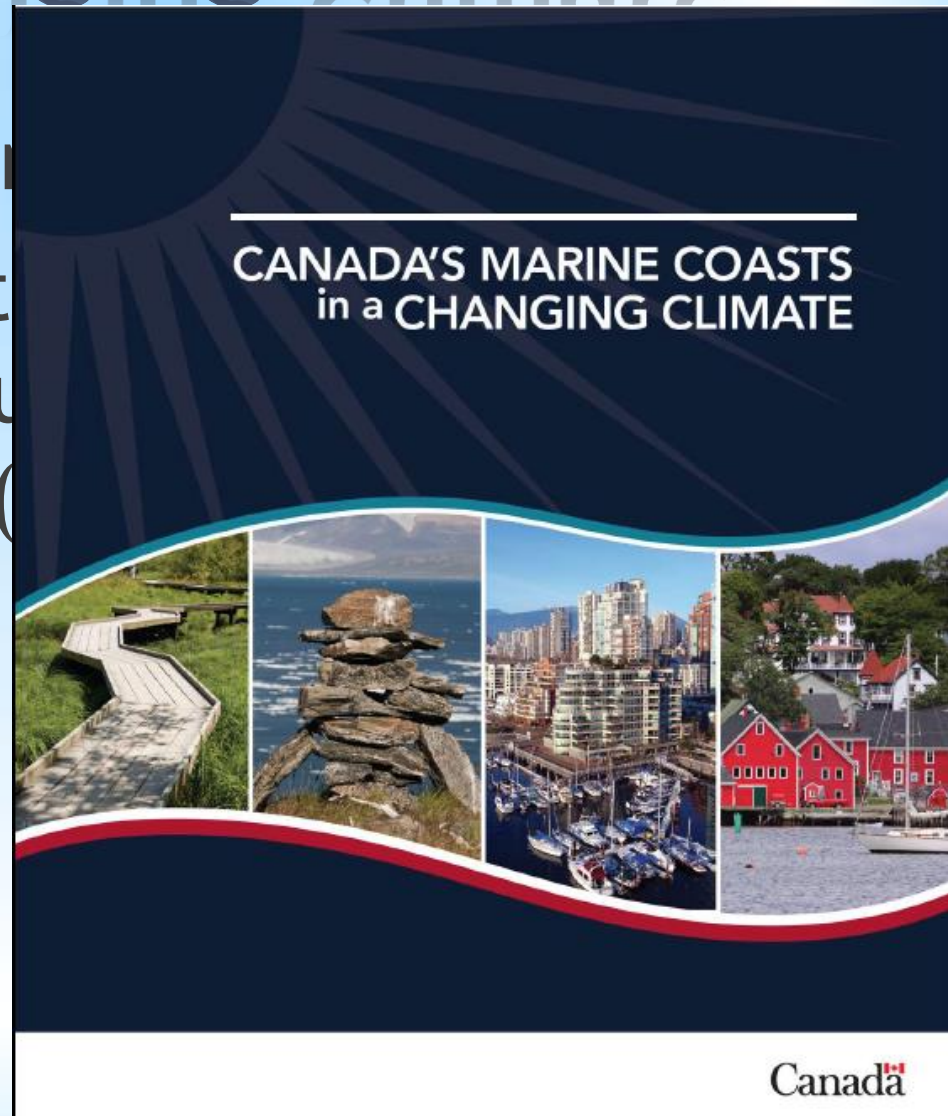
(Source: <http://www.independent.co.uk/environment/donald-trump-election-us-global-warming-climate-change-fossil-fuels-petrol-oil-a7402276.html>)



Source: IPCC, 2013: Summary for Policymakers. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Figure SPM 10, p.28
 Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

*The Changing Climate

- * Global evidence
- * Canada's natural resources government (



Climate Change Impacts and Adaptation

ASSESSMENT OF CANADA'S MARINE COASTS

-Natural Resources Canada document in development (2016)

1. Warming - air temperatures, land surface, oceans trend attributed to global warming due to increasing GHGs in the atmosphere
2. Increased frequency and severity of coastal storms - events of extreme precipitation, high winds and seasonal storms, storm surge aggravated by sea-level rise, extended periods of drought
3. More human development in coastal areas - higher pollution, GHG emissions, and maladaptation practices along the coastal zones.

* Guangdong coast evidence

* Guangdong coast - Guangzhou loss potential from sea level rise is world's highest (World Bank, China Climate Science Report 2015, Dec 2015)

* <http://www.theglobeandmail.com/news/rising-waters-prompt-chinas-sea-change-onclimate/article27608966/>

* 2. Coastal Climate Challenges

* Climate Challenges for the 21st Century



United Nations

Report of the United Nations Conference on Sustainable Development

**Rio de Janeiro, Brazil
20–22 June 2012**

c0010 **Managing Adaptation to Changing Climate in Coastal Zones**

Daniel E. Lane¹, Colleen M. Clarke¹, John D. Clarke¹, Michelle Mycoo², Judith Gobin²

¹Telfer School of Management, University of Ottawa, Ottawa, ON, Canada; ²The University of the West Indies, St. Augustine Campus, Trinidad and Tobago

Chapter Outline

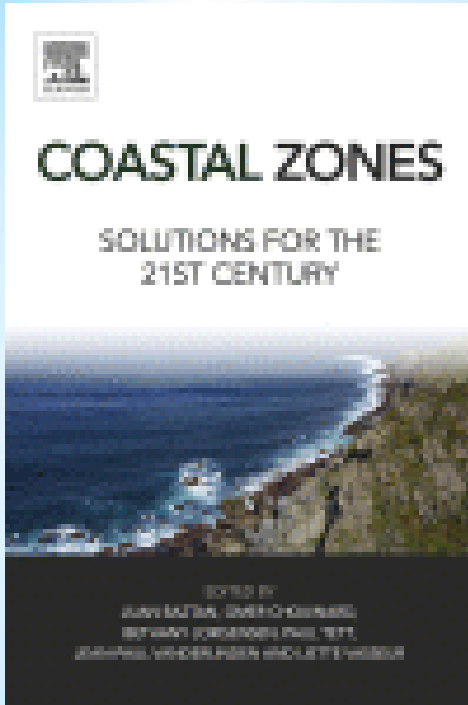
Introduction	1	Policy Challenges	6
The C-Change Project	2	Research Challenges	10
C-Change Communities and Partners	3	Solutions	13
Environmental, Policy, and Research Challenges	3	Conclusions	16
Environmental Challenges	6	Glossary	16
		Acknowledgments	16
		References	17

s0010 **INTRODUCTION**

p0015 Coastal zones are the most biologically and economically productive regions in the world. Over 40% of the world's population lives within 150km of the shore (United Nations Atlas of the Oceans, 2010), and that figure is growing. In Canada, approximately 38% of Canadians live within only 50km of one of three surrounding oceans—the Atlantic, Pacific, or Arctic Oceans—or one of the Great Lakes. In the Caribbean region, coastal populations in 28 independent territories and island states are generally clustered along thin bands of land in close proximity to the shore. An estimated 60% of the Caribbean's total population of approximately 40 million people lives within less than 100 km from the coast, and approximately 40% of the population resides within a mere 2 km of the coast.

p0020 These coastal zones, where land and water interact, are key landscapes when considering (1) the environmental challenges faced by human societies and (2)

Coastal Zones. <http://dx.doi.org/10.1016/B978-0-12-802748-6.00010-3>
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 Jean-Paul Vanderlinden and
 Liette Vasseur
 ISBN: 978-0-12-802748-6

*Challenges for the 21st Century

Rio +20

1. Identify community priorities
2. Cede authority to local communities, municipalities
3. Measure, track, and exercise preparedness
4. Implement the precautionary approach and plan strategically
5. Build an education legacy

Laudato Si'

1. ...dialogue that includes everyone
2. We require a new and universal solidarity.
3. drawing on the results of the best scientific research available today (Chapter 1)
4. Article 186 and the Rio Declaration (1992)
5. change is impossible without motivation and a process of education (Article 15)

* 3. Understanding Adaptation Needs - Profiling Coastal Communities

* Understanding Adaptation Needs

1. Profiling Coastal Communities
2. Assessing Coastal Vulnerabilities
3. Determining Relative Importance of Sustainability Pillars

*The Importance of Context - Examples from C-Change

1. Isle Madame - coastal community, aging and declining population
2. Charlottetown - coastal community; location on 3 rivers; provincial capital city
3. Grande Riviere, Trinidad - tourism development versus conservation



Arctic Ocean



Beaufort Sea

Baffin Island

Iqaluit

Hudson Strait

Labrador Sea

Pacific Ocean

Hudson Bay

Newfoundland & Labrador

St. John's

British Columbia

Alberta

Manitoba

Quebec

Prince Edward Island

Charlottetown

Victoria

Gibsons

UNITED STATES OF AMERICA

Edmonton

Saskatchewan

Regina

Winnipeg

Ontario

Québec

Fredericton

Halifax

Isle Madame

New Brunswick

OTTAWA

Atlantic Ocean



Isle Madame (Source: Google Earth 2010)



Image © 2008 GeoEye

© 2008 Tele Atlas

Image NASA

Image © 2008 TerraMetrics

elev 133 ft

China-ASEAN Advanced Academy on Oceans Law and Governance

22

PART 1-AM, November 12, 2016

©2008

Google

31°38.89' N 61°02'31.66" W

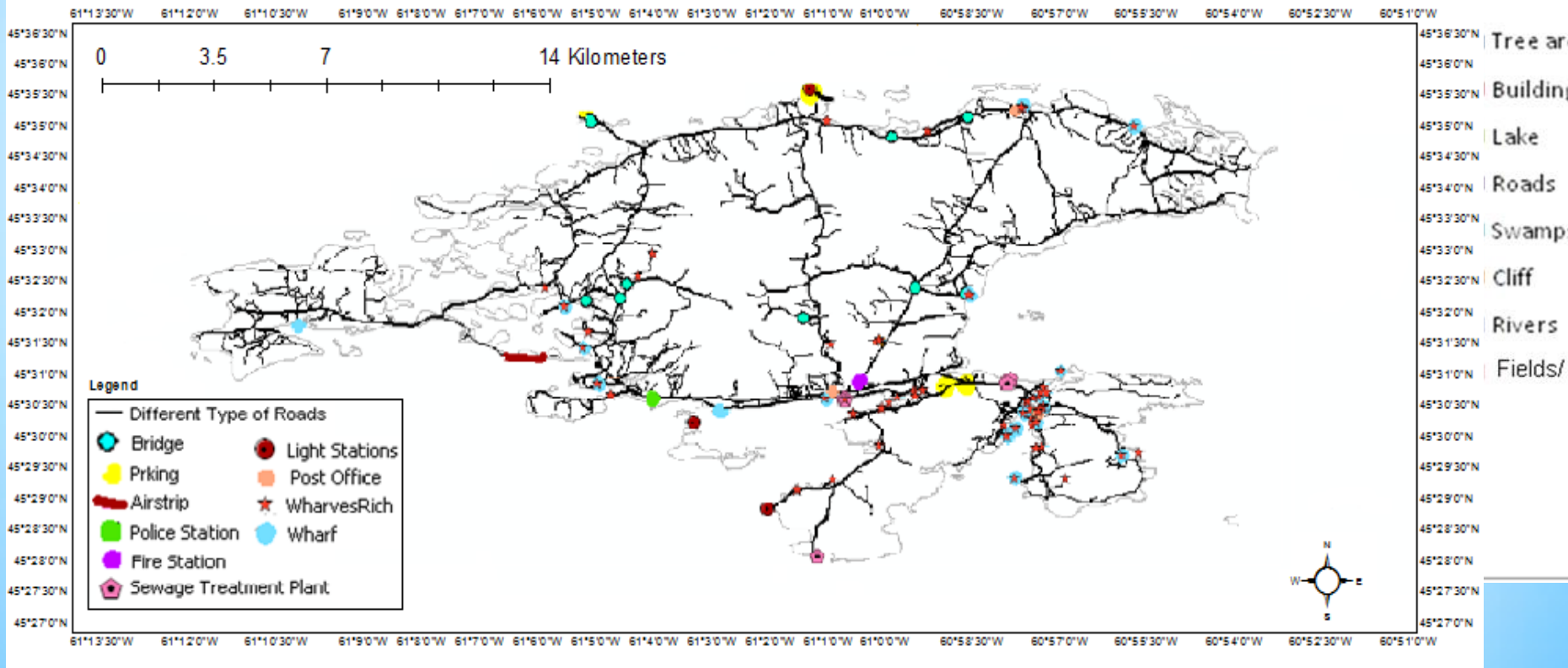
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* Profiling - Examples

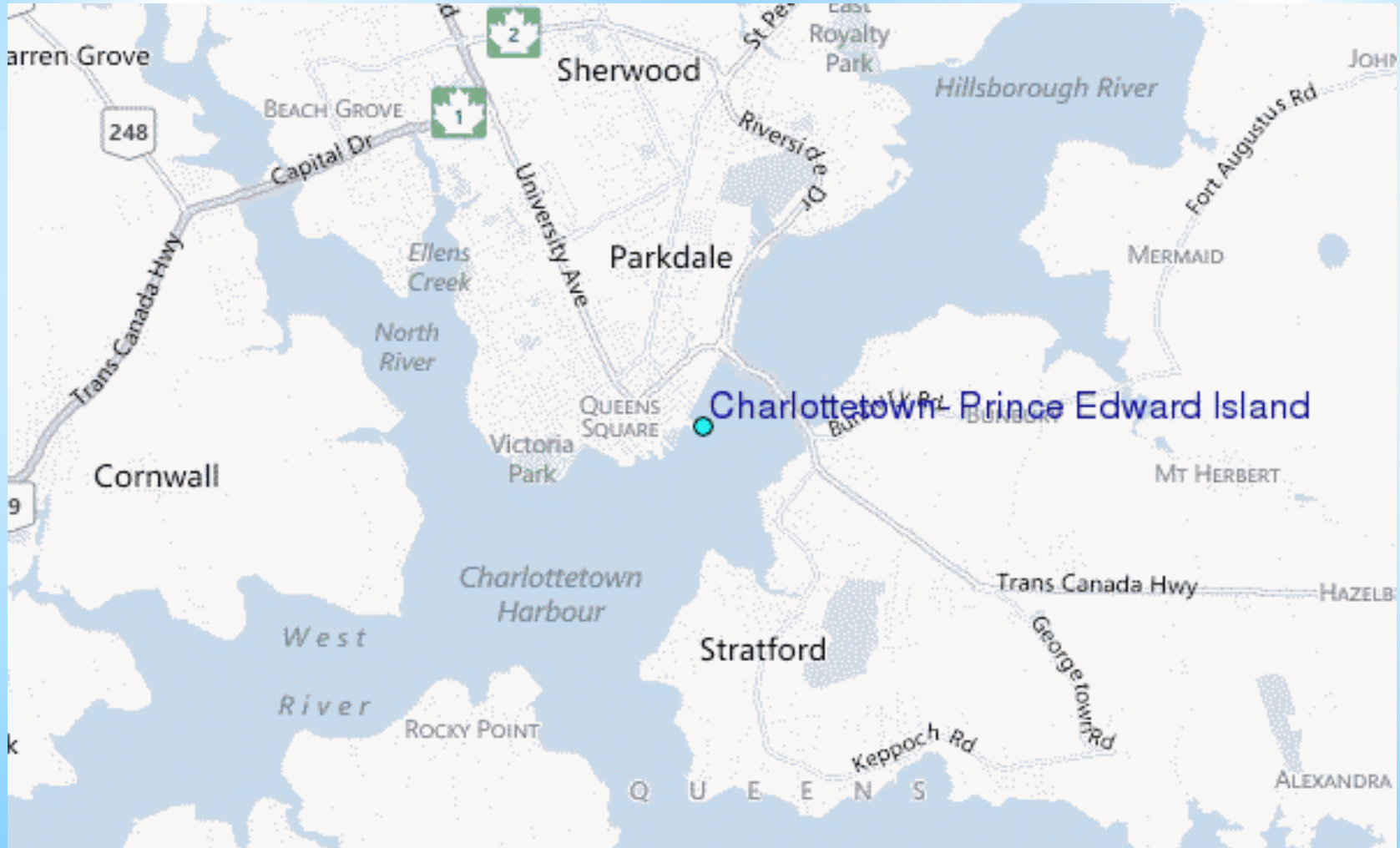


Hydrology, Land Use & Land Cover Distribution

Fields/Beaches

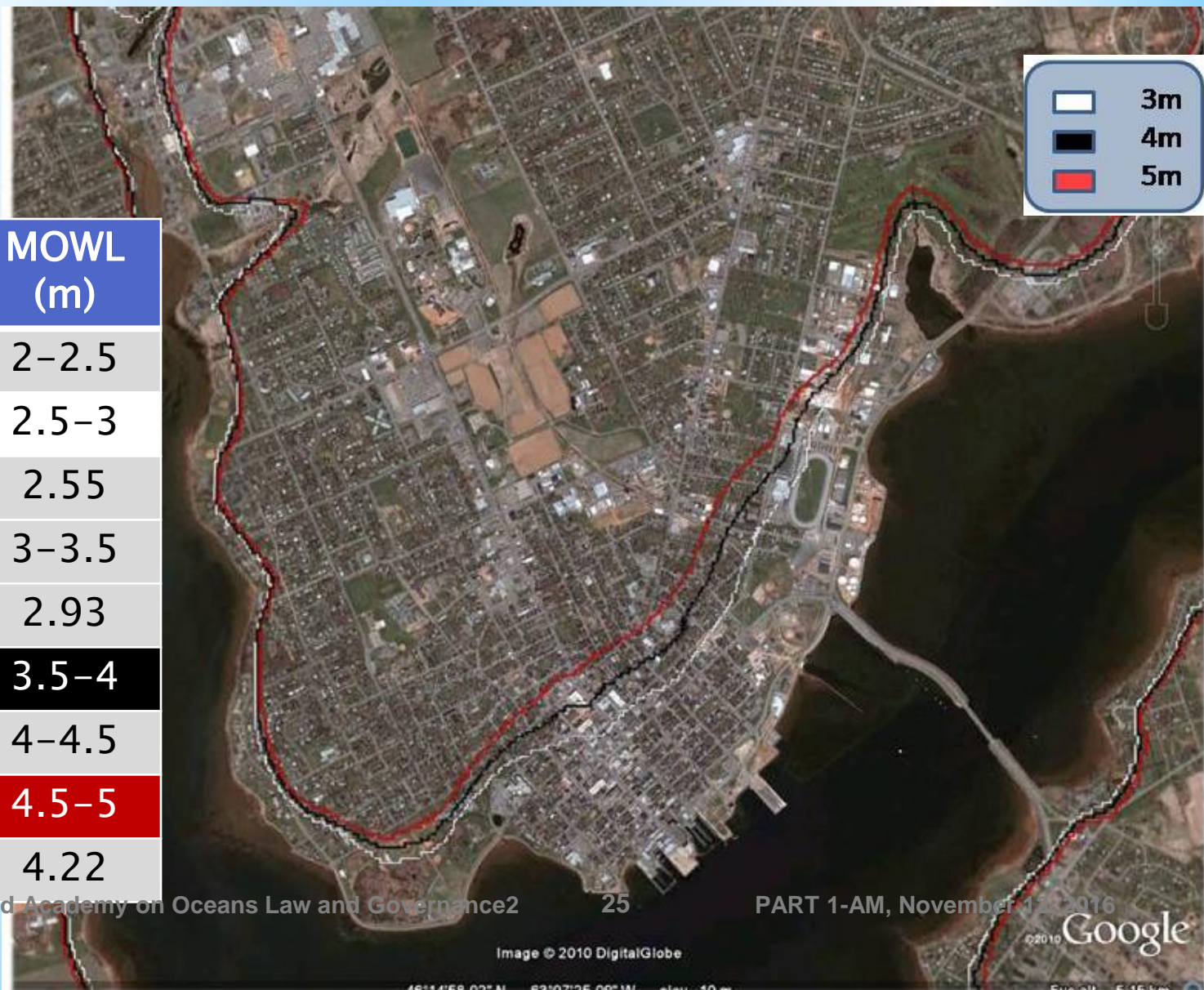


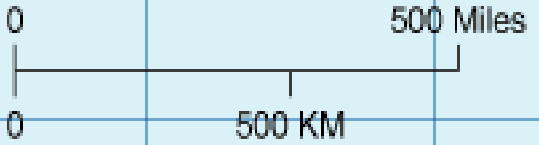
* City of Charlottetown



*Charlottetown Spatial/GIS Model

Scenario	MOWL (m)
I	2-2.5
II	2.5-3
NN1962	2.55
III	3-3.5
Juan	2.93
IV	3.5-4
V	4-4.5
VI	4.5-5
NN2000	4.22





Parallel scale
at 20 degrees N 0 degrees E

20 degrees N

Gulf of Mexico

Atlantic Ocean

Pacific Ocean

Caribbean Sea

THE BAHAMAS

VENEZUELA

COLOMBIA

GUYANA

TRINIDAD AND TOBAGO

MEXICO

CUBA

CAYMAN ISLANDS

JAMAICA

HAITI DOMINICAN REPUBLIC

PUERTO RICO

VIRGIN ISLANDS (U.S. & UK.)

ANGUILLA

ANTIGUA AND BARBUDA

MONTserrat

DOMINICA

MARTINIQUE

SAINT LUCIA

BARBADOS

SAINT VINCENT AND THE GRENADINES

TRINIDAD AND TOBAGO

GUAYANA

TRINIDAD AND TOBAGO

TRINIDAD AND TOBAGO

TRINIDAD AND TOBAGO

TRINIDAD AND TOBAGO

TRINIDAD AND TOBAGO

CAMPECHE

CHETUMAL

BELIZE

GUATEMALA

EL SALVADOR

NICARAGUA

COSTA RICA

PANAMA

PANAMA

PANAMA

Havana

George Town

Kingston

Santo Domingo

San Juan

Panama

Montería

Medellín

Willemstad

Caracas

Valencia

San Cristóbal

Bequia

St. George's

Port of Spain

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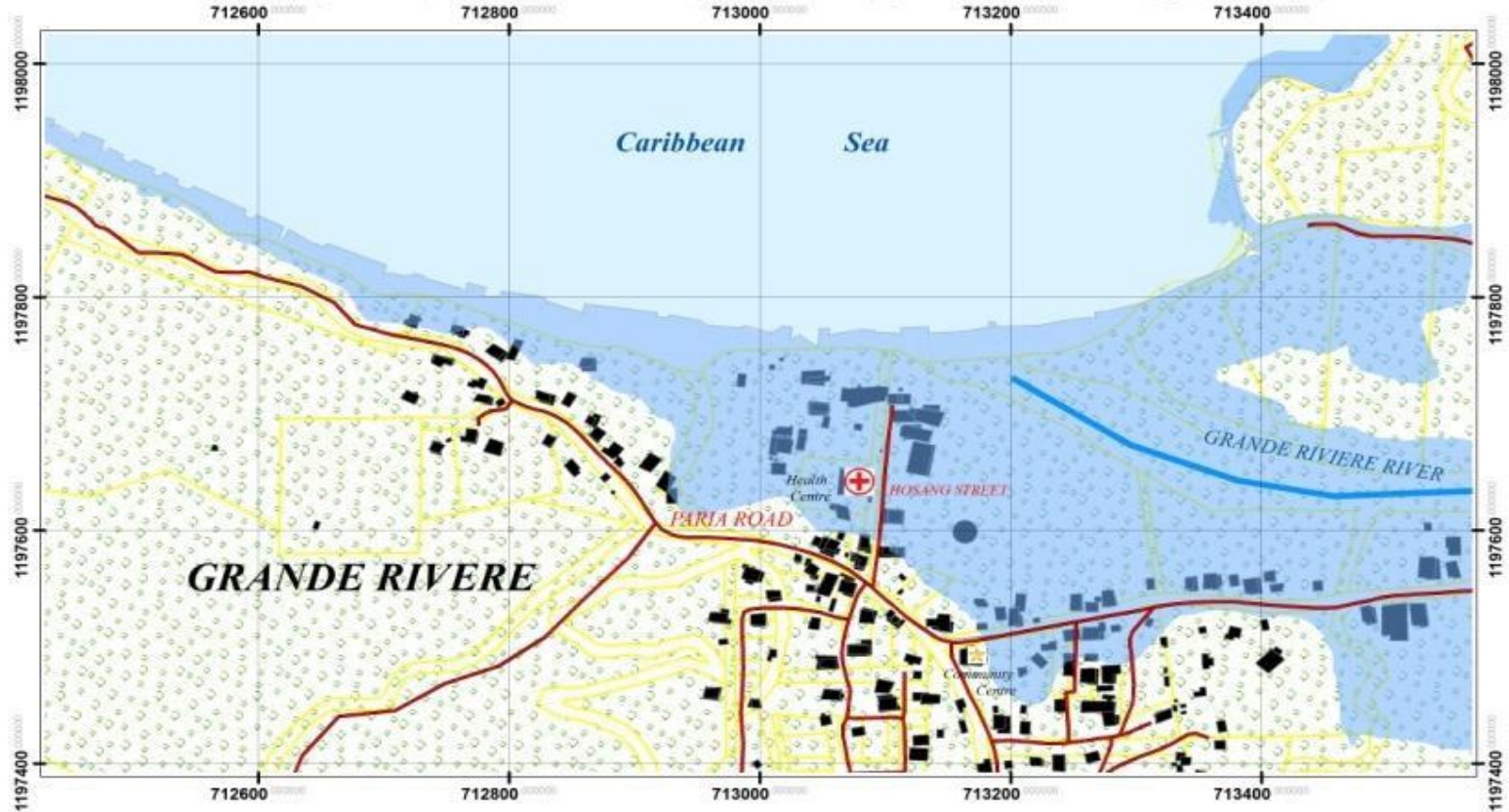
Panama

Panama

* Grande Riviere, NE T&T -
Leatherback turtle tracks (March 22,
2010)



MAP OF GRANDE RIVIERE SHOWING 7m RISE IN SEA LEVEL



0 155 310 620 Meters

Data collected by Surveying and Existing Topographic Data
 Data process in ArcGIS 9.3 & Map created in ArcGIS 9.3

1:5,000

Projection: UTM Zone 20N
 Datum: WGS84
 Vertical Datum: Mean Sea Level

Prediction of 50m was derived from the M.E.T office in the U.K Government

Produced on 3rd April 2010 by Amit Seeram

-  Roads
-  River
-  7m rise
-  Buildings
-  Contours
-  Parcels



*Tools

1. Geographical Information Systems - (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data.
 - * ArcGIS - Esri Mapping Systems
2. System dynamics - a computer-aided approach to policy analysis and design. It applies to dynamic problems arising in complex social, managerial, economic, or ecological systems – literally any dynamic systems characterized by interdependence, mutual interaction, information feedback, and circular causality.
 - * STELLA - ISEE Systems
 - * Vensim (Open source, free download)
3. MCDM - MultiCriteria Decision Making - Problems characterized by multiple stakeholders, community participants, many and conflicting criteria (environmental, economic, social)
 - * AHP - the Analytic Hierarchy Process (Saaty)

* Adaptation Problem Solving

1. Profile the Community (Problem Definition & Data)
 - * GIS, local issues, key participants, identify community preferences, pairwise comparison (tradeoffs) - AHP
2. Assess Vulnerability “hotspots” (Data Analysis)
 - * Determine potential impacts based on historical events, develop adaptation alternatives and options, costs
3. Simulate Strategic Systems (Modelling & Analysis)
 - * System dynamics modelling, strategic planning period
4. Evaluate Strategy Alternatives
 - * Apply indices for Vulnerability, Resilience, Adaptive Capacity
5. Recommend, Implement & Monitor

Profiling Communities

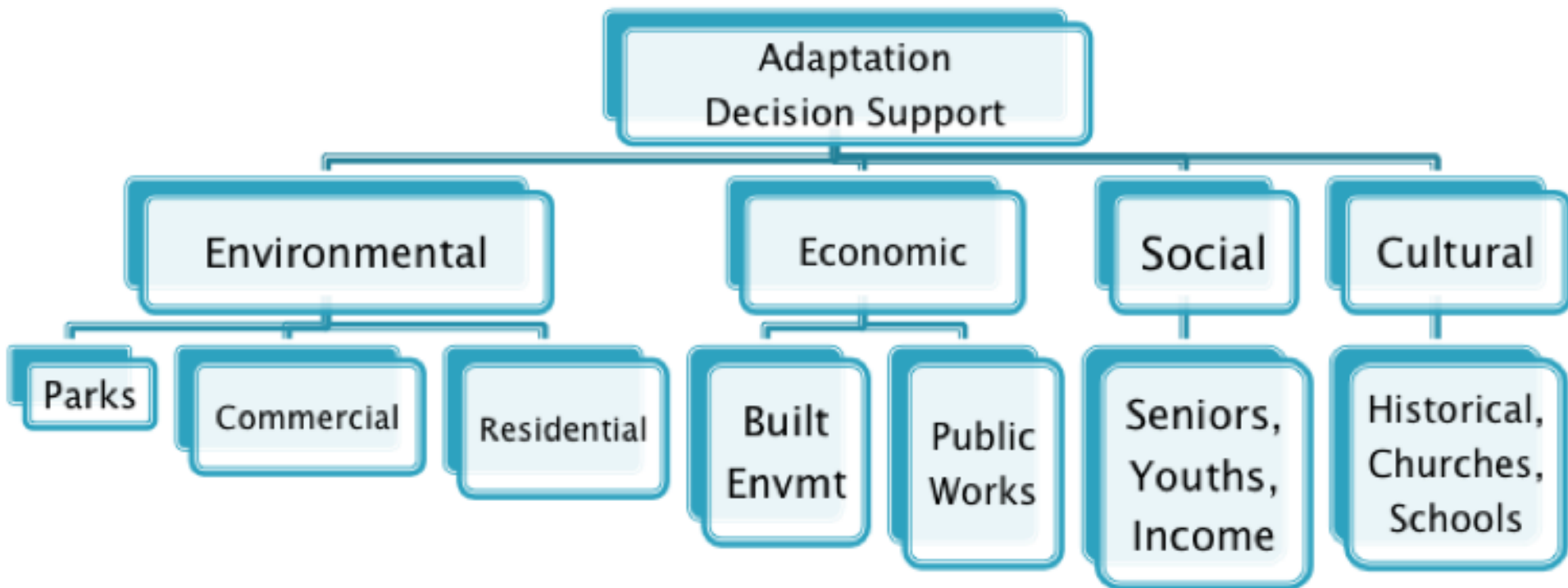
1. Community preferences
 - * Ecological, economic, social, cultural
2. Recognition of assets
 - * Natural, industrial, demographic, cultural
3. History of storm events and impacts
 - * Hurricanes, high wind and snow/rain events
4. Sources of community vulnerability

* 4. Pillars of Sustainability

* Community Profile - 4 Pillars of Sustainability (ICSPs)

	Dimension	Sub-categories
1	Environmental	Topography, Land and Marine Use, Natural Resources, Climate
2	Economic	Employment, Industry, Property, Occupation, Revenues, Earnings, Public Works, Built Environment
3	Social	Population, Health, Education, Communications, Community Dynamics, Governance
4	Cultural	Places, Groups, Events, Language

*Coastal Community Adaptation Problem Hierarchy



* How to compare the relative importance of problem elements?

- * Pairwise comparison exercise
- * Example: Community Profile Dimensions - Environmental, Economic, Social and Cultural

	Economic	Social	Cultural
Environmental	Value1	Value2	Value3
Economic	-	Value4	Value5
Social	-	-	Value6

* MCDM Worksheets

(1)

		Pairwise Scores										
		1	2	3	4	5	6	7	8	9	(2) Calculated Cells Ratio	
Row												
1	Environmental	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	Economic	<input type="text"/>
2	Environmental	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	Social	<input type="text"/>
3	Environmental	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	Cultural	<input type="text"/>
4	Economic	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	Social	<input type="text"/>
5	Economic	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	Cultural	<input type="text"/>
6	Social	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	Cultural	<input type="text"/>

(2) Go back to row 1 and calculate the cells ratio for each row 1-6.

(3) Fill in the table below that summarizes the overall weights for all the pillars.

(3)

	Environmental	Economic	Social	Cultural
1 Environmental	1			
2 Economic	-	1		
3 Social	-	-	1	
4 Cultural	-	-	-	1

* MCDM Worksheet Worked Example

(1)		Pairwise Scores									(2)				
		1	2	3	4	5	6	7	8	9	Calculated Cells Ratio				
Row											Row	Col	Ratio		
1	Environmental	██████████										Economic	5	4	1.25
2	Environmental	██████████									Social	4	5	0.8	
3	Environmental	██████████									Cultural	5	4	1.25	
4	Economic	██████████									Social	6	3	2	
5	Economic	██████████									Cultural	6	3	2	
6	Social	██████████									Cultural	4	5	0.8	

(2) Go back to row 1 and calculate the cells ratio for each row 1-6.

(3) Fill in the table below that summarizes the overall weights for all the pillars.

(3) Matrix	Environmental	Economic	Social	Cultural
1 Environmental	1	1.25	0.80	1.25
2 Economic	0.80	1	2.00	2.00
3 Social	1.25	0.5	1	0.80
4 Cultural	0.80	0.5	1.25	1

* Participants' Preferences/Profiling Exercise

* China-ASEAN Academy 1 (January 2016)

China-ASEAN Academy on Ocean Law and Governance
NISCSS, Haikou, Hainan, China

January 24-31, 2016

Thursday, January 28

Climate Change Adaptation (Lane, IOI-Canada)

Multicriteria Problem Solving Session - Participant Feedback Pillar Importance Inputs

Name:	All 40 China-ASEAN participants (12 empty)
Country:	All nations - China-ASEAN

Pairwise Comparison Exercise

(1)		Pairwise Scores									
		1	2	3	4	5	6	7	8	9	
Row											
1	Environmental	[Bar chart showing score .57]				.57					Economic
2	Environmental	[Bar chart showing score .93]				.93					Social
3	Environmental	[Bar chart showing score 1/4]				1/4					Cultural
4	Economic	[Bar chart showing score .27]				.27					Social
5	Economic	[Bar chart showing score .34]				.34					Cultural
6	Social	[Bar chart showing score .70]				.70					Cultural

*China-ASEAN Academy 1 (January 2016)

AHP Community Profile Dimensions Results

Inconsistency Measure*

0.0011

*This indicator should not exceed 0.10 for reliable rational results.

Pillar Ratings

Normalized

Idealized

Environmental

0.28378

0.96665

Economic

0.29357

1

Social

0.22073

0.75189

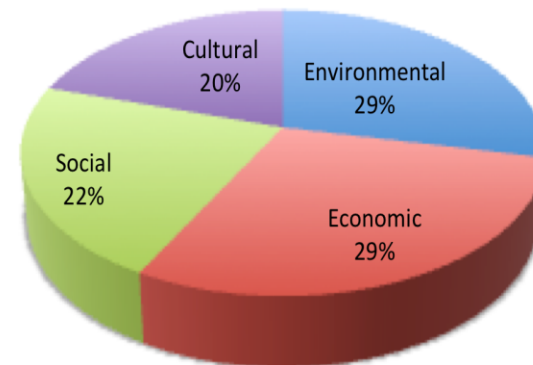
Cultural

0.20191

0.68776

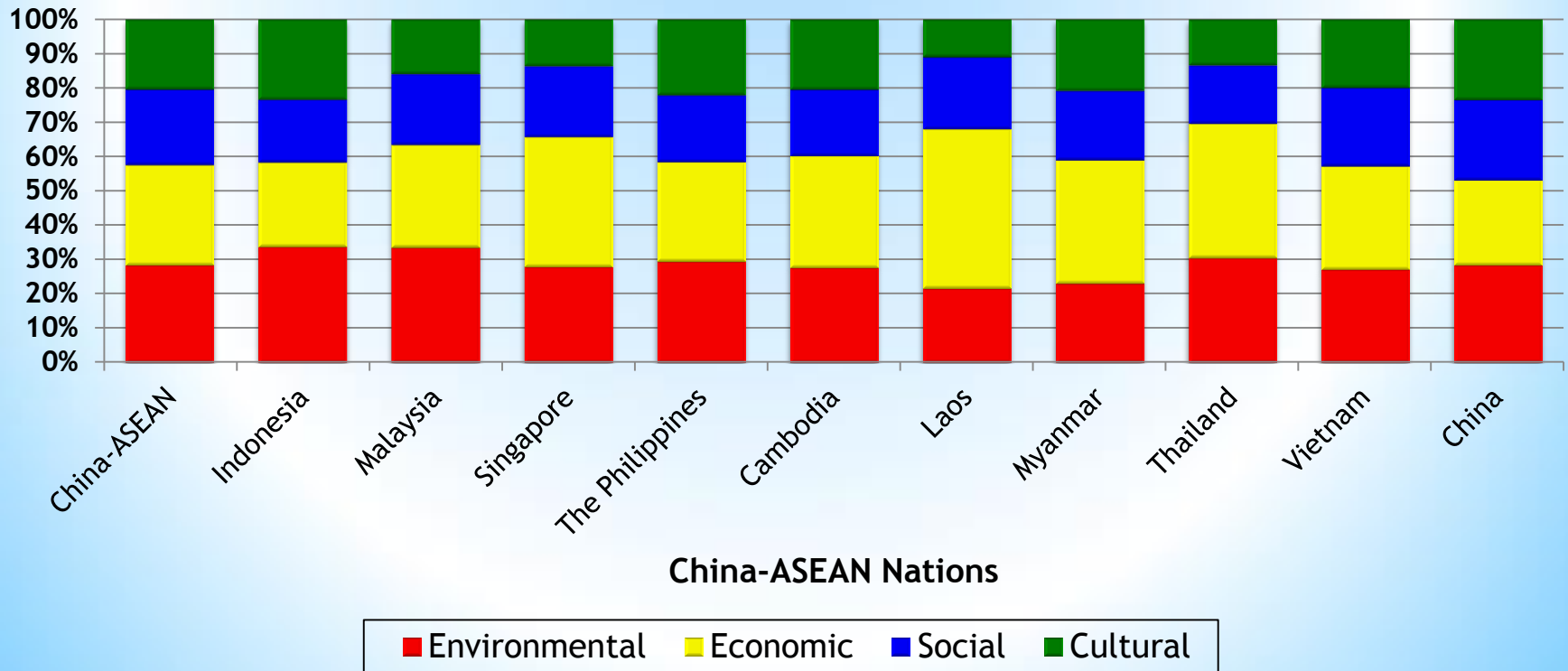
Total 1

All Participants Normalized Community Profile Sustainability Pillar Ratings



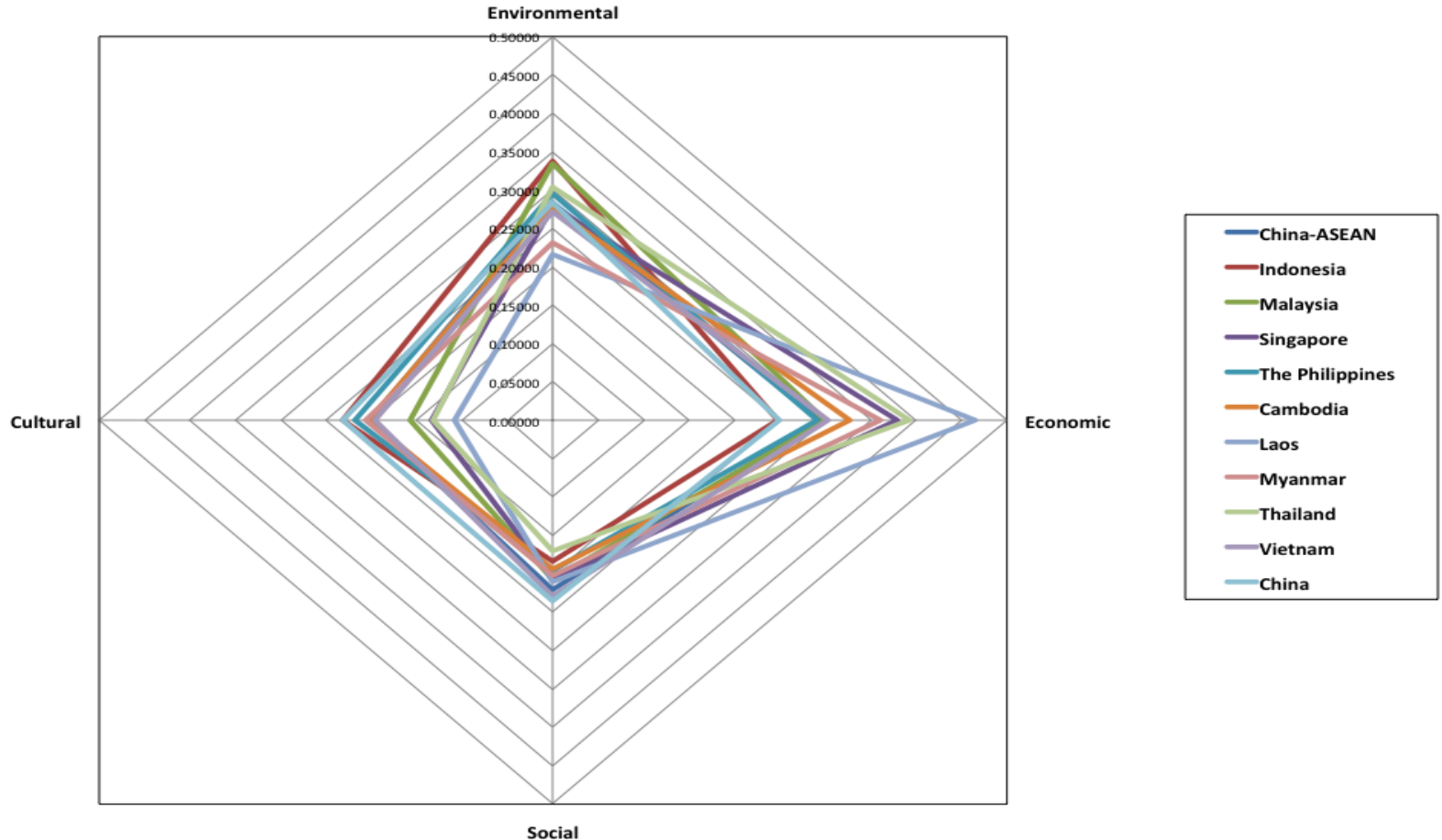
*China-ASEAN Academy 1 (January 2016)

China-ASEAN Nationals Comparison of Participants' Average Weights by Pillar



*China-ASEAN Academy 1 (January 2016)

Radar Graph of China-ASEAN Nationals Participants' Average Weights by Pillar



* Little Anse Case Study

Pairwise Comparison Trade-offs (Input):

	Economic	Social	Cultural
Environmental	1.3	1.0	1.25
Economic	-	1.3	1.5
Social	-	-	1.0

Corresponding Criteria Weights (Output):

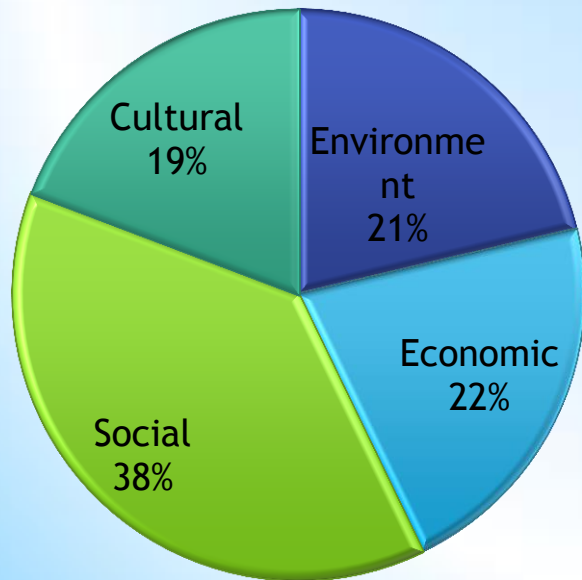
Environmental	Economic	Social	Cultural
0.28	0.27	0.24	0.21

*Priorities & Multi-Participants

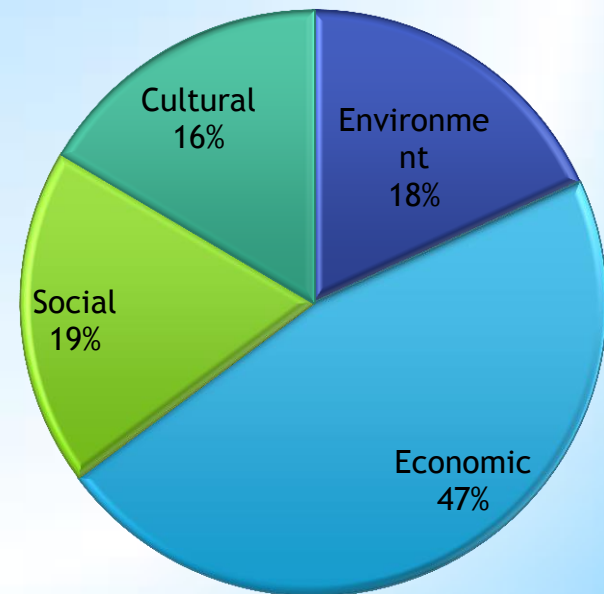
1. Community: representatives of the community at large
2. Local Government: representatives of local (municipal) government
3. Business/Industry: community industries
4. Professional: professionals providing service to the community, e.g., lawyers, doctors, nurses, engineers, etc.

*Participants

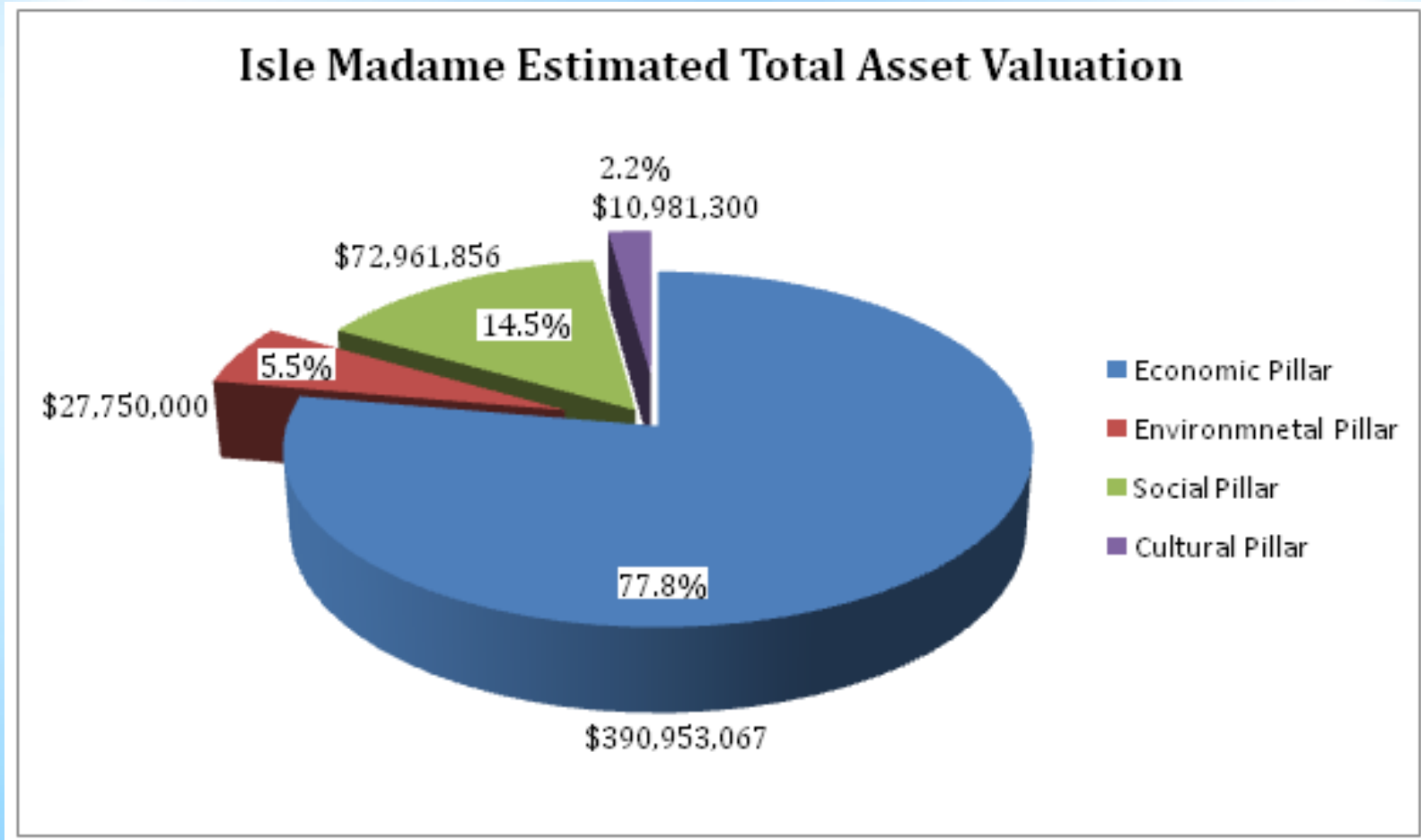
Local Government



Business/Industry



* Isle Madame Asset (Pakdel 2011)



 **Break (Lunch!)**