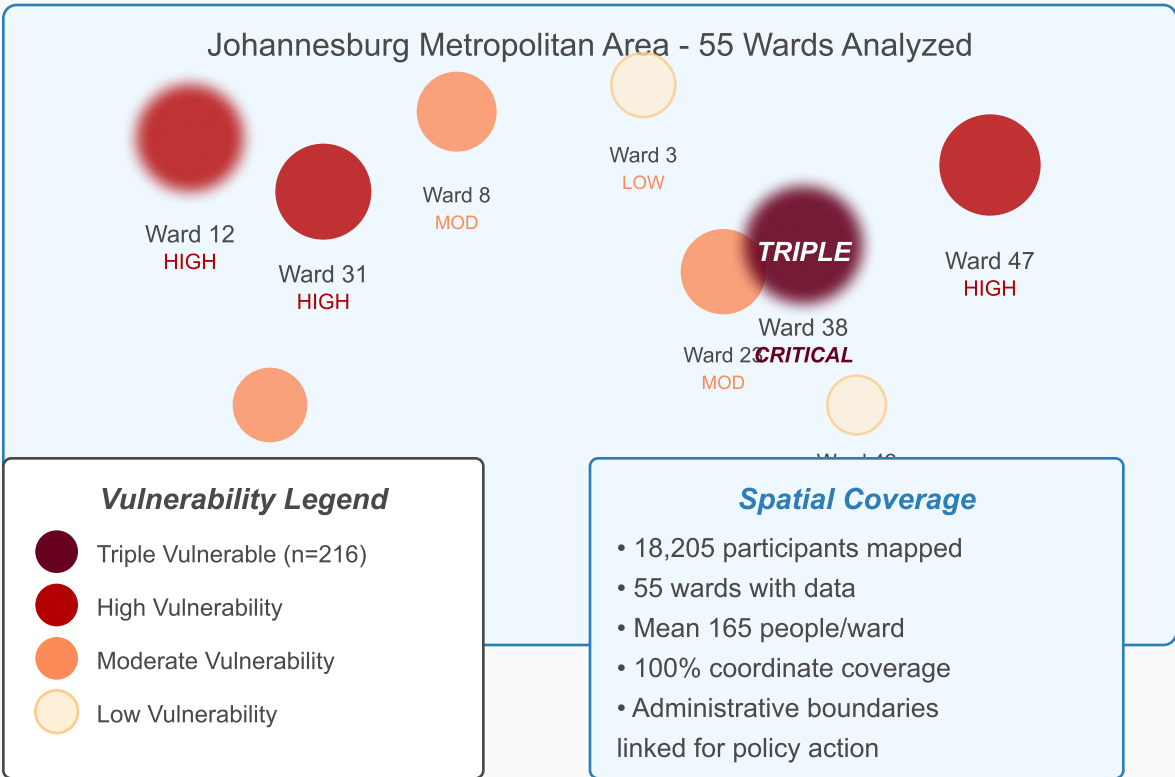


Figure 3: Spatial Vulnerability and Environmental Justice Analysis

Panel A: Johannesburg Ward-Level Vulnerability Hotspots

Spatial Distribution of Climate-Health Vulnerabilities



Panel B: Environmental Justice Demographics

Triple Vulnerability Crisis: 216 Individuals at Compound Risk

Triple Vulnerability Definition

- Simultaneous exposure to:
- High heat exposure (top 33% of population)
 - High socioeconomic vulnerability (top 33%)
 - Poor health outcomes (hypertension or diabetes)

Severe Demographic Disparities in Triple Vulnerability

Race/Ethnicity Disparities

Black: 75.6% 2.4× over
Asian: 2.3% 16.8× over
White: 0.19% under

Severe Racial Inequality
(Population baseline %)

Gender Disparities

Female 50.5%
1.8× overrepresented

Male 49.5%
2.4× overrepresented
(vs population baseline)

Environmental Justice Evidence: $r = 0.100$, $p < 10^{-42}$
Economic vulnerability significantly correlates with climate exposure (n = 18,205)

Panel C: Climate Exposure Inequality Patterns

Heat Exposure by Socioeconomic Indicators

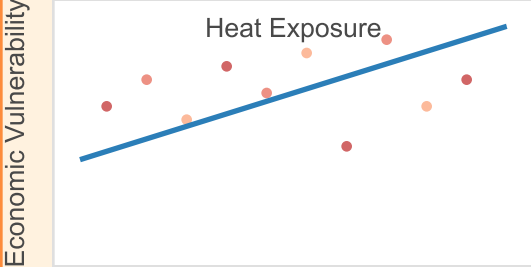
Education Level Effects

No formal	15.46°C	n=981
Some primary	15.47°C	n=1,962
Primary done	15.47°C	n=1,717
Some secondary	15.49°C	n=1,057

Pattern: Lower education
→ slightly higher exposure

Evidence quality: MODERATE

Economic Vulnerability-Heat Correlation



$r = 0.100$, $p < 10^{-42}$

Strong evidence of climate injustice

Environmental Justice Documentation

Evidence of climate injustice: Economic vulnerability correlates with heat exposure
Compound vulnerabilities: 216 individuals face triple risk burden
Demographic disparities: Severe overrepresentation in vulnerable populations
Policy urgency: Immediate targeted interventions required for equity

Panel D: Intervention Priority Mapping

Evidence-Based Intervention Priority Framework

Priority 1: IMMEDIATE

(0-6 months)

- Emergency interventions
- Triple vulnerable support
- Budget: ZAR 8-15M

Priority 2: SHORT-TERM

(6-18 months)

- Monitoring systems
- Community planning
- Budget: ZAR 60-120M

Priority 3: MEDIUM-TERM

(18 months-5 years)

- Health system integration
- Economic justice programs
- Budget: ZAR 100-200M

Priority 4: LONG-TERM

(5-10 years)

- Legal framework
- Regional leadership
- Sustainable financing

Implementation Success Indicators

- Reduction in economic vulnerability-climate exposure correlation
- Decrease in triple vulnerability prevalence (<1% target)
- Elimination of demographic disparities in climate health burden