Capacity, Vulnerability, and Disaster Aid: Spatial Pattern and Path Dependence in Disaster Assistance After Hurricane Helene

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Abstract

This study examines the distribution of FEMA Individuals and Households Program assistance following Hurricane Helene (2024) across 562 counties in five affected states. Using an Aid/Damage Ratio Index that links federal disbursements to American Red Cross dwelling damage assessments, we apply a two-part model to separately estimate the probability of receiving any aid and the amount received per unit of documented damage. Findings reveal that racial composition and poverty shape aid access at the program entry stage, while recent institutional experience with federal disaster systems is the strongest correlate of aid recovery among recipients. Persistent state-level gaps and a paradoxical negative association between wind exposure and aid receipt further suggest that recovery outcomes reflect procedural and structural factors beyond damage severity alone.

Introduction

Why this matters

- Disasters expose and deepen social inequities, including in federal recovery assistance.
- Prior research finds persistent disparities in FEMA aid by race, income, and geography (Emrich et al., 2020; Rivera et al., 2022; Miao et al., 2024).

Key gap in the literature

- Many studies rely on per-capita or aggregate funding measures.
- These measures often do not link aid to documented damage, making "need-based" evaluation difficult (Waters et al., 2024).

What this study contributes

- Introduces an Aid/Damage Ratio Index:
  - FEMA Individuals and Households Program (IHP) dollars
  - normalized by American Red Cross dwelling damage assessments
  - at the county level.

Case: Hurricane Helene (2024)

Analytical approach

- Two-part model across 562 counties:
  - Probability of receiving any aid → procedural equity
  - Aid per unit of documented damage → distributive equity (Rivera et al., 2022; Jerolleman et al., 2024)

What findings point to

- Recovery outcomes are shaped by institutional capacity, racial composition, and state administrative context
- Implications for improving equity and efficiency in federal disaster assistance.

Data and Methodology

Table 1: Description of Datasets & Measurements used in the study

Data type	availability unit	Data source & Measurements
Hazard Intensity	Highest Precipitation and Wind speed per county	NOAA national weather station data on wind speed and precipitation
Dwelling Units Damage Measure	Number of impacted units per County	Red Cross dwelling unit damage assessment for Helene
Sociodemographic	Race, ethnicity, income, education	Census ACS data
Helene Disaster Aid	Helene Aid Amount per county	OpenFEMA dataset for all types of disaster aid (HMA, PA, IA, etc.) with the disaster number
Disaster Response Capacity - Previous PDD record	Number of PDDs per County	OpenFEMA PDD dataset 2013-2023
Disaster Response Capacity - Previous Disaster Aid from FEMA	Number of grants per County	OpenFEMA Aid dataset 2013-2023

For each county c, the Aid–Damage Ratio Index is computed as:

$$Aid/Damage_c = \frac{\text{Total FEMA Aid}_c}{\text{Total Documented Damage}_c}$$

Where:

- Total FEMA Aid includes Individuals and Households Program (IHP), Housing Assistance (HA), and Other Needs Assistance (ONA) disbursed at the ZIP code or county level.
- Total Documented Damage is based on dwelling damage assessments provided by the American Red Cross, aggregated to the county level.

A higher ratio suggests that a community received relatively more aid per unit of damage, while a lower ratio indicates that aid provision was disproportionately low compared to damage.

Findings

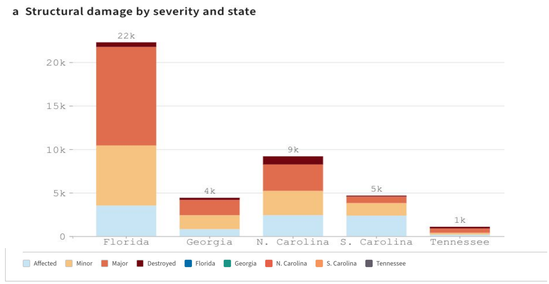
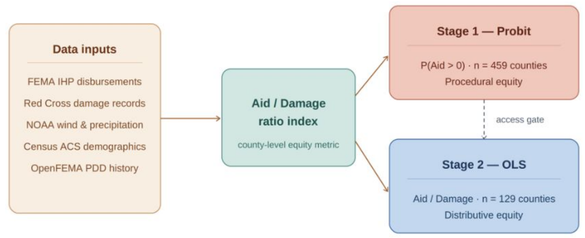
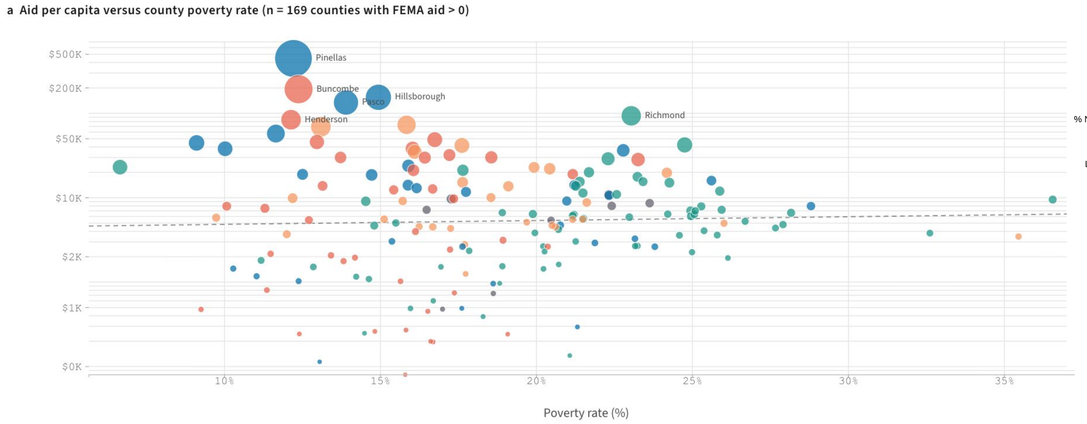
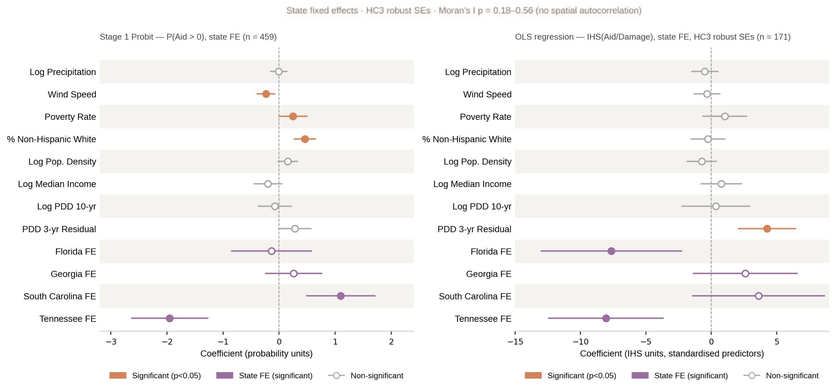


Figure 1a: State-level overview of structural damage and FEMA Aid disbursement following Hurricane Helene. a. Stacked counts of damage-assessed structures by Red Cross severity category across 467 counties. 1b. Total FEMA Aid (IHP + HA + ONA combined) by state. Florida leads absolute disbursement driven by high-density coastal counties; North Carolina receives relatively more aid versus total damage.







Access to FEMA aid after Hurricane Helene was shaped more by community characteristics than damage severity — counties with higher shares of non-Hispanic White residents and higher poverty rates were more likely to receive any aid, while among recipients, recent institutional experience with federal disaster systems was the strongest predictor of how much aid they received per unit of documented damage.

Takeaways and Application

- **Inequity operates at program entry, not allocation.** Majority-minority counties are significantly less likely to receive any FEMA assistance, but racial composition does not explain aid amounts among recipients. Outreach and application support, not formula reform, are the more promising intervention points.
- **Poverty shapes eligibility but not recovery quantity.** Low-income counties are more likely to qualify for aid but do not receive disproportionately more once enrolled, suggesting that reducing application barriers may better serve vulnerable communities than revising allocation criteria.
- **Institutional capacity supports stronger aid recovery.** Counties with recent federal disaster engagement show higher aid-to-damage ratios. Sustained investment in local emergency management capacity, especially in under-resourced jurisdictions, may improve access to federal recovery resources.
- **State-level systems are an important part of the recovery equation.** Substantial cross-state variation remains after accounting for damage severity, pointing to opportunities to strengthen administrative infrastructure, agency relationships, and community outreach at the state level.

source: shutterstock

Key References

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Acknowledgement

The authors are grateful for the help from Mr. Greg Tune at the American Red Cross in accessing Dwelling Unit Damage Assessment data. The authors acknowledge the support from Dr. Zihui (Helen) Ma (Emory University) and Dr. Songhua Hu (Hong Kong City University) with data collection. We thank Undergraduate Research Assistant Sean Olcese (Rowan University) for his help in processing the dataset.

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