



From At Risk Areas to Vulnerable Communities: the Human Dimension of Coastal Management

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Research

Selected Research Projects

2010-present *Researcher*, The conundrum of development, risk, and social vulnerability to disasters in Puerto Rico: An ecological approach to Emergency Management. PhD Dissertation Research. Department of Sociology and Criminal Justice. University of Delaware.

2003-2010 *Lead Graduate Research Assistant*, “National Science Foundation Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere (CASA)”. End User Integration Thrust: Brenda Phillips, MBA (UMASS), Havidán Rodríguez Ph.D (UDEL), and Walter Díaz Rodríguez, Ph.D (UPRM).

2007 *MA Thesis*, Development, Social Vulnerability and Disasters in the West Coast of Puerto Rico: A Social Vulnerability Index. Department of Sociology and Criminal Justice. University of Delaware.

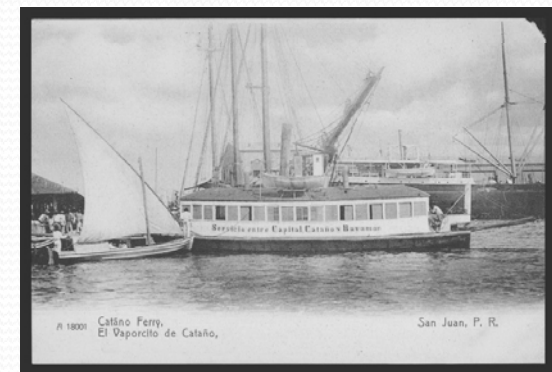
2004-2006 *Lead Graduate Research Assistant*, “Population Composition, Geographic Distribution, and Natural Hazards: Vulnerability in the Coastal Regions of Puerto Rico” Disaster Research Center, University of Delaware, Physical Oceanography Laboratory (POL) and Center for Applied Social Research (CISA), University of Puerto Rico at Mayagüez. Researchers: Havidán Rodríguez, Ph.D. (DRC), Aurelio Mercado, Ph.D. (POL) and Walter Díaz, Ph.D. (CISA)

Graduate Research Fellowship

2010-2012 *Research Associate*, Geographic Information Sciences and Technology Group (GIST), Climate Change Science Institute (CCSI), Oak Ridge National Laboratory, Oak Ridge, TN.

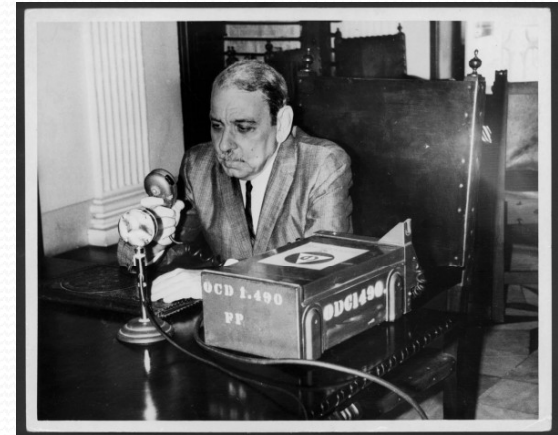
Physical Vulnerability and the Human Dimension of Coastal Management

- Inadequate planning and zoning has led to a large increase in the number of persons living in areas susceptible to storm surge, tsunami and flooding.
 - Over a million people in Puerto Rico reside in areas susceptible to flooding
- Governmental policy has also contributed to increasing physical vulnerability by allowing high-rise construction projects along coastal areas and by locating critical infrastructure in known at risk areas.



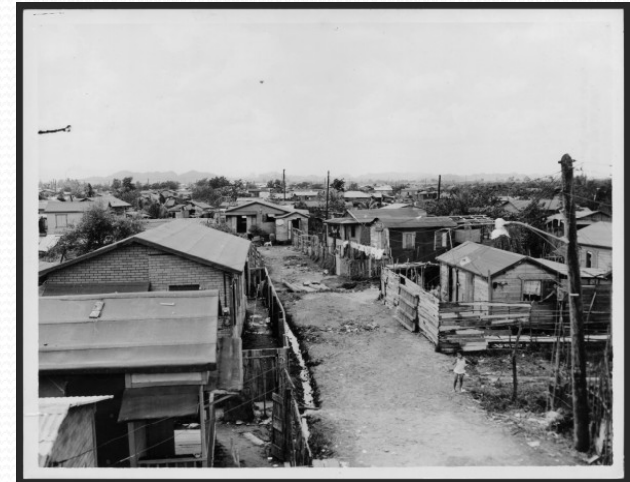
What engenders vulnerable communities?

- Amartya Sen (1999) :
Development is... “a process that enables freedom (1999:36).”
- Development often leads to vulnerability (Lewis, 1999)
- Disasters are **social processes and not events** (Oliver-Smith, 1998) and framing vulnerability as an issue of capital accumulation affords an opportunity to understand the differential impact and consequences of disasters.



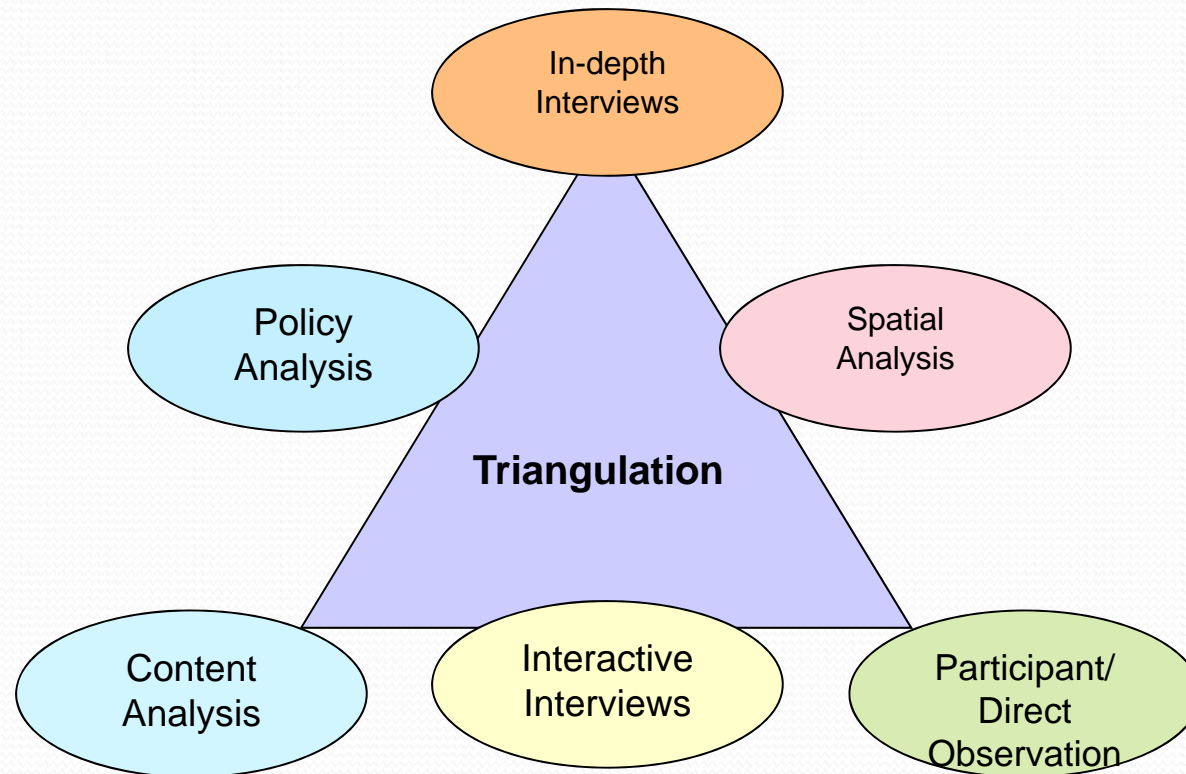
What engenders vulnerable communities?

- Vulnerability is often defined as “***the characteristics of a group and their situation*** that influence their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard; an extreme natural event or process.” (Wisner et al., 2004:11)



Triangulation: Vulnerability in Puerto Rico

The use of multiple methods of research to enhance the accuracy of the findings



Static Approach: Social Vulnerability to Coastal Hazards

“A basic need in responding to disasters is to know the characteristics of the population residing in affected areas.”¹

Research Questions ²

- How has vulnerability to disasters in Puerto Rico changed from 1990 to 2000?
- What geographic areas present a higher level of social vulnerability?

Methodology: Additive Model

$$\% \text{ VAR } X = ((X \div X \text{ Population}) \times 100)$$

	0.00 – 19.99 = 1
	20.00 – 39.99 = 2
	40.00 – 59.99 = 3
Recode % VAR X (RVAR)	60.00 – 79.99 = 4
	80.00 – 100.00 = 5

$$\text{Social Vulnerability Index} = \text{RVAR}_1 + \text{RVAR}_2 + \text{RVAR}_3 + \text{RVAR}_4 + \text{RVAR}_5 + \text{RVAR}_6 + \text{RVAR}_7 + \text{RVAR}_8 + \text{RVAR}_9 + \text{RVAR}_{10} + \text{RVAR}_{11}$$

Variables examined 1990-2000:

- Population Density
- Poverty
- Renters
- Low education
- Children
- Female Headed Households
- Unemployment
- Elderly
- Disabled population
- Lack of access to transportation
- Lack of access to phone service

¹National Research Council Committee on the Effective Use of Data, Methodologies, and Technologies to Estimate Subnational Populations at Risk, 2007

²Santos-Hernández, J. 2007. Development, Vulnerability and Disasters in the West Coast of Puerto Rico. MA Thesis. Department of Sociology and Criminal Justice, Disaster Research Center, University of Delaware.

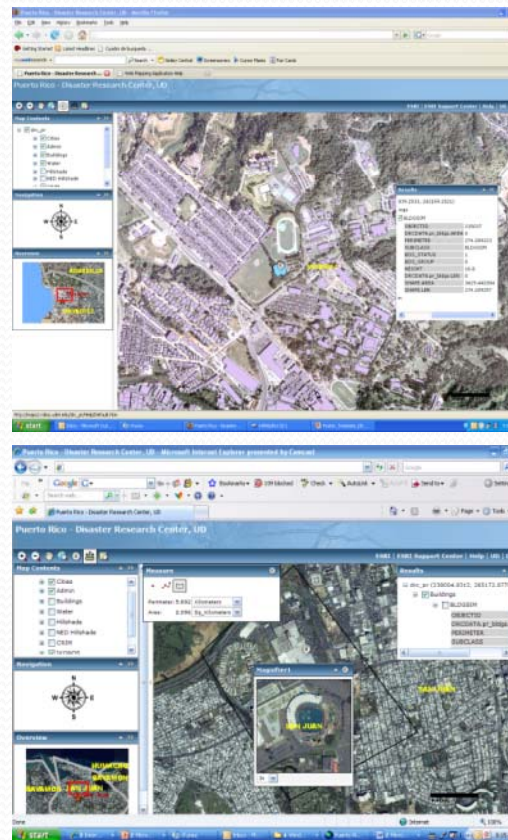
Disaster Decision Support Tool (DDST)

prddst.uprm.edu/apps/ddst

“Geospatial data and tools should be an essential part of all aspects of emergency management.”¹

Objectives

- Disseminate maps and research findings to the end-user community
- Develop a scalable risk and disaster-related geographic information platform
- Provide end users with no GIS training or access to GIS software with geographic information products that they can consume and incorporate into their decision-making in a no cost and considerably easier online application.



Spatial Information includes: Vector Layers

- Roads
- Hydrography
- Buildings Footprints
- Neighborhoods
- Coastal Barriers
- Airports
- Schools
- Hospitals
- Flood Prone Areas
- Tsunami Areas
- Storm Surge Areas
- Social Vulnerability Assessment 1990 and 2000
- Demographic and Socioeconomic Information at the municipal, tract, block group, and block (if available) levels

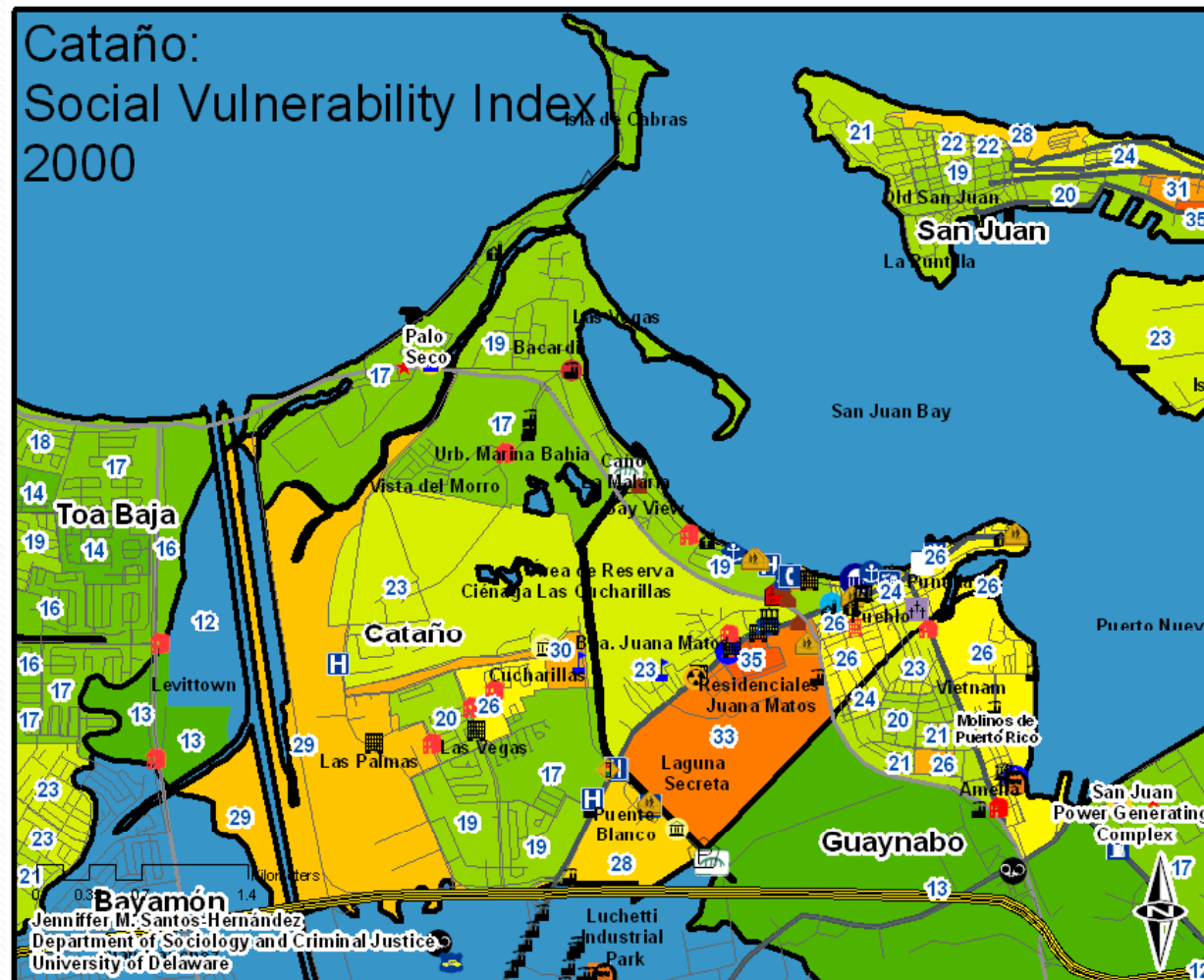
Raster Layers

- Aerial Imagery
- IKONOS
- Digital Elevation Models (DEMs)
- Hillshades

¹ National Research Council. 2007. *“Successful Response Starts with a Map”*. Washington, DC: The National Academies Press.

Puerto Rico Social Vulnerability Index

(Santos-Hernández, 2007)





From Static to Dynamic Vulnerability

- Social Vulnerability Indexes:
 - Often ignore the organizational features of disasters because they rely on demographic data
 - Fail to capture the essence of social relations which are vital to understand social vulnerability to disasters
 - Sensitivity to monitor change is a challenge

“vulnerability... involves the totality of relationships in a given social situation producing a set of conditions that render a society unable to absorb the impacts of natural or social agents without significant disruption of its capacity to fulfill the basic needs of its members.” (Oliver-Smith, 2009)



Research Questions

- What are the organizational features of emergency management in Puerto Rico? How is the governance of disasters and emergencies shared in Puerto Rico?
 1. How the historical origins of the agency have evolved over time?
 2. What are the legal mechanisms supporting emergency management in Puerto Rico and how they emerged?
 3. What is the structure of the emergency management organization in Puerto Rico?
 1. (i.e. the extent to which the organization is recognizable using Weber's approach on matters related to decision making, hiring, external politics, assumptions regarding state practices, service effectiveness)
 4. How does the current organizational structure of government in Puerto Rico shapes preparedness efforts?
 5. What disaster reduction policies are in place, the challenges they confront, and how they relate to social vulnerability? Is social vulnerability "managed"? How?

Findings: Emergency Management and Disaster Policy

- In-depth interviews with emergency managers at all levels and NWS personnel.
- Our research highlights important differences in terms of:
 - the role of emergency managers,
 - the levels of training,
 - access, preferences, and use of information sources,
 - the organizational features of the State Emergency Management Agency (AEMEAD)
 - the formation of an irrational bureaucracy



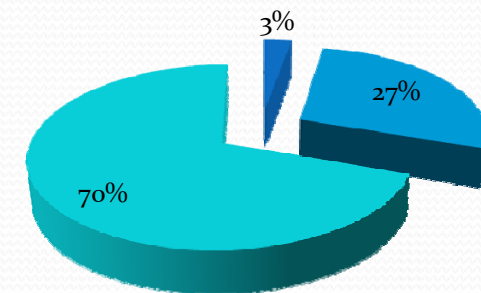
Findings

Cultural Practices:

- Shared conventions, expectations, and cultural concerns are brought to bear when making decisions (Douglas, 1992) i.e.;
- Long standing issue of unemployment
- How external political processes mediate *organizational change* (e.g. cyclical changes in the number of employees)
 - Politics in the island
 - Distributions and internal power constellations
 - Politics from outside the island
 - Increasing reliance on U.S. funds and the exportation of U.S. emergency management policies to Puerto Rico create bureaucratic irrationality as well as new forms of vulnerability (e.g. language limitations).
- Convergence of Internal and external politics
 - Discrepancy between the events perceived as more frequent, more dangerous, and preparedness efforts.

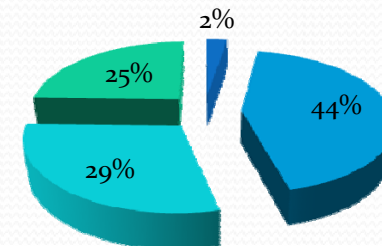
Origen de Recursos, 2002

■ Ingreso Propio ■ Fondos Federales ■ Otros Ingresos



Origen de Recursos, 2010

■ Ingreso Propio ■ Fondos Federales
■ Otros Ingresos ■ Asignación Especial

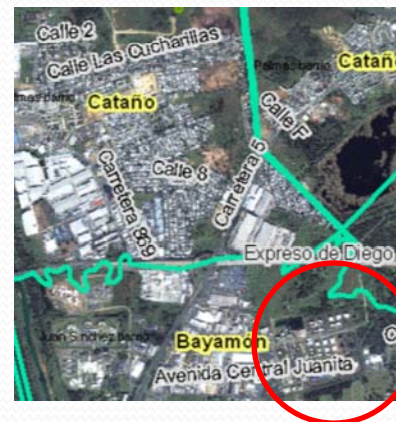


Cataño: From Risk to Social Vulnerability

- To examine the evolution of risk and social vulnerability in Cataño and the role of the municipality in Puerto Rico's development.
- Site presents an example of the integration of internal and external politics and the convergence of "natural", industrial, and environmental risks
- Caribbean Petroleum Corporation Explosion (CAPECO) – October 23, 2009



Source: University of Puerto Rico-Río Piedras Archive

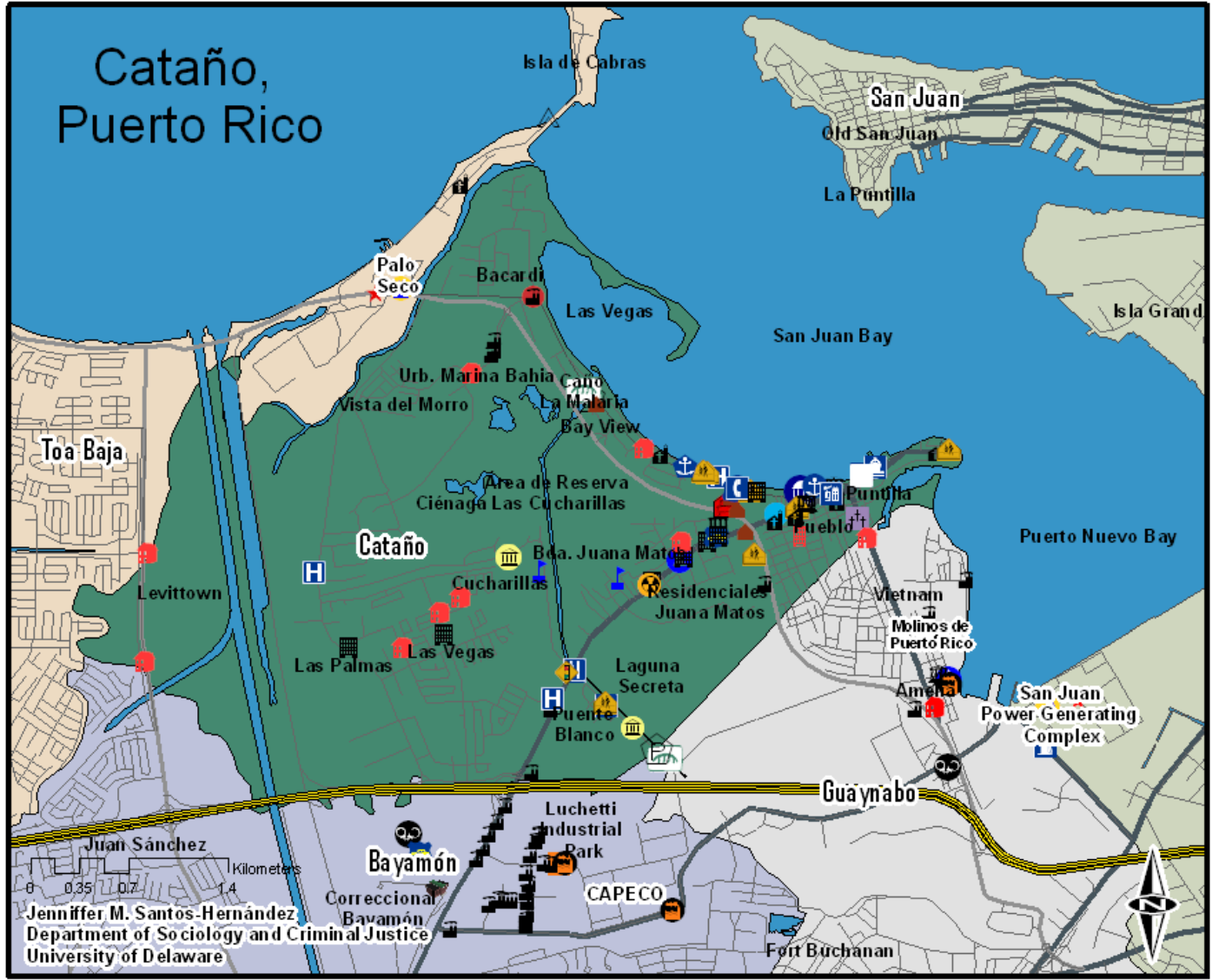


Why Cataño? Changes in Energy Storage, Production, and Distribution

- With the transition to an industrial economy there was a shift towards fossil fuels
- Cataño became a major hub in the production, storage, and distribution of energy and fuels.
- Limited emergency planning
- No evacuation routes

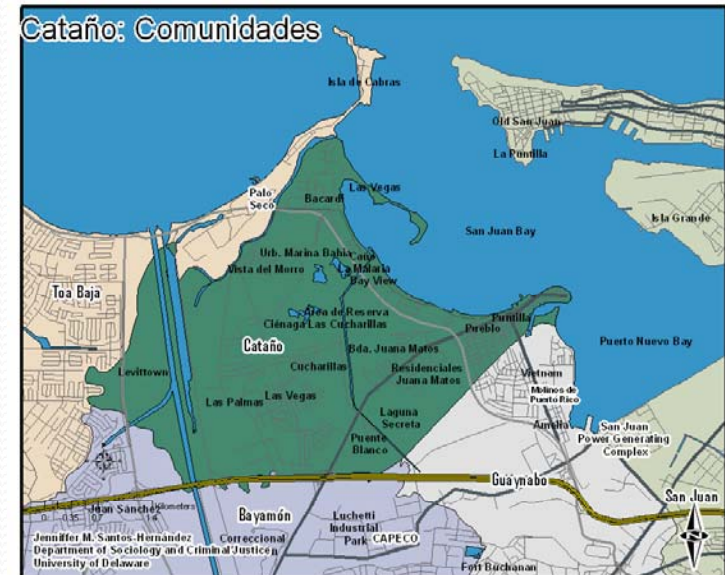


Cataño, Puerto Rico



Findings

- Themes:
 - Transportation systems and changes in land use
 - Changes in energy production, storage, and distribution
 - Soil changes
 - Community organizations
 - Community resistance to government intervention
 - Community adaptations
 - Drugs and violence
 - Long standing history of environmental and health issues (e.g. air and waterways pollution, respiratory, skin, and cancer prevalence, among others)
 - Concerns about unknown risks
 - Multiple leaders and conflicting messages
- The CAPECO explosion illustrates the pre-existing vulnerability in the region.



Findings: Changes in Population Distribution

- Area originally filled under Spain – one of the first actions after the creation of the Spanish republic
- Road and railway construction
- Channeling of the river
- Military base runway construction attempts



Findings: The 2009 Explosion

- Lack of information
- Pro-social behavior and concern for neighbors
- No alert system
- Outdated official information
- Claims of perceived as a political opportunity
- Police was in charge of the evacuation
- Multiple leaders and conflicting messages
- Current construction at CAPECO and community meetings



Concluding Remarks

- This research suggest the need to develop emergency preparedness and response plans that attend the needs of a changing population with relatively high levels of vulnerability. However, the majority of disaster scholars are not experts in bringing about massive cultural change (Aguirre, 2002: Can Sustainable Development Sustain Us)
- There is a need to develop and implement programs that increase awareness and mitigation for hazards that more frequently affect communities.



Concluding Remarks

- The need to review emergency management and disaster policies:
 - Promote individual awareness and responsibility in a context of competing priorities and limited resources,
 - Develop assessment capabilities,
 - Training to maximize the use of the technology available and reduce unnecessary costs,
 - Promote organizational learning,
 - Collaborate and provide guidance to community organizations,
 - Revise contradicting policies,
 - Standardize emergency management functions at all levels,
 - Reduce/eliminate patronage
 - Adopt and enforce a land use plan
 - Provide residents with a worst case scenario to facilitate preparedness and create awareness (Right to Know Act, 1986).



Impacts of Policy Exports



Alert Message:

***“Attention, a shooting
has been reported.
Please shelter
immediately”***

Tsunami Ready Program
Exercise –
March 28, 2012

Aguadilla, PR

Questions

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