

AI Agents for Long-Term Disaster Recovery

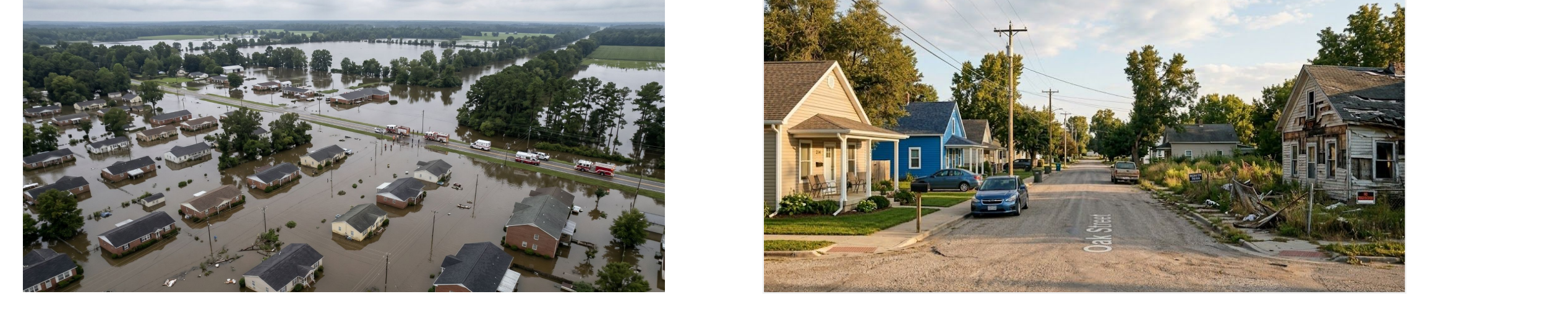
Supporting Vulnerability Assessment and Recovery Practice · A Lumberton, NC Case Study

Di Wang | University of Utah, Scientific Computing and Imaging Institute, Responsible AI Initiative | di.wang@utah.edu

The Problem

When disaster strikes, federal aid arrives quickly. But recovery takes a decade — and recovery programs, and attention move on long before communities do.

- Communities face:**
- Federal aid ends in 18–24 months — recovery takes a decade
 - No system tracks community conditions after programs close
 - The most vulnerable fall further behind, out of sight

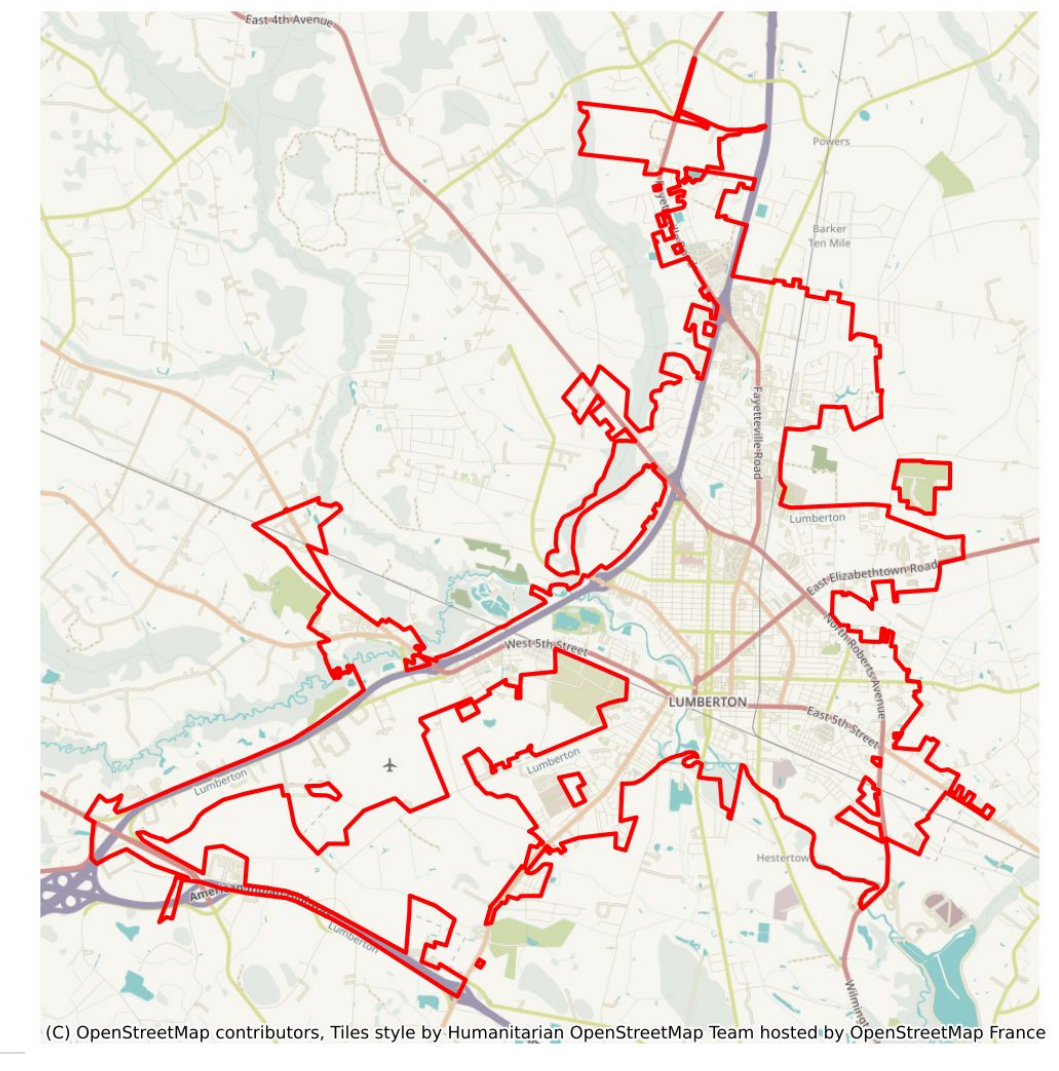


Case Study — Lumberton, NC

Deeply vulnerable before the first storm:
35% poverty, \$17,500 per capita income, 70% minority population (2015)

Two floods, no gap to recover:
Matthew (Oct 2016), then Florence (Sep 2018) before Matthew assistance closed

Eight years on: no strong recovery signal:
Population ~13%, housing burden unchanged, hardest-hit area: poverty 29%→42%



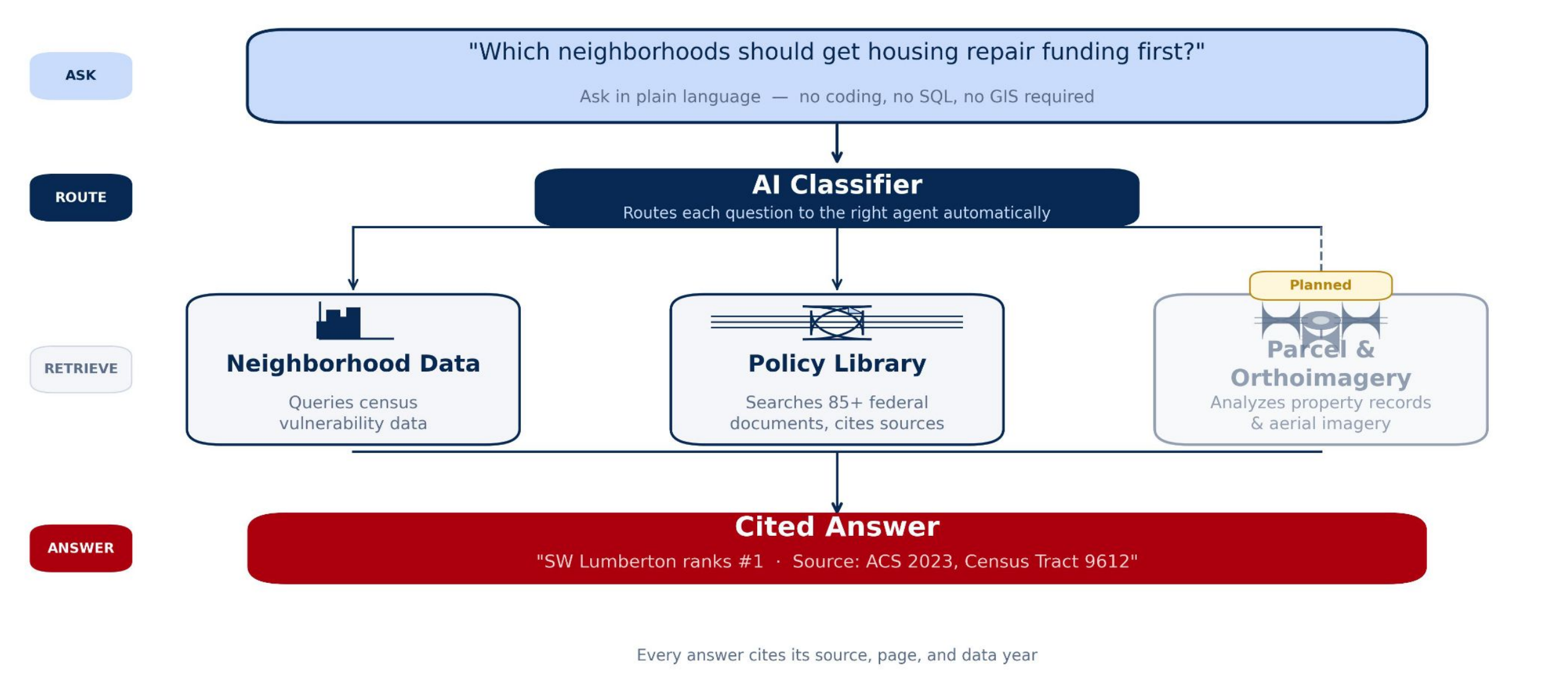
Research Goal

Goal: Democratize Access to Recovery Information with AI
Recovery knowledge is fragmented across dozens of federal agencies, technical databases, and policy documents — creating barriers for everyone who needs it.

- Ask policy questions in plain language — without reading 85+ federal documents across Federal Emergency Management Agency (FEMA), the Department of Housing and Urban Development (HUD), the Economic Development Administration (EDA) & 12+ agencies
- Identify highest-need neighborhoods — without mapping software or database skills
- Track who has and hasn't recovered — using real local data, with every answer cited to its source

How the AI System Works

Decision-makers face a common bottleneck: the data exists, but accessing varying data sources is challenging. This system removes that barrier. A planner types a question in plain English; the AI routes it to the right data source and returns a cited, source-traceable answer.



A hybrid classifier routes each question automatically — no commands, no syntax, no technical knowledge required.

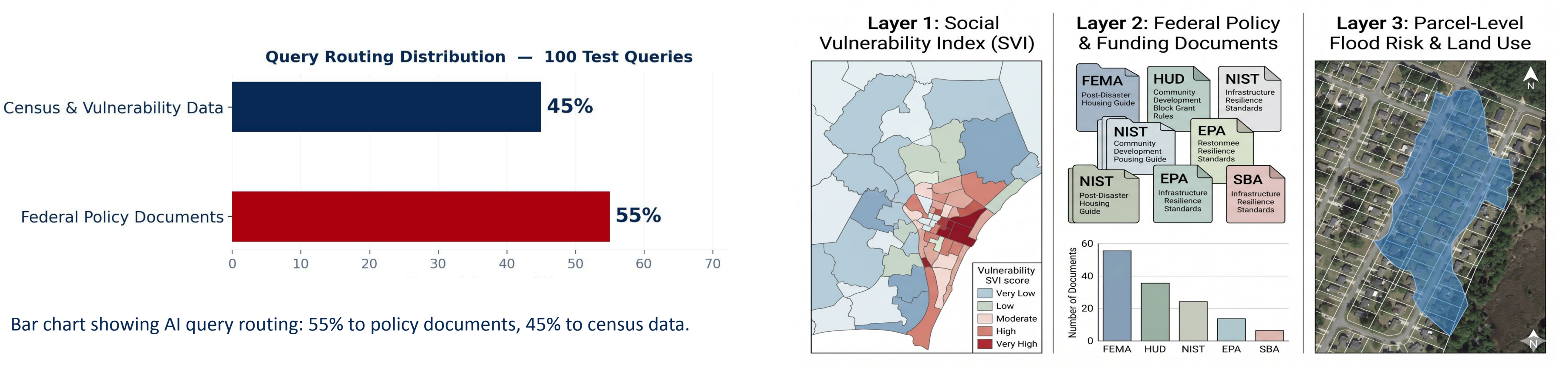
Acknowledgments: This work is conducted at the University of Utah. The author thanks the Natural Hazards Workshop community and recovery partners for their contributions to this research.

Data Foundation

Census Vulnerability Data
American Community Survey (ACS) vintages (2015–2024) · 17 Robeson County tracts
50 Social Vulnerability Index (SVI) indicators (poverty, housing burden, unemployment, disability, mobility)

Policy Corpus — 85+ Official Documents, 352 Records
FEMA (29) · National Institute of Standards and Technology (NIST) (21) · HUD (16) · 12+ agencies
5 authority tiers from binding federal regulations to recommended practice · Full disaster lifecycle coverage

Image and Geospatial (On-going)
Parcel records · FEMA flood zones · National Agriculture Imagery Program (NAIP) pre/post imagery · OpenStreetMap building footprints



Pipeline vs. General AI — Why Grounding Matters

A general-purpose AI can answer recovery questions — but without access to local data or authoritative documents, its answers are not verifiable. This system grounds every response in real census records and official federal policy, making outputs auditable and actionable.

General AI	This Pipeline
<p>Q1: Which neighborhoods in Lumberton should get housing repair funding first?</p> <p>✗ Communities with high poverty and housing damage are typically prioritized. Areas with low-income households and significant flood impact should be considered first.</p>	<p>✓ Southwest Lumberton ranks #1 — 64.3% of residents below 150% of the federal poverty level, 39.4% of households spending more than 30% of income on housing, median home value \$74,100. Source: ACS 5-year estimates, Census Tract 960801, 2023.</p>
<p>Q2: How has housing affordability changed in Downtown Lumberton since Hurricane Matthew?</p> <p>✗ Recovery programs typically reduce housing cost burden over time as households stabilize and federal assistance takes effect.</p>	<p>✓ Housing cost burden in Downtown Lumberton improved from 34.2% in 2015 to 23.5% by 2021 — a positive recovery signal. But poverty rebounded to 31.4% in 2023 (near its post-Matthew peak), while median home values jumped 24% in two years (\$125,600 in 2021 → \$155,800 in 2023) — a displacement risk signal. Source: ACS 5-year estimates, Census Tract 960900, 2015–2023.</p>
<p>Q3: What share of beneficiaries must be low-income for a Community Development Block Grant (CDBG)-funded project to qualify?</p> <p>✗ CDBG programs generally require that activities primarily benefit low- and moderate-income people, though the exact threshold may vary by activity type and state guidelines.</p>	<p>✓ At least 51% of persons benefited must be low- and moderate-income (at or below 80% of area median income). The service area must be primarily residential and meet threshold. Source: 24 Code of Federal Regulations (CFR) Part 570 Subpart I, p.10.</p>
<p>Q4: Can a household receive both FEMA individual assistance and CDBG-DR housing repair funds?</p> <p>✗ Generally, households should not receive duplicate assistance for the same need. However, FEMA and CDBG-DR serve different purposes, so it may be possible to receive both depending on the situation.</p>	<p>✓ Yes, but only for unmet needs. Federal law prohibits duplication of benefits (Stafford Act §312). Community Development Block Grant–Disaster Recovery (CDBG-DR) covers costs not reimbursed by FEMA, insurance, or Small Business Administration (SBA) — grantees must document the gap. Source: Stafford Act (2019), p. 28; FEMA IA Program Guide v1.1, p. 18.</p>

Scalability

Designed to generalize — deploying for any US jurisdiction requires adding the census data and policy corpus, with no changes to core architecture.

Geographic — any US jurisdiction with ACS coverage (all 73,000+ census tracts)

Corpus — policy library can be extended with state, county, or program-specific documents

Data agents — new agents (damage assessments, permit records, utility data) plug into the existing pipeline

Applications

- 1 For practitioners in the field**
- Quickly screen neighborhoods for program eligibility
 - Answer household-level questions about program options during intake
 - Pull regulatory requirements on demand during grant writing

- 2 For researchers and planners**
- Track recovery trajectories across census vintages for any jurisdiction
 - Compare vulnerability trends before and after a disaster event
 - Identify which populations are falling behind after programs close

- 3 For policy and program design**
- Audit whether recovery investments reached the most vulnerable tracts
 - Surface gaps between where federal programs were active and where need persisted
 - Build evidence base for future CDBG-DR allocation arguments

Contributions

Modular multi-agent pipeline — routes natural language recovery questions to census, policy, or geospatial agents with no coding required

Authority-tiered policy corpus — 85+ federal documents across 12+ agencies, ranked by normative force and lifecycle phase for citation-verified retrieval

Longitudinal multi-domain vulnerability dataset — Census data (2015–2024) across SVI indicators to enable tract-level recovery monitoring unavailable from any single federal source

On-going Tasks & Future Goals

Geographic Information System (GIS) Agent (next priority):

Parcel records and flood zones	NAIP imagery indexed as Cloud Optimized GeoTIFFs	Remote sensing damage proxies
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Multi-community rollout:
Replicate to disaster-affected jurisdictions across NC; validate routing accuracy across diverse recovery contexts.

Practitioner dashboard:
Map-based interface for tract-level vulnerability rankings, policy citations, and parcel overlays.

Live Demo & Feedback

This system is under active development.

Scan to share what recovery questions matter most to your work.

Tried it? Share what worked, what didn't, and what recovery questions matter most to your work. Your feedback directly shapes the next version.

Interested in piloting this system for your community or research? We'd love to hear from you.

Contact Information

Di Wang, Postdoc
di.wang@utah.edu
University of Utah
Scientific Computing and Imaging Institute
Responsible AI Initiative

Divya Chandrasekhar, Associate Professor
d.chandrasekhar@utah.edu
University of Utah
Department of City & Metropolitan Planning

Natural Hazards Workshop 2026
Poster Presentation

Seeking collaborators from recovery practice, policy, and research — and communities interested in piloting the system. Feedback from practitioners is especially welcome.