IPReM

Greater Caribbean 2023

IDENTIFICATION | PROTECTION | RESTORATION | MANAGEMENT

JUNE 28th-30th, PANAMA

Science and technology for sustainablebeaches in a climate change scenario

ACS AEC
ASSOCIATION OF CARIBBEAN STATES
ASOCIACION DE ESTADOS DEL CARIBE
ASSOCIATION DES ETATS DE LA CARAIBE

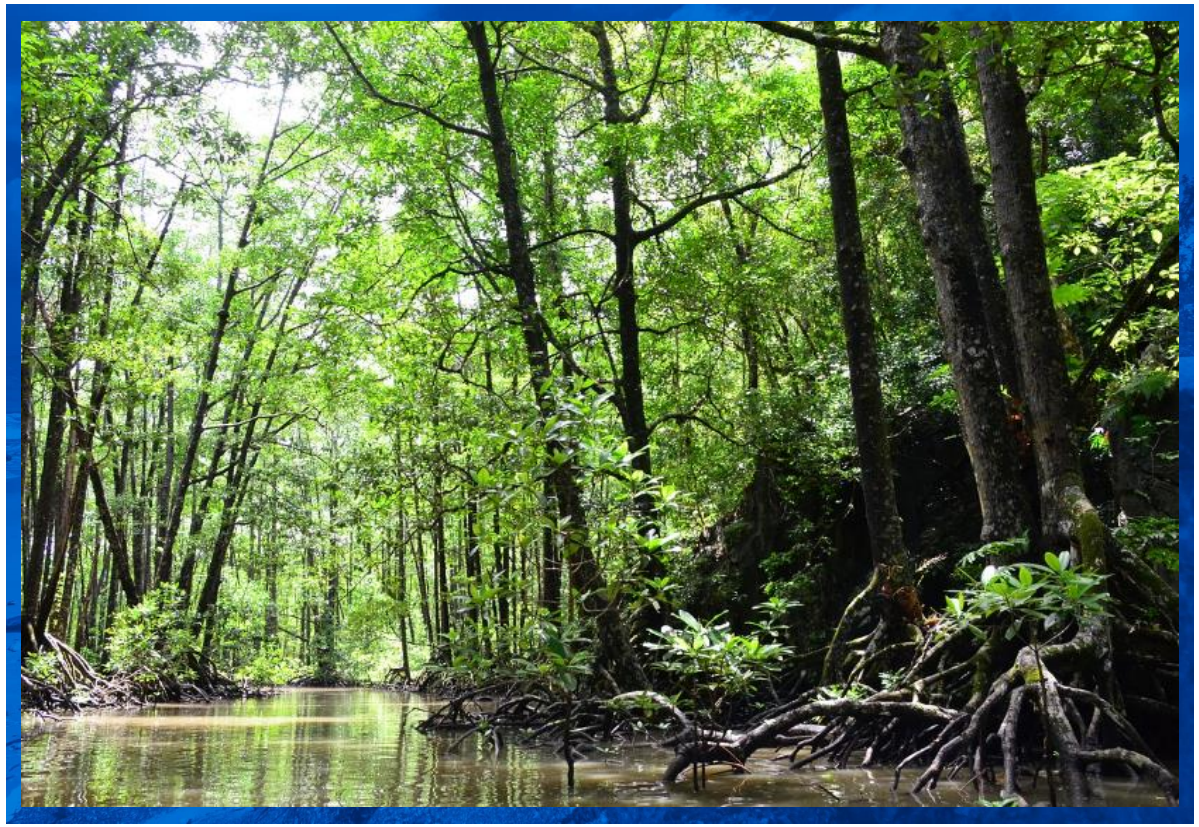
CARIBBEAN SEA COMMISSION
Preserving what connects us

KOICA
Korea International Cooperation Agency

CITMA
MINISTERIO DE CIENCIA TECNOLOGIA Y MEDIO AMBIENTE

REPÚBLICA DE PANAMÁ
GOBIERNO NACIONAL
MINISTERIO DE AMBIENTE

IPReM
Greater Caribbean 2023
IDENTIFICATION | PROTECTION | RESTORATION | MANAGEMENT
JUNE 28th-30th, PANAMA



A TRANSDISCIPLINARY AND TRANS-SECTORIAL APPROACH FOR UTILISING MANGROVE FORESTS TO PROTECT COASTLINES IN TRINIDAD AND TOBAGO

Christian Virgil and Kit Fai Pun

Introduction

Mangrove Forest at the Bon Accord Lagoon, Tobago

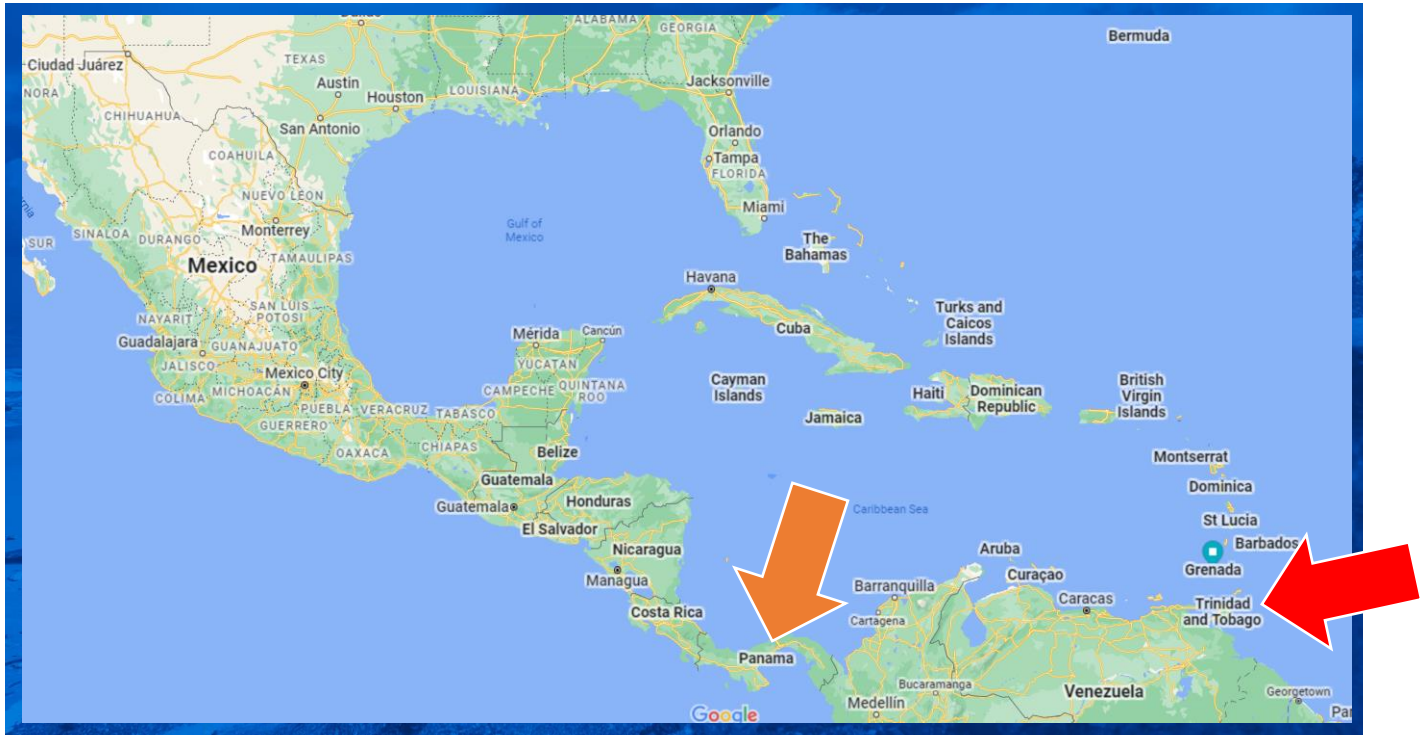
Introduction

- This presentation examines various enablers versus barriers and proposes that mangrove coastal protection functionality can be improved by using a comprehensive and collaborative approach across disciplines and sectors to integrate various co-benefits.

Mangrove Forest at the Bon Accord Lagoon, Tobago

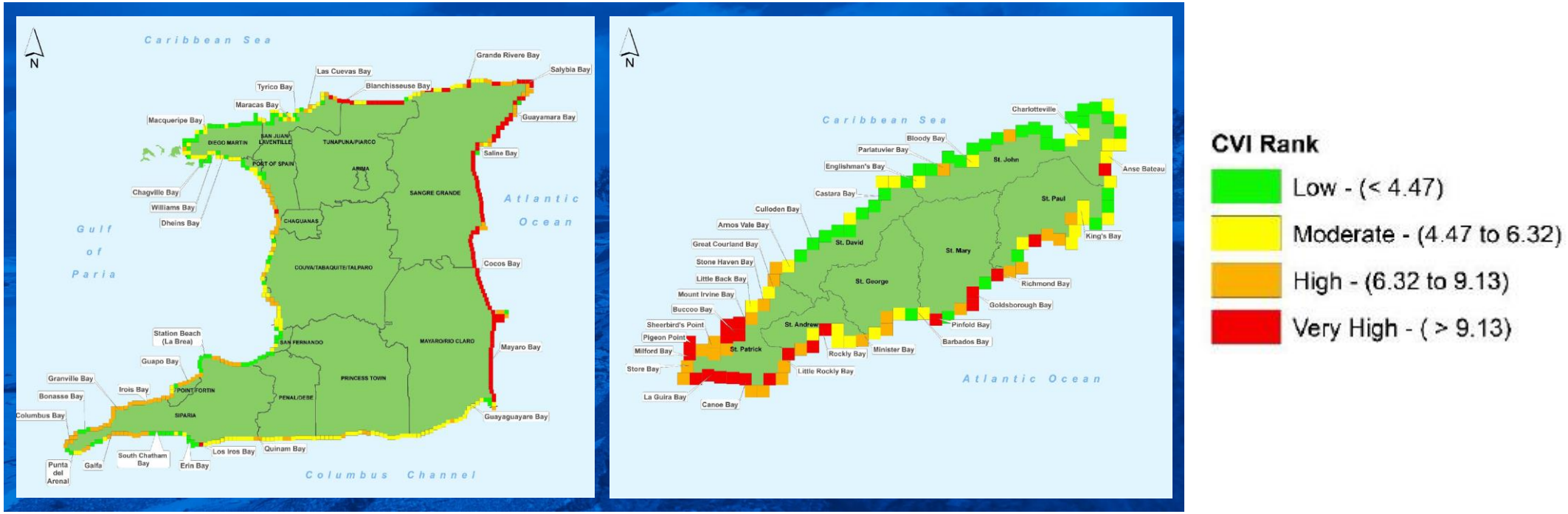
Background

Trinidad and Tobago is a highly industrialized twin-island state located at the southernmost point of the Caribbean archipelago.



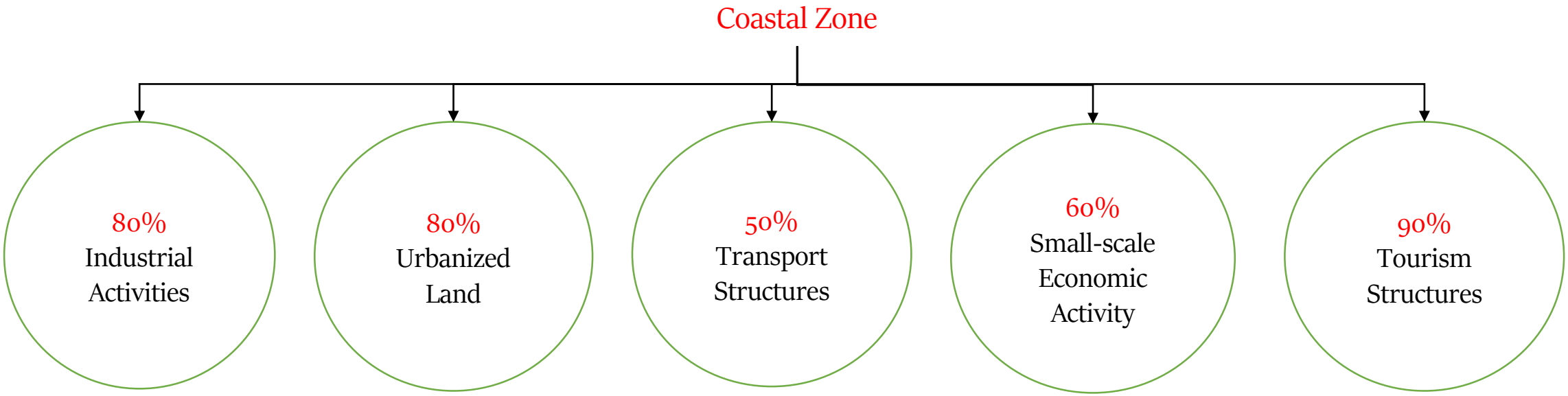
Coastal Zone

69.5% of Trinidad and 42.7% of Tobago's coastal zones are susceptible to coastal erosion and coastal flooding.

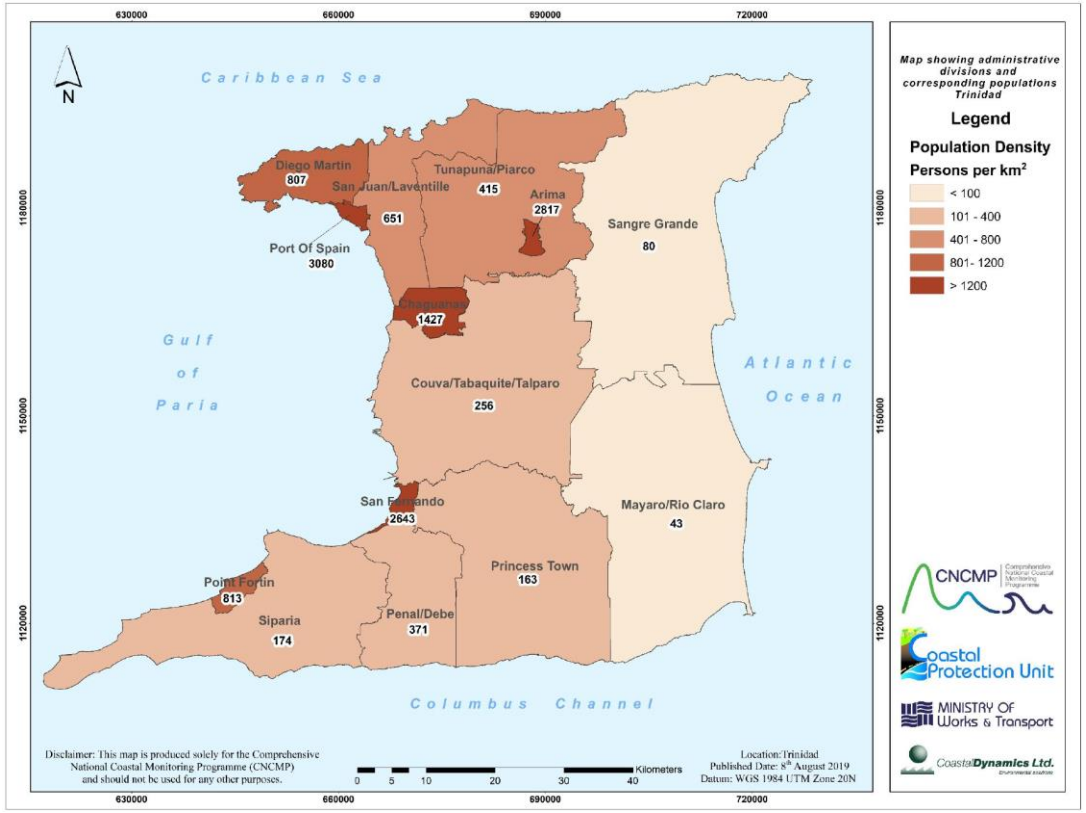


Trinidad and Tobago Coastal Vulnerability Assessment (Ministry of Works and Transportation, 2019)

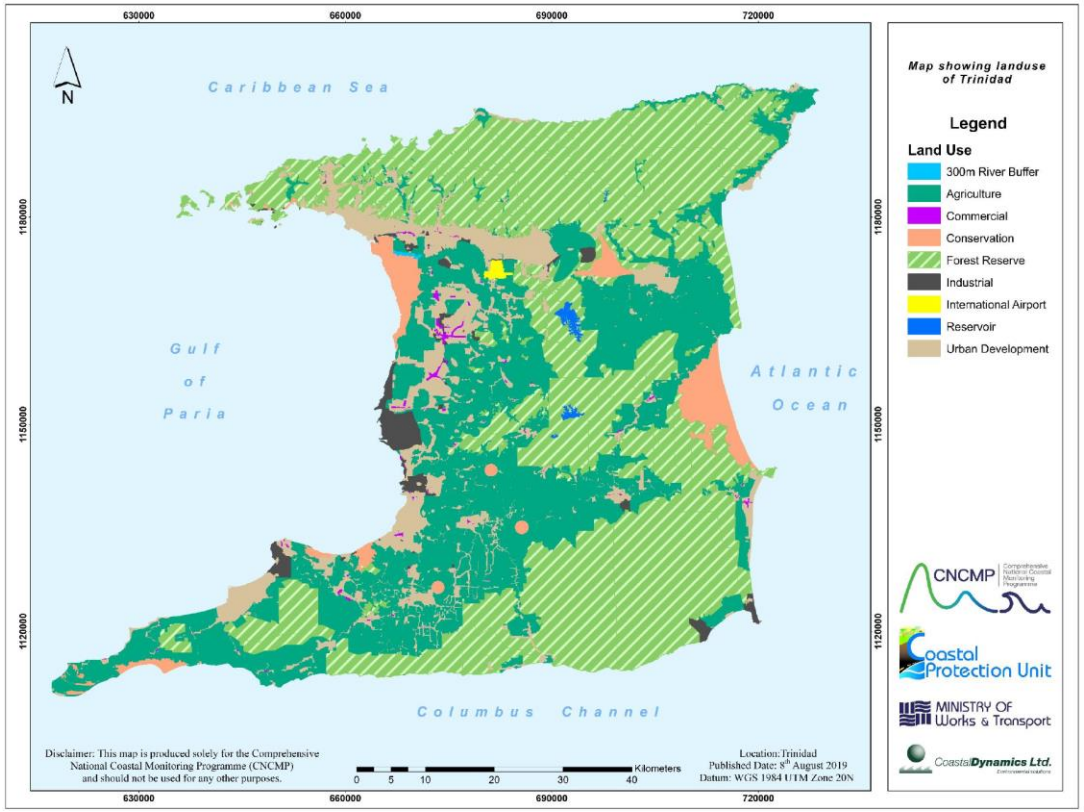
Coastal Zone



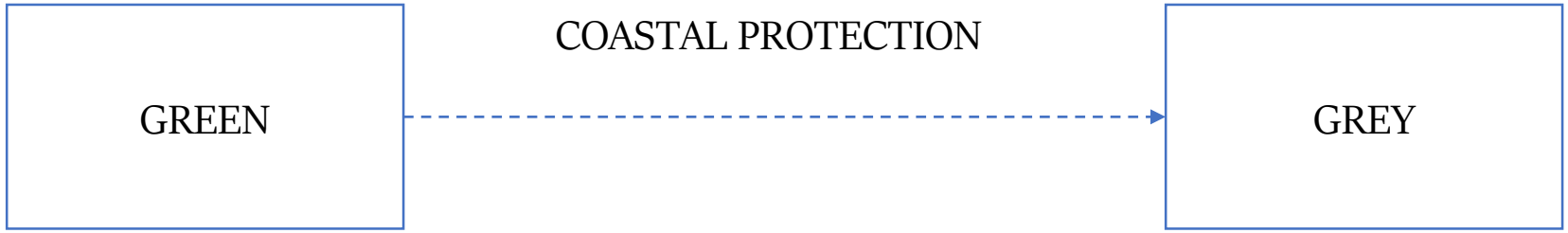
Coastal Zone



Trinidad Population Density (Ministry of Works and Transportation, 2019)



Land Use in Trinidad (Ministry of Works and Transportation, 2019)



mangrove forest and seagrass conservation

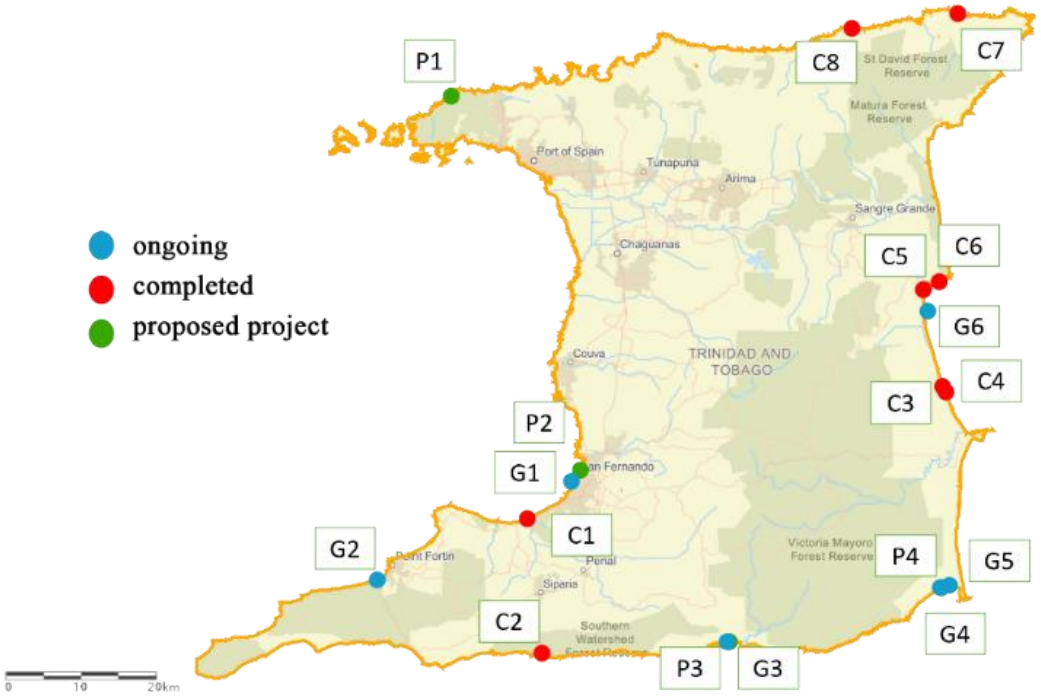
coastal protection function is derived from ecosystem features

artificial or engineered structures

seawalls and groynes

Why are green measures not as popular as grey?

Grey Coastal Protection



Location of Hard Engineering Coastal Protection Measures in Trinidad (CPU, 2022)

Cap de Ville Shoreline Stabilization Works (G2)

San Souci Shoreline Stabilization Works (C7)

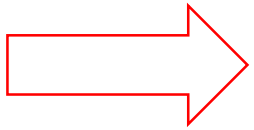
Strategically Using Mangroves to Protect Coastlines

1. Biophysical
2. Hydrological and Coastal
3. Environmental
4. Legislation and Enforcement
5. Social and Cultural
6. Co-benefits

Ecosystem Coastal Protection Capacity

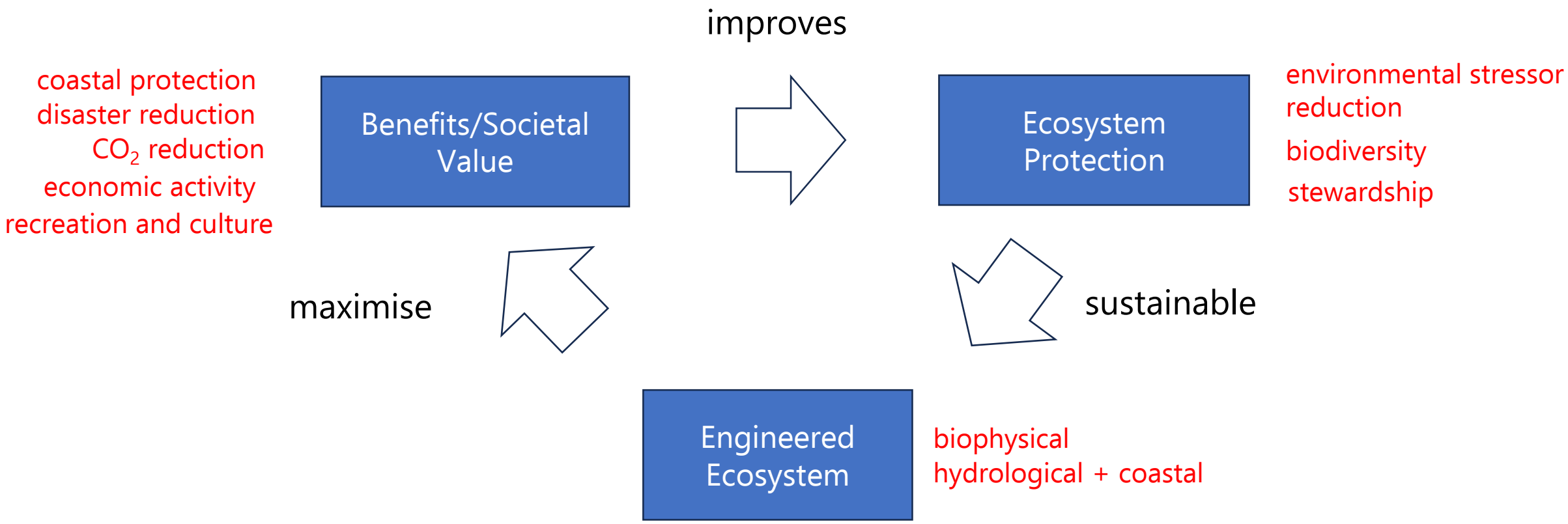
Strategically Using Mangroves to Protect Coastlines

1. Biophysical
2. Hydrological and Coastal
3. Environmental
4. Legislation and Enforcement
5. Social and Cultural
6. Co-benefits



Ecosystem Protection Capacity

A Transdisciplinary and Trans-sectorial Approach



Ecological Engineering

Hydrological Data and Biophysical Data

- Biological and Fauna-based Sciences
- Marine and Coastal Sciences
- Climate Sciences
- Civil and Environmental Engineering

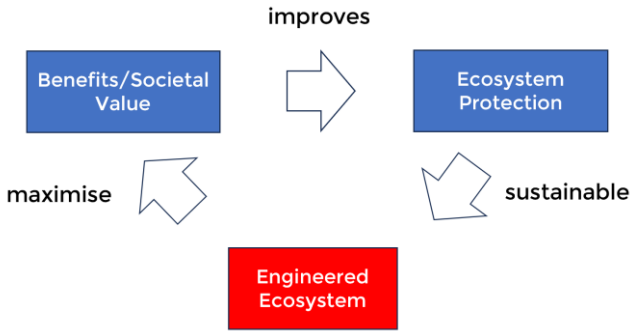
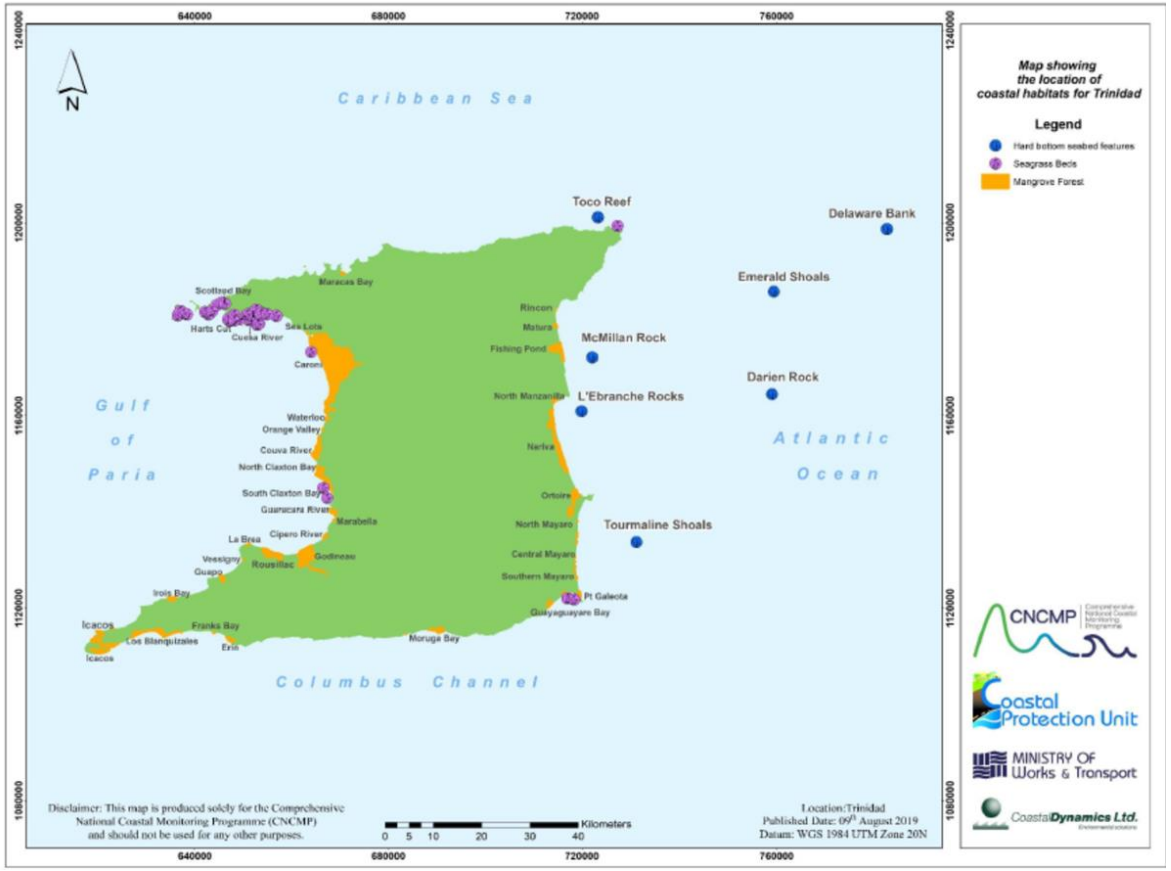


Photo rights: Nepf Environmental Fluid Mechanics Lab at MIT, Coastal Ocean Fluid Dynamics Lab at WHOI

Ecological Engineering



Location of Mangroves and Seagrass Beds in Trinidad

Ecological Engineering

1. Rhizophora mangle
2. Rhizophora racemose
3. Rhizophora harrisonii
4. Avicennia germinans
5. Avicennia schaueriana
6. Laguncularia racemose
7. Conocarpus erectus

The root system of the Rhizophora genus provides stability which helps the plant withstand currents and stormy conditions.

Ecological Engineering

1. Rhizophora mangle
2. Rhizophora racemose
3. Rhizophora harrisonii
4. Avicennia germinans
5. Avicennia schaueriana
6. Laguncularia racemose
7. Conocarpus erectus

Laguncularia racemosa has an extensive root system that protects against coastal erosion.

Ecological Engineering

1. Rhizophora mangle
2. Rhizophora racemose
3. Rhizophora harrisonii
4. Avicennia germinans
5. Avicennia schaueriana
6. Laguncularia racemose
7. Conocarpus erectus

Conocarpus erectus is highly resistant to environmental stressors such as extreme temperatures.

Ecological Engineering

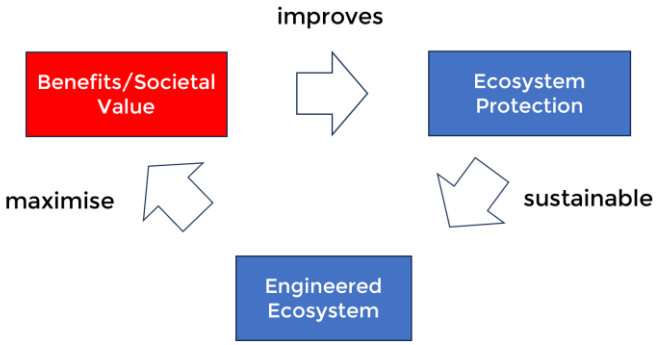
1. Rhizophora mangle
2. Rhizophora racemose
3. Rhizophora harrisonii
4. Avicennia germinans
5. Avicennia schaueriana
6. Laguncularia racemose
7. Conocarpus erectus

Resistant to termite and decay, useful in construction industry

Value Engineering

Socioeconomic and Practical Benefits

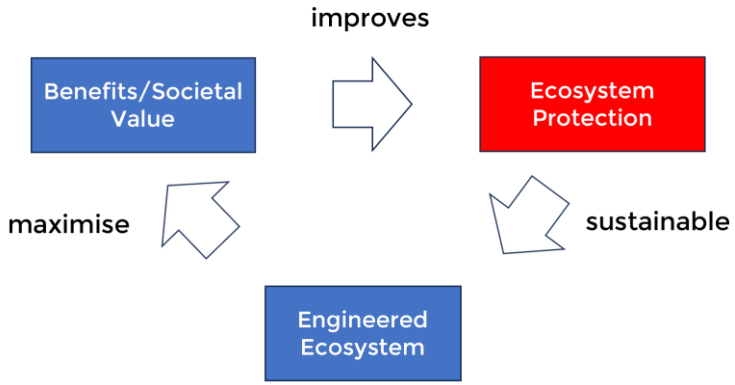
- Social Sciences
- Economics
- Disaster Experts
- Climate Sciences
- Biological Sciences



Nepf Environmental Fluid Mechanics Lab at MIT, Coastal Ocean Fluid Dynamics Lab at WHOI

Ecosystem Protection

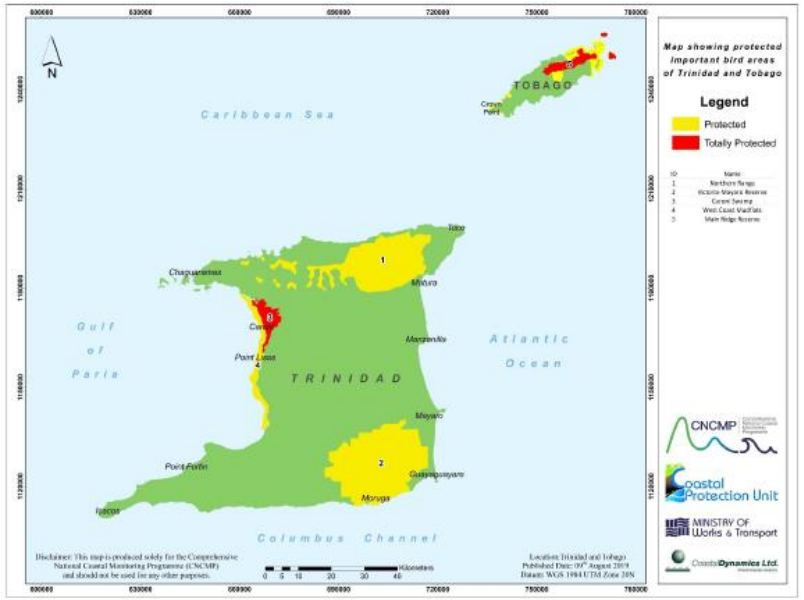
Environmental stressor reduction through mangrove ownership and stewardship from a wide cross-section of society.



Nepf Environmental Fluid Mechanics Lab at MIT, Coastal Ocean Fluid Dynamics Lab at WHOI

Ecosystem Protection

There was a decline in the size of protected and unprotected mangrove forests.



Protected Areas

- Eutrophication
- Sedimentation
- Water Quality
- Dredging

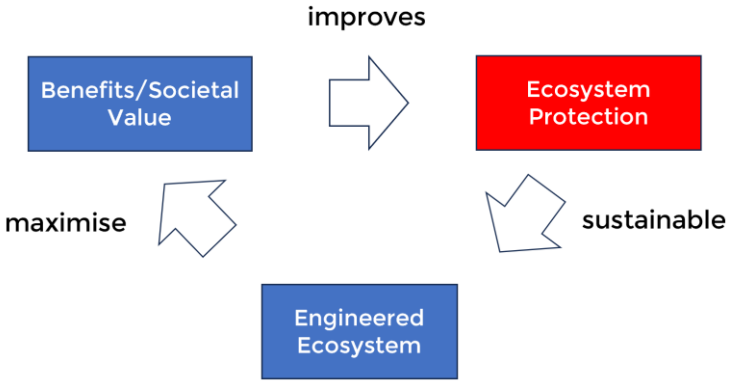
→ Mangrove Degradation →

- Diseases
- Shoreline Modification
- Coastal Construction
- Sea Surface Temperatures
- Air Exposure

Ecosystem Protection

- Forest Act Chapter 66:01
- The Conservation of Wildlife Act Chapter 67:01
- Marine (Preservation and Enhancement) Act Chapter 37:01
- The Environmental Management Act (2000)
- Ramsar Convention

Why are they not effective?

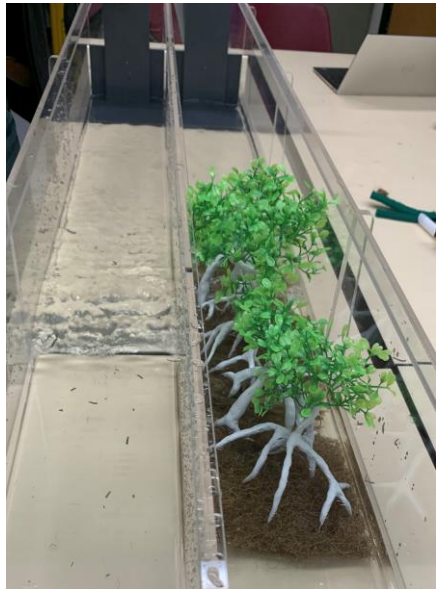


Mangrove Forest at the Bon Accord Lagoon, Tobago

360° Living Laboratory

A 360° living laboratory is suitable framework for examining the effectiveness of a transdisciplinary and trans-sectorial approach for sustainably engineering mangroves for protecting coastlines.

Experts from various sectors and disciplines can collaborate to design a comprehensive and evidenced-based manual for sustainably using mangroves to protect our coastlines.



Thank You

Bibliography

- Coastal Protection Unit. (2022). https://www.arcgis.com/home/webmap/viewer.html?webmap=27a1fb71085241cd8dfe3dcda3733a49&extent=-61.0861,10.1309,-60.9849,10.1826.
- Juman, R., & Hassanali, K. (2013). Mangrove Conservation in Trinidad and Tobago, West Indies. https://www.ima.gov.tt/wp-content/uploads/2018/04/Mangrove-Conservation-in-TT.pdf
- Juman, R., & Ramsewak, D. (2013a). Land cover changes in the Caroni Swamp Ramsar Site, Trinidad (1942 and 2007): implications for management. Journal of Coastal Conservation, 17(1), 133-141. https://doi.org/https://doi.org/10.1007/s11852-012-0225-0
- Juman, R., & Ramsewak, D. (2013b). Status of Mangrove Forests in Trinidad and Tobago, West Indies. Caribbean Journal of Science, 47, 291-304. https://doi.org/10.18475/cjos.v47i3.a18
- Ministry of Works and Transportation. (2019). *National Coastal Assessment Report-Volume II: Maps and Tables*.
- Roopnarine, R., Opadeyi, J., Eudoxie, G., Thongs, G., & Edwards, E. (2018). GIS-based flood susceptibility and risk mapping Trinidad using weight factor modeling. Caribbean Journal of Earth Science, 49(1), 1-9.
- Spalding, M., Mcivor, A., Tonneijck, F., Tol, S., & Eijk, P. v. (2014). Mangroves for coastal defence.