

Resilient İzmir: Seismic Risk and Urban Systems Vulnerability Assessment

Executive Summary Presentation (ToR T10)

İzmir Disaster Resilience Advisory Team

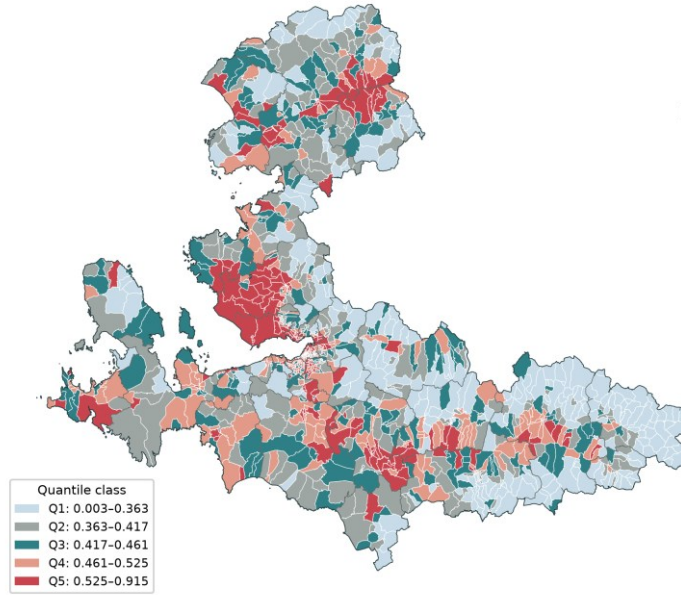
1. Introduction and Project Framework

Resilient İzmir: Urban Vulnerability and Systems Assessment

- **Objective:** Apply a tiered screening and spatial decision-support methodology to assess earthquake and cascading multi-hazard risks across İzmir.
- **Scope:** Macro-screening across 1,317 neighbourhoods (Tier A) and high-priority deep dive across 3 focal districts—Bayraklı, Bornova, and Konak (Tier B).
- **Institutional Setup:** Coordinated by AFAD (Disaster and Emergency Management Presidency) and the World Bank; integrated with İzmir Metropolitan Municipality GIS data.

2. Why İzmir? Multi-Hazard Profile & 2020 Lessons

Provisional hazard
Neighbourhood | EPSG:5253 | exploratory non-final



- **Tectonic Setting:** High seismic hazard driven by the İzmir Fault, Gülbahçe, Seferihisar, Tuzla, and Menemen active fault systems.
- **October 30, 2020 Samos–İzmir Earthquake:** Although the epicentre was over 70 km away, deep alluvial basin amplification caused 117 fatalities and heavy damage to 739 buildings in Bayraklı and Bornova.
- **Multi-Hazard Drivers:** Strong ground motion compounded by coastal liquefaction susceptibility, potential tsunami wave inundation, and slope instability in hilly settlements.

3. Tiered Methodology & Multi-Criteria Decision Framework

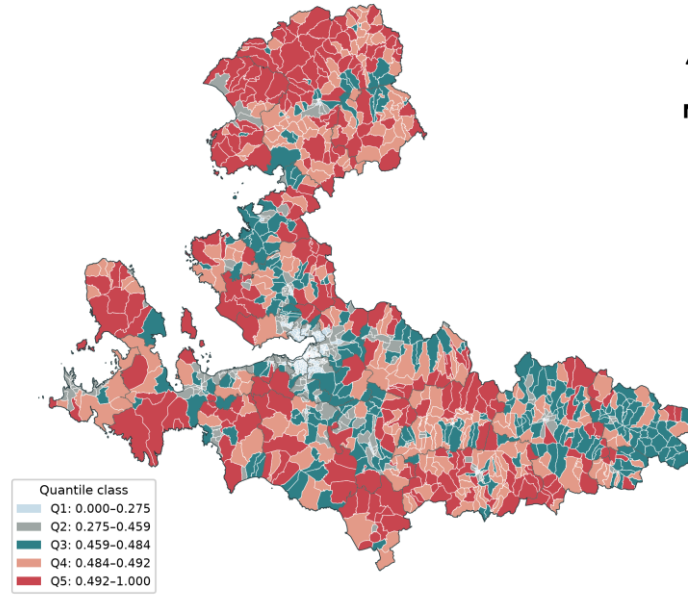
- **Tier A (Metropolitan Screening):** Comprehensive comparative ranking of all 30 districts and 1,317 neighbourhoods across 5 resilience dimensions.
- **Tier B (Focal Deep-Dive):** Building-level structural vulnerability assessment protocol designed for Bayraklı, Bornova, and Konak.
- **F-BWM (Fuzzy Best-Worst Method):** 15-expert interdisciplinary panel weights:
 - Hazard (H): 22.6%
 - Structural Vulnerability (S): 19.7%

4. Data Reality & Evidence Grading

- **Grade A (Official Authoritative GIS Layers):**
 - İzmir Metropolitan Municipality 1,317 neighbourhood polygons and address points.
 - 207,257 road centreline segments and 7,530 green space polygons in EPSG:5253.
- **Grade B (Proxy and Derived Indicators):**
 - TurkStat 2023 neighbourhood population (preserving 513 disclosure-suppressed units).
 - SRTM / ALOS DSM elevation and slope; USGS/Global Vs30 ground stiffness proxy.
- **Grade C / Critical Data Gaps (AEAD Formal Request List):**

5. Lifeline & Transport Network Vulnerability

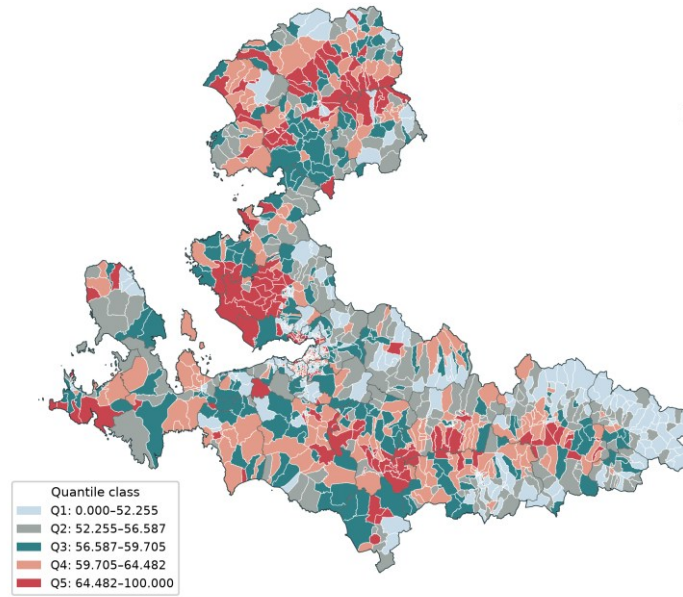
Provisional network
Neighbourhood | EPSG:5253 | exploratory non-final



- **Network Topology:** 149,798 nodes and 207,257 edges analysed with 1 m endpoint tolerance; 517 connected components identified.
- **Single Points of Failure (SPoF):** Narrow coastal and rail-adjacent choke points (especially Konak–Alsancak and Bayraklı–Turan) threaten to sever metropolitan connectivity under structural collapse.
- **Accessibility Analysis:** 5, 10, and 15-minute reachability buffers mapped for 71 designated assembly areas; inner hillside neighbourhoods show acute pedestrian deficits.

6. Spatial Priority Map (Priority Index Hotspots)

Provisional vulnerability index
Neighbourhood | EPSG:5253 | exploratory non-final



- **Spatial Autocorrelation (LISA):** Statistically significant ($p < 0.05$) high-risk clusters (High-High) identified via Local Moran's I across 1,317 neighbourhoods.
- **Robustness Check:** 126 core hotspot neighbourhoods remain stable across both Queen contiguity and KNN-8 spatial weight matrices.
- **Getis-Ord Gi* Hotspots:** $Z > +2.58$ concentrations clearly highlight the combination of soft alluvial soils, dense building footprints, and evacuation bottlenecks.

7. Priority Zones & Dominant Drivers

- **Zone 1: Bayraklı – Bornova Basin**
 - *Drivers:* Deep alluvial basin amplification + pre-1999 multi-storey reinforced concrete buildings + high population density.
- **Zone 2: Konak – Karabağlar Historic Core**
 - *Drivers:* Narrow street geometry prone to debris blockage + high density of vulnerable stone/masonry buildings + shelter deficits.
- **Zone 3: Karşıyaka – Çiğli Coastal Strip**
 - *Drivers:* Severe liquefaction susceptibility + shallow water table + potential tsunami inundation risk.
- **Zone 4: Menemen – Kemalpaşa Industrial & Transport**

8. Action Strategies: No-Regret & Quick-Win Measures

- **No-Regret / Quick-Win Packages:**
 - *Assembly Area Standardisation:* Equipping 71 primary open spaces with autonomous water, solar microgrids, and satellite communication.
 - *Arterial Corridor Protection:* Establishing building set-back enforcement ($\geq 1.5 \times$ street width) and debris clearance routing along vital routes.
 - *Shared GIS Resilience Clearinghouse:* Deploying an inter-agency spatial data platform connecting AFAD, İzmir Municipality, and utilities.
- **Structural Interventions:**

9. Feasibility & Rapid Economic Assessment

- **5-Dimensional Feasibility Index:**
 - Technical feasibility, financial cost-effectiveness, institutional mandate clarity, social acceptability, and environmental impact ($F_i \in [0,100]$).
- **Triple Dividend Framework:**
 1. *1st Dividend:* Direct avoidance of lives lost, injuries, and structural reconstruction costs during earthquakes.
 2. *2nd Dividend:* Unlocking economic productivity, investment security, and property value stability during non-disaster times.
 3. *3rd Dividend:* Co-benefits from green open spaces, stormwater drainage, and enhanced everyday public transit corridors.

10. Phased Investment Roadmap

- **Phase 1 (0 – 6 Months) / Immediate Actions & Data Finalisation:**
 - Formalise data-sharing protocols with AFAD for Tier B structural building attributes.
 - Eliminate bottlenecks on emergency corridors and install standardized signage at all 71 assembly sites.
- **Phase 2 (6 – 18 Months) / Infrastructure & Network Hardening:**
 - Seismic retrofitting of key bridges, flyovers, and lifelines along the Gulf transport axis.
 - Install autonomous backup water and solar microgrid units at

11. Strategic Disaster Resilience Recommendations

- **Inputs to the İzmir Urban Disaster Resilience Strategy:**
 - Adopt the neighbourhood-level Priority Index as the spatial foundation for the Municipal 2025–2029 Strategic Investment Plan.
 - Align municipal and utility capital expenditure (İZSU, GDZ Electricity, İzmirgaz) with designated spatial hotspots.
- **Dynamic Risk Monitoring System:**
 - Institutionalise the automated Python GIS analytics pipeline (`resilient_izmir`) for annual indicator updates using TurkStat and building registry data.
 - Establish a formal spatial data agreement and open-access metadata catalog.

12. Thanks & Contacts

Resilient İzmir Study Team

- **Contact:** `resilient.izmir@afad.gov.tr` | `project-desk@worldbank.org`
- **Repository:**
`C:\Users\YE\PyCharmMiscProject\resilient_izmir`

Disclaimer & Visibility:

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