CLIMAAX
climate ready regions

Deliverable Phase 3 – Climate risk management

Sustainable Climate Outcomes for People of Eastern Slovakia (SCOPE)

Slovakia, Košice urban development area

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Abbreviations and acronyms

Abbreviation / acronym	Description
CRM	Climate risk management
UMR	Functional urban region
KSK	Košice Self-Governing Region
SHMÚ	Slovak Hydrometeorological Institute
VVS	East Slovak Water Company
LESY SR	State forest of Slovak Republic
CINEA	European Climate, Infrastructure and Environment Executive Agency
SECAP	Sustainable Energy and Climate Action Plan
OECD	Organisation for Economic Co-operation and Development
SCOPE	Sustainable Climate Outcomes for People of Eastern Slovakia
CLIMAAX	CLIMAte Risk and Vulnerability Assessment Framework and ToolboX
EU	European Union
GIS	Geographic Information System
KPI	Key Performance Indicator
NBS	Nature-Based Solutions
NGO	Non-Governmental Organisation
PDF	Portable Document Format
PNG	Portable Network Graphics
SMS	Short Message Service
SVK	Slovakia (ISO 3166-1 alpha-3 country code)

Executive summary

The SCOPE (Sustainable Climate Outcomes for People of Eastern Slovakia) project aims to strengthen climate resilience in the Košice Urban Development Region (UMR) through a harmonized and evidence-based climate risk assessment and management process developed within the CLIMAAX framework. Building on the results of Phase 1 (scoping and stakeholder engagement) and Phase 2 (climate risk assessment), this third phase focuses on translating climate-risk findings into practical Climate Risk Management (CRM) measures and implementation pathways that can be directly applied by municipalities, regional authorities, and other stakeholders.

The deliverable provides a comprehensive overview of the climate risk management approach developed for the Košice region. It summarizes the key climate risks identified during Phase 2, namely heatwaves, extreme rainfall and flash floods, agricultural drought, and wildfires, and evaluates the region's current resilience capacity. The report also examines the policy context, governance structures, stakeholder roles, and lessons learned from past climate-related events that influence climate adaptation and resilience-building efforts.

A major outcome of Phase 3 is the development of a set of practical CRM objectives and adaptation measures tailored to regional needs. The proposed measures include nature-based solutions, heatwave preparedness systems, drainage and retention infrastructure improvements, drought management practices, wildfire prevention measures, and climate-proof planning standards. Particular attention is given to protecting vulnerable population groups, including children, seniors, hospital patients, and socially disadvantaged communities.

The project further identifies supportive elements required for successful climate risk management, including improved data availability, monitoring systems, stakeholder engagement, institutional coordination, financing mechanisms, and governance arrangements. Recommendations are provided for integrating climate-risk information into spatial planning, sectoral strategies, infrastructure investments, public health policies, and municipal decision-making processes.

An important contribution of this phase is the establishment of a shared evidence base that enables cooperation between municipalities, regional institutions, utilities, emergency services, research organizations, and civil society. The project has strengthened local capacity to understand climate risks, prioritize adaptation actions, and communicate climate-related challenges to decision-makers and the public through policy notes, geo-stories, visual materials, workshops, and stakeholder consultations.

The results demonstrate that the Košice region possesses a strong strategic foundation for climate adaptation but requires improved coordination, enhanced local monitoring, and greater integration of climate risks into everyday planning and investment decisions. The climate risk management framework developed through the SCOPE project provides practical guidance for addressing these challenges and supports the long-term resilience of the region.

In conclusion, Phase 3 successfully bridges the gap between climate-risk assessment and climate-risk management. The deliverable transforms scientific risk information into actionable recommendations that can support policy development, investment planning, and cross-sectoral cooperation. The outcomes provide municipalities and regional authorities with a robust basis for implementing effective adaptation measures, protecting vulnerable populations, and strengthening resilience to future climate impacts across the Košice Urban Development Region.

1 Introduction

1.1 Main objectives of the project

Phase 3 of the SCOPE project focuses on transforming the scientific climate-risk findings from Phase 1 and Phase 2 into practical and locally relevant Climate Risk Management actions for the Košice Urban Development Region (UMR). The main objective of this phase is to ensure that municipalities, regional authorities, and local institutions can directly use the results in their planning, investment decisions, and everyday governance. Phase 3 translates complex climate data into clear, actionable measures that help municipalities address the four priority risks identified in earlier phases: heatwaves, extreme rainfall and flash floods, agricultural drought, and wildfires. A strong emphasis is placed on protecting vulnerable groups such as children, seniors, hospital patients, and socially disadvantaged communities, as these groups are most affected by climate impacts.

Another key objective of Phase 3 is to support municipalities in integrating climate resilience into their spatial planning, infrastructure development, crisis management, and public-space design. This includes providing guidance on how to incorporate climate risks into zoning regulations, investment priorities, and local development strategies. The phase also strengthens cooperation across the Functional Urban Region by encouraging joint projects, shared data, and coordinated adaptation strategies, recognizing that many climate risks extend beyond municipal boundaries and require collective action.

Phase 3 additionally delivers political and communication tools—such as political notes, geo-stories, and visual materials—that help mayors and councils quickly understand climate risks and communicate them effectively to residents, stakeholders, and funding bodies. These tools make climate adaptation more accessible and support informed decision-making at the local level. Finally, Phase 3 prepares the region for the next steps in climate adaptation, establishing a solid foundation of measures, governance mechanisms, and strategic recommendations that will guide the Košice UMR toward a more resilient future.

1.2 Project team

The project is implemented by a multidisciplinary team combining expertise in climate adaptation, urban planning, data analysis, and stakeholder engagement. The core team consists of three internal specialists responsible for project management, climate-risk assessment, and communication with municipalities. They are supported by external experts providing advanced data processing, modelling, and visualisation. The team collaborates closely with local authorities, regional institutions, universities, and sectoral stakeholders to ensure that all outputs are scientifically sound, locally relevant, and practically applicable. Together, they translate complex climate data into actionable measures and support municipalities across the Košice UMR in strengthening their climate resilience.

1.3 Outline of the document's structure

This deliverable is structured into seven main chapters that guide the reader from the context of climate risks in the Košice Urban Development Region to the development of practical Climate Risk Management (CRM) measures and recommendations.

Following the Executive Summary and Introduction, Chapter 2 presents the local profile, including a summary of the key climate-risk assessment results, the policy and governance context, the main actors involved in climate risk management, and lessons learned from past climate-related events.

Chapter 3 forms the core of the deliverable and describes the Climate Risk Management framework developed during Phase 3. It outlines CRM objectives, supportive conditions for effective implementation, proposed adaptation and resilience measures for priority climate risks, and recommendations for integrating climate-risk considerations into planning and decision-making processes.

Chapter 4 evaluates the project results, focusing on their usability, practical application, and the lessons learned throughout the project implementation. Chapter 5 summarizes the main conclusions and key findings of Phase 3.

Chapter 6 provides an overview of project progress, including the achievement of key performance indicators, milestones, and outputs. Chapter 7 lists the supporting documentation and materials produced during this phase, while Chapter 8 contains the references used throughout the report.

Together, these chapters demonstrate how the climate-risk assessment conducted in previous phases has been translated into actionable recommendations that support climate resilience, informed decision-making, and long-term adaptation planning in the Košice Urban Development Region.

2 Local profile

2.1 Summary of Key Risk Assessment results

Based on the Phase 2 results and the Key Risk Assessment Evaluation Dashboard, four priority climate risks were identified for the Košice Urban Development Region: heatwaves, extreme rainfall and flash floods, agricultural drought, and wildfire risk. Heatwaves represent the most urgent risk, with medium resilience capacity. Although the region has begun implementing shading, greenery, and cooling measures, vulnerable groups remain highly exposed and systematic heat-action planning is still missing. Extreme rainfall and flash floods also show medium resilience capacity: municipalities possess strong local knowledge and partial drainage upgrades, but infrastructure remains undersized and retention systems insufficient for future rainfall intensities.

Agricultural drought shows low to medium resilience capacity. Rural municipalities face increasing crop losses, limited irrigation, and weak soil-retention measures, while technical and financial capacities remain constrained. Wildfire risk also demonstrates low to medium resilience capacity. Operational response is strong, but preventive measures, biomass management, and public awareness are inconsistent across municipalities, especially in forest-adjacent areas.

The assessment involved a wide range of stakeholders, including municipalities, regional authorities, SHMÚ, water utilities, fire brigades, forest managers, farmers, schools, hospitals, and social-care institutions. Engagement modalities included workshops, co-design sessions, geo-story presentations, surveys, expert consultations, and validation meetings. This participatory approach ensured that the resilience assessment reflects both scientific evidence and local knowledge.

Table 2-1 Overview of Priority Climate Risks, Resilience Capacity and Stakeholder Engagement

Priority climate risk	*Resilience capacity (low, medium, substantial, high)*	*Description of the resilience capacity (such as existing knowledge, planned measures, gaps)*	*Stakeholders, experts and priority groups involved in the key risk assessment & modality of engagement*
Heatwaves	Medium	The region has growing awareness of heat risks and initial measures (tree planting, shading, cooling shelters), but lacks systematic heat-action plans, building-level cooling strategies, and long-term monitoring. Vulnerable groups (children, seniors, socially disadvantaged communities) remain highly exposed.	City of Košice, UMR municipalities, KSK, SHMÚ, public-health experts, schools, hospitals, social-care facilities. Engagement through workshops, geo-stories, stakeholder meetings, and co-design sessions.
Extreme rainfall & flash floods	Medium	Municipalities have partial drainage upgrades and crisis protocols, but infrastructure is undersized for projected rainfall intensities. Local knowledge is strong, yet retention and infiltration systems are insufficient. Data from Phase 2	Municipal technical departments, VVS (water utility), firefighters, crisis-management units, local residents. Engagement via hazard-impact mapping

		improved understanding but implementation capacity varies.	sessions, consultations, and validation workshops.
Agricultural drought	Low–Medium	Rural municipalities have limited irrigation systems, low soil-water retention, and insufficient long-term planning. Awareness is increasing due to economic losses, but adaptation capacity is constrained by funding and technical expertise. Cooperation with farmers is improving but fragmented.	Farmers, agricultural cooperatives, KSK, water managers, SHMÚ, rural municipalities. Engagement through surveys, interviews, and co-design of drought-impact maps.
Wildfire risk	Low–Medium	Fire brigades and forest managers have operational capacity, but prevention measures (fire-breaks, biomass removal, access routes) are inconsistent. Public awareness is low. Recreational pressure increases ignition risk. Municipalities lack wildfire-specific planning tools.	Fire brigades, forest managers (LESY SR, urban forests), recreational groups, municipalities near forest edges. Engagement through exposure-map validation, expert consultations, and scenario discussions.

2.2 Key implementation mechanisms and policy context for CRM

Climate risk management in the Košice region is strongly influenced by European, national, regional, and local policy frameworks that support climate adaptation, resilience building, sustainable urban development, and environmental protection. The SCOPE project builds upon these existing strategies while contributing to their further development through improved climate risk knowledge, stakeholder cooperation, and evidence-based planning.

At the European level, the project aligns with the objectives of the European Green Deal, the EU Adaptation Strategy, and the Mission on Climate-Neutral and Smart Cities. These initiatives emphasize the importance of increasing resilience to climate change, promoting sustainable urban transformation, and integrating climate considerations into all sectors of governance and investment planning. Through the CLIMAAX framework, the project contributes to strengthening local and regional capacities for climate risk assessment and adaptation across Europe.

At the national level, the project is consistent with the Slovak National Adaptation Strategy (2025) and the National Adaptation Plan (2021), which identify increasing temperatures, heatwaves, droughts, and extreme precipitation as major climate threats for Slovakia. National policies stress the need for comprehensive risk assessments, improved preparedness, ecosystem-based adaptation, and stronger cooperation between public institutions and local governments. The project also reflects recommendations from OECD studies focused on climate risk assessment and municipal adaptation planning in Slovakia.

At the regional level, the Košice Self-Governing Region has adopted the Adaptation Strategy for the Consequences of Climate Change, which supports climate resilience, sustainable water management, biodiversity protection, and preparedness for extreme weather events. However, previous assessments often used different methodologies and datasets, which limited comparability and coordination between regional and municipal adaptation planning. The SCOPE project contributes to reducing these inconsistencies by introducing a harmonized and reproducible climate risk assessment framework based on the CLIMAAX methodology.

At the local level, the City of Košice has already implemented several climate-related strategic documents and initiatives, including the Adaptation Plan of the City of Košice (2022–2030), the Sustainable Energy and Climate Action Plan (SECAP), and activities related to the EU Mission for 100 Climate-Neutral Cities. These policies focus on reducing greenhouse gas emissions, increasing energy efficiency, improving urban environmental quality, and strengthening resilience to climate impacts.

The SCOPE project directly supports these local policies by providing updated climate risk information and identifying practical adaptation measures that can be integrated into spatial planning, infrastructure investments, civil protection systems, environmental management, and public health policies. The project also strengthens the evidence base needed for future funding applications and long-term climate resilience planning.
An important aspect of the policy context is the increasing recognition that climate adaptation requires an integrated and cross-sectoral approach. Climate risks affect multiple sectors simultaneously, including water management, transportation, housing, public health, biodiversity, and social services. Therefore, effective climate risk management depends on cooperation between municipalities, regional authorities, state institutions, universities, NGOs, and local communities.
The participatory approach applied within the SCOPE project supports this objective by strengthening communication and cooperation among stakeholders while improving public awareness and engagement. The project therefore contributes not only to technical climate risk assessment but also to the development of governance structures and institutional capacities necessary for long-term climate resilience.
Overall, the policy context demonstrates that the Košice region already possesses a strong strategic foundation for climate adaptation. However, the increasing intensity and frequency of climate-related hazards highlight the need for more detailed localized data, better coordination between governance levels, and stronger integration of climate risks into everyday decision-making processes. The SCOPE project addresses these needs by bridging the gap between climate science, public policy, and practical implementation.

2.3 Key actors and systems for CRM

Climate risk management in the Košice region involves a wide range of governmental and non-governmental actors whose roles, motivations, and capacities differ across sectors and governance levels. Municipalities within the UMR play a central role in spatial planning, drainage management, greenery maintenance, and crisis response. Their motivation lies in protecting residents and infrastructure, but they often face limited staff capacity and technical expertise. The City of Košice, as the largest urban centre, has strong strategic frameworks and the ability to integrate CRM into planning and investment processes.

Regional authorities (KSK) contribute through transport, education, health, and water-management competencies, while national institutions such as SHMÚ provide essential climate and hydrological data. Water utilities, fire brigades, forest managers, and agricultural actors are key sectoral stakeholders whose involvement is crucial for addressing floods, droughts, and wildfires. NGOs, universities, and community groups support awareness, data interpretation, and participatory planning.

During the SCOPE project, these actors were engaged through scoping workshops, risk-exploration sessions, geo-story presentations, expert consultations, surveys, and validation meetings. This participatory approach ensured that the CRM framework reflects both scientific evidence and local knowledge, while strengthening cooperation across the region.

Table 2-2 Overview of Key Actors, Responsibilities, Needs and Engagement in Climate Risk Management

Key actors	Role and responsibility	Motivation and needs	Opportunities for involvement	Barriers to involvement	Type of engagement
City of Košice	Lead urban governance, spatial planning, civil protection, infrastructure management, data provision	Need for updated climate-risk data, support for planning, investment prioritization, protection of vulnerable groups	Strong mandate for CRM integration into planning, SECAP, Adaptation Plan, Mission Cities	Limited staff capacity, fragmented data, budget constraints	Scoping, risk exploration, co-design workshops, geo-story sessions
UMR municipalities	Local land-use decisions, drainage, greenery, crisis management	Practical guidance, simple measures, funding access, clear responsibilities	Joint projects, shared data, coordinated adaptation	Small staff, low technical capacity, competing priorities	Scoping, hazard validation, stakeholder meetings
Košice Self-Governing Region (KSK)	Regional planning, transport, education, health, social services, water and landscape management	Consistent regional data, alignment with municipal plans, support for vulnerable groups	Regional adaptation strategy, coordination platform, funding leverage	Methodological inconsistencies, limited integration across departments	Risk exploration, strategy alignment, expert consultations
SHMÚ	Climate and hydrological data, early warning systems, national monitoring	High-quality data, improved local inputs, cooperation with municipalities	Strong scientific authority, data for modelling and thresholds	Limited local-scale datasets, resource constraints	Data provision, expert validation
Water utility VVS	Drainage, water supply, wastewater, flood-risk infrastructure	Need for rainfall thresholds, flood maps, investment prioritization	Joint retention projects, drainage upgrades, nature-based solutions	Ageing infrastructure, high investment costs	Hazard mapping, co-design of measures
Fire brigades & civil protection	Emergency response, wildfire prevention, crisis protocols	Clear risk zones, early-warning data, training	Improved preparedness, wildfire-risk reduction	Limited prevention capacity, equipment gaps	Risk exploration, scenario discussions

Forest managers (LESY SR, urban forests)	Biomass management, fire-breaks, forest health	Need for wildfire exposure maps, visitor-pressure data	Joint wildfire-prevention planning	Limited staff, inconsistent maintenance	Exposure-map validation, expert consultations
Farmers & agricultural cooperatives	Land management, irrigation, soil protection	Drought forecasts, economic loss estimates, funding	Adoption of drought-resilient practices, soil retention	Low investment capacity, fragmented ownership	Surveys, interviews, drought-impact mapping
Universities & research institutions	Scientific support, modelling, data analysis	Access to datasets, research opportunities	Innovation, student involvement, pilot projects	Limited long-term funding	Expert consultations, data analysis
NGOs & community groups	Awareness, community engagement, environmental protection	Clear communication tools, local data	Mobilizing residents, participatory planning	Limited influence on formal planning	Public engagement, geo-story dissemination
Healthcare & social-care institutions	Protect vulnerable groups during heatwaves and floods	Heat-risk maps, emergency protocols	Targeted adaptation for schools, hospitals, seniors	Low adaptation budgets	Risk exploration, vulnerability mapping
Private sector & utilities	Infrastructure, logistics, business continuity	Risk forecasts, insurance incentives	Investment in resilience, innovation	Low awareness, cost concerns	Consultations, data sharing

2.4 Lessons learned from past events

Košice has accumulated valuable experience from past climate-related events—heatwaves, extreme rainfall, flash floods, drought periods, and peri-urban wildfires—that now significantly shape both emergency management and long-term climate adaptation. These events, regularly communicated through municipal platforms such as kosice.sk and cokosice.sk, have revealed critical vulnerabilities in the city's built environment, infrastructure, and social systems. Heatwaves have repeatedly demonstrated the sensitivity of densely built housing estates and essential public services, prompting Košice to shift from reactive emergency responses to proactive heat-action planning, including shading, cooling shelters, and targeted communication for vulnerable groups. Flash-flood incidents in districts such as Juh, Staré Mesto, and Nad jazerom exposed the limitations of traditional drainage systems, leading to the development of nature-based retention solutions through the AquaUrban project, including the Ťahanovská water garden designed to retain stormwater in hilly urban areas.

The CODESIC project (2022) further highlighted the importance of coordinated crisis management, unified emergency messaging, and shared data platforms, especially in relation to technical hazards linked to the Ružín and Bukovec dams. Wildfire incidents in recreational zones such as Bankov and Čermeľ underscored the need for preventive forest management, including biomass reduction and visitor-awareness campaigns. These lessons have been reinforced by Košice's participation in the Mission CE Climate and the establishment of the Local Climate Resilience Mission, which unify municipal departments, research institutions, and utility providers into a coordinated governance structure. Real-time climate data from monitoring stations installed at local schools now support evidence-based decision-making, improve public communication, and strengthen preparedness across sectors.

All these insights were systematically integrated into the SCOPE methodology. During the scoping phase, risks were prioritised based on historical frequency and documented impacts. In the risk-exploration phase, hazard maps were validated with emergency services to ensure alignment with operational realities identified in CODESIC. The co-design phase produced actionable measures that bridge technical infrastructure and community needs, such as nature-based retention systems and heat-resilient public spaces. Stakeholder engagement brought together fire brigades, water utilities, municipal departments, and the Local Climate Resilience Mission to ensure cross-sectoral coordination. Geo-stories were used to visually communicate the evolution of risks and the effectiveness of planned interventions to policymakers and the public.

Together, these lessons form a coherent foundation for climate resilience planning in Košice. They directly support the city's strategic frameworks, including the Adaptation Plan of the City of Košice (2022–2030), the Kosice SECAP, and the ambition to achieve climate neutrality by 2030. They also demonstrate that Košice is evolving from a city responding to climate impacts toward a city actively preparing for them—supported by strong governance, innovative EU-funded projects, and a growing culture of public engagement.

3 Climate risk management – phase 3

3.1 CRM objectives

The CRM objectives for Košice are designed to directly address the priority climate risks identified in Phase 2 while ensuring that vulnerable groups and critical services are protected. The CRM

strategy for Košice focuses on four key climate hazards: heatwaves, extreme rainfall, drought, and wildfires. These objectives reflect the city's strategic direction, including the Adaptation Plan of Košice (2022–2030), SECAP, Climate city contract,….

Table 3-1 Climate Resilience Objectives and Key Assessment Indicators

Primary objectives	*Examples of assessment indicators*
Mitigate Heatwave Risk	Frequency of heatwave days, tropical days, and tropical nights; heat exposure levels at critical locations (e.g., kindergartens, hospitals, social-care facilities).
Reduce Extreme Rainfall & Flash Flood Risk	Frequency and intensity of high-impact precipitation events; resilience of transport infrastructure and drainage systems.
Manage Drought and Wildfire Risks	Potential agricultural yield/revenue loss for key crops (e.g., wheat, maize, rapeseed); wildfire exposure levels for critical buildings in forest-adjacent areas.

Table 3-2 Cross-Cutting Resilience Objectives and Key Assessment Indicators

Additional objectives	*Examples of assessment indicators*
Public health	Mapping and protecting vulnerable population groups (children, senior citizens, hospital patients) in high-exposure locations.
Social well-being	Percentage of urban area covered by parks
Environmental quality	Expansion of green and blue infrastructure (e.g., tree planting, rain gardens, permeable surfaces).
Justice and equity	Explicit mapping of vulnerable groups; prioritization of equitable adaptation measures for socially disadvantaged settlements (e.g., Roma settlements).
Strengthen Resilience Capacity	Improvement in adaptive capacity; level of cross-municipal cooperation and policy alignment.
Enhance Social Awareness	Number of stakeholders involved and communication actions completed (12 stakeholder engagements and 12 communication actions achieved).

3.2 Supportive elements for effective CRM

Phase 2 of the SCOPE project significantly strengthened the foundations for effective Climate Risk Management in Košice by providing a unified and scientifically robust understanding of climate hazards, exposure, and vulnerability. The new datasets and risk dashboards created during Phase 2 now serve as the primary knowledge base for municipal planning, enabling the city to identify the most affected neighbourhoods, infrastructure systems, and population groups. This improved risk understanding is one of the strongest supportive elements for CRM, as it allows Košice to move from general assumptions to precise, evidence-based decision-making.

The technical and infrastructural insights gained from Phase 2 highlight where the city needs to focus its adaptation investments. The analysis revealed undersized drainage systems in central districts, limited retention capacity in hilly areas, insufficient shading in public spaces, and wildfire-prone forest edges. These findings help the city prioritize upgrades to green and grey infrastructure, early-warning systems, and monitoring networks.

Phase 2 also provided a deeper understanding of social and behavioural vulnerabilities. The assessment showed that seniors, children, low-income households, and socially excluded communities are disproportionately exposed to heatwaves and floods. It also revealed differences in risk awareness across districts, emphasizing the need for targeted communication and behavioural change initiatives.

Citizen engagement emerged as a valuable supportive element during Phase 2. Residents contributed local knowledge about micro-hotspots, flood-prone streets, and forest-fire ignition points, improving the accuracy of hazard and vulnerability maps. This demonstrated that community participation is essential for refining risk assessments and ensuring that CRM measures reflect real local conditions.

Financial and resource considerations were also clarified through Phase 2. By quantifying expected annual damages from floods and droughts, the project provided a strong economic justification for future adaptation investments. However, the analysis also highlighted disparities in financial and technical capacity between municipal districts.

Finally, Phase 2 exposed governance gaps but also created opportunities for improvement. Fragmented responsibilities between municipal departments, utilities, crisis-management units, and forest managers were identified as barriers. The harmonized datasets and dashboards now offer a shared evidence base that can support better coordination, clearer mandates, and more consistent decision-making across institutions.

Together, these supportive elements—knowledge, infrastructure insights, social understanding, citizen engagement, financial clarity, and improved governance—form a strong foundation for effective CRM in Košice and guide the development of Phase 3 adaptation measures.

Table 3-3 Supportive Elements for Strengthening Climate Resilience: Phase 2 Findings

Supportive element	*Description (based on Phase 2)*
Knowledge and data	Phase 2 delivered harmonized climate-risk datasets for heatwaves, extreme rainfall, flash floods, drought, and wildfire exposure. Municipal experts now have access to consistent hazard maps, vulnerability layers, and risk dashboards. This improved institutional understanding of where risks are highest (e.g., overheating housing estates, flood-prone intersections, drought-sensitive peri-urban areas).
Tech and infrastructure	Phase 2 identified critical infrastructure gaps: undersized drainage in Juh and Staré Mesto, limited retention capacity in hilly districts, insufficient shading in public spaces, and vulnerable forest edges. These findings highlight where upgrades to green/grey infrastructure, early-warning systems, and monitoring networks are most needed.
Social-behavioral aspects	The vulnerability assessment revealed that seniors, children, low-income households, and socially excluded communities are disproportionately affected by heatwaves and floods. Phase 2 also showed that risk awareness varies across districts, indicating the need for targeted communication and behavioural change strategies.
Citizen engagement	Phase 2 workshops and validation meetings demonstrated strong willingness of residents/students and local stakeholders to participate in risk identification. Citizens provided local knowledge about

	micro-hotspots, flood-prone streets, and forest-fire ignition points, improving the accuracy of risk maps.
Finances & resources	Phase 2 highlighted the financial implications of climate risks, including estimated annual damages from floods and droughts. These quantified impacts help the city justify future investments and prioritize cost-effective adaptation measures. Smaller municipal districts, however, still face resource limitations.
Governance arrangements & political leadership	Phase 2 revealed fragmented responsibilities between municipal departments, water utilities, crisis-management units, and forest managers. The risk dashboards and shared datasets now provide a common evidence base that can support better coordination, clearer mandates, and more consistent decision-making.

3.3 Potential CRM measures

Table 3-4 Proposed Climate Risk Management Measures and Their Expected Impacts

Key climate risk	*CRM measure*	*Effectiveness / Risk reduction*	*Contribution to CRM objectives*	*Possible co-benefits (incl. equity & justice)*	*Timeline*	*Responsible organisation*	*Possible adaptation limits*
Heatwaves	Shading & cooling of public spaces (trees, pergolas, cool pavements) in overheating estates	High	Reduces overheating, protects public health	Better comfort, cleaner air; benefits seniors, children, low-income households	Short–medium	City of Košice, city districts	Limited space; tree growth time
Heatwaves	Heat-health action plans + early warning (SMS, apps)	High	Reduces heat-related morbidity	Strong protection for vulnerable groups; improves institutional trust	Short	City, Public Health Authority	Extreme heat may still cause residual risk
Heatwaves	Adjusted working/school hours during heatwaves	Medium	Reduces exposure of workers & children	Safer working conditions; protects schools without cooling	Short–medium	Employers, schools	Some sectors cannot shift hours
Heatwaves	Climate-proof building standards (cool roofs, shading, ventilation)	High	Integrates CRM into investments	Long-term overheating reduction; reduces energy poverty	Medium–long	City planning dept.	High upfront costs; retrofitting limits
Extreme rainfall & flash floods	Retention & infiltration systems (rain gardens, permeable surfaces)	High	Reduces flood peaks	More greenery, cooler microclimate; protects low-income	Medium	City, VVS	Space constraints; extreme events exceed capacity

				households in basements			
Extreme rainfall & flash floods	Drainage upgrades at critical nodes (underpasses, intersections)	High	Reduces frequency of flooding	Protects transport, schools, emergency access	Medium–long	City, VVS	High investment; extreme cloudbursts still overload
Extreme rainfall & flash floods	Local flood-risk maps & awareness	Medium	Enhances preparedness	Supports renters, seniors, small businesses	Short	City, crisis management	Behaviour change not guaranteed
Extreme rainfall & flash floods	Climate-proofing new developments (mandatory on-site retention)	High	Prevents creation of new hotspots	Fairer distribution of risk; protects future residents	Long	City planning dept., developers	Enforcement challenges
Drought (urban)	Soil-water retention & mulching in parks & schoolyards	Medium	Strengthens drought resilience	Healthier greenery; benefits children & communities relying on public spaces	Short–medium	City, city districts	Long droughts may still cause vegetation loss
Drought (urban)	Efficient irrigation systems for key green areas	Medium–High	Maintains greenery	Supports community gardens; benefits low-income households	Medium	City, community groups	Water availability constraints
Drought (agriculture)	Training for farmers on drought-resilient practices	Medium	Supports food production	Stabilizes farmer income; supports small farms	Short–medium	Regional authorities	Severe drought may exceed adaptation
Drought (agriculture)	Crop lands irrigation infrastructure	Medium-High	Supports food production	Stabilizes farmer income; supports	Short–medium	Regional authorities	Water sources during severe

				small farms, can raduc ethe food prices			drought are limited in the eastern SVK
Drought (public sector)	Water-saving technologies in public buildings	Medium	Reduces water demand	Lower costs; educational value for students	Medium–long	City, facility managers	Limited impact if household use stays high
Wildfires	Fire-breaks & access roads maintenance in peri-urban forests	High	Reduces wildfire spread	Protects recreational users; supports firefighters	Medium	Forest managers, City	Extreme drought/wind may still cause spread
Wildfires	Visitor awareness campaigns	Medium	Reduces ignition risk	Protects families, seniors, cyclists; reduces emergency burden	Short	City, forest managers	Behaviour compliance varies
Wildfires	Training & equipment for volunteer brigades	Medium–High	Increases response capacity	Builds social capital; supports small communities	Short–medium	Fire brigades, region	Volunteer availability limits
Wildfires	Wildfire-risk integration into land-use planning	High	Aligns land use with risk	Avoids new housing in high-risk zones; protects vulnerable communities	Long	City planning dept., forest managers	Development pressure; climate change increases baseline risk

3.4 Integration into planning and decision making

The climate risk assessment provides Košice with a harmonised, spatially explicit evidence base on heatwaves, extreme rainfall/flash floods, drought and wildfire risk. These results can be systematically integrated into local policies, municipal strategies, sectoral plans and investment decisions in several concrete ways:

- Spatial planning and land-use regulation:
  - Revision of the Spatial plan to incorporate flood- and heat-risk zones as regulatory layers (e.g. restrictions on new development in micro-depressions, wildfire-prone forest edges, and strongly overheating areas).
  - Mandatory on-site retention and infiltration for new developments in high-runoff areas, based on Phase 2 flood and pluvial maps.
  - Zoning rules for peri-urban forests, limiting new housing in high wildfire-risk zones and guiding recreation infrastructure to safer areas.
- Municipal strategies and sectoral plans:
  - Adaptation Plan of the City of Košice (2022–2030) and SECAP can be updated to explicitly reference CRM risk maps and vulnerability hotspots as priority areas for measures (e.g. shading, NBS, drainage upgrades).
  - Transport and mobility plans can use flood-risk maps to prioritise protection of critical intersections, underpasses and public transport routes.
  - Social and health strategies can integrate heat-risk and vulnerability layers to target seniors, children and socially disadvantaged groups with heat-health action plans and cooling shelters.
  - Forest and landscape management plans can incorporate wildfire-exposure maps to guide biomass management, fire-breaks and access routes.
- Future investment decisions and project design:
  - All new public buildings, schools, sports facilities and housing projects can be required to demonstrate how they address local heat, flood or drought risk (e.g. cool roofs, shading, retention, water-saving systems).
  - Infrastructure investments (roads, drainage, parks, riverfronts) can be screened against Phase 2 risk layers to ensure they reduce, rather than increase, exposure and vulnerability.
  - Project selection and prioritisation in municipal budgets can use risk indicators (e.g. number of vulnerable people protected, expected damage reduction) as evaluation criteria.

Synergies for CRM in Košice:

- SCOPE created a shared evidence base that can be used by multiple departments (planning, environment, transport, social services, crisis management), which supports better coordination and joint prioritisation of measures.
- Many CRM measures (NBS, shading, retention, cycling paths) generate co-benefits for health, quality of life and environmental quality, making them attractive across sectors and easier to justify politically.
- The focus on vulnerable groups and high-risk neighbourhoods aligns CRM with social and health policies, strengthening the justice and equity dimension.

Tensions and challenges fo Kosice:

- Coordination challenges between city departments, municipal districts, regional authorities and utilities (e.g. VVS, forest managers) can slow down implementation, especially where mandates overlap or are unclear.
- Cross-scale tensions may arise when regional or national priorities (e.g. transport corridors, development pressure) conflict with local risk-reduction needs (e.g. preserving retention areas, limiting building in risky zones).
- Stakeholder dynamics can be complex: developers may resist stricter climate-proofing requirements; some residents may oppose changes in land use or new infrastructure.

Actions to improve CRM:

- Establish or formalise a cross-departmental CRM coordination group that uses Phase 2 data as a common reference for planning and investments.
- Introduce clear procedural requirements (e.g. “climate-risk check” for all major projects and spatial-planning changes).
- Develop standard guidelines for integrating risk maps into everyday planning practice (for planners, designers, project managers).
- Strengthen dialogue with developers and key stakeholders, explaining long-term benefits and co-benefits of climate-proofing.

New data now available:

- Harmonised hazard maps for heat, pluvial flooding, drought and wildfire exposure at local scale.
- Exposure and vulnerability layers, including identification of sensitive groups and critical infrastructure.
- Risk indicators (e.g. expected damage, number of people exposed) that can be used for prioritisation and economic justification of measures.

Košice still needed:

- More detailed local monitoring data, especially for:
    - micro-climate (urban heat islands at street level),
    - small-scale pluvial flooding (intensity, frequency),
    - soil moisture and drought impacts in peri-urban and agricultural areas.
- Better data on social vulnerability, including health status, mobility limitations, energy poverty and access to cooling.
- Capacity building and competencies in municipal departments to work with GIS, risk indicators and climate scenarios.
- Applied research and pilot projects to test the effectiveness of specific measures (e.g. different NBS configurations, shading solutions, wildfire-prevention practices).

Monitoring and evaluation of CRM objectives

At present, Košice has partial monitoring systems (e.g. hydrological and meteorological data, some health statistics, project-based indicators), but no fully integrated CRM monitoring and evaluation system that tracks progress across all CRM objectives defined in Chapter 3.1.

A suitable monitoring system for Košice could include:

- Indicator framework aligned with CRM objectives, for example:
  - number of people exposed to floods/heat,
  - annual average damage from floods and droughts,
  - area of green and blue infrastructure,
  - number of shaded public spaces and cooling shelters,
  - heat-related hospitalisations,
  - share of new developments with on-site retention and climate-proof design.
- Regular updates of risk maps and indicators (e.g. every 3–5 years), incorporating new data from monitoring stations, events and implemented measures.
- A centralised data platform or dashboard accessible to key municipal departments and decision-makers.
- Clear responsibilities: which department collects which data, who compiles the indicators, who reports to political leadership.
- Feedback loop into planning and budgeting: monitoring results used to adjust priorities, update strategies and justify further investments.
- Equity-focused indicators, tracking how benefits and protections are distributed across neighbourhoods and vulnerable groups.

Such a system would allow Košice not only to track progress towards its CRM objectives, but also to learn from implementation, refine measures over time and demonstrate accountability to residents and partners.

Based on the climate risk assessment results, stakeholder consultations, and identified implementation priorities, four key policy recommendations were developed to support political decision-making and facilitate the integration of climate resilience into local and regional governance.

1. Policy Note: Establish a Unified Heatwave Preparedness System for the Košice UMR

Heatwaves are the most urgent climate risk for the Košice region, disproportionately affecting children, seniors, hospital patients, and socially disadvantaged communities. Municipalities currently implement fragmented measures, but the region lacks a coordinated heat-action system with clear thresholds, responsibilities, and communication protocols. A unified regional Heatwave Preparedness System would ensure consistent early warnings, targeted protection of vulnerable groups, and integration of cooling measures into urban planning and public-space design.

A coordinated heatwave system is a **visible, politically resonant action** that protects lives, reduces hospitalizations, and demonstrates leadership in public health and climate resilience. It also strengthens alignment with the Adaptation Plan of Košice, SECAP, and the EU Mission for Climate-Neutral Cities.

2. Policy Note: Accelerate Investments in Nature-Based Retention and Drainage Upgrades

Extreme rainfall and flash floods repeatedly overwhelm existing drainage systems, causing damage to transport infrastructure, public buildings, and residential areas. Phase 2 results show that current infrastructure is undersized for future rainfall intensities. Municipalities need political support to scale up nature-based retention systems (rain gardens, infiltration zones, green roofs) and strategically upgrade drainage networks in high-risk zones.

Investing in retention and drainage is **cost-effective, fundable, and politically defensible**. It reduces flood damage, supports EU funding applications, and aligns with the region's adaptation strategy. Visible projects—such as the Ťahanovská water garden—demonstrate innovation and deliver tangible benefits to residents.

3. Policy Note: Strengthen Cross-Municipal Governance Through a Regional Climate Resilience Platform

Climate risks do not respect municipal boundaries. Drought, flash floods, and wildfires require coordinated planning, shared data, and joint investments. The SCOPE project revealed strong motivation among municipalities but also limited staff capacity and fragmented responsibilities. A permanent Regional Climate Resilience Platform—building on the Local Climate Resilience Mission—would institutionalize cooperation, standardize data use, and support joint adaptation projects.

A regional platform increases **political coherence**, improves access to EU funding, and reduces duplication of efforts. It positions Košice as a leader in climate governance and strengthens the region's long-term resilience capacity.

Within the CLIMAAX project, this platform is being prepared under the name CLIMAAX data repository, (kosice_scope map). The data repository should contain datasets from all regions participating in the CLIMAAX Open Call, together with standardized metadata information. These datasets will be connected with Zenodo, where the CLIMAAX deliverable documents are stored and where the full process behind the data creation is described.

4. Policy Note: Prioritize Vulnerable Groups in All Climate Adaptation Investments

Phase 2 and Phase 3 clearly show that climate impacts disproportionately affect vulnerable groups—children, seniors, hospital patients, and socially disadvantaged communities, including Roma settlements. Adaptation measures must therefore explicitly integrate vulnerability mapping, targeted interventions, and equity-based prioritization. This includes cooling shelters, safe schoolyards, flood-resilient social housing, and wildfire-safe recreational zones.

Equity-focused adaptation is **politically strategic**: it protects the most at-risk residents, strengthens social cohesion, and aligns with EU expectations for just transition and inclusive climate action. It also demonstrates responsible governance and improves public trust.

Overall Recommendation

Political leadership in Košice and UMR is encouraged to adopt these four actions as a unified climate-resilience agenda. Together, they provide a clear, evidence-based pathway to protect residents, modernize infrastructure, strengthen regional cooperation, and ensure that adaptation investments are equitable and future-proof. This agenda positions the Košice region as a proactive, responsible, and forward-looking leader in climate resilience.

4 Project Evaluation

4.1 Usability of the results

The results of the Phase 2 climate risk assessment provide Košice with a fundamentally improved and more precise understanding of local climate risks, making them highly usable for policy-making, spatial planning and future investment decisions. For the first time, the city has access to harmonised hazard maps, exposure layers, vulnerability assessments and quantified risk indicators that clearly show where heatwaves, pluvial flooding, drought and wildfire risks are most acute. This new knowledge confirms and updates a comprehensive evidence base that supports strategic and operational decisions across individual government departments.

The usability of these results is particularly strong because they directly support updates to local policies and regulatory frameworks. Spatial planning can now integrate climate-risk zones as binding layers, ensuring that new development avoids micro-depressions, wildfire-prone forest edges or strongly overheating neighbourhoods. Planning authorities can require on-site retention, shading, cool materials and water-saving systems in new buildings, embedding climate adaptation into the construction process. Municipal strategies such as the Adaptation Plan, SECAP, health and social strategies, mobility plans and green-infrastructure plans can use the Phase 2 maps to prioritise interventions in the most affected districts, from shading schoolyards to upgrading flood-prone intersections.

The results also strengthen the city's ability to justify and prioritise investments. Risk indicators quantifying expected annual damages and the number of people exposed help identify where adaptation measures will have the greatest impact. Vulnerability maps highlight neighbourhoods where seniors, children, low-income households and socially excluded communities face disproportionate risks, ensuring that adaptation planning is equitable and socially just. This supports more transparent and defensible decision-making, especially when allocating limited municipal resources.

Beyond policy and investment, the Phase 2 results improve coordination across municipal departments and external stakeholders. A shared evidence base reduces inconsistencies, supports joint planning and helps align actions between the city, municipal districts, utilities, crisis-management units and regional authorities. At the same time, the results reveal remaining gaps—such as limited micro-climate monitoring, insufficient pluvial flood data, or incomplete social vulnerability information—which can guide future data collection, research and capacity building.

Overall, the usability of the Phase 2 results is high: they provide Košice with actionable knowledge, clear policy implications, and a strong foundation for updating spatial planning regulations and designing climate-resilient investments. They also support a shift toward more coordinated, equitable and evidence-based climate governance, ensuring that the city is better prepared for current and future climate risks.

4.2 Lessons learned

During the third phase of the project, the main learning was how to translate the results of the climate risk assessment into practical climate risk management recommendations. The project improved the understanding of how risk levels can be estimated for four different hazards: heatwaves, extreme rainfall and flash floods, agricultural drought, and wildfires. This required gathering different types of data, harmonising them into comparable spatial scales, classifying hazard, exposure, and vulnerability layers, and combining them into understandable risk levels. The process showed that

climate risk management is not only a technical exercise, but also a communication and coordination process.

Another important lesson was the value of cooperation between project participants. The creation of the CLIMAAX Slovak group proved to be very effective, as it allowed project partners to share experience, discuss methodological questions, exchange data sources, and support each other in solving similar problems. This cooperation helped individual regions and municipalities move towards a common goal and increased the overall quality and consistency of the project outputs.

The main difficulties were related to data availability and data quality. In several cases, national or local datasets were difficult to access, incomplete, or available only in non-spatial formats. Some important information was provided only as PDF documents, images, or PNG maps, rather than as structured datasets suitable for GIS analysis. This made the data processing more time-consuming, because the information first had to be interpreted, digitized, harmonised, or replaced by alternative datasets. These difficulties confirmed the importance of open, well-documented, and machine-readable datasets for effective climate risk assessment and climate risk management.

Overall, the third phase showed that successful climate risk management depends on the combination of reliable data, transparent methodology, stakeholder cooperation, and clear communication of the results. The project also demonstrated that even when data limitations exist, useful and locally relevant outputs can be prepared if scientific methods are combined with local knowledge and continuous exchange between project partners.

Role of stakeholders and feedback on CRM recommendations

Stakeholders played a central role throughout all phases of the SCOPE project. Municipalities, regional authorities, public institutions, utilities, emergency services, researchers, NGOs, and community representatives contributed to the identification of climate risks, validation of results, and formulation of Climate Risk Management (CRM) recommendations. Their involvement ensured that the proposed measures reflected local realities, operational needs, and existing policy frameworks.

Stakeholder feedback on the CRM recommendations was largely positive. Municipal representatives appreciated the practical orientation of the proposed measures and the availability of spatially explicit risk information that can support planning and investment decisions. Regional stakeholders highlighted the importance of improved coordination among municipalities and the need for common adaptation priorities across the Košice Urban Development Region. Several participants also emphasized the necessity of strengthening financial support mechanisms and technical guidance for smaller municipalities with limited administrative capacity.

The policy recommendations developed through the project were considered particularly valuable because they translate complex climate-risk information into clear actions for decision-makers. Stakeholders recognized their potential to support updates of local adaptation plans, SECAPs, spatial planning documents, and future investment projects.

Ensuring learning and capacity building

Learning was ensured through a continuous process of stakeholder engagement, knowledge exchange, and practical application of project outputs. Workshops, co-design sessions, webinars, expert consultations, and validation meetings enabled participants to better understand climate risks and adaptation opportunities.

The project also contributed to institutional learning by introducing a harmonized climate-risk assessment methodology and providing municipalities with new analytical tools, datasets, maps, dashboards, and communication materials. The CLIMAAX Slovak network facilitated peer-to-peer learning among participating regions and municipalities and helped disseminate good practices beyond the project consortium.

The preparation of geo-stories, policy notes, and communication materials further strengthened the capacity of local authorities to communicate climate risks and adaptation needs to political representatives, stakeholders, and citizens.

The final outcomes of the project were communicated through multiple channels targeting decision-makers, stakeholders, technical experts, and the wider public.

- **Conferences and stakeholder meetings:** The results were presented and discussed with stakeholders, including municipalities, regional representatives, experts, and project partners. These meetings helped validate the outcomes and collect feedback on the proposed climate risk management measures.
- **Policy Notes and Policy Briefs** – Four policy notes were prepared addressing the most important climate resilience priorities identified by the project. In addition, concise information policy briefs summarising project findings, climate risks, and recommended actions will be distributed to all municipalities participating in the Košice Urban Development Region to facilitate local decision-making and awareness raising.
- **Publications and written outputs:** The project prepared written materials for both stakeholders and the scientific community. These outputs summarize the methodology, results, and practical recommendations, and support further dissemination of the project findings.
- **Webinars and online presentations:** Webinars were used to communicate the outcomes to stakeholders, experts, and the wider scientific community. This format allowed the project team to present results efficiently and reach participants who could not attend physical meetings.
- **Geo-stories:** Interactive geo-stories were prepared to present the results in a more accessible and visual form. They help explain climate risks, vulnerable areas, and proposed measures to the public, local authorities, and non-technical audiences.
- **CLIMAAX data repository:** The CLIMAAX data repository serves as the main storage and sharing platform for the produced datasets, maps, and related outputs. It supports transparency, reproducibility, and future reuse of the project results.
- **Košice web platform:** The Košice web platform provides a public communication channel where results can be presented in a user-friendly way. It supports public awareness and helps residents understand how climate risks may affect their municipality or neighbourhood.
- **Dissemination through other projects:** The outcomes are also shared through related national and European projects, which increases their visibility and supports knowledge transfer beyond the Košice UMR.

Several elements of the project proved particularly successful. The harmonized CLIMAAX methodology enabled a transparent and reproducible climate-risk assessment process. Stakeholder engagement was strong throughout all phases, and cooperation among municipalities, experts, and regional institutions significantly improved the quality of the outputs. The use of geo-stories and

visual communication tools proved effective in explaining complex climate-risk information to non-technical audiences.

The most significant challenges were related to data availability, differences in data quality, and varying capacities among municipalities. Some important datasets were unavailable in machine-readable formats, requiring additional processing and interpretation. Smaller municipalities often had limited technical and staffing capacities to engage in detailed analyses or implementation planning.

The project made efficient use of available financial and human resources by combining internal expertise with targeted external support. Cooperation within the CLIMAAX network reduced duplication of effort and enabled the sharing of methodologies, datasets, and lessons learned. Existing municipal initiatives and previously developed strategic documents were also used wherever possible, increasing efficiency and ensuring consistency with ongoing adaptation activities.

The project significantly improved the understanding of climate risks among municipalities, stakeholders, and decision-makers. Climate risks that were previously perceived as isolated events are now understood as interconnected challenges requiring coordinated adaptation measures.

5 Conclusions Phase 3

Phase 3 of the SCOPE project successfully translated the results of the climate risk assessment into practical Climate Risk Management (CRM) recommendations for the Košice Urban Development Region. Building on the evidence generated during the previous phases, the project established a clear link between climate-risk analysis and decision-making processes, providing municipalities and regional stakeholders with actionable guidance for strengthening climate resilience.

The project confirmed that heatwaves, extreme rainfall and flash floods, agricultural drought, and wildfires represent the most significant climate risks for the region. While existing strategic documents and adaptation initiatives provide a strong foundation for climate resilience, the assessment revealed several challenges related to fragmented governance, uneven technical capacities among municipalities, limited local monitoring data, and insufficient integration of climate risks into everyday planning and investment decisions.

One of the main achievements of Phase 3 was the development of a comprehensive Climate Risk Management framework that combines risk information, stakeholder knowledge, and practical adaptation measures. The project identified priority CRM objectives, supportive implementation mechanisms, and a portfolio of adaptation actions that can be incorporated into spatial planning, infrastructure investments, environmental management, public health policies, and municipal development strategies. Particular attention was given to vulnerable population groups, including children, seniors, hospital patients, and socially disadvantaged communities.

The project also demonstrated the importance of cooperation and stakeholder engagement throughout the climate adaptation process. Municipalities, regional authorities, public institutions, emergency services, utilities, researchers, and civil society organizations contributed valuable knowledge and feedback that improved both the quality and applicability of the project outputs. The participatory approach strengthened regional cooperation and increased awareness of climate risks among decision-makers and stakeholders.

An important outcome of the project is the creation of a shared evidence base consisting of harmonized datasets, risk maps, geo-stories, policy notes, and communication materials. These outputs support evidence-based decision-making and provide municipalities with practical tools for prioritizing adaptation investments and preparing future funding applications. The four policy notes developed during the project further translate technical findings into concise recommendations for political leaders and public authorities.

At the same time, several challenges remain. The project highlighted the need for more detailed local climate and vulnerability data, stronger institutional coordination, enhanced technical capacities, and long-term financing mechanisms for adaptation measures. Some municipalities continue to face limitations in staff resources and access to specialized expertise, which may affect the implementation of climate resilience actions.

Overall, Phase 3 successfully achieved its objective of bridging the gap between climate-risk assessment and climate-risk management. The project provides a robust foundation for future adaptation planning in the Košice Urban Development Region and contributes to the long-term resilience of municipalities, infrastructure, ecosystems, and communities. By combining scientific evidence, stakeholder participation, and practical policy recommendations, the SCOPE project has

strengthened the region's capacity to anticipate, prepare for, and respond to future climate challenges.

Key findings of Phase 3 include:

- Heatwaves, extreme rainfall and flash floods, agricultural drought, and wildfires remain the priority of climate risks for the Košice Urban Development Region.
- Harmonized climate-risk assessment results provide a reliable basis for planning and investment decisions.
- Stakeholder engagement significantly improved the relevance and usability of project outputs.
- Climate-risk information can be effectively integrated into spatial planning, infrastructure development, environmental management, and public health policies.
- Vulnerable population groups should remain a priority in future adaptation planning and investment decisions.
- Stronger regional cooperation, improved data availability, and enhanced institutional capacities are essential for successful long-term climate risk management.
- The policy notes, geo-stories, and communication materials developed through the project support the practical uptake of results by municipalities and regional stakeholders.

6 Progress evaluation

6.1 Project outputs

The project produced a range of technical, communication, and policy-oriented outputs designed to support climate adaptation and climate risk management within the Košice Urban Development Region.

Key outputs developed during Phase 3 include:

- Climate Risk Management framework for the Košice Urban Development Region.
- Portfolio of adaptation and resilience measures addressing heatwaves, flash floods, drought, and wildfire risks.
- Four policy notes translating project findings into practical recommendations for political leaders and decision-makers.
- Policy briefs and communication materials supporting dissemination of project results among municipalities and stakeholders.
- Geo-stories and visual communication products presenting climate risks and adaptation opportunities in an accessible format.
- Harmonized climate-risk datasets, maps, indicators, and analytical outputs prepared under the CLIMAAX methodology.
- Stakeholder engagement activities, workshops, consultations, and validation meetings supporting co-creation of project outputs.
- Final Phase 3 report and technical documentation.

The project outputs contribute to improved climate-risk awareness, stronger institutional capacity, enhanced cooperation among municipalities, and better integration of climate resilience considerations into planning and investment decisions.

Table 6-1 Overview key performance indicators

Key performance indicators	*Progress*
12 stakeholders involved in the activities of the project	*completed*
12 communication actions taken to share results with your stakeholders	*completed*
4 publications and dissemination actions	*completed*
4 notes for policy makers	*completed*
2 of workflow successfully applied on deliverable 1	*completed*
2 of workflow successfully applied on deliverable 2	*completed*

All KPI targets were achieved. Stakeholder engagement exceeded initial expectations, with municipalities, regional institutions, researchers, public authorities, and sectoral experts actively

participating throughout the project. Communication activities included stakeholder meetings, presentations, webinars, geo-stories, publications, policy notes, and dissemination through municipal and project communication channels.

Table 6-2 Overview milestones

Milestones	*Progress*
Mls 1 Stakeholder meeting in phase 1	*completed*
Mls 2 Phase 1 result presented	*completed*
Mls 3 Stakeholder meeting and co-design in phase 2	*completed*
Mls 4 Attend the CLIMAAX workshop held in Barcelona	*completed*
Mls 5 Policy recommendation actions	*completed*
Mls 6 Attend the CLIMAAX workshop held in Brussels	*Will be completed*

All project milestones were successfully achieved within the planned timeframe. Participation in CLIMAAX workshops provided valuable opportunities for knowledge exchange, methodological alignment, and sharing experiences with other European regions. The lessons learned from these events were incorporated into the project methodology and final recommendations.

Overall, the project progressed according to plan and delivered all expected outputs. The achieved results provide a strong foundation for future climate adaptation actions and support the long-term resilience of municipalities within the Košice Urban Development Region.

7 Supporting documentation

Main Report

The SCOPE project has generated a comprehensive set of technical materials that serve as a methodological and data foundation for climate adaptation planning and climate risk management in the Košice Urban Development Region. Developed within the CLIMAAX process, the project outputs are structured as follows:

- *Technical and Analytical Core:* The project followed a three-phase approach: identification and prioritization of climate hazards, comprehensive expert risk assessment (including hazard, exposure, and vulnerability analyses), and the development of actionable implementation recommendations for municipalities.
- *Data and Mapping Base:* Analytical inputs, including GIS analyses and datasets, focus on four priority risks: heatwaves, extreme rainfall and flash floods, agricultural drought, and wildfires. These materials provide the essential evidence base for spatial planning and investment decision-making.
- *Strategic Decision Support:* Research findings were translated into four analytical policy notes, providing recommendations for policymakers on heatwave preparedness, flood-risk reduction, regional climate governance, and the protection of vulnerable population groups. A policy brief summarising the main findings and recommendations was also prepared and distributed to all affected municipalities, heads of district offices, the Fire and Rescue Corps, and other relevant institutions and stakeholders.
- *Expert Participation:* The project involved a structured process of consultations and expert meetings with local stakeholders. The outcomes and validation results from these sessions are documented as a core part of the project's methodological framework.
- *Communication and Outreach:* The project emphasized the dissemination of findings to the public and educational institutions. This included the publication of two journal articles (happysmartmagazine, greenmagazine.sk) regular updates on social media ((10) Košice - Mesto Košice | Facebook, , and the delivery of specialized presentations for high school students.
- *Accessibility and Transparency:* All outputs, analytical reports, and datasets are archived in the CLIMAAX repository and on the Zenodo platform, ensuring long-term accessibility and reuse for public administration, research, and future regional development.

Visual Outputs

ArcGIS Story Maps

Horúčavy v Košiciach a okolí

Poľnohospodárske sucho a požiare v Košiciach a okolí

Bleskové záplavy v Košiciach a okolí

Communication Outputs – social media, journals

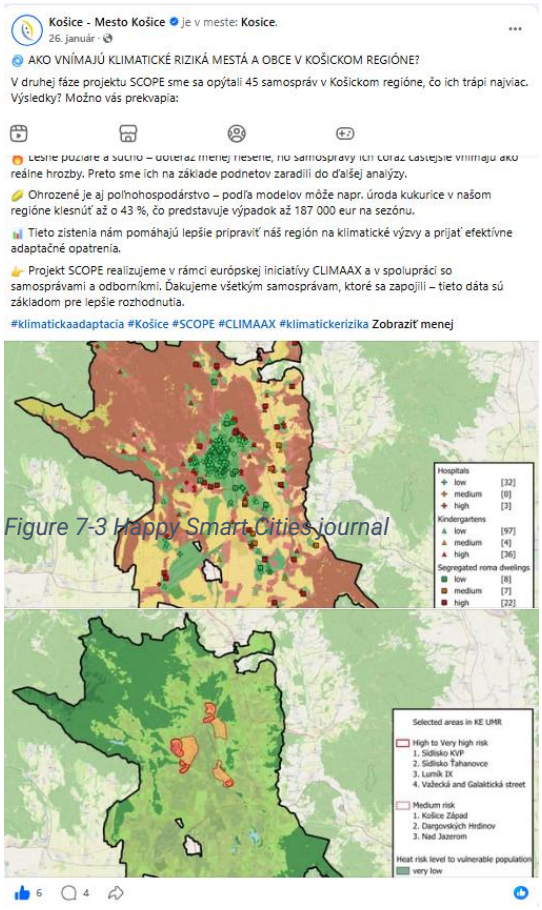


Figure 7-3 Happy Smart Cities journal

Figure 7-1 Facobook post

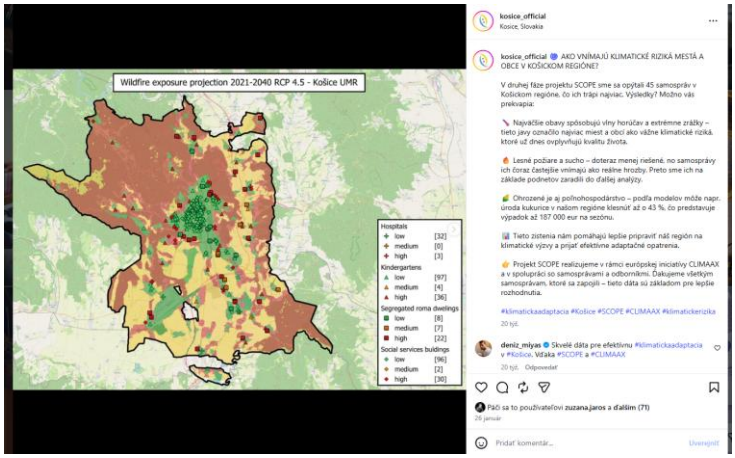
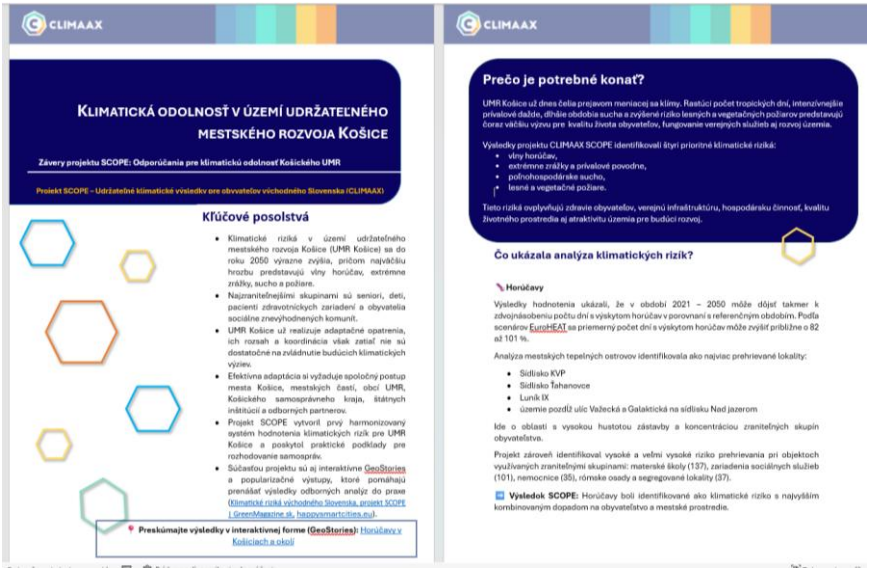


Figure 7-2 Instagram post



Figure 7-4 Green magazine



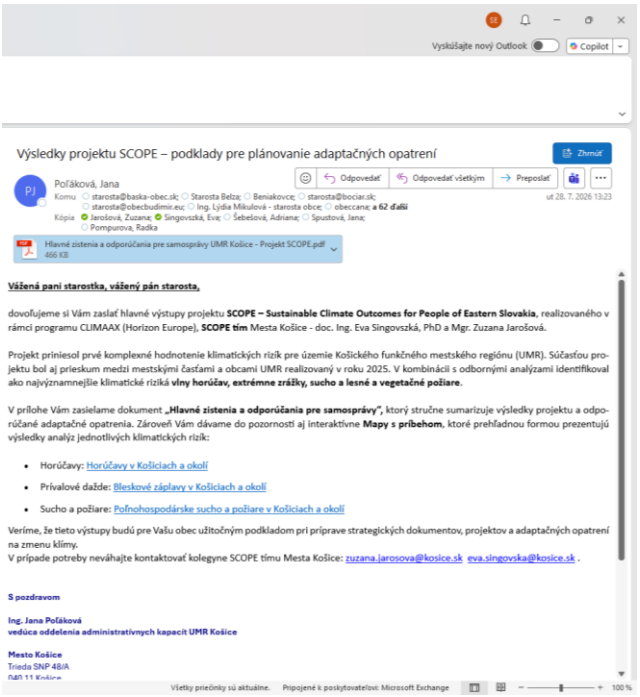


Figure 7-5 Policy brief

Datasets collected

Heatwave:

1. KE_UMR_risk_LST_2024_2025.tif **(hazard)**
2. KE_letisko_Tmin_Tmax_JJA_2013_2024.csv **(hazard)**
3. KE_Podhradova_Tmin_Tmax_JJA_2013_2024.csv **(hazard)**
4. KE_UMR_risk_pop.tif **(vulnerability)**
5. KE_UMR_possible_heat_risk_to_vulnerable_population.tif **(risk)**
6. scope_hospitals_heat24_25.gpkg **(exposure)**
7. scope_social_services_buildings_jtsk_heat24_25.gpkg **(exposure)**
8. scope_vulnerabl_roma_dwelings_heat24_25.gpkg **(exposure)**

9. scope_vulnerabl_kindergarten_merge_jtsk_heat24_25.gpkg **(exposure)**
10. scope_hospitals_cap_q5_risk.gpkg **(risk)**
11. scope_social_services_buldings_jtsk_cap_q5_risk.gpkg **(risk)**
12. scope_vulnerabl_roma_dwelings_cap_q5_risk.gpkg **(risk)**
13. scope_vulnerabl_kindergarten_merge_jtsk_heat_cap_q5_risk.gpkg **(risk)**
14. heat_wave_risk_assessment_local_level_KEUMR.ipynb **(risk)**
15. heat_metadata.docx

Extreme rainfall:

16. hazard_impact_database.xlsx **(risk, exposure, vulnerabilty, hazard)**
17. kosice_hazard_impact_points.gpkg **(risk)**
18. kosice_rain_gauges.gpkg **(hazard)**
19. KEUMR_precipipation_4_stations_SHMU_and_NOAA.xlsx **(hazard)**
20. idf_24h_ichec-ec-earth_knmi-racmo22e_historical_1976-2005.nc **(hazard)**
21. idf_24h_ichec-ec-earth_knmi-racmo22e_rcp45_2021-2050.nc **(hazard)**
22. idf_24h_ichec-ec-earth_knmi-racmo22e_rcp45_2021-2050_change.nc **(hazard)**
23. idf_24h_ichec-ec-earth_knmi-racmo22e_rcp85_2021-2050.nc **(hazard)**
24. idf_24h_ichec-ec-earth_knmi-racmo22e_rcp85_2021-2050_change.nc **(hazard)**
25. idf_24h_mohc-hadgem2-es_knmi-racmo22e_rcp45_2021-2050.nc **(hazard)**
26. idf_24h_mohc-hadgem2-es_knmi-racmo22e_rcp45_2021-2050_change.nc **(hazard)**
27. df_24h_mohc-hadgem2-es_knmi-racmo22e_rcp85_2021-2050.nc **(hazard)**
28. idf_24h_mohc-hadgem2-es_knmi-racmo22e_rcp85_2021-2050_change.nc **(hazard)**
29. idf_24h_mohc-hadgem2-es_knmi-racmo22e_historical_1976-2005.nc **(hazard)**
30. EXTREME_PRECIPITATION_Risk_Assessment_KEUMR.ipynb **(risk)**
31. EXTREME_PRECIPITATION_Hazard_Assessment_KEUMR_results_duration_curve.ipynb **(hazard)**
32. extreme_rainfall_metadata.docx

Wildfires:

33. hazard_HIST_199110.tif **(hazard)**
34. hazard_RCP45_CLMcom_CCLM_202140.tif **(hazard)**
35. hazard_RCP85_CLMcom_CCLM_202140.tif **(hazard)**
36. registered_wildfire_keumr.gpkg **(hazard, risk)**
37. scope_hospitals_wildfire_hazard.gpkg **(exposure)**
38. scope_social_services_buldings_jtsk_wildfire_hazard.gpkg **(exposure)**
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