Working Group 3

- **Society and Economy**
  - Challenges and opportunities for resiliency in Puerto Rico in the context of: policy and governance; society and economy; infrastructure and land use planning

Policy and governance

Social context

Human Well- Being

Historic and cultural sites

Health

Vulnerability Index

Economic context

Banking and insurance

Tourism

Agriculture

Infrastructure

Energy

Water management

Transport and mobility

Risk assessment

Land use development and planning

Challenges and opportunities for resiliency in Puerto Rico

Coordinator: Dr. Félix Aponte González

APONTE, APONTE & ASOCIADOS, LLC

Vulnerability of Puerto Rican Tangible Cultural Heritage

Isabel Rivera-Collazo

UC San Diego,

Scripps Institution of Oceanography

Vulnerability

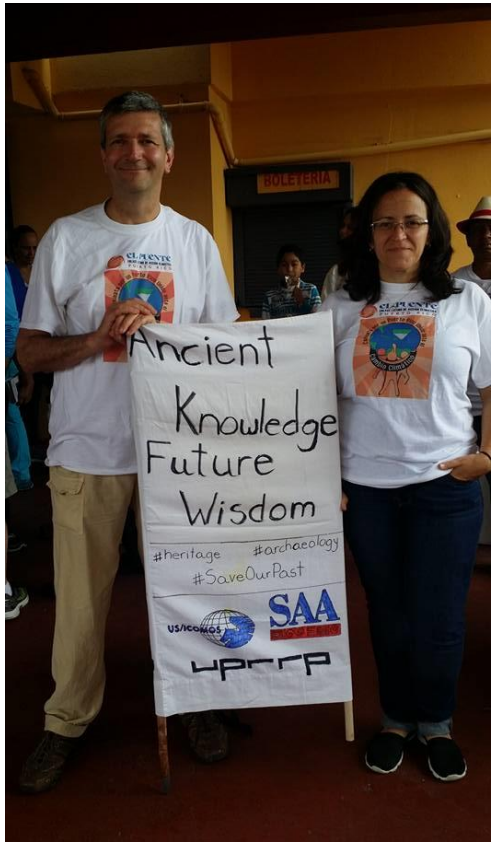
- Place-based knowledge as a source of resilience
- Tangible heritage
  - Archaeological sites
  - Cultural landscapes
  - Historic buildings
  - Monuments
  - Archaeological and historical collections
- Intangible
  - Myths
  - Stories
  - Traditions
  - Practices

Current work

- Committee on Climate Change Strategies and Adaptation Resources, Society for American Archaeology
- University of St. Andrews
- UC San Diego
  - Department of Anthropology
  - Scripps Institution of Oceanography
  - Qualcomm Institute

Cultural Heritage

EL PUENTE
ENLACE LATINO DE ACCIÓN CLIMÁTICA
PUERTO RICO



Puerto Rican Cultural Heritage

- Institute of Puerto Rican Culture
- State Historic Preservation Office
- National Parks Service
- University of Puerto Rico
- Centro de Estudios Avanzados de Puerto Rico y el Caribe
- Museums (NGOs, Government, Municipalities, etc.)

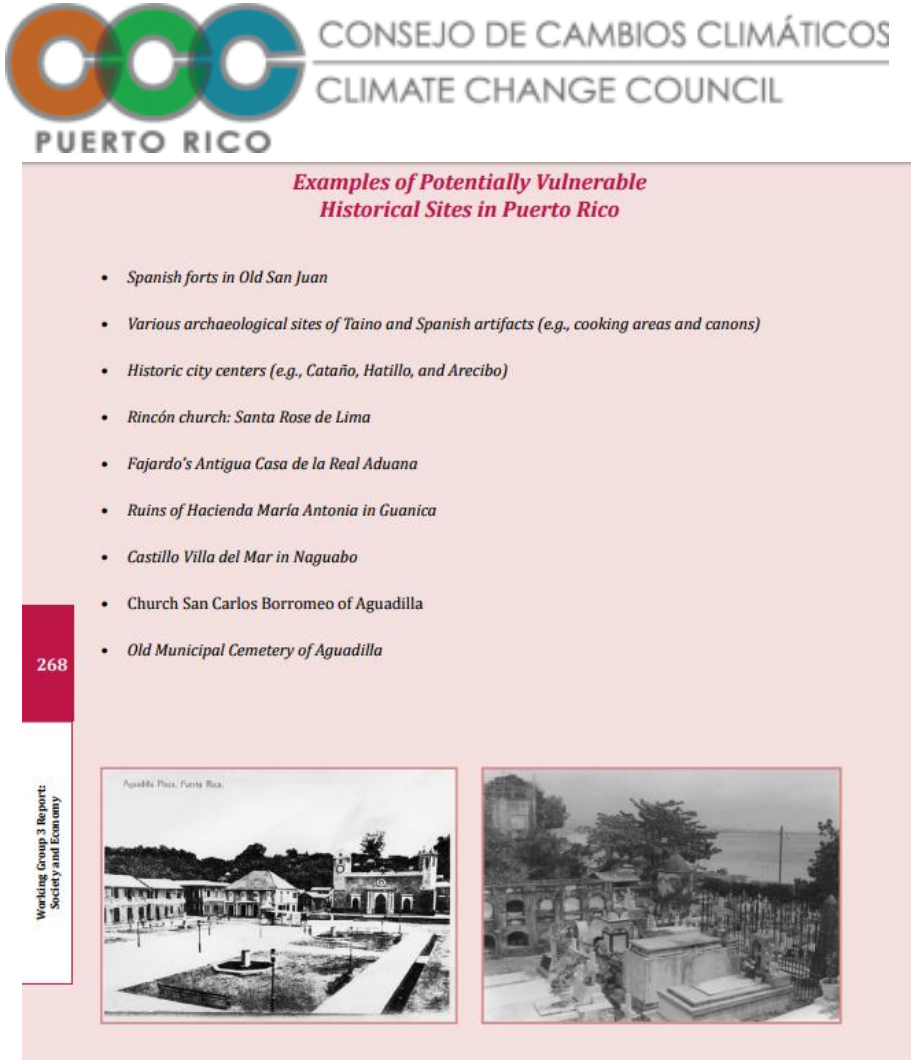
Archaeological research, data and curation facilities

Artefacts at the Center for Archaeological Research, UPR Rio Piedras

Prof. Reniel Rodríguez in his lab at the UPR Utuado

2013 Cultural Heritage Assessment

- About ½ page long
- 9 sites
- "Increased frequency of flooding from sea level rise and heavy precipitation events could cause more structural damage to this historic building and many others, perhaps even complete loss of such treasures"

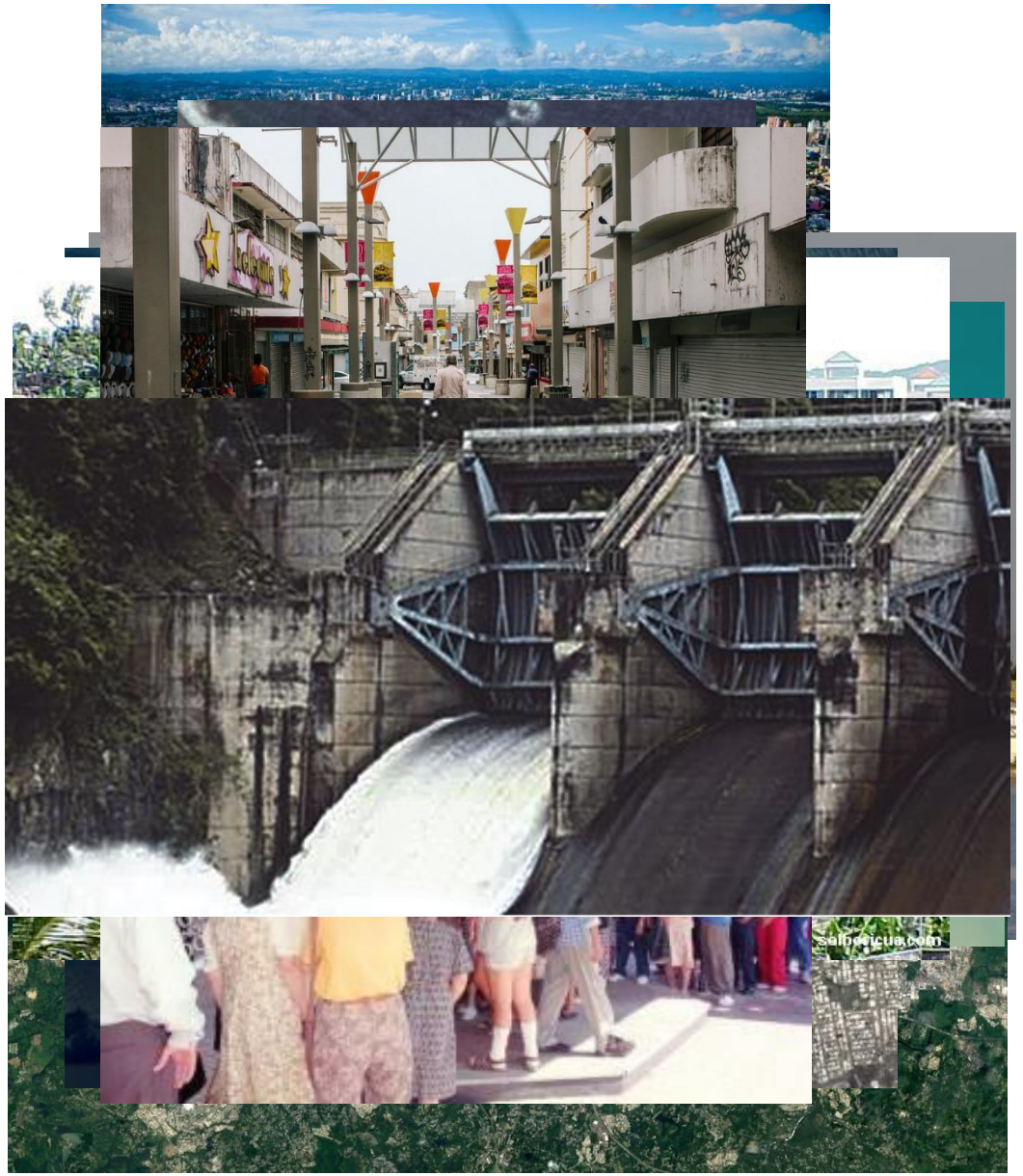


Expected Climate Change Impacts

- Air temperature
  - Decomposition of organics and others
- Precipitation and extreme events
  - Erosion of sites, burial of sites, flooding of storage facilities
- Storms and hurricanes
  - Coastal erosion, affected historical buildings, flooding, loss of power
- Sea surface temperature
  - Ocean acidity affects preservation of underwater heritage
- Sea level rise
  - Coastal and near shore erosion, flooding

Social variables

- High density coastal development
- Essential infrastructure at the coast
- Very high atmospheric and land pollution
- Unsound construction practices
- Low-income and high unemployment



Stakeholders

- Department of Natural Resources (DRNA)
- Institute of Puerto Rican Culture (ICP)
- National Parks Service – San Juan
- Para la Naturaleza (PLN)
- Enlace Latino de Acción Climática
- University of Puerto Rico

Action Plan

- Steps 1 and 2: State of the Issue
  - Assess available data
  - Create threat assessment
- Step 3
  - Identify gaps in data
  - Vulnerability assessment
- Sub-Projects

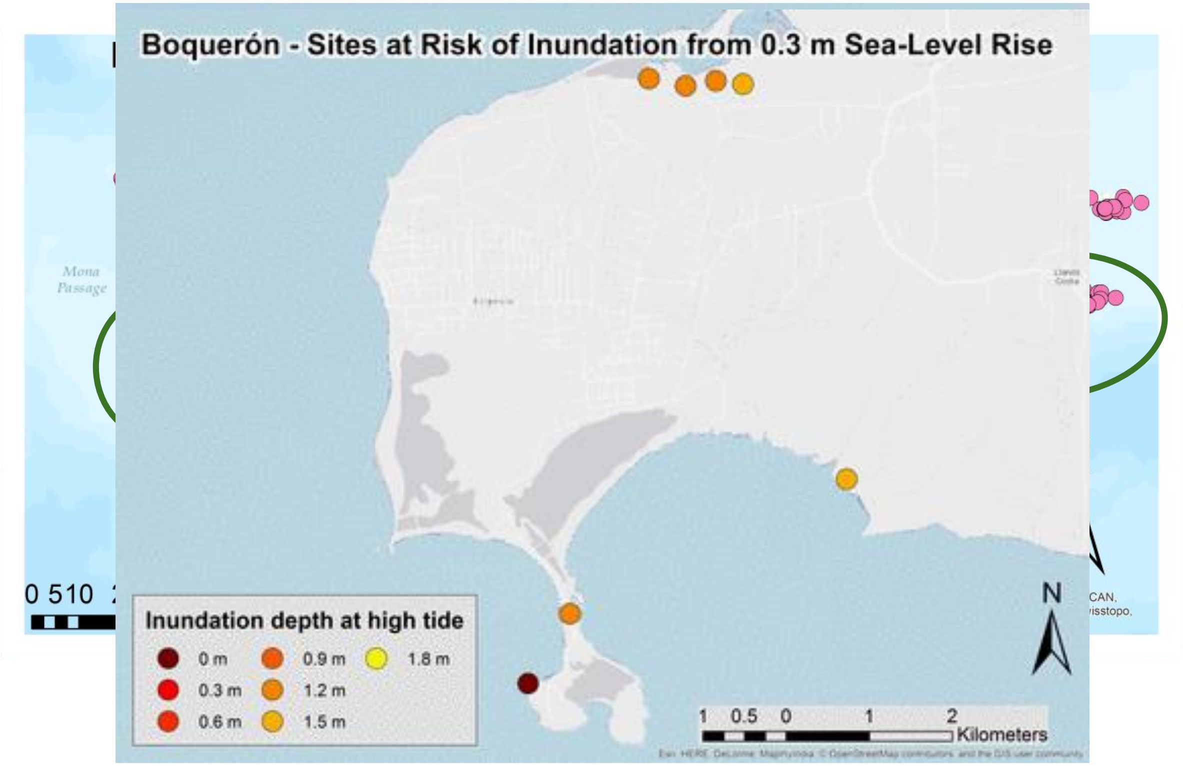
Walakpa site, North Alaska.
Photo Credit: Anne Jensen. DONOP

Sub-Projects

Sub-Project	Output
1. Survey	Multiple reports along the coast
2. Prioritization and Action	Prioritised list of sites that require action, with associated recommendations for action
3. Intervention	Project design and practical project, including full reports and other outputs, at vulnerable site
4. Outreach and Education	Education and Outreach Package for various audiences
5. Dissemination and Sharing experiences	Publications and conference participation
6. Protocols, Storage and facilities	1. Concrete protocols 2. Plans for Cultural Tourism 3. Develop idea of Museum and Store / Deposit

Steps 1 and 2

	Total	2050	2100
Historic	555	18	46
Indigenous	534	34	81
Both	48	2	4
Unknown	48	2	9
TOTAL	**1185**	**56**	**140**



Cabo Rojo area
Loiza area

Step 3

- Sub-Projects 1 and 2: Survey, Prioritization, Survey and Action
  - Engage communities and rangers

Conclusion

- Smoke Alarm!
  - 27 sites need to be checked out ASAP
  - No information on large areas of the island
- Cultural heritage falling through the cracks
- Urgency to recover local traditional knowledges forgotten due to environmental and cultural discrimination

Human bones embedded in beachrock.
Playa Jayuya site, Fajardo

UC San Diego
SOCIAL SCIENCES
Anthropology

SCRIPPS INSTITUTION OF OCEANOGRAPHY

SAA

EL PUENTE
ENLACE LATINO DE ACCIÓN CLIMÁTICA
PUERTO RICO

UPR RP LA IUPI

para la Naturaleza

NATIONAL PARK SERVICE

Coastal Scotland's Heritage At Risk

DRNA

Many Thanks

To all the amazing Puerto Rican volunteer and students, who make it all worth it

Estudios Técnicos Inc.
Investigación | Estrategias | Soluciones

Puerto Rico's Economy: Background, Current Trends and Climate Change

April 7, 2017

Economic History

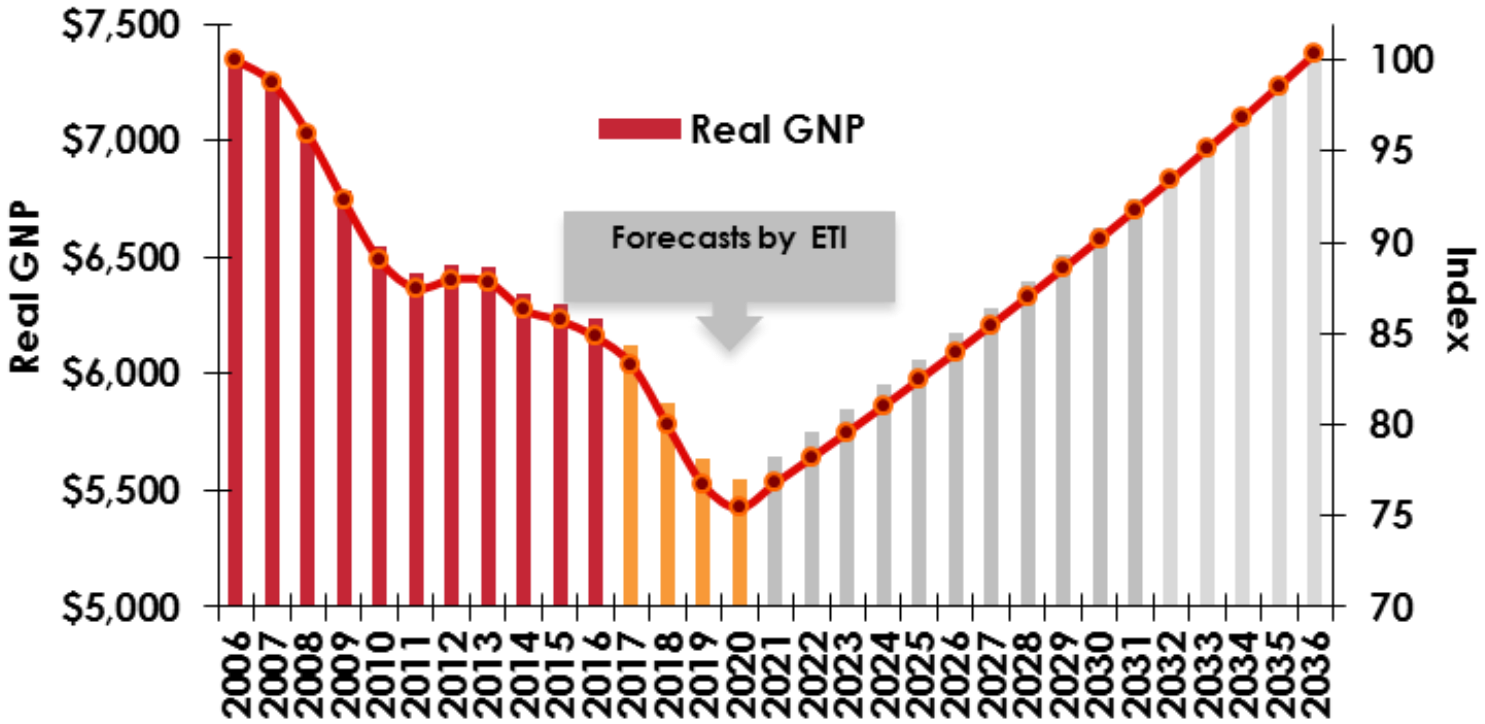
- Exhaustion of industrial policy based on pharma exports and tax incentives (external changes)
- Decade-long economic contraction
    - Steady decrease of the quality of life in the island
    - Massive loss of jobs
    - Outmigration
    - Increasing recognition that the institutional framework is obsolete
- Real GNP growth has experienced long-term stagnation from fiscal 1975 onwards. Since 2000 two trends have characterized Puerto Rico's economic performance

    (1) Declining real GNP growth at the beginning of the decade. Economy declining at an average rate of -1.6%. Since fiscal 2007 the economy has contracted since then by -16.4%.

    (2) A widening gap between P.R.'s and the U.S. Between 2000 and 2016; **while P.R.'s economy contracted at an average rate of -0.3%, the U.S. economy expanded at an average annual rate of 2.1%.**

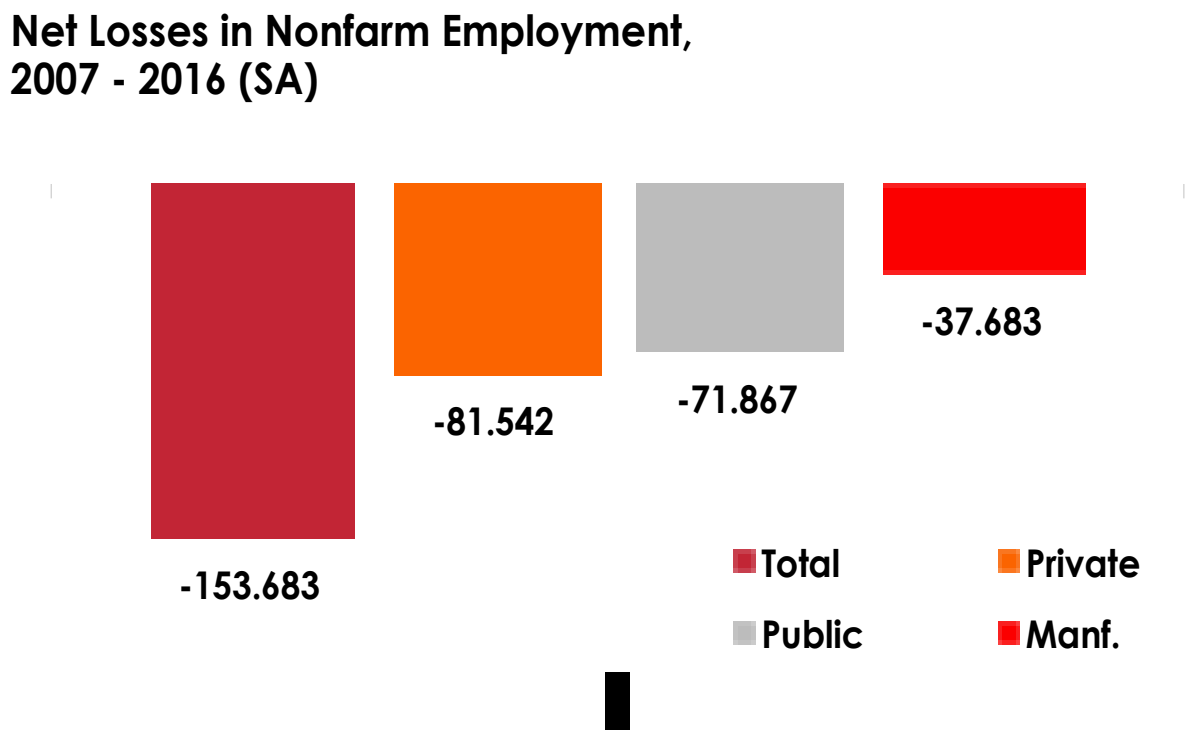
Deep Economic Contraction

How Long it Will take the Economy to Achive GNP Level of 2006
(Assuming an average anual growth rate of 1.8% from 2021 to 2036)



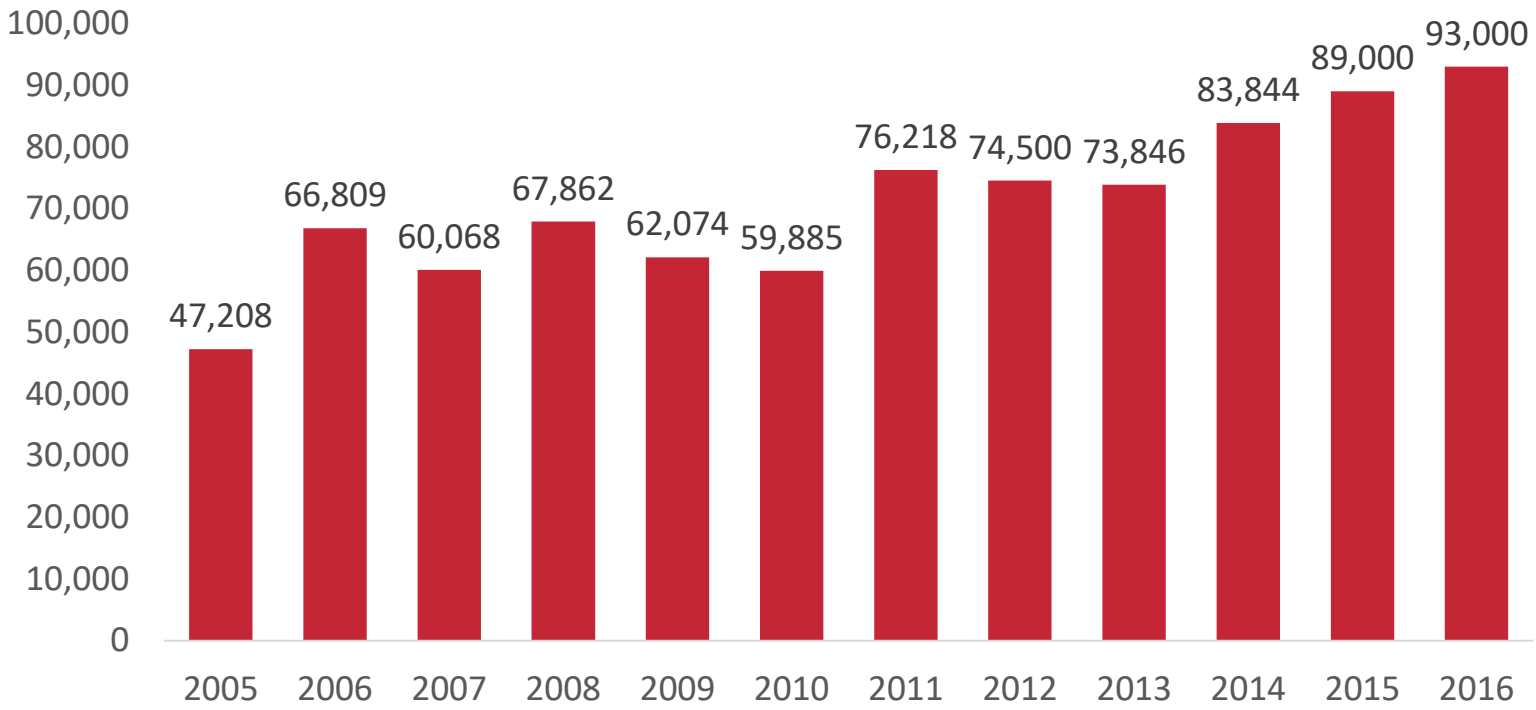
Sources: P.R. Planning Board (2017); Estudios Técnicos, Inc. (2017).

Employment



Source: U.S. BLS. Establishment Survey. SA = Seasonally adjusted. * Central government, public corporations, and municipalities.

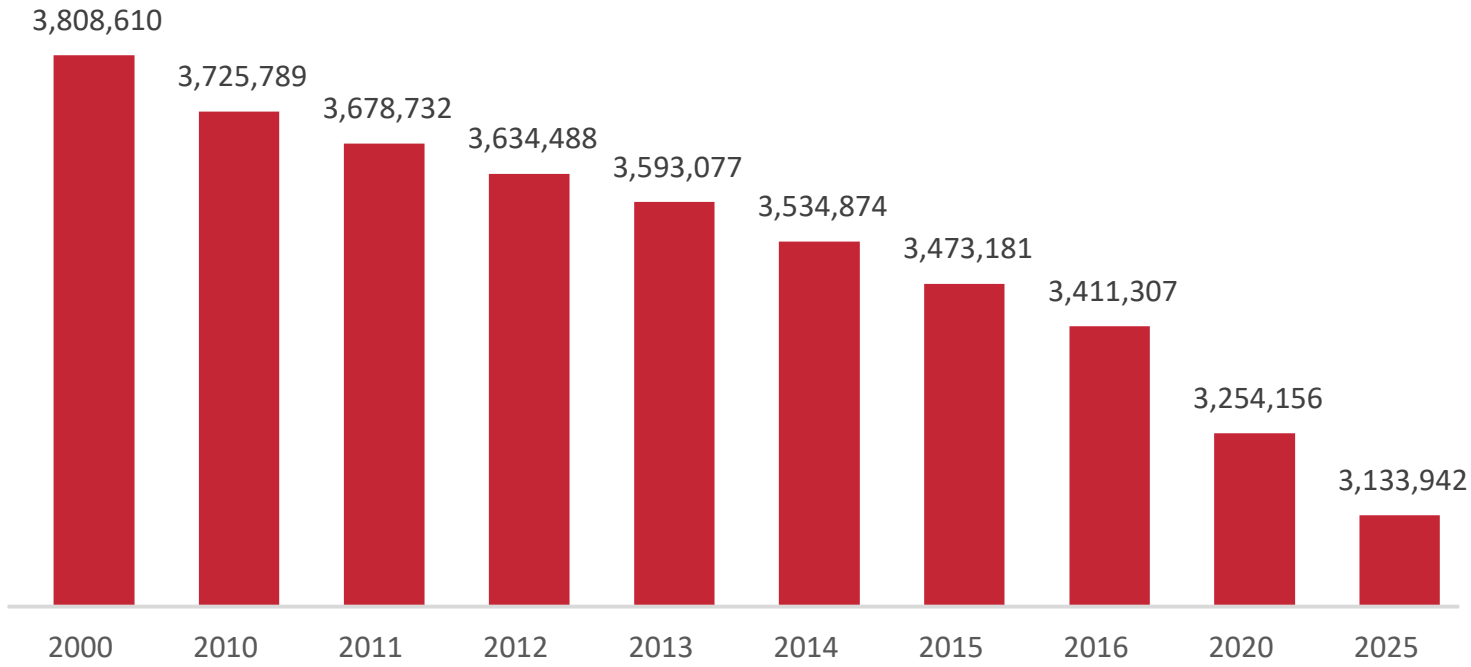
Annual Out-migration



Note: Net out-migration in 2016 is estimated at 65,000.

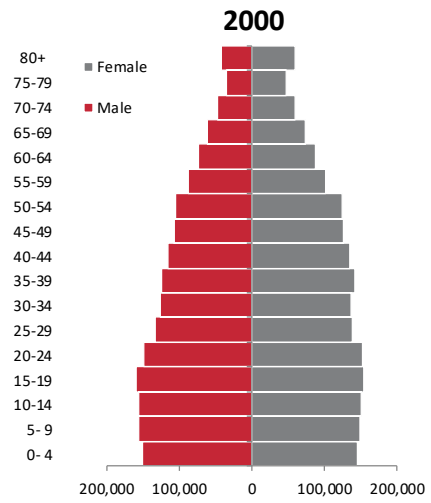
Population

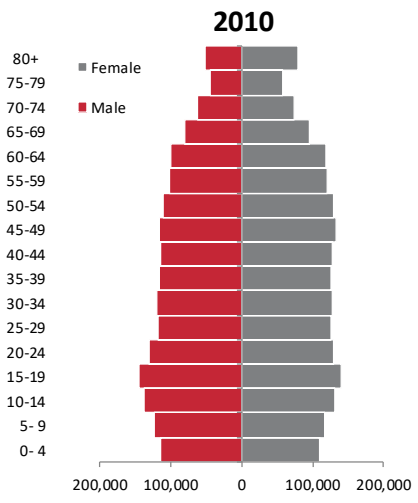
According to the 2016 Community Survey, every municipality lost population between 2010 and 2015 with the exception of Gurabo (3.7%)and Toa Alta (0.1%).

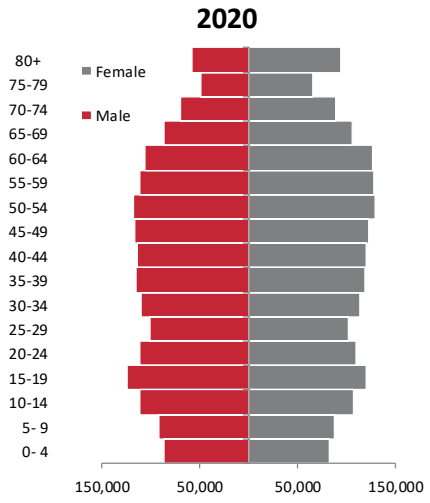


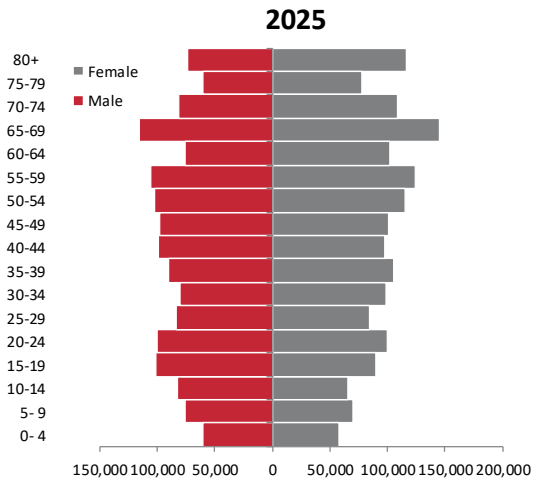
Source: Census Bureau and ETI.

Population Pyramids









The Social Dimension

39.9%
Labor participation rate

46.2%
Families under poverty level

A population with an accelerated rate of aging

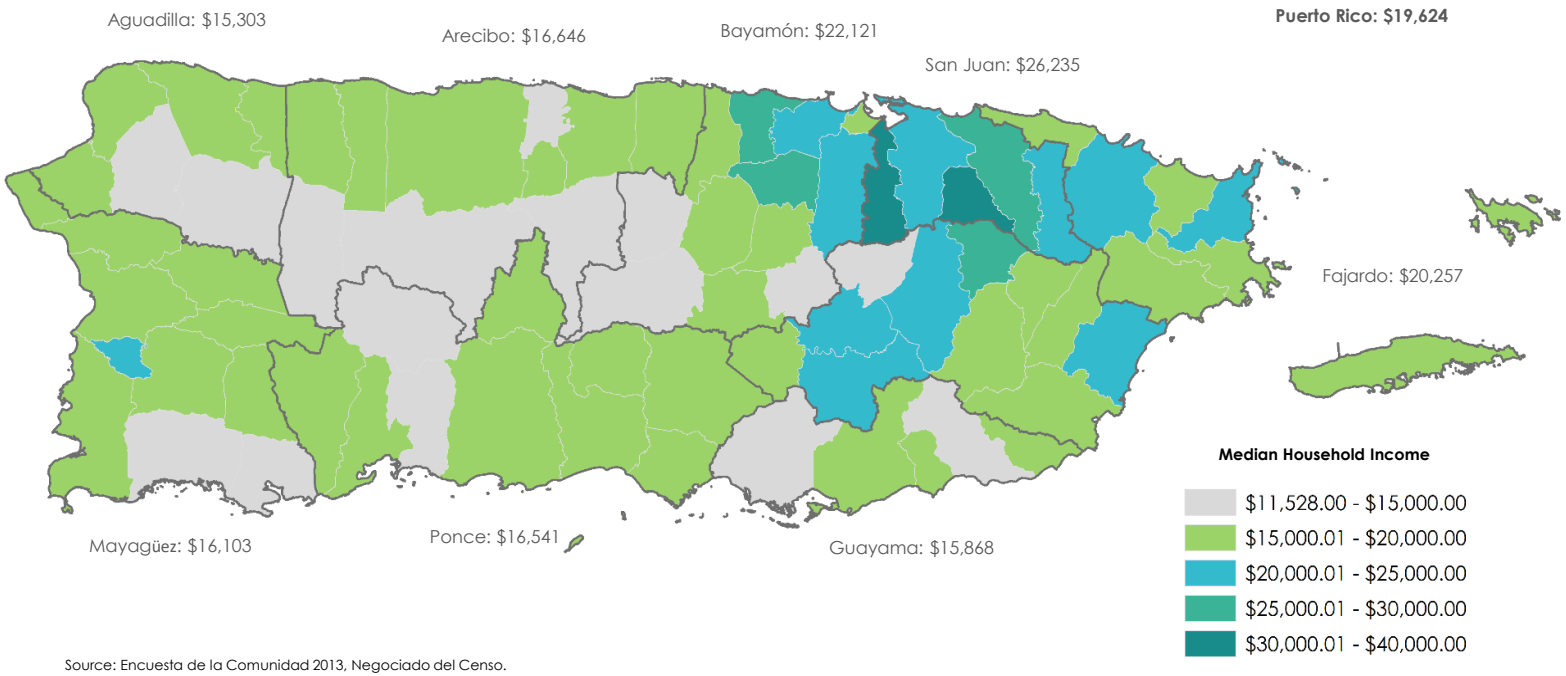
37.7%
Families receiving nutritional assistance

+40,000
Net migration in recent years

0.54
Gini coefficient , the highest level of inequality in the U.S.

Inequality

Median Household Income by Municipality and Region

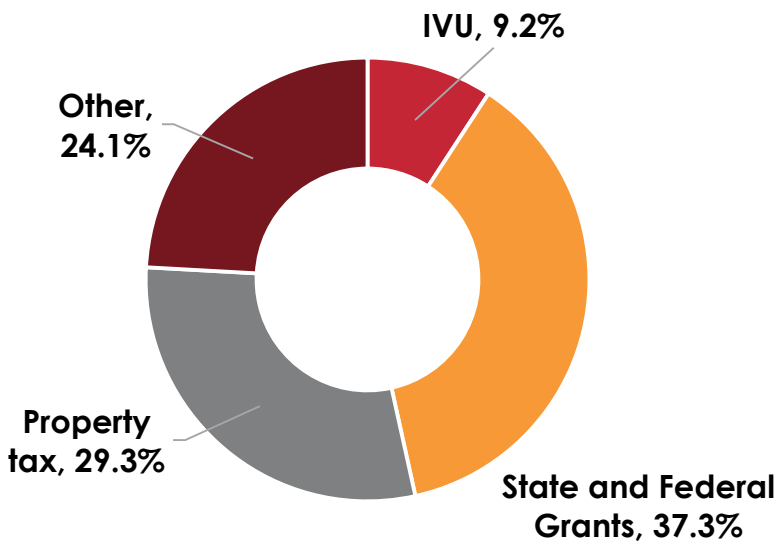


Source: Encuesta de la Comunidad 2013, Negociado del Censo.

Note: Even in a 100 X 35 mile island, there are wide geographic disparities

Local Governments

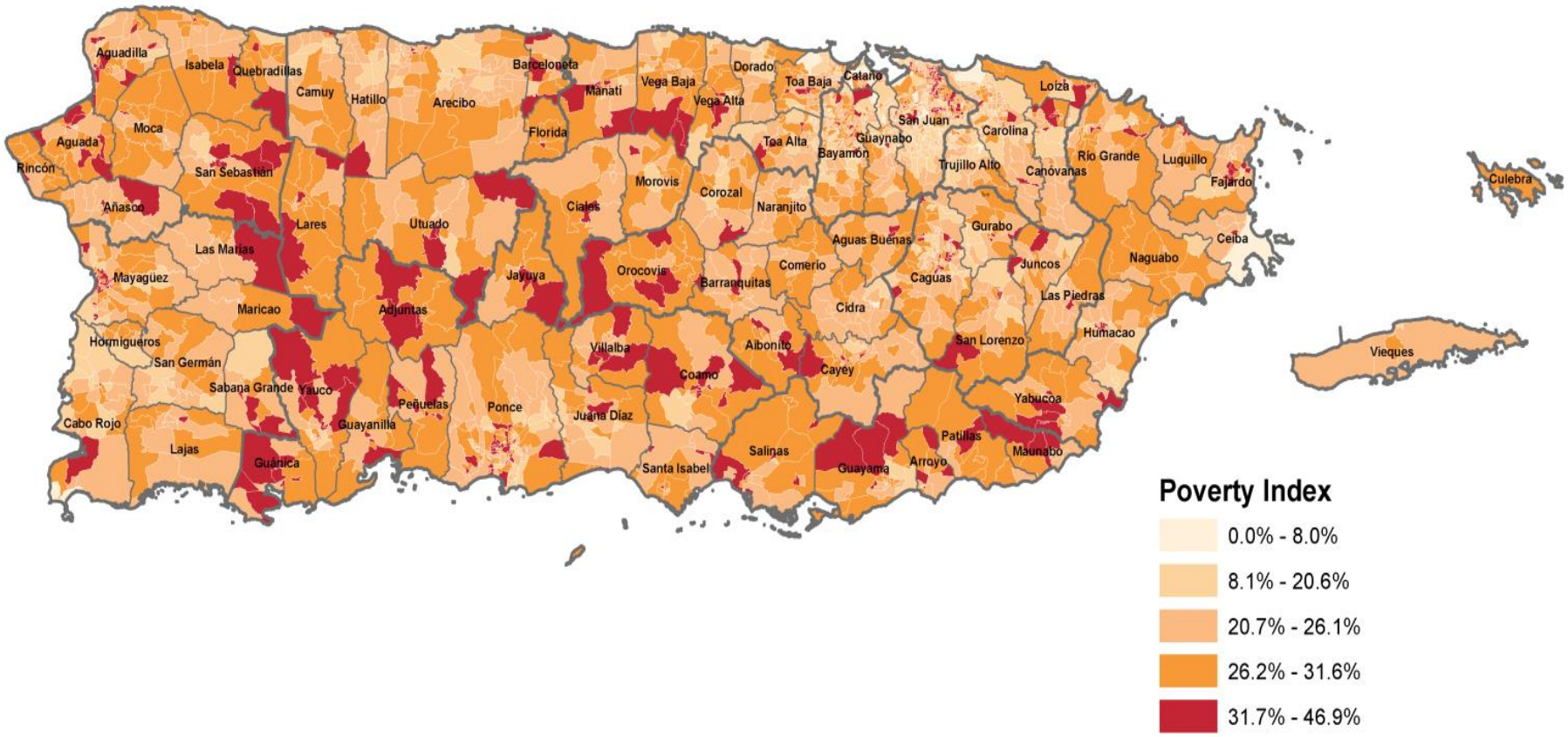
Revenue Structure: Municipalities



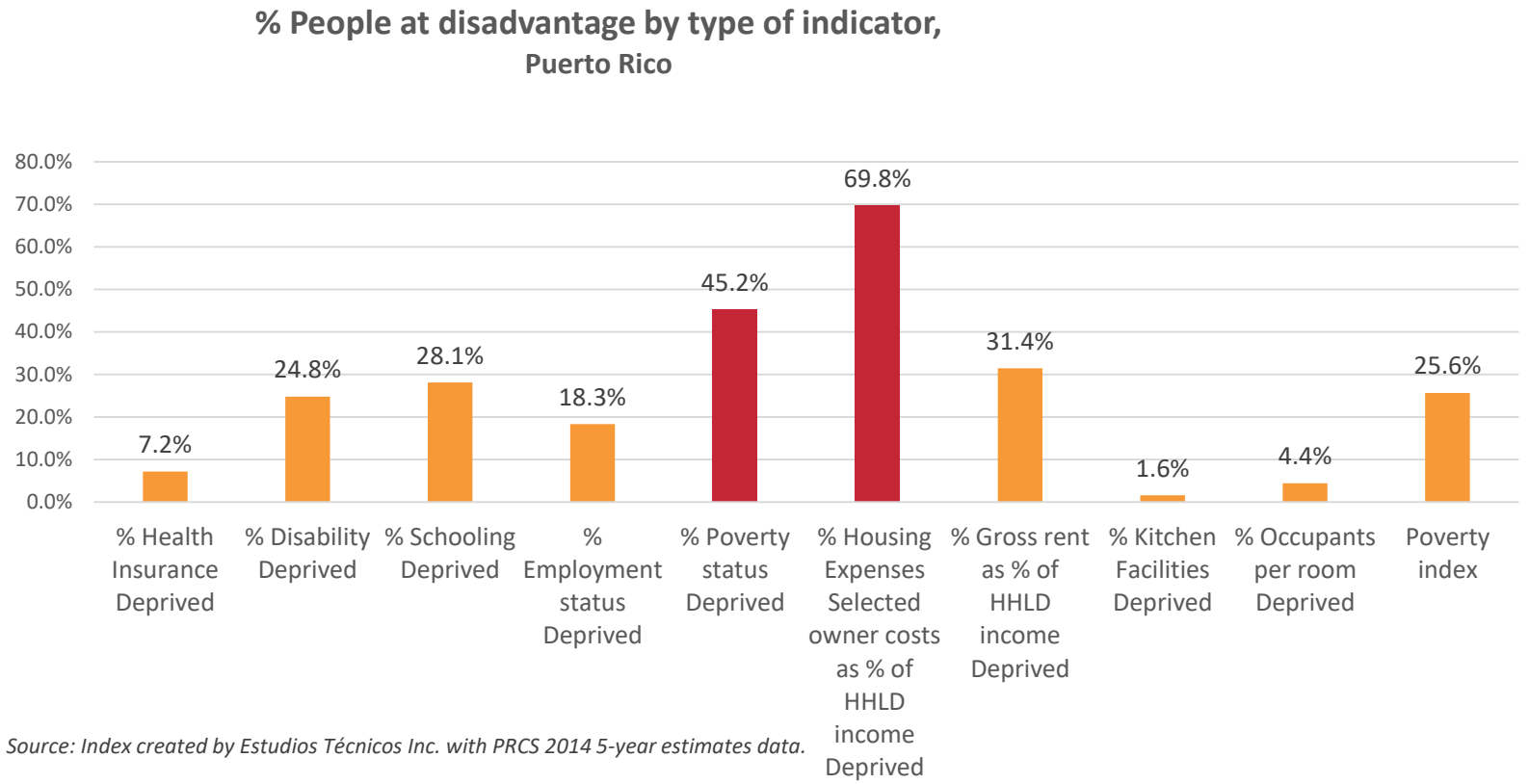
Source: Estados Financieros Auditados 2013 y 2014

- Under an scenario of economic and social uncertainty, Municipalities will experience a strong pressure from locals
- Federal programs are expected to decrease ("skinny budget" $18b program cuts)
- i.e. Deep cuts in HUD- CDBG Program 50%
- i.e. "Coastal Zone Management Grants (-$70m, eliminated), resilience grants (-$15m, eliminated), and climate grants (-$30m). The cut to climate research grants is consistent with 2017 House marks"

Adaptive Capacity



Adaptive Capacity



Source: Index created by Estudios Técnicos Inc. with PRCS 2014 5-year estimates data.

- 14% of all property value in coastal zones are potentially at risk of sea level rise (2m) ($11.8b)*
- Total Population in flood zones: 524,469 / Population with no high school diploma in the same areas 94,456 (18%)

Preliminary Conclusions

- Socioeconomic conditions as drivers of adaptive capacity
  - Current fiscal contraction with prolonged consequences
  - Increased vulnerability from both physical and social variables
  - Fertile grounds for profound institutional changes (collaboration) i.e. Fed Funds
  - Strategies must consider adequate adaptation policies under current scenarios

- Climate change interrelated with economic development
  - Adaptation as an opportunity for economic development
  - Increased competitiveness
  - Visitor economy and short term potential to bootstrap growth

¡Gracias!

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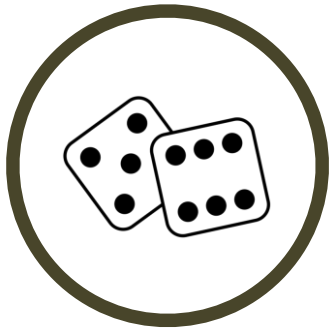
CRITICAL INFRASTRUCTURE RISK ASSESSMENT

WORKING GROUP III
CLIMATE CHANGE COUNCIL

RISK MANAGEMENT



WHAT IS A RISK?

Risk is the uncertainty to reach the objectives. Risk has consequences in terms of economic performance, environmental, safety and social considerations. **Climate change risks can be controlled through better management and governance**.

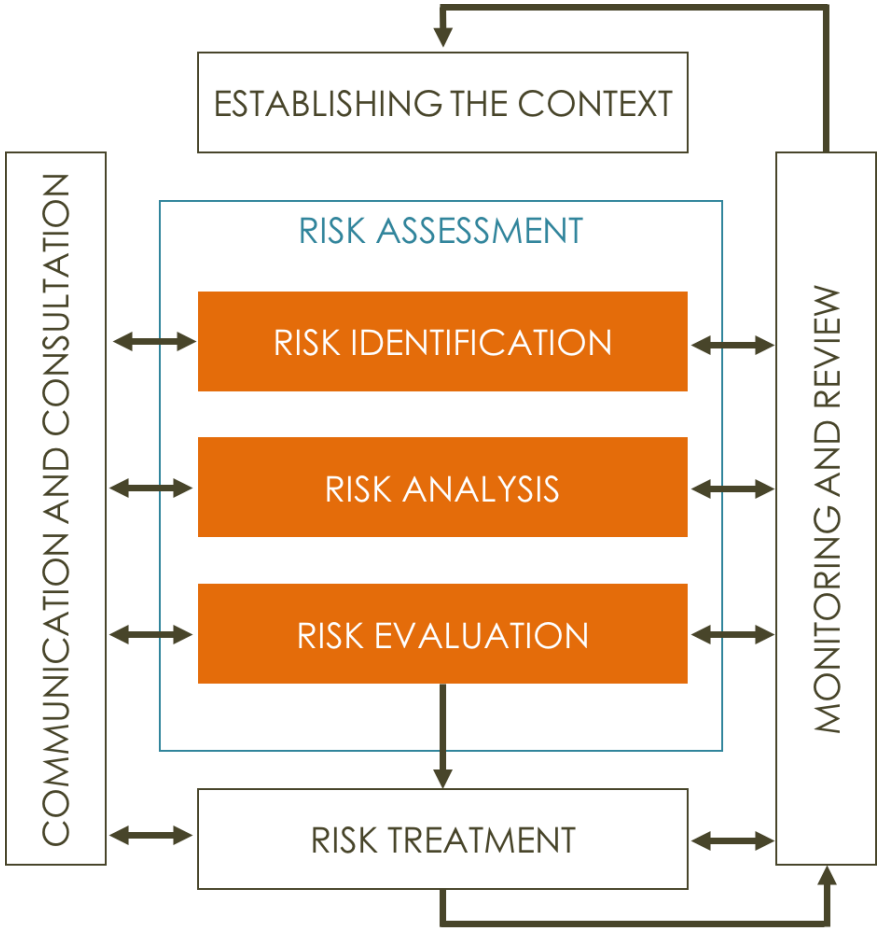
WHAT IS RISK MANAGEMENT?

Coordinated activities to direct and control an organization with regard to risk and foster a risk-informed culture and capacity to maximize the positive effects of risk and to minimize the negative effects of risk.

WHY A RM PROGRAM?

In a dynamic and complex environment, organizations should have a **scientific and robust framework** that provides the tools to effectively manage the climate change risk and improves decision-making, allocates resources and, ultimately, better results for the citizens of Puerto Rico.

The International Organization for Standardization (ISO) develops international standards that support innovation and provide solutions to global challenges



ISO 31000: RISK MANAGEMENT INTERNATIONAL STANDARD

The International Organization for Standardization (ISO) develop international standards integrated that support innovation and provide solutions to global climate challenges

ISO 31000

The standard is a brief and high-level set of principles and guidelines on how to Implement risk management. **It provides a set of principles, a framework and a process for managing risk.** It is a holistic approach to integrating internal controls, compliance and governance initiatives under a Risk Management framework.

STRATEGIC TOOL

Using ISO 31000 can help **improve the identification of opportunities and threats, effectively allocate and use resources for risk treatment**, which will in turn contribute to the achievement of their objectives and public service to the citizens of Puerto Rico.

MITIGATION AND ADAPTATION POLICIES

ISO 31000 allows to establish a a structured and transparent risk management program that improves the confidence of the interested parties and it would **allow to better take mitigation and adaption actions based on the results of the risk assessment.**

Considerations for Risk Assessment

Critical Infrastructure

Based on Homeland Security

- Commercial
- Communications/IT
- Manufacturing (including pharmaceuticals and aerospace)
- DAMS & Water Resources
- Energy
- Government Facilities
- Healthcare
- Waste Management
- Transportation

Threats

Climate change threats presented by the CCC for consideration

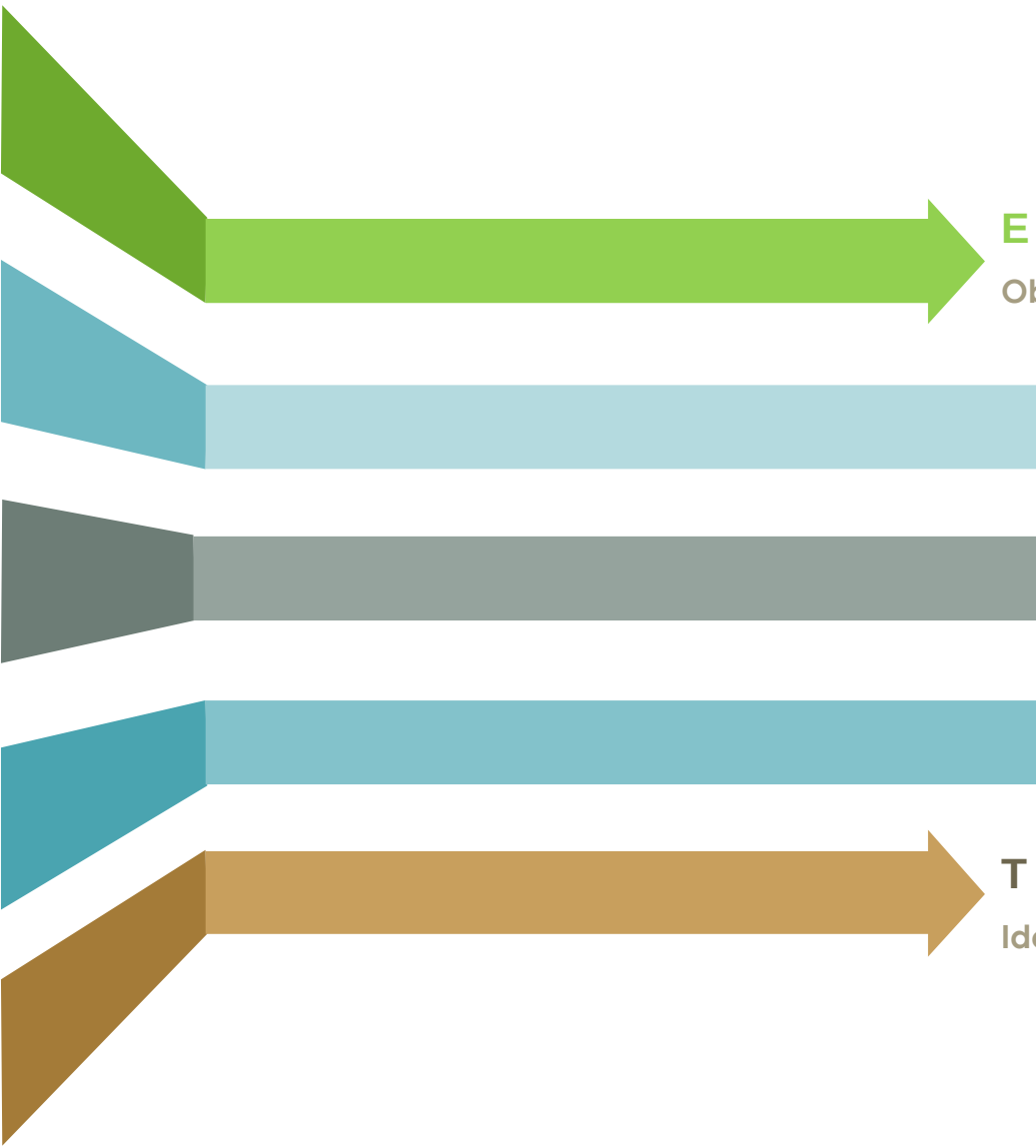
- Increase in CO2 and other greenhouse gases
- Temperature variability
- Precipitation patterns (wet vs dry /extreme events)
- Tropical Storms and Hurricanes
- Sea Level Change
- Others and deemed necessary

Assets

Threats considered against the following assets of each Critical Infrastructure

- Management
- Physical
- Financial
- Regulatory
- Supply Chain
- Product/Service Technology
- Legal
- Reputation
- Response

Risk Assessment



ESTABLISH THE CONTEXT

Objectives, Stakeholders, Criteria, Key Elements, Climate Scenarios

IDENTIFY THE RISKS

What can happen? How can it happen?

ANAYIZE THE RISK

Review Controls, Likelihood, Consequences, Level of Risk

EVALUATE THE RISK

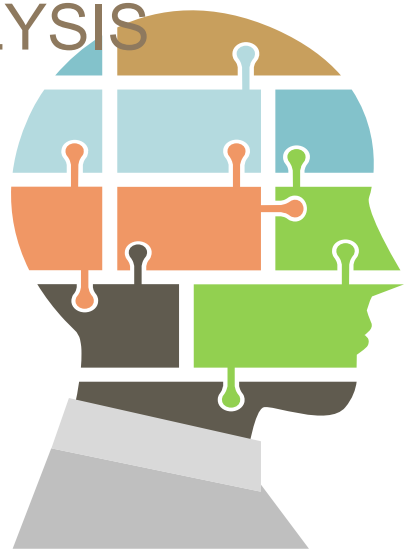
Evaluate and Rank Risks

TREAT THE RISK

Identify Options, Select the Best, Develop Plans, Implement

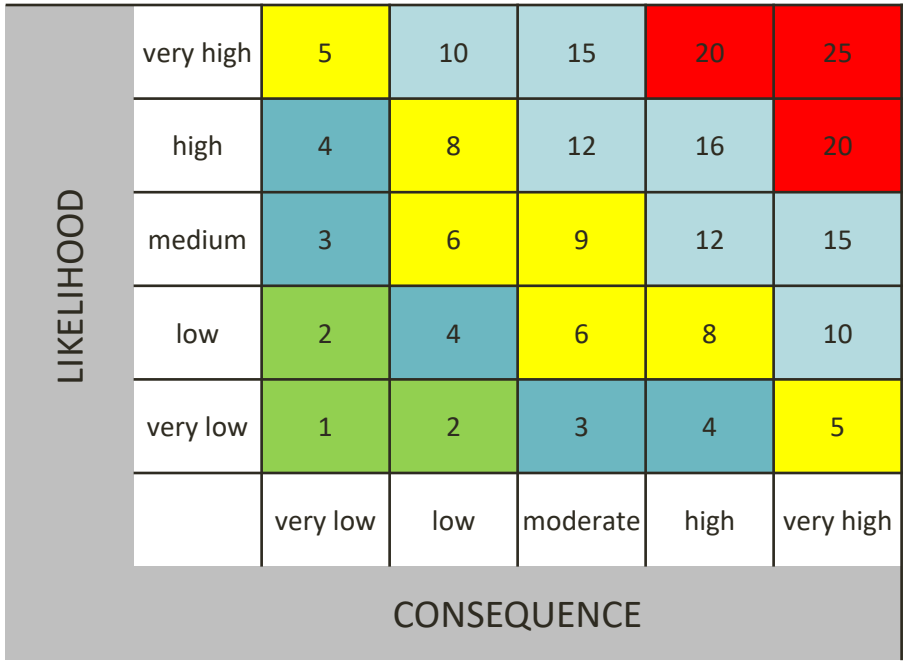
Likelihood and Consequence Criteria

QUALITATIVE ANALYSIS



LIKELIHOOD Possibility of occurrence	CONSEQUENCE Evaluation of the severity of the consequences (impacts) upon assets
Very Low - Not likely to occur	Very Low
Low - Likely to occur once between 20 and 50 years	Low
Moderate - Likely to occur once between 10 and 20 years	Moderate
High - Likely to occur at least once a decade	High
Very High - Likely to occur once or more annually	Very High

Risk Exposure Rating



Risk Exposure Rating	Number Scale	Description	Color Code
VERY HIGH	20-25	Extreme Risk: Immediate controls required	Red
HIGH (H)	10-16	High Risk: High priority control measures required	Orange
MODERATE (M)	5-9	Some controls required to reduce risks to lower levels	Yellow
LOW (L)	3-4	Low Risk: Controls likely not required	Blue
VERY LOW	1-2	Negligible Risk: Risk events do not require further consideration	Green

STAKEHOLDERS

- Public and private operators of the systems or management alternatives,
- Front-line workers,
- Communities,
- Central government,
- Residential, commercial, and industrial owners or facility operators.

WASTE MANAGEMENT

Risk Exposure Evaluation

ASSET SUCEPTIBILITY

Most susceptible:

- Management
- Financial

Moderately susceptible:

- Physical
- Legal
- Reputation

Least susceptible:

- Regulatory
- Supply Chain
- Product/Service
- Response

RISK EXPOSURE RATING

Highest to lowest rating:

- Precipitation Patterns
- Greenhouse Gas Emissions increase
- Storm surge scenario based on Category one (1) thru five (5) hurricane flood
- One (1) meter sea level rise

WM Infrastructure Risk Register Results

Risk Treatment or Adaptation Measures (existing or potential)

Train emergency response personnel in site-specific risks or vulnerabilities; improve operator-response agency communication.
Improve weather prediction technology and communications.
Promote Best Available Control Technology (BACT) and Best Management Practices (BMPs) when designing, constructing, and operating Landfill Gas (LFG) systems.

WM Infrastructure Risk Register Results

Risk Treatment or Adaptation Measures (existing or potential)

Improve monitoring technology to improve statistics and projections.
Research and development opportunities in the island's solid waste industry.
Promote waste diversion by implementing Integrated Solid Waste Management (ISWM) alternatives.
Ensure no landfill expansions towards potentially affected areas are approved or built.

STAKEHOLDERS

- Public and private operators of the systems or management alternatives,
- Front-line workers,
- Communities,
- Central government,
- Residential, commercial, and industrial owners or facility operators.

WATER RESOURCES

Infrastructure Evaluated

Potable Water and Sanitary infrastructure service chain **elements** evaluated

Source: PRASA Climate Change Adaptation Plan

- Water Supply: Reservoirs, dams, outlets and wells
- Water Distribution: Potable and Waste water pipelines/ pumping stations / Tanks
- Water treatment: Water treatment plants / Waste Water Treatment Plants / Desalinization Plant (Culebra)

Water & WW Infrastructure – Impacts

Source: PRASA Climate Change Adaptation Plan

Temperature	1) reduced availability of water resources 2) lower groundwater level 3) increase on irrigation 4) greater need for consumption
Precipitation	Less annual precipitation: impact on the operation of drinking water treatment plants due to lack of raw water and could result in the closure of the same, thus causing areas and sectors with poor service or without service. Increase in precipitation: Reservoir is overfilled and a failure occurs in the dam that causes problems to drain the reservoir in a controlled manner. This would cause sudden flooding in the area and could affect nearby infrastructure of everything from pipelines, access roads to homes and shops. Flood cause high turbidity, causing the need to shut the treatment plants.
Sea Level Rise	Impacting those PRASA facilities that are located at an elevation of less than 0.5 m by the year 2050 and at 1.0 m and 2.0 m by the year 2100. The facilities located at these elevations are expected to be partially or totally flooded.
Storms & Hurricanes	1) impacts on the PRASA surface freshwater intakes and on the reservoirs used by the PRASA as water reserves. Duplication in the number of Category 5 hurricanes increases the likelihood of damage to PRASA facilities in general. 2) Reduce water storage capacity of reservoirs and increase turbidity of raw water in PRASA outlets.
Acidification	1) Results in the need to implement more advanced technology to desalinate water, which in turn would result in a greater need for capital investment. 2) Deterioration and corrosion of emissaries and pipelines for the distribution of drinking water underwater.

Water & WW Infrastructure – Adaptive Measures

Source: PRASA Climate Change Adaptation Plan

Temperature	Changes in operations to optimize available resources and the production of drinking water, among others.
Precipitation	Greater short-term precipitation events: operational and maintenance improvements to ensure that equipment operates efficiently Fewer long-term precipitation events (more droughts): 1) Operational and maintenance measures to reservoirs and basins. 2) Advanced water conservation program at both PRASA and household facilities (ie, rainwater harvesting system for toilet and plant watering).
Sea Level Rise	Setback and relocation of infrastructure on impacted areas.
Storms & Hurricanes	Operational and maintenance improvements and coordination with the Department of Emergencies of the PRASA.
Acidification	Maintenance programs to avoid the expected corrosion in the underground drinking water pipelines (Naguabo-Vieques-Culebra) and the emissaries of the sanitary water treatment plants that discharge to the sea.

MITIGACIÓN
PREPARACIÓN
RECUPERACIÓN
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COLEGIO DE INGENIEROS Y AGRIMENSORES DE PUERTO RICO
1938
COMISIÓN PARA LA ASISTENCIA EN EL MANEJO DE DESASTRES NATURALES

THANK YOU!