



Integrating Equity Principles in Hurricane Mitigation: Evaluating Resource Allocation Strategies and Risk Reduction Outcomes

Gulrukh Kakar, Jingya Wang and Amanda Stoltz

Introduction

Hurricane-driven flooding and storm surge increasingly affect North Carolina, placing the greatest burdens on socially vulnerable communities. These groups often lack the resources to adapt or recover. Traditional mitigation funding, prioritizing property value and economic efficiency frequently overlooks these populations.

This research is part of the CHEER Hub, a Coastlines and People (CoPe) initiative funded by the NSF. At the center of this effort is the STARR (Stakeholder Tool for the Analysis of Regional Resilience) framework, a dynamic simulation platform designed to model how households, governments, and insurers make decisions over time in response to hurricanes and evolving policies. Unlike static tools, STARR integrates policy constraints, hazard projections, socioeconomic data, and behavioral dynamics to simulate the long-term effects of competing strategies.

By applying the STARR model to equity-centered funding scenarios, this research explores how resource allocation can be redesigned to not only reduce damages but also enhance distributional outcomes and community resilience.

Research Question

How does the incorporation of different equity priorities or the application of equity-based optimization objectives within a hurricane risk management model affect the allocation of mitigation funding and the distribution of risk reduction outcomes across communities?

Scenario Design

This research uses the STARR framework to simulate how different combinations of prioritization strategies and optimization objectives affect hurricane mitigation funding. All three objectives will be tested using mock data to assess their suitability for final implementation. Results will help determine which strategies best balance equity trade-offs with efficiency.

Matrix of Equity Principles and Optimization Objectives

		Prioritization Criteria		
		A: Status Quo (utilitarian)	B: SVI W/Race (Rawls)	C: SVI WO/Race (Rawls)
Optimization Objectives	1: Maximum Net Benefit	1A	1B	1C
	2: Minimum Risk Burden (Damage over home value)	2A	2B	2C
	3: Minimum Residence Equivalent Loss	3A	3B	3C

Anticipated Contributions

This research provides both strong intellectual merit and meaningful societal impact. It advances equity-focused disaster management by translating justice theories into actionable strategies and evaluates efficiency–equity trade-offs using simulation modeling. By focusing on a case study in North Carolina, the research generates insights applicable to other hazard-prone regions.

On a broader level, the work supports the design of more effective mitigation policies by identifying gaps in current funding systems. It demonstrates how different vulnerability metrics can influence resource allocation and offers simulation tools that help assess impacts on high-need communities. Ultimately, the research contributes a flexible framework for guiding equitable and resilient disaster investment strategies.

Evaluation Metrics

- Key metrics include;
- . Damage reduction over time
 - . Benefit per dollar spent
 - . Risk burden across tracts
 - . Equity via Gini score
 - . Funding-vulnerability match
 - . Coverage across scenarios

Acknowledgement

Gratefully acknowledging the support of Dr. A.R. Siders, Dr. Rachel Davidson and Dr. Linda Nozick. This work is supported by the NSF under the CHEER Hub project.

