Climate Risk Assessment of Urban Mobility in Tirana

Regional Climate Partnership
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Implemented by

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This Climate Risk Assessment (CRA) provides a rigorous, data-driven evaluation of the current and projected climate risks threatening the urban mobility ecosystem of Tirana, Albania. Developed under the regional project "Green Agenda: Climate Change Adaptation in the Western Balkans," implemented by GIZ, this report establishes the empirical evidence base required to integrate climate resilience directly into Tirana's local climate action planning, future Sustainable Urban Mobility Plan (SUMP) updates, and municipal capital infrastructure procurement frameworks.

Project Context

Funded by the German Federal Ministry for Economic Cooperation and Development (BMZ) and spanning six Western Balkan countries (2024–2026), this regional initiative aims to accelerate the implementation of the Green Agenda. The project focuses on improving decision-making foundations, boosting regional knowledge sharing, and implementing scalable climate adaptation strategies specifically within the agriculture and urban transport sectors.

Disclaimer

The findings, interpretations, and conclusions expressed in this report are entirely those of the authors and do not necessarily reflect the official views or policies of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, its commissioning federal ministries, or any other public or private entity mentioned herein.

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EXECUTIVE SUMMARY

This Climate Risk Assessment (CRA) provides a rigorous, data-driven evaluation of the current and projected climate risks threatening the urban mobility ecosystem of Tirana, Albania. Developed under the regional project Climate Change Adaptation in the Western Balkans (WB Adapt) implemented by GIZ, this report establishes the empirical evidence base required to integrate climate resilience directly into Tirana's local climate action planning, future Sustainable Urban Mobility Plan (SUMP) updates, and municipal capital infrastructure procurement frameworks.

Tirana combines a rapidly growing urban core, a high reliance on private motorized vehicles, and an expanding public transit network. Its topographically constrained basin location, paired with extensive surface sealing, constrained river corridors, and rapid runoff from surrounding hillsides, severely limits natural water absorption and exacerbates heat retention. These baseline environmental conditions make Tirana highly climate-exposed, with risks directly impacting the safety, comfort, and reliability of daily movement patterns.

The assessment strictly follows the risk-based methodological framework outlined in the GIZ Climate Risk Sourcebook (2023), utilizing the standard core risk paradigm:

$$\text{Risk} = \text{Hazard} \times \text{Exposure} \times \text{Vulnerability}$$

To ground the risk profile in local, empirical evidence, the framework normalizes and integrates multi-source geospatial, climatic, and socio-demographic indicators into a standardized five-class scoring system (20% increments) across three core pillars:

- Hazard Identification: Derived from the Western Balkans Climate-Proofing Platform (historical baseline 1981–2010), IGJEUM datasets, and Copernicus ERA5 urban downscaling. Long-term climate projections are modeled under the high-emissions RCP 8.5 scenario up to the year 2100.
- Spatial Exposure Mapping: Processed in a GIS environment by overlaying calculated climate hazard layers over transport network vectors provided by Tirana Municipality (including 504.93 km of roads/pedestrian networks, 62 km of cycling lanes, and 469 bus stops in the urban area).
- Vulnerability Metric Integration: Rooted in the 2023 INSTAT Population and Housing Census, tracking populations with reduced physiological or socio-economic adaptive capacity to withstand transit disruptions.

The analytical results identify specific structural and operational vulnerabilities across Tirana's transport network, categorized by their systemic risk levels:

Critical Tier: Urban Heat Islands (UHI) & Extreme Heatwaves

Extreme summer heat waves intersect with intense UHI effects to form the city's most critical mobility threat. Driven by a regional warming trend of 0.40.6°C since the 1980s, approximately 60 – 75 days per year currently exceed 30°C, projected to reach 90–110 days/year by late century under RCP 8.5.

Spatial analysis confirms that 30–40% of the dense built-up core experiences elevated thermal amplification. Physical exposure mapping tracks deep vulnerabilities located within high heat zones:

- 100% of tunnels and underpasses,
- 93% of traffic signaling systems,
- 88% of parking surfaces,
- 76% of cycling routes.

This causes asphalt softening and rutting along high-volume arterials, drops active transit safety, and triggers mechanical breakdowns or air conditioning overloads across the public transport fleet (48.8% route exposure).

Moderate Tier: Pluvial (Urban) Flooding & Precipitation Extremes

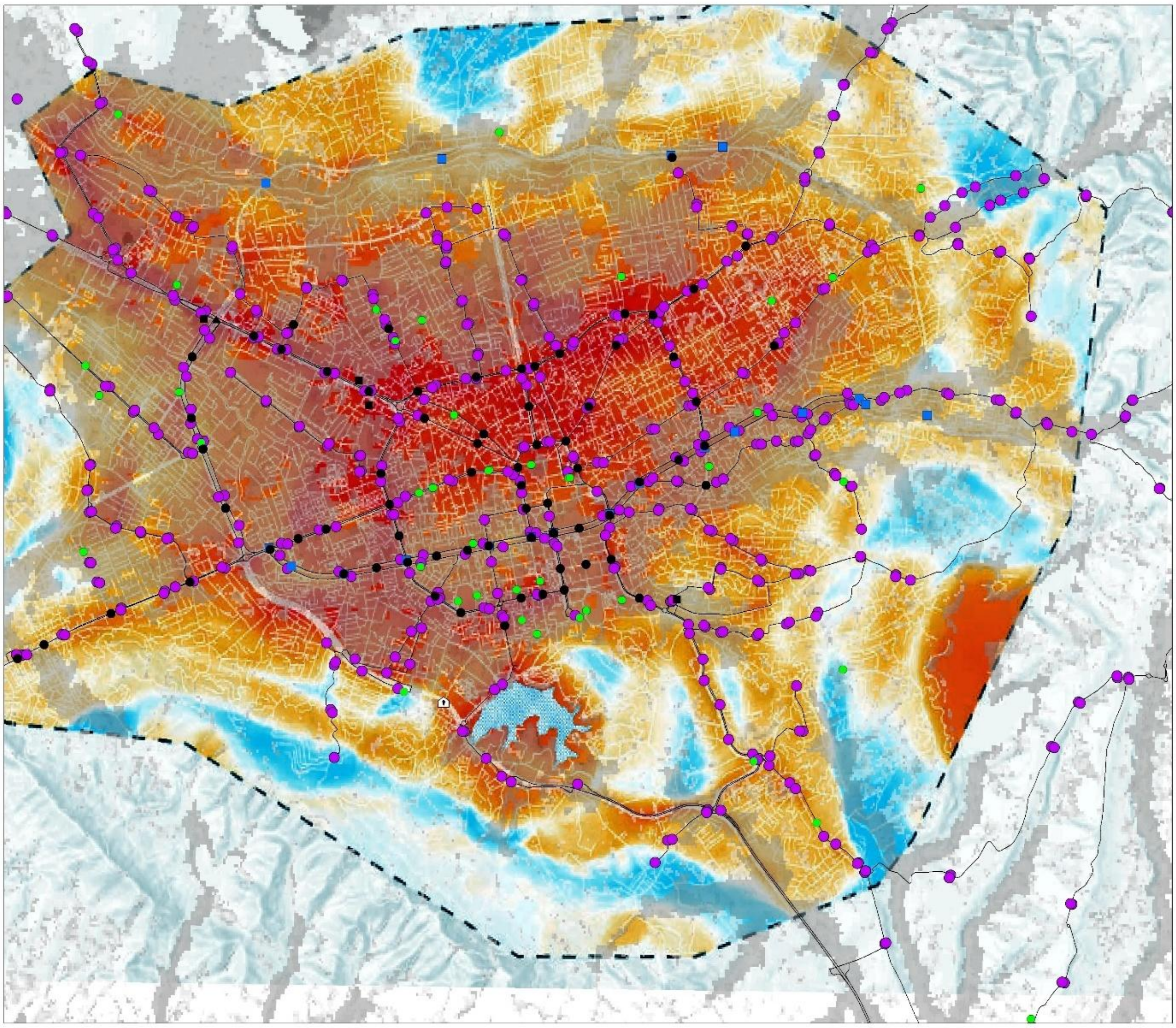
While total annual precipitation remains highly variable (1,100-1,300 mm), short-duration, high-intensity cloudbursts frequently overwhelm the urban drainage network. Under the RCP 8.5 pathway, the contribution of extreme daily rainfall events (99.9th percentile) is projected to increase to 7-9% of the annual total, and events exceeding 20 mm/day will expand to 15-29% of all rainy days. High surface sealing creates localized pluvial flooding sinks along key intersections and underpasses, causing temporary grid lock, vehicle stalling, and severe safety hazards for non-motorized users.

Localized Strategic Tier: Riverine Flooding

Riverine flooding linked to the Lana and Tirana rivers affects a geographically limited (0.5% of roads and public transport routes) but operationally sensitive portion of the mobility system. Channelization, heavy sedimentation, and historical urban encroachment make these corridors highly reactive to extreme precipitation. One structural road bridge (5.3% of municipal spans) and 2% of cycling paths are directly exposed, threatening strategic connectivity, emergency access, and logistics routing during peak discharge events.

To shift from reactive maintenance to proactive climate risk management, Tirana must prioritize green infrastructure, including expanding tree canopies, constructing bioswales, and replacing heat-exposed asphalt parking lots with permeable pavers to maximize natural water filtration and lower intense urban heat. Concurrently, the municipality must mandate climate-resilient engineering standards by specifying heavy-duty HVAC systems for public transit fleets, deploying cool pavement technologies, and establishing an integrated IoT environmental monitoring database to secure the city's networks against escalating weather anomalies.

Figure 1. Map of urban mobility components and climate hazards



TIRANA PROFILE

The Climate Risk Profile for Tirana City is based on a combination of national, regional, and city-specific climate assessments and policy documents referenced throughout this report.

Baseline climate conditions are further informed by Albania's national meteorological and hydrological datasets (IGJEUM)[1], Copernicus ERA5[2] data, and the Heat Watch Albania campaign[3], which offers high-resolution observations of urban heat island (UHI) intensity and air quality patterns across Tirana's neighbourhoods. Strategic planning documents such as

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[1] https://www.geo.edu.al/
[2] https://cds.climate.copernicus.eu/datasets/reanalysis-era5-single-levels?tab=overview
[3] World Bank & GFDRR (2023). Heat Watch Albania: Urban Heat Mapping Campaign: https://documents1.worldbank.org/curated/en/099052825225387202/pdf/P177209-930133c5-204d-445e-968b-150cbfdd9e44.pdf

the Green City Action Plan (GCAP)[4], the Sustainable Urban Mobility Plan (SUMP)[5], and the Updated Vulnerability Assessment and Adaptation Action Plan for Tirana[6] provide essential contextual information on land use, transport infrastructure, population distribution, and existing climate pressures.

Baseline Environmental and Air Quality Context

The Municipality of Tirana features a Mediterranean climate, sitting within a topographically constrained basin framed by the Dajti Mountain to the east and rolling hills to the south. Rapid urban expansion over the past three decades has largely replaced the basin's former agricultural soils with dense built-up surfaces, reducing natural infiltration and increasing pressure on local water management and runoff dynamics. The city core relies on a network of green and blue spaces (including the Grand Park of Tirana, linear river corridors, and neighborhood parks) to support urban biodiversity, though ongoing densification challenges the integration of these ecosystems.

Ambient air quality remains a core environmental and public health challenge, displaying significant diurnal and spatial fluctuations driven by vehicular traffic and urban form. Mobile measurements collected during recent monitoring campaigns (Heat Watch Albania[7]) show that median fine particulate matter ($PM_{2.5}$) concentrations hover between 10 μg/m^3 and 16 μg/m^3. While median values fall within a moderate range, peak localized exposure values reach up to 465 μg/m^3 during morning rush hours along heavily congested transport arteries with minimal tree cover, such as rruga Dritan Hoxha and rruga Kongresi i Manastirit. These localized pollution hotspots create severe respiratory hazards for sensitive individuals, such as children, the elderly and active commuters, nagivating the outdoor mobility network.

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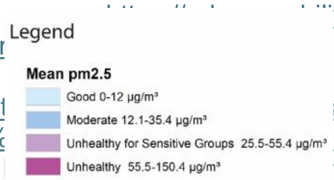
4 https://www.ebrdgreencities.com/assets/Uploads/PDF/Tirana-GCAP.pdf

5 ty-observatory.transport.ec.europa.eu/resources/case-studies/sump-city-tir



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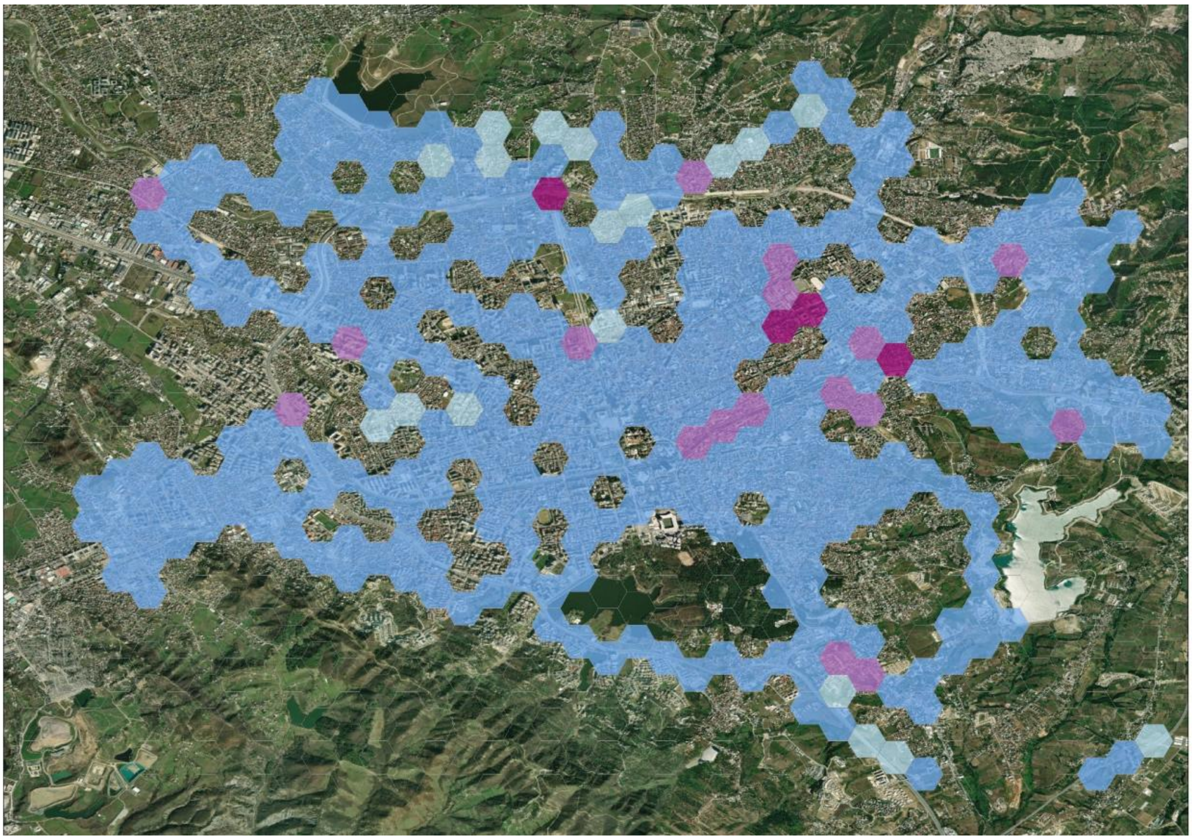
7 n/stories/0acc8804f35e4ca9b907bb93e0f1d11c

Figure 2. Map of PM2.5 averages



Demographic and Social Vulnerability Matrix

Populations with reduced physiological or socio-economic adaptive capacity face heightened exposure risks during transit disruptions. According to the INSTAT 2023 Population and Housing Census data, the demographic profile of Tirana reflects a highly dynamic urban population with clear pockets of socio-economic and structural vulnerability. The Municipality of Tirana has a population of 598,176 inhabitants (as of 18 September 2023). Of these, roughly two-thirds live within the urbanized metropolitan core, while the remainder are spread across semi-urban and rural administrative units. Population growth continues to be driven by rural-to-urban migration, internal mobility from other regions, and the city’s concentration of employment and education opportunities.

Figure 3. Land-use map for the Municipality of Tirana

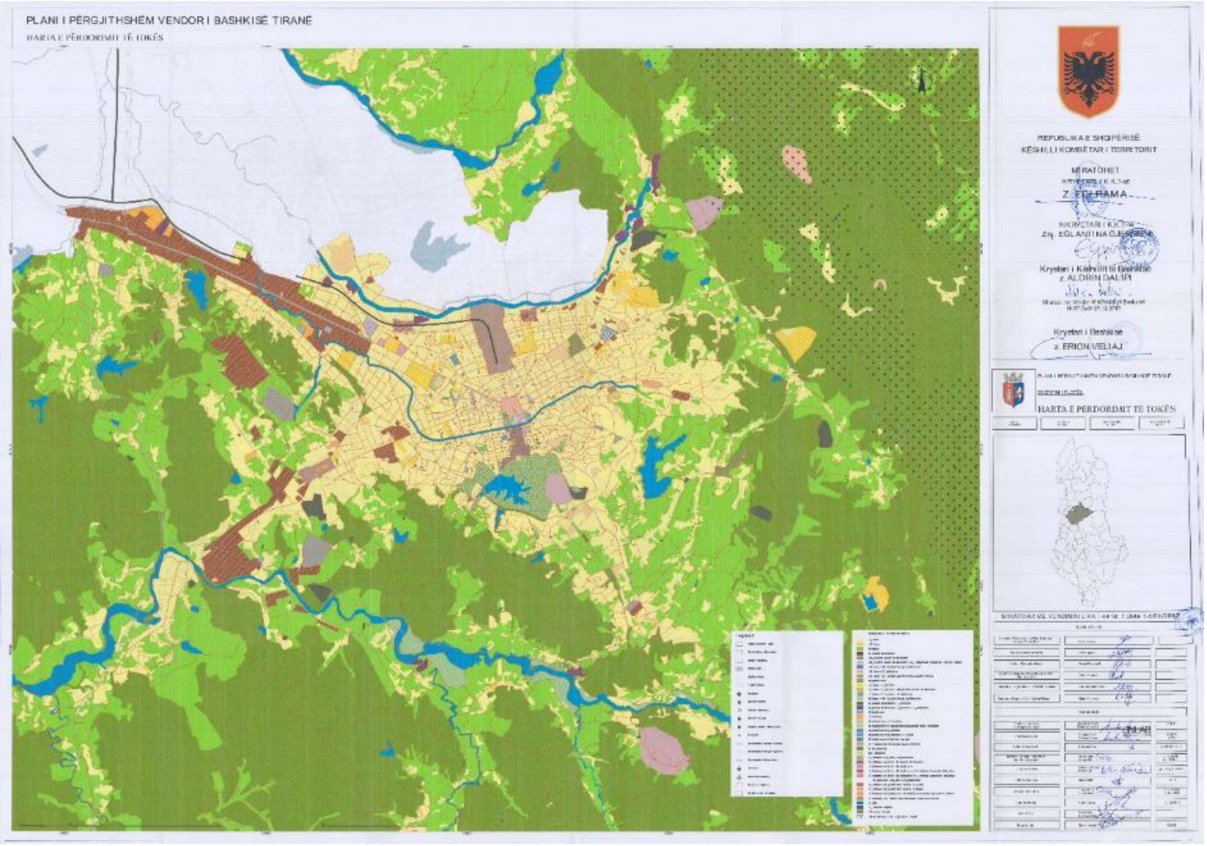


Figure 4. Map of bus routes and population density

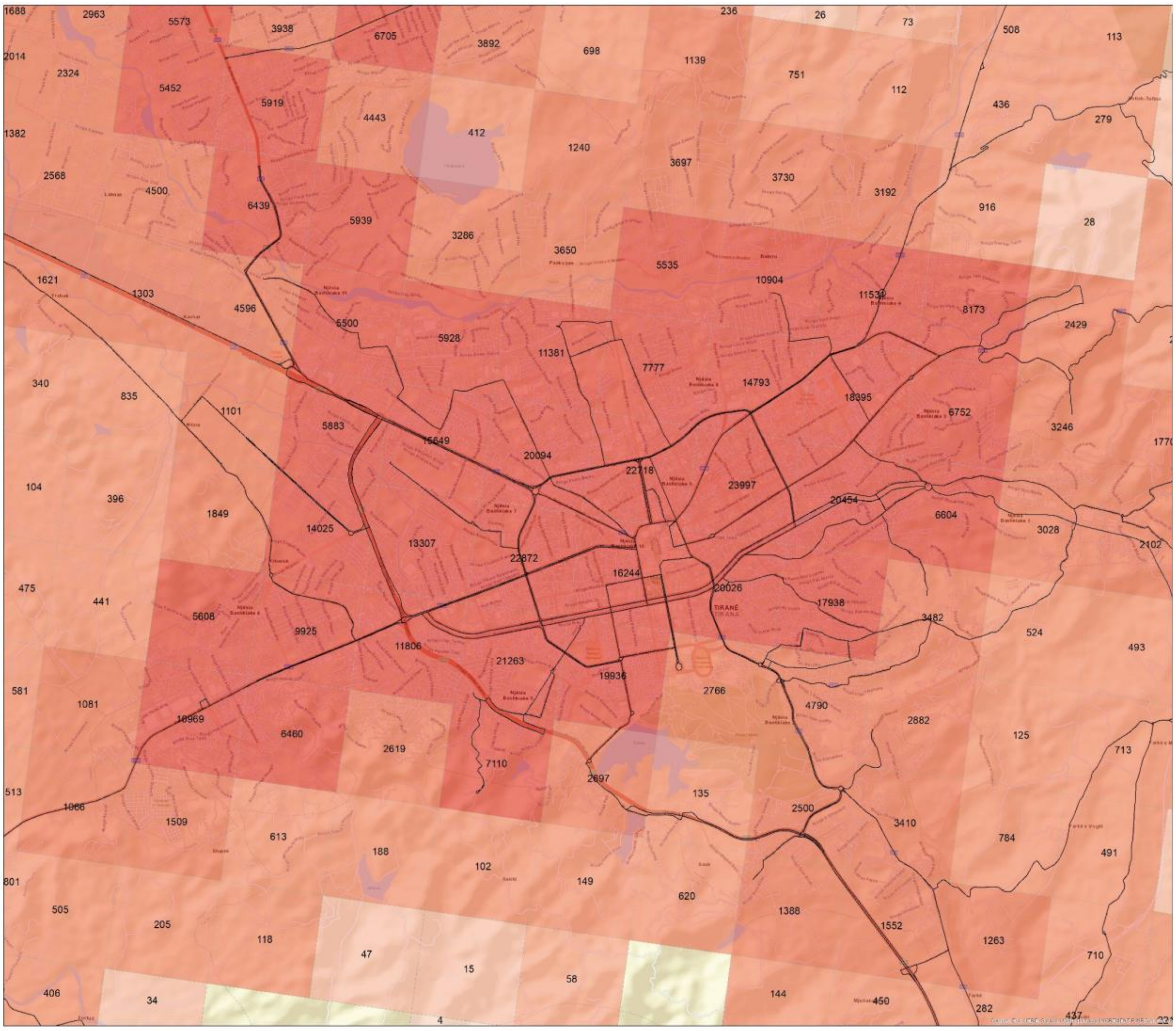


Table 1. Social vulnerability indicators for the Municipality of Tirana

Indicator	Estimated % (Tirana)	Basis for estimate (attached sources)
Elderly population (65+)	13–14%	Tirana has a younger age structure than most prefectures; national share of 65+ is ~13.8% in 2023, with Tirana slightly below the national average due to in-migration of working-age population[8]
Children population (<14)	16–17%	Census 2023 data show declining child shares nationally; Tirana follows an urban demographic pattern with lower fertility than rural areas

[8] https://www.instat.gov.al/media/1582/population_ageing_situation_of_elderly_people_in_albania.pdf

Low-income households	14–17%	Census 2023 reports a national at-risk-of-poverty rate of **19.7%**; urban areas and Tirana perform better than the national average, with poverty concentrated in specific household types
Population with chronic illness	12–15%	Chronic illness prevalence rises sharply with age; urban areas show slightly lower prevalence than rural but increasing exposure due to ageing and environmental factors; consistent with INSTAT ageing and health analysis
Single-parent households	7–9%	Census household structure data indicate higher prevalence of single-parent and single-adult households in Tirana compared to other regions, linked to migration and urban living patterns
Disabled population	6-8%	Disability prevalence is lowest in Tirana compared to other prefectures (below 5%), but absolute numbers remain high due to population size; based on Census/LSMS disability profile using Washington Group methodology[9]
Informal settlements	8–12%	Census and planning analyses indicate informality is spatially concentrated in peri-urban administrative units (e.g. Kamëz, Kashar, parts of Laprakë), rather than citywide; figure reflects households in informal or semi-formal housing areas

Transport and Modal Split

Tirana’s mobility framework is characterized by a radial road network that channels traffic from peripheral links toward the historic core centred on Skanderbeg Square and Boulevard Dëshmorët e Kombit. The city's registered fleet has swelled to 307,839 vehicles, creating intense pressure on street capacity and generating peak-hour delays. Non-motorized transport and public transit remain highly critical, with walking and bus transit combined accounting for over 60% of daily trips according to the Sustainable Urban Mobility Plan (SUMP) baseline. Private cars represent roughly one-third of motorized trips, driven by rising incomes and rapid peri-urban expansion.

The city’s public transport infrastructure consists of 15 urban lines utilizing 243 buses (including 3 electric and 42 hybrid vehicles) and 17 peri-urban lines with 125 vehicles, serving approximately 80 million passengers in 2025. Active mobility is supported by 62 km of cycling lanes and 12 km of dedicated public transport lanes. Bicycles show expanding utility, as evidenced by 1.59 million crossings recorded between January and September 2025 across four automated municipal counters. The need for better traffic management is evident: the city currently monitors 76 signalized intersections (with 12 more planned) and 71 traffic cameras, but data integration and adaptive control remain limited. Despite these investments, structural issues remain widespread: buses are routinely delayed by mixed-traffic congestion, and active mobility infrastructure faces discontinuities and frequent vehicle encroachment.

[9] https://www.instat.gov.al/media/3706/profili_i__personave_me_aft_si_t__kufizuar_n__shqip_ri.pdf

Figure 5. View of a recently upgraded street (Ismail Qemali)

Two main terminals, South-North and South-East at TEG, are being developed to strengthen intercity and regional connectivity.

The city also operates 3,100 taxis (4+1), including 1,883 electric and 146 hybrid vehicles, and provides 120 electric charging stations, reflecting its gradual shift toward low-emission mobility.

Strategic Direction of the Sustainable Urban Mobility Plan (SUMP)

The Tirana Sustainable Urban Mobility Plan (SUMP) outlines an integrated framework to transition the city toward a low-emission, multimodal, and climate-adaptive transport network by 2030. Key priorities include:

- **Multimodal Corridors:** Redesigning major radials with dedicated bus priority lanes, continuous protected cycle tracks, and tree-lined pedestrian buffers.
- **Public Transport Modernization:** Optimizing network routing, scaling up fleet electrification, and rolling out smart ticketing and real-time passenger information displays.
- **Active Mobility Infrastructure:** Expanding the cycling network, implementing low-speed "School Streets," and expanding pedestrianized public zones.

- **Smart Traffic & Parking Management:** Regulating parking through integrated pricing and off-street facilities, while deploying adaptive traffic signals across the city's 76 monitored intersections.

CLIMATE HAZARD DEEP-DIVE AND EXPOSURE METRICS

Based on observed meteorological trends and downscaled climate projections, landslide risks are localized primarily to the peripheral Dajti foothills, leaving the urban core exposed to three primary climate hazards: Extreme Heat/UHI, Pluvial Flooding, and Riverine Flooding.

Table 2. Hazard profile for the Municipality of Tirana

EXTREME HEAT & UHI		
% of days exceeding average summer temp	70%	WB-CCP data shows the majority of summer days exceed the historical baseline mean (24–26°C).
% of days exceeding heat threshold (≥30∘C)	20%	Approximately 60–75 days per year exceed 30∘C based on historical maximum readings.
% of city area with elevated UHI	40%	High surface temperature anomalies concentrated inside dense built core and major asphalt links.
URBAN FLOODING		
% annual heavy rainfall contribution	6–7%	Cloudbursts (99.9th percentile) deliver 90–125 mm daily accumulations in short windows.
% of rainfall events exceeding 20 mm/day	12–15%	High-intensity storms concentrated in autumn-winter seasons.
RIVER FLOODING		
% peak river discharge increase	5–10%	Observed flow surges along Lana and Tirana river channels during extreme downpours.
% of city area in river flood-prone zones	15%	Flood exposure concentrated along the Lana corridor and northern low-lying districts.

Urban Heat Island and Extreme Heatwaves

Climate Trends and Projections

Tirana features a clear warming signal, with mean annual temperatures rising by approximately 0.4-0.6°C since the 1980s. By mid-century (2036-2065), annual mean temperatures are projected to increase by 1.5-2.0°C under a moderate emissions scenario (RCP 4.5) and by 2.2-2.8°C under high-emissions pathways (RCP 8.5). Toward the end of the century, summer warming could exceed 4.0°C. This long-term trend will dramatically increase the frequency of hot days (above 30°C) from the current baseline of 60-75 days/year up to 90-110 days/year, accompanied by persistent tropical nights (above 20°C) that restrict nocturnal cooling.

National projections from Albania's Fourth National Communication on Climate Change indicate a substantial increase in the frequency and duration of heatwaves, with hot days (≥35°C) becoming significantly more common and tropical nights (≥20°C) increasingly persistent during summer months. For Tirana, where night-time cooling is already constrained by dense construction and limited ventilation, rising minimum temperatures are particularly critical. The WB Climate-Proofing Platform graphs show minimum and mean temperatures increasing in parallel, reducing nocturnal cooling and reinforcing UHI effects.

Table 3. Quantified Hazard Indicators for Extreme Heat & Urban Heat Islands (UHI) in Tirana

Indicator	Quantification (Current State)	Projection (RCP 8.5 scenario)	Source
% of days exceeding heat threshold (≥30°C)	60–75 days/year (≈ 16–20% of the year)	**≈90–110 days/year** (≈ **25–30%** of the year) by mid- to late century; upper-percentile years may exceed **110 days/year**	WB-CCP Observation: *"Heat days (30°C)"* for Tirana grid cells
% of days exceeding average summer temperature	**≈50–70% of summer days** exceed the historical average summer temperature (≈24–26°C)	**≈70–85% of summer days** exceed the historical average, indicating prolonged and near-continuous above-average heat conditions	WB-CCP *"Average temperature"* observations and projections
% of city area with elevated UHI	**30–40%** of the dense built-up urban area shows elevated surface temperatures (≥5–6°C contrast), concentrated in the central core and western districts	**≈40–50%** of the built-up urban area likely to experience ≥5–6°C surface temperature contrast, with expansion and intensification of UHI hotspots	Heat Watch Albania 2023; urban heat mapping for Tirana

Spatial Extents and Urban Hotspots

Thermal remote sensing and high-resolution observation from the Heat Watch campaign confirm a pronounced UHI profile. Built districts exhibit marked temperature anomalies compared to the surrounding rural baseline. The strongest UHI signatures are concentrated within the historical core (Skanderbeg Square, Boulevard Dëshmorët e Kombit, Zogu I Boulevard), major transport arteries (Rruga e Durrësit, Unaza e Madhe, Bulevardi i Ri), and peripheral industrial/expansion zones (Kombinat, Laprakë). Continuous asphalt, high building density, and vehicular heat emissions create severe microclimatic hotspots, whereas the Grand Park and river corridors serve as cooling zones.

Mobility Asset Exposure Metrics

Spatial analysis calculates the percentage of specific urban mobility assets situated directly within high land surface temperature hazard zones (27-34°C).

Table 4. Quantified Exposure Indicators for Urban Heat Islands and heatwaves for Tirana urban area

Elements	Unit	Total Asset	Affected Asset	Percentage of Affected Assets
Nr of tunnels	number	1	1	100.00%
Number of underpasses	number	1	1	100.00%
Nr of traffic lights	number	71	66	93.00%
Number of parking spaces (including parking lots and on-street parking)	m²	56775.3	49940	88.00%
Nr of EV charging stations	number	42	32	76.20%
Length of cycling roads	km	50	38	76.00%
Nr of bus depots	number	4	3	75.00%
Nr of road bridges	number	19	11	57.90%
Length of public transport routes	km	462.9	225.7	48.80%
Railway Length	km	13	5.3	40.80%
Number of bus stops	number	1717	594	34.60%
Length of the road network	km	504.93	154	30.50%
Length of walking roads (total of sidewalks and pedestrian areas)	km	504.93	154	30.50%

Figure 6. Urban mobility elements exposed to UHI

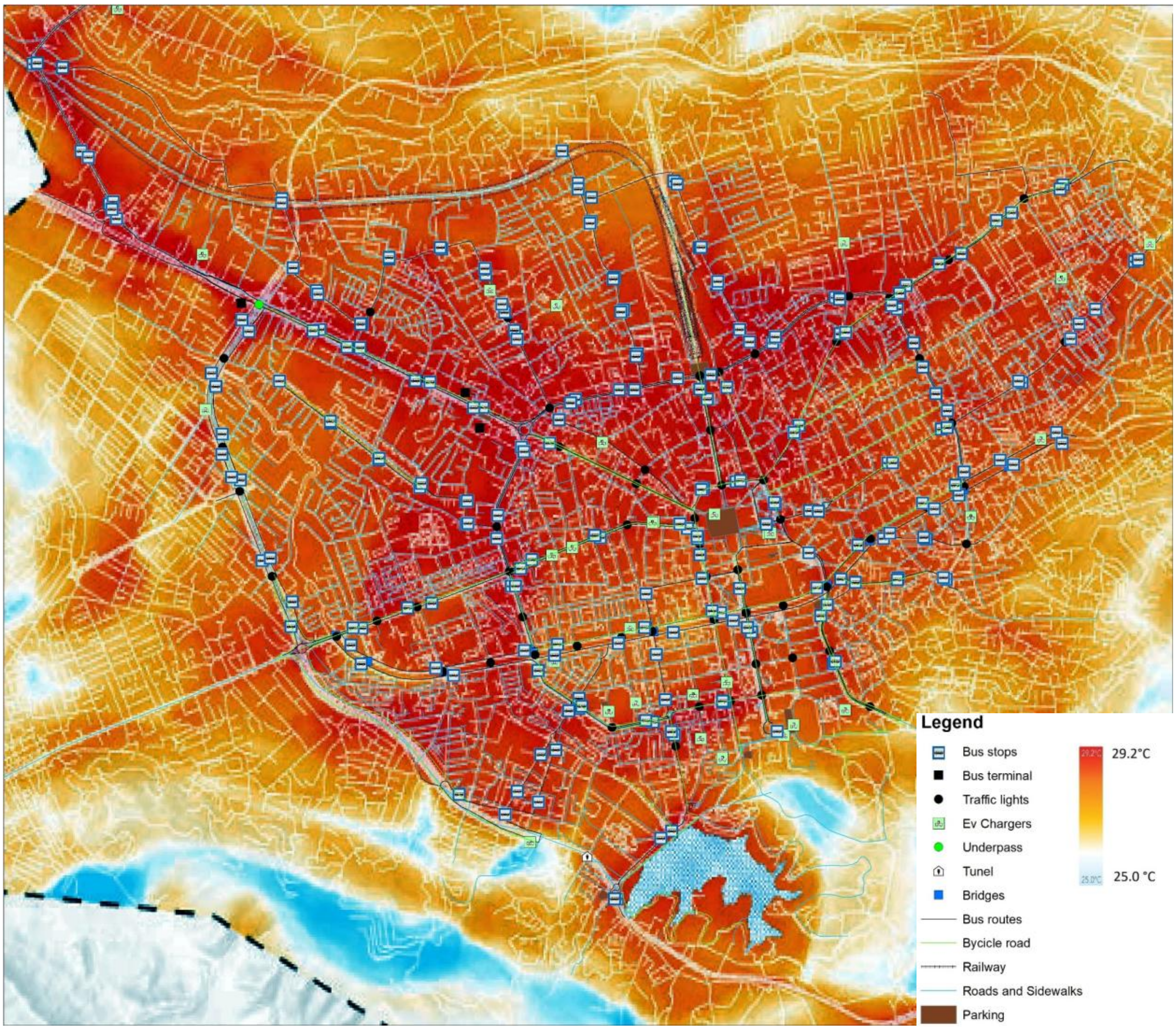
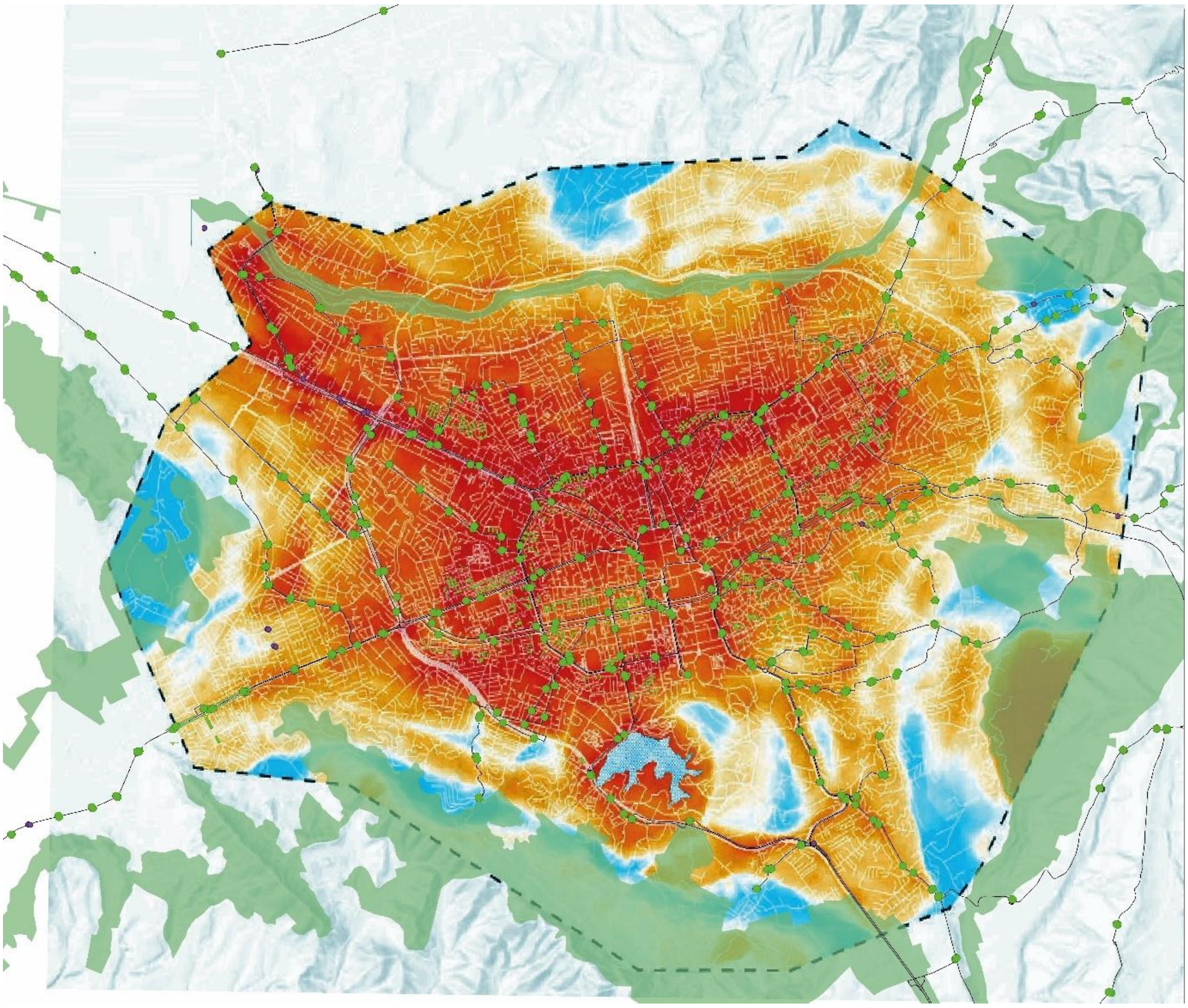


Figure 7. Map of bus stops and parks overlaying urban heat findings



Systemic Mobility Risk Analysis

- **Logistics & Microclimatic Loops**: Parking infrastructure is highly exposed, with **88% of parking surfaces situated in high-heat zones**. These large asphalted surfaces absorb radiant energy, raising vehicle interior temperatures and increasing fuel consumption and emissions from air conditioning at startup. Logistics fleets operating through heat-prone corridors experience reduced vehicle performance and accelerated tire wear.
- **Active Mobility Deterioration**: Active transit faces severe challenges; **76% of cycling tracks and 30.5% of walking corridors sit within high-heat anomalies**. Central pedestrian zones and wide paved boulevards lack continuous tree canopies, exposing non-motorized users to solar radiation and heat exhaustion, which undermines modal-shift objectives during summer.
- **Public Transit Operational Failures**: **Nearly half (48.8%) of public transit routes and 34.6% of bus stops experience elevated heat stress**. Waiting at unsheltered stops increases vulnerability for elderly and chronically ill riders, while bus engines and

air-conditioning systems experience mechanical failures, driving up maintenance costs for the municipal fleet.

- **Infrastructure Asset Degradation**: High land surface temperatures accelerate asphalt softening, rutting, and cracking across 30.5% of the main road network, particularly under heavy bus and freight loads. Overheating threatens electronic controls, with **93% of traffic signaling units and 76.2% of EV charging infrastructure exposed to intense thermal stress**. Enclosed structural links (**100% of tunnels and underpasses**) trap warm air, increasing ventilation demands.

Pluvial (Urban) Flooding and Intense Precipitation Runoff

Climate Trends & Projections

Climate models project increasing precipitation variability across central Albania. While annual totals (1,100-1,300 mm) exhibit a slight long-term downward trend under RCP 8.5, extreme, short-duration downpours are projected to intensify. The return period of a historical 150 mm/day extreme storm event is expected to shorten from 50 years down to approximately 30 years under RCP 8.5 by late century. High-intensity rainfall days (above 20 mm/day) are projected to increase from the current baseline of 10-15% up to 15-20% of all rainy days, increasing the risk of pluvial flash flooding.

Figure 8. Annual average precipitation in Albania for 1986 to 2099

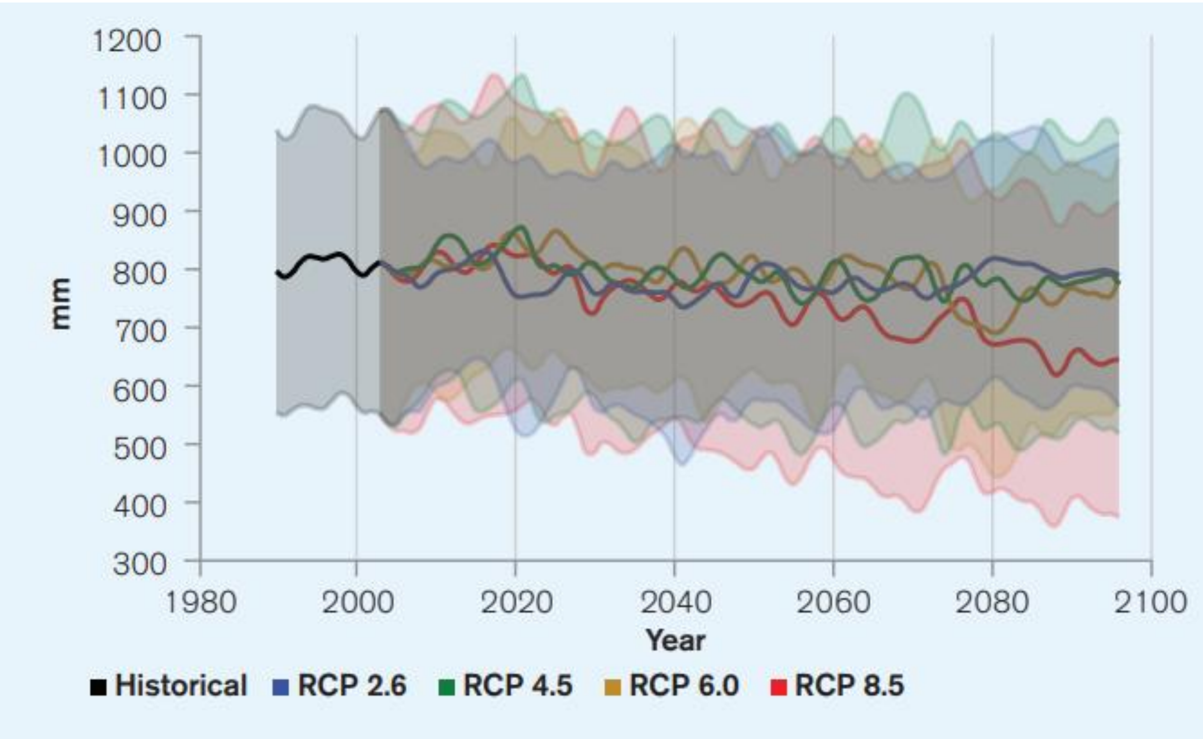


Table 5. Quantified hazard indicators for urban flooding

Indicator	Quantification (Current State)	Projection (RCP 8.5 scenario)	Source
% annual heavy rainfall	WB-CCP observations (1981–2010) indicate that the 99.9th percentile of daily precipitation in Tirana typically falls within the 70–100 mm per event range. Such high-intensity events contribute an estimated **5–7%** of total annual precipitation, despite relatively moderate annual totals (≈1,000–1,250 mm/year).	Under RCP 8.5, WB-CCP projections show a systematic increase in high-percentile precipitation, with median extreme daily rainfall rising toward 95–100 mm by late century, and the upper (75th percentile) exceeding 100 mm. As a result, the contribution of extreme rainfall to annual totals is projected to increase to approximately **7–9%**, raising the likelihood of repeated pluvial flooding events.	WB-CCP "Precipitation extremes (99.9th percentile)" – observation and RCP8.5 scenario
% of rainfall events exceeding 20 mm/day	Based on observed daily precipitation distributions, high-intensity rainfall days (>20 mm/day) occur mainly in autumn and winter and are estimated to account for **10–15% of rainfall days**, consistent with frequent short-duration storm events.	RCP 8.5 projections indicate a relative increase in the frequency of high-intensity rainfall days, with the share of events exceeding 20 mm/day rising to approximately **15–20% of rainfall days** by mid- to late century, reflecting more frequent cloudburst-type storms capable of overwhelming urban drainage systems.	Derived from WB-CCP precipitation amount and precipitation extremes indicators (observation and RCP8.5)

Pluvial flooding is driven by the intersection of high-intensity cloudbursts and structural stormwater constraints. Dense urbanization and extensive surface sealing in the city center and rapidly growing peripheral administrative units (Kombinat, Laprakë, Kashar, Astir, Allias, and Bregu i Lumit) reduce natural infiltration. When short-duration rainfall exceeds local drainage capacity, localized low-lying areas, underpasses, and key traffic intersections function as stormwater sinks.

Mobility Asset Exposure Metrics

Note: Due to structural upgrades, high investment frequency, and a lack of static cartographic data showing urban stormwater pooling separate from river models, explicit municipal exposure percentages for pluvial flooding are not modeled within the current GIS template. However, historical events confirm high operational exposure across major intersections.

Systemic Mobility Risk Analysis

- **Active Mobility Disruptions**: Intense rainfall creates immediate accessibility barriers for pedestrians and cyclists. Sidewalks, pedestrian crossings, and cycle lanes regularly experience localized ponding due to blocked or undersized storm drains. Standing water creates slipping hazards, hides pavement defects, and discourages active commuting.
- **Public Transport Delays**: Bus transit lines operating through low-lying corridors (such as the Kombinat-Kashar link and the Lana axis) face recurring delays or detours during major cloudbursts. Water intrusion at unsheltered bus stops impacts passenger access, while street pooling increases the risk of mechanical and electrical breakdowns in older transit vehicles.
- **Traffic Congestion & Infrastructure Wearing**: Stormwater accumulation triggers immediate congestion across primary intersections and roundabouts (e.g., Zogu i Zi, Sheshi Shqiponja, Rruga e Elbasanit). Hydroplaning risks and stalled vehicles cause delays that ripple across the network. Recurrent flooding accelerates subgrade saturation and pothole formation along older links (Unaza e Re, Rruga e Durrësit), leading to high municipal maintenance costs.
- **Logistics & Parking Constraints**: Flooded streets restrict delivery access to industrial and commercial hubs in Laprakë and Kashar. Furthermore, surface and underground parking structures in central districts are vulnerable to stormwater ingress, damaging parked vehicles and reducing road capacity when drivers park informally to avoid low-lying zones.

Riverine Flooding and Channel Overchannelling

Climate Trends and Projections

Riverine flooding risks are directly tied to the hydrological response of small urban streams to extreme rainfall events. The Lana River, crossing the urban core, and the Tirana River to the north drain the rapid runoff from the surrounding steep hillsides of Dajti, Sauk, and Farkë. Projections under RCP 8.5 indicate that while average precipitation shifts, short-duration extreme downpours will drive a 10-20% increase in peak river discharge by mid-century, increasing the frequency of channel overtopping.

Spatial Extents and Urban Hotspots

According to historical observations[10] and Copernicus Global Flood Monitoring data[11], riverine flood hazards are highly localized along the immediate margins of the Lana and Tirana river corridors. Channelization, heavy sedimentation, and urban encroachment have restricted natural floodplains. While major flood zones sit outside the primary built core, river overtopping

10 https://www.geo.edu.al/MonitoringForecast/Hydrologic_Meteorological_Forecast/Bulletin_on_Natural_Hazards/
11 https://portal.gfm.eodc.eu/products

frequently coincides with urban drainage backups inside low-lying neighborhoods such as Kombinat, Laprakë, Paskuqan, and Bregu i Lumit.

Mobility Asset Exposure Metrics

Spatial overlay analysis indicates that riverine flooding impacts a geographically limited but strategically critical portion of Tirana's transport network:

Figure 9. Tirana riverine flooding likelihood map, Copernicus Global Flood Monitoring Portal, 2026

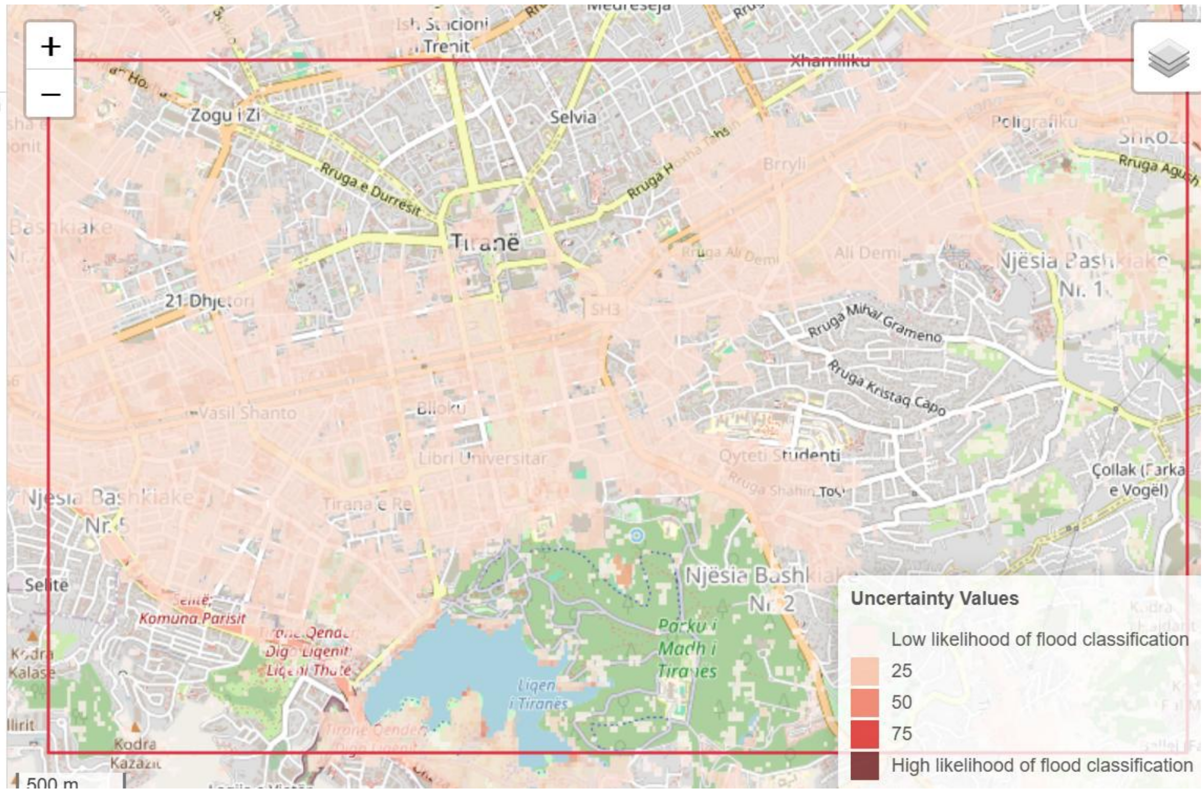


Figure 10. Map of riverine flooding

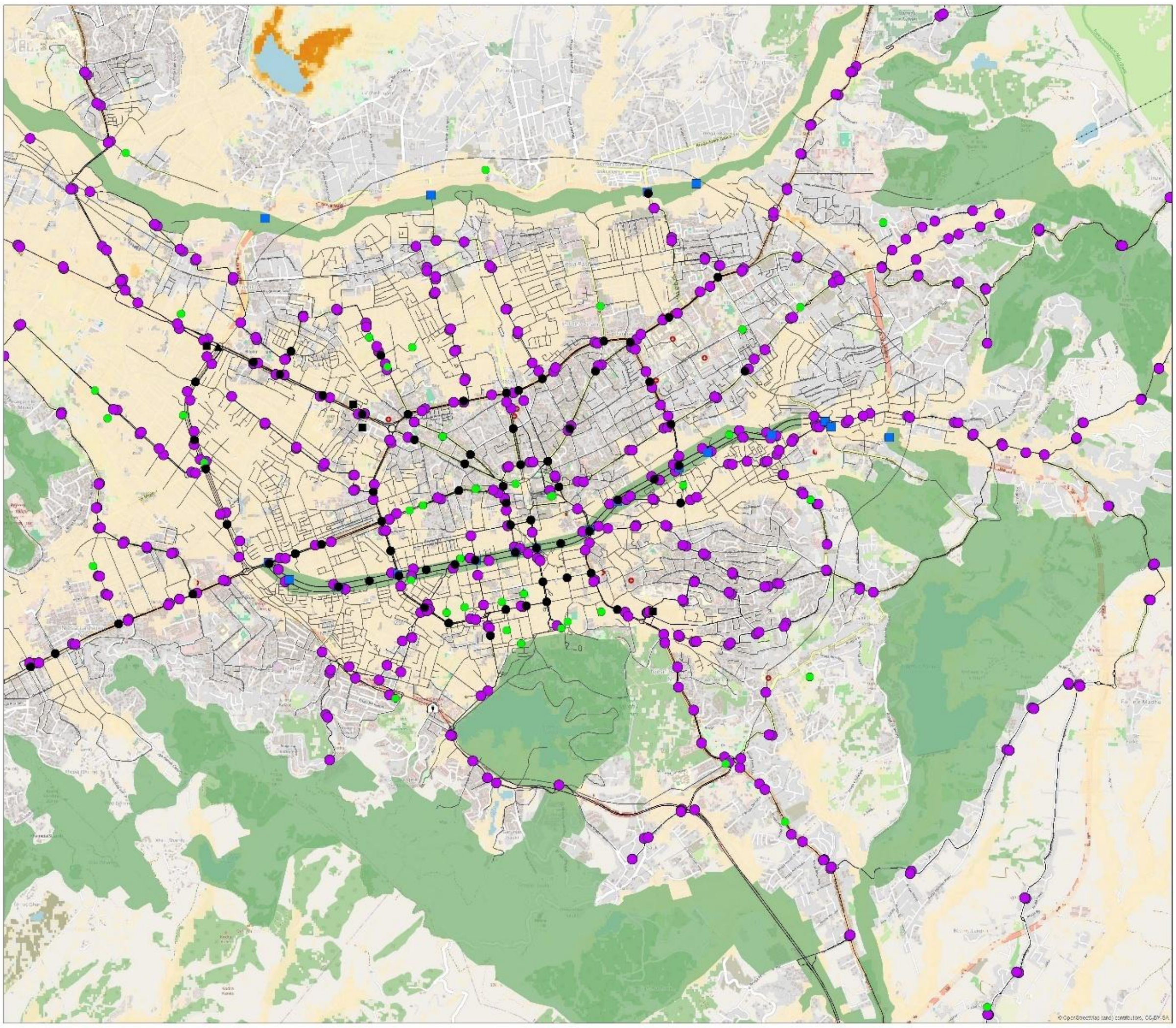


Table 6. Quantified hazard indicators for river flooding

Indicator	Quantification (Current State)	Projection (RCP 8.5 scenario)	Source
% peak river discharge	Observed flood events along the Lana and Tirana rivers (e.g. 2017, 2020, 2023) indicate short-duration peak discharge increases of approximately **5–10%** during extreme rainfall events (>70–100 mm/24h), driven by rapid runoff and limited channel capacity rather than sustained river flooding.	Under RCP 8.5, peak discharge during extreme rainfall events is projected to increase by approximately **10–20% by mid-century**, driven by intensified short-duration rainfall, higher runoff coefficients due to surface sealing, and reduced infiltration capacity. This is expected to increase the frequency of channel	IGJEUM Hydrological Bulletins; Fourth National Communication (2023); WB-CCP precipitation extremes

		exceedance and localized river overtopping.	
% of population in flood-prone areas	An estimated **10–15%** of Tirana's population resides or works in areas exposed to recurrent riverine or pluvial flooding, primarily in Kombinat, Laprakë, Bregu i Lumit, Kinostudio, where drainage and river capacity are constrained.	Without additional flood mitigation and land-use controls, the exposed population is projected to increase to approximately **15–20%**, reflecting higher flood frequency, expansion of built-up areas in flood-prone zones, and increased exposure of informal and peri-urban settlements.	Municipal flood assessments; IGJEUM; Fourth National Communication (2023)

CONCLUSIONS AND WAY FORWARD

Based on the empirical findings of the **Tirana Climate Risk Assessment (CRA)**, developed under the GIZ *Climate Change Adaptation in the Western Balkans (WB Adapt)* framework, the following conclusions summarize the core systemic risks facing the capital's urban mobility ecosystem:

The Risk Paradigm & Methodological Core

The assessment effectively moves Tirana from a reactive infrastructure maintenance posture to a proactive, climate-informed planning model. By normalizing multi-source geospatial, climatic, and socio-demographic indicators into a standardized five-class scoring system aligned with the **GIZ Climate Risk Sourcebook (2023)**, the report provides a legally and technically defensible baseline for future updates to Tirana's Sustainable Urban Mobility Plan (SUMP).

Systemic Hazard Hierarchies

- **The Critical Tier (Urban Heat Islands & Extreme Heatwaves):** Extreme summer heat waves intersect with intense UHI effects to form the city's most critical mobility threat. Driven by a regional warming trend of 0.4–0.6°C since the 1980s, approximately 60–75 days per year currently exceed 30°C, projected to reach **90–110 days/year by late century under RCP 8.5**. Spatial analysis confirms that 30–40% of the dense built-up core experiences elevated thermal amplification. Physical exposure mapping tracks deep vulnerabilities located within high heat zones: **100% of tunnels and underpasses, 93% of traffic signaling systems, 88% of parking surfaces, and 76% of cycling routes**. This causes asphalt softening and rutting along high-volume arterials, drops active transit safety, and triggers mechanical breakdowns or air conditioning overloads across the public transport fleet (48.8% route exposure).
- **The Moderate Tier (Pluvial Flooding & Precipitation Extremes):** While total annual precipitation remains highly variable (1,100–1,300 mm), short-duration, high-intensity cloudbursts frequently overwhelm the urban drainage network. Under the RCP 8.5 pathway, the contribution of extreme daily rainfall events (99.9th percentile) is projected to increase to **7–9% of the annual total**, and events exceeding 20 mm/day will expand to **15–29% of all rainy days**. High surface sealing creates localized pluvial flooding sinks along key intersections and underpasses, causing temporary gridlock, vehicle stalling, and severe safety hazards for non-motorized users.
- **The Localized Strategic Tier (Riverine Flooding):** Riverine flooding linked to the Lana and Tirana rivers affects a geographically limited (**0.5% of roads and public transport routes**) but operationally sensitive portion of the mobility system. Channelization, heavy sedimentation, and historical urban encroachment make these corridors highly reactive to extreme precipitation. One structural road bridge (**5.3% of municipal spans**) and **2% of cycling paths** are directly exposed, threatening strategic connectivity, emergency access, and logistics routing during peak discharge events.

Vulnerability as a Risk Multiplier

Socio-demographic exposure fundamentally amplifies these physical hazards. With **13–14% elderly residents, 16–17% children, and 14–17% low-income households** (many concentrated in dense informal or peri-urban settlements like Laprakë, Kombinat, Kashar, Astir, Allias, and Bregu i Lumit), over 60% of daily commuters rely strictly on active mobility (walking/cycling) and public transit. Because much of the existing mobility infrastructure lacks climate-proofing measures such as shading, heat-resistant materials, sheltered bus stops, and climate-adaptive drainage, even moderate hazard levels translate into intermediate to high risks for mobility, accessibility, and social equity.

Action Plan Conclusions & Priority Interventions

The operationalization of these findings is channeled through a structured Action Plan. Modeled around multi-criteria analysis (MCA) evaluating infrastructure impact, vulnerable population protection, urgency, and cost-effectiveness, the strategic priorities are finalized across two structural pillars:

Cross-Cutting System Actions (Capacity & Policy)

To support structural interventions and build institutional and strategic frameworks, the Action Plan prioritizes four core systemic planning tools:

- **E-Mobility Framework:** Financial and regulatory incentives for electric and hybrid taxis to reduce ambient transit heat and local emissions.
- **Smart Space Management:** Implementation of a new urban parking strategy alongside a comprehensive logistics study to reorganize spaces for goods loading during weather anomalies.
- **Active Transit Policy:** Execution of the Tirana Cycling Strategy to streamline active infrastructure build-outs.

Infrastructure Priority Projects (The Top 5 Roadmap)

The Action Plan prioritizes five foundational infrastructure interventions designed to weave digital connectivity, nature-based solutions (NBS), and sustainable transit directly into Tirana's urban fabric:

Table 7. Priority projects list and adaptation potential

Priority Project	Key Climate Adaptation Mechanics
Rationalization of Goods Distribution (New Infrastructures)	Develops logistics hubs and loading zones outside unstable zones using permeable yards, shaded loading areas, and elevated equipment to secure supply chain continuity.
Integration of Cycling Routes in Google Maps	Implements real-time navigation mapping that highlights shaded corridors, avoids flood-prone underpasses, and dynamically updates routes during intense downpours.

Integrated Green Corridors	Plants ~200 drought-tolerant, broad-canopy trees along 11 km of the Lana Corridor, Great Park, and Metrobosco; utilizes permeable paving to capture stormwater runoff.
Heat-Resilient LED Lighting Retrofit with Smart Lighting Controls	Deploys automated high-temperature rated fixtures and smart dimming controls to mitigate grid stress during prolonged heatwaves while ensuring safe nighttime pedestrian spaces.
Shaded, Traffic-Calmed School Streets	Covers 5 km of priority school zones with ~250 new trees, raised crossings, and permeable paving to isolate vulnerable children from extreme microclimatic heat.

Strategic Outlook: By grounding capital allocation in the metrics of the SECAP, SUMP, GCAP, and Tirana 2030 Masterplan, the municipality successfully transitions from vulnerability modeling into a targeted, climate-resilient engineering paradigm.