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Deliverable Phase 3 – Climate risk management

CLIMAAX Risk Assessments Methodology Implementation for the Region Şanlıurfa (CRAS)

Türkiye, Southeastern Anatolia Region / Şanlıurfa Metropolitan Municipality

July 2026

HORIZON-MISS-2021-CLIMA-02-01 - Development of climate change risk assessments in European regions and communities based on a transparent and harmonised Climate Risk Assessment approach

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101093864. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Climate, Infrastructure and Environment Executive Agency (CINEA). Neither the European Union nor the granting authority can be held responsible for them.

Document Information

Deliverable Title	Phase 3 – Climate risk management
Brief Description	This deliverable presents the Climate Risk Management (CRM) framework for Şanlıurfa Metropolitan Municipality developed under Phase 3 of the CLIMAAX project. Building on the climate risk assessment completed in previous phases, it defines climate risk management objectives, adaptation measures, governance arrangements, monitoring indicators, and recommendations for integrating climate resilience into municipal planning and decision-making.
Project name	CLIMAAX Risk Assessments Methodology Implementation for the Region Şanlıurfa (CRAS)
Country	Türkiye
Region/Municipality	Southeastern Anatolia Region/Şanlıurfa Metropolitan Municipality
Leading Institution	Şanlıurfa Metropolitan Municipality, Climate Change and Zero Waste Department
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Deliverable submission date	29/07/2026
Final version delivery date	29/07/2026
Nature of the Deliverable	R – Report
Dissemination Level	PU - Public

Version	Date	Change editors	Changes
1.0	11/06/2026	Şanlıurfa Metropolitan Municipality	First draft initiated
2.0	02/07/2026	Atalay Climate Consulting: Tamer Atalay-Soner Atalay	Parts 3, 4, 5, and 6 added
3.0	17/07/2026	Şanlıurfa Metropolitan Municipality	Final Draft Review
4.0	29/07/2026	Şanlıurfa Metropolitan Municipality	Final version to be submitted

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Abbreviations and acronyms

Abbreviation / acronym	Description
AFAD	Turkish Disaster and Emergency Management Authority
AWC	Soil Available Water Capacity
CCAP	Climate Change Action Plan
CDP	Carbon Disclosure Project
CDS	Copernicus Data Store
CLIMAAX	Climate Adaptation and Risk Assessment Methodology
CRAS	CLIMAAX Risk Assessments Implementation for the Şanlıurfa Region
ÇŞİDB	Ministry of Environment, Urbanization, and Climate Change
DRMKC	Disaster Risk Management Knowledge Centre
ET_0	Reference Evapotranspiration
FAO	Food and Agriculture Organization of the United Nations
GAEZ	Global Agro-Ecological Zones
GAP	Southeastern Anatolia Project
GCM/RCM	Global Climate Model / Regional Climate Model
GCoM	Global Covenant of Mayors for Climate and Energy
GIS	Geographic Information System
HDD/CDD	Heating Degree Days / Cooling Degree Days
LST	Land Surface Temperature
MGM	Turkish General Directorate of Meteorology
NUTS	Nomenclature of Territorial Units for Statistics
P2R	Pathways2Resilience
RCP	Representative Concentration Pathways
SECAP	Sustainable Energy and Climate Action Plan
SMM	Şanlıurfa Metropolitan Municipality
SPEI	Standard Precipitation Evaporation Index
SSP	Shared Socioeconomic Pathways
ŞUSKI	Şanlıurfa Water and Sewerage Administration
UTCI	Universal Thermal Comfort Index
WASP	Weighted Anomaly of Standardized Precipitation
WHO	World Health Organization

Executive summary

This deliverable presents the Climate Risk Management (CRM) framework developed for Şanlıurfa Metropolitan Municipality during Phase 3 of the CLIMAAX project. Building on the climate risk assessments completed during Phases 1 and 2, the report translates scientific evidence into a practical framework for climate adaptation, governance and long-term resilience planning. It also reflects the synergies between CLIMAAX and the Pathways2Resilience (P2R) programme, ensuring continuity from climate risk assessment to adaptation strategy, investment planning and implementation.

The climate risk assessment identified **heatwaves and drought** as the most significant climate risks affecting Şanlıurfa. Climate projections indicate that the number of heatwave days is expected to increase from approximately **80 days per year today to around 100 days per year by 2050**. At the same time, the region faces a **high relative drought risk (4/5)**, with annual precipitation projected to decrease by approximately **30%** and reference evapotranspiration projected to increase by around **10%**. These changes are expected to place increasing pressure on water resources, agricultural production, public health and ecosystems. Under insufficient irrigation, agricultural yield losses could reach **up to 60% for maize**, while significant reductions are also projected for cotton, pistachio and wheat production. Vulnerable population groups—including elderly people, young children, refugees, outdoor workers and farming communities—are expected to be disproportionately affected.

Phase 3 transformed these scientific findings into a comprehensive Climate Risk Management framework. The report defines strategic CRM objectives, proposes measurable assessment indicators, identifies the institutional, technical and financial conditions required for effective implementation, and presents a portfolio of structural, non-structural, nature-based, technological, social and governance-related adaptation measures. Particular emphasis is placed on reducing heat-related health impacts, improving water security, strengthening climate-resilient agriculture, enhancing urban resilience and protecting vulnerable communities through equitable and evidence-based adaptation measures.

The report also demonstrates how climate risk management can be integrated into municipal planning and decision-making. The proposed framework supports the revision and implementation of the Sustainable Energy and Climate Action Plan (SECAP), Climate Change Action Plan, disaster risk management plans, spatial planning policies, water resource management strategies and agricultural adaptation policies. It further promotes climate-proofing of future municipal investments by incorporating climate resilience into infrastructure, public buildings, irrigation systems, urban regeneration projects and other strategic investments.

An important outcome of Phase 3 is the establishment of a strong link between CLIMAAX and the Pathways2Resilience programme. While CLIMAAX provides the scientific evidence and Climate Risk Management framework, P2R supports the preparation of a Climate Resilience Strategy, Climate Resilience Action Plan and Investment Plan. Together, these initiatives provide Şanlıurfa with a clear pathway from climate risk assessment to implementation, financing and long-term adaptive management.

The project also strengthened institutional capacity and stakeholder cooperation. Climate Risk Management was developed through close collaboration among Şanlıurfa Metropolitan

Municipality, ŞUSKİ, DSİ, AFAD, Harran University, the Provincial Directorate of Agriculture and Forestry, the Turkish General Directorate of Meteorology (MGM) and other regional stakeholders. Workshops, expert working groups, surveys and technical consultations improved the quality of the assessment, strengthened local ownership of the proposed adaptation measures and enhanced institutional capacity for evidence-based climate planning.

Overall, Phase 3 successfully established Şanlıurfa's first comprehensive Climate Risk Management framework, connecting scientific evidence with governance, planning, investment and implementation. The project has significantly strengthened the municipality's capacity to manage current and future climate risks while providing a practical foundation for integrating climate resilience into long-term municipal development. Continued implementation through the Pathways2Resilience programme, regular updates of the climate risk assessment, strengthened institutional coordination and sustained stakeholder engagement will be essential to ensure that the benefits achieved through CLIMAAX are translated into long-term climate resilience for Şanlıurfa.

1 Introduction

1.1 Main objectives of the project

Phase 3 aims to translate the climate risk assessment completed during Phases 1 and 2 into practical Climate Risk Management (CRM) approaches that support adaptation planning, governance and investment decisions in Şanlıurfa. Building on the evidence generated through the CLIMAAX Heatwave, Relative Drought and Agricultural Drought workflows, this phase establishes a practical framework for integrating climate risk information into municipal planning, sectoral policies, governance arrangements and long-term resilience actions.

In parallel, the **Pathways2Resilience** (P2R) programme, which concluded in February 2026, provided an opportunity to develop a Climate Resilience Strategy, Climate Resilience Action Plan and Climate Resilience Investment Plan based on the priority risks identified through CLIMAAX. Phase 3 builds on these P2R outputs by translating climate risk assessment results into practical climate risk management approaches, governance mechanisms and investment priorities, ensuring continuity between risk assessment, resilience planning and implementation.

The main objectives of Phase 3 are:

1. **Translate climate risk assessment into climate risk management**
   Phase 3 builds upon the priority risks identified in Phase 2 and supports the translation of scientific evidence into practical measures implemented by Şanlıurfa Metropolitan Municipality and relevant institutions. Particular emphasis is placed on strengthening cooperation among municipal departments, integrating climate risks into sectoral activities, and promoting risk-informed decision-making related to heatwaves, drought and water scarcity.
2. **Strengthen sectoral resilience**
   Given the importance of agriculture and water resources for the local economy, the project supports climate risk management approaches that enhance irrigation efficiency, promote sustainable water use, reduce agricultural losses and strengthen resilience to extreme heat and water scarcity. Particular attention is given to vulnerable populations, including elderly people, outdoor workers, low-income communities and climate-sensitive livelihoods.
3. **Strengthen stakeholder cooperation and institutional capacity**
   Through continued engagement with municipal departments, ŞUSKİ, AFAD, DSİ, the Provincial Directorate of Agriculture and Forestry, Harran University and other stakeholders, Phase 3 aims to strengthen coordination mechanisms and improve institutional capacity for climate adaptation. The project also supports cross-sectoral collaboration through expert groups and participatory processes established during the CLIMAAX process.
4. **Integrate climate risks into planning and investment decision-making**
   The outputs of Phase 3 provide practical guidance for incorporating climate risks into local policies, adaptation strategies and future investment priorities. Particular attention is given to urban greening, water efficiency, sustainable agriculture and public health measures. Phase 3 also provides an opportunity to strengthen further and operationalise the resilience outcomes developed under the Pathways2Resilience programme, including the Climate Resilience Strategy, Climate Resilience Action Plan and Climate Resilience Investment Plan, thereby ensuring continuity between climate risk assessment, resilience planning and implementation.

5. **Align with regional, national and European climate policies**
   The project contributes to the implementation of existing climate policies and supports broader climate resilience objectives at multiple governance levels. In particular, it ensures coherence with the Şanlıurfa Sustainable Energy and Climate Action Plan (SECAP)[1], the GAP Regional Development Administration Strategy and Action Plan[2], Türkiye's climate adaptation agenda[3], and European initiatives including CLIMAAX, Pathways2Resilience and the Global Covenant of Mayors (GCoM)[4].

1.2 Project team

The Climate Risk Management activities carried out under Phase 3 are led by the Şanlıurfa Metropolitan Municipality (SMM) through its Climate Change and Zero Waste Department, which coordinates project activities and supports the integration of climate risk management approaches into municipal planning processes. Atalay Climate Consulting provides technical and methodological support. A multidisciplinary team of six experts contributes to the project, including specialists in project management and risk governance, climate and environmental engineering, climate risk assessment, GIS and spatial analysis, and data analysis and workflow programming. In addition, two expert working groups—one on heatwaves and one on drought—meet monthly to provide technical input, validate results, and support the development of climate risk management approaches adapted to local conditions.

1.3 Outline of the document's structure

This deliverable follows the CLIMAAX Phase 3 template and presents the climate risk management framework developed for Şanlıurfa, building on the results of the previous climate risk assessment phases. The document is organized as follows:

- **Introduction** outlines the objectives of Phase 3, describes the project team and explains the structure of the report.
- **Local Profile** summarizes the key climate risks identified during Phase 2, describes the policy and institutional context for climate risk management, identifies the main actors involved and highlights lessons learned from past events.
- **Climate Risk Management – Phase 3** presents the objectives of climate risk management, supportive elements required for effective implementation, potential adaptation measures and their integration into planning and decision-making processes.
- **Project Evaluation** discusses the usability of the project results, stakeholder feedback, and lessons learned during Phase 3.
- **Conclusions** summarize the main achievements and findings of the project.
- **Progress Evaluation** reviews the key performance indicators and milestones achieved during this phase.

[1] Şanlıurfa SECAP Report: https://www.sanliurfa.bel.tr/uploads/2024/20240930103339-32137-48344.pdf
[2] GAP Strategy Report 2024-28: https://www.gap.gov.tr/Yayin/Dosya/www.gap.gov.tr_391_DE7I44GX.pdf
[3] ÇŞDİB Climate Change Adaptation Strategy and Action Plan (2024-2030) https://iklim.gov.tr/db/turkce/icerikler/files/Uyum.pdf
[4] GCoM: https://www.globalcovenantofmayors.org/cities/middle-east-and-north-africa/turkey/sanliurfa-metropolitan-municipality/

- **Supporting Documentation** lists the reports, maps, datasets and communication outputs produced throughout the project to ensure transparency and facilitate future use of the results.

2 Local profile

2.1 Summary of Key Risk Assessment results

Based on existing knowledge of Şanlıurfa's climate challenges and the municipality's previous climate planning activities, the Heatwave, Relative Drought and Agricultural Drought workflows were selected during the CLIMAAX proposal stage as the most relevant assessments for the region. Phase 2 subsequently quantified and validated these risks using the CLIMAAX methodology, confirming that heatwaves and drought represent the highest-priority climate risks for Şanlıurfa. The Phase 2 results then provided the evidence base for the Climate Resilience Strategy, Climate Resilience Action Plan and Climate Resilience Investment Plan developed under the Pathways2Resilience (P2R) programme, and subsequently informed the Climate Risk Management framework presented in this Phase 3 deliverable.

Figure 2-1 summarises the results of the Phase 2 climate risk assessment. The dashboard combines the CLIMAAX risk evaluation with stakeholder and community surveys, illustrating how climate risks were prioritised according to severity, urgency, resilience capacity and overall risk priority.

Risk Workflow	Severity		Urgency	Capacity	Risk Priority
	C	F		Resilience/ CRM	
River flooding	N.A	N.A	N.A	N.A	N.A
Coastal flooding	N.A	N.A	N.A	N.A	N.A
Heavy rainfall	1	2	2	2	Moderate
Heatwaves	4	4	4	1	Very High
Drought	3	4	3	1	Very High
Fire	1	1	1	3	Low
Snow	N.A	N.A	N.A	N.A	N.A
Wind	1	1	1	3	Low

Severity	Urgency	Resilience Capacity	Risk Ranking
Critical	Immediate action needed	High	Very high
Substantial	More action needed	Substantial	High
Moderate	Watching brief	Medium	Moderate
Limited	No action needed	Low	Low

Figure 2-1 Key Hazard Dashboard of Şanlıurfa

The two priority risks affect different but highly interconnected sectors of the regional economy. Heatwaves primarily threaten public health, urban systems and vulnerable populations, whereas drought directly affects agricultural productivity, water security and rural livelihoods. Given Şanlıurfa's strategic role as one of Türkiye's most important irrigated agricultural regions under the GAP programme, increasing drought pressure also poses significant risks to regional economic resilience. These findings justify prioritising integrated water management, urban heat adaptation and climate-resilient agricultural practices within the Climate Risk Management framework.

The resilience capacity of Şanlıurfa was assessed using the qualitative framework recommended in the CLIMAAX Handbook, considering the region's ability to anticipate, cope with, adapt to and recover from climate-related impacts. Although Şanlıurfa benefits from strong agricultural expertise, extensive irrigation infrastructure, and increasing institutional awareness of climate risks, its overall resilience capacity remains low because of growing water scarcity, rising temperatures, socio-economic vulnerabilities, and limited adaptive capacity among vulnerable population groups.

Assessment of Resilience Capacity across key dimensions:

- Financial capacity: Funding for drought response, irrigation upgrades, and heatwave preparedness is constrained. Heavy dependence on national funds and donor programs limits flexibility. Rating: Low
- Human capacity: Awareness of climate risks is increasing, and municipal technical staff, universities, and sectoral experts contribute expertise. However, capacity gaps remain in municipal departments and agricultural directorates, as well as among smallholder farmers. Rating: Medium
- Natural capacity: Very low precipitation, extremely high evapotranspiration, soil degradation, and dominance of water-intensive crops limit natural resilience. Rating: Low
- Physical capacity: Although irrigation networks exist, modern pressurized systems are incomplete, canal losses remain high, very limited urban green space per capita, and cooling infrastructure in cities is limited. Rating: Low
- Social capacity: High poverty rates, large vulnerable populations (elderly, refugees, seasonal agricultural workers), and limited community-level adaptation awareness reduce resilience. Rating: Low

Table 2-1 Priority climate risks and resilience capacity

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	*Low*	*Existing climate knowledge, SECAP, CLIMAAX heatwave maps and increasing awareness provide a basis for adaptation. However, insufficient urban cooling infrastructure (very low green land per capita) and dedicated heat-health action plans remain limited.*	*Şanlıurfa Metropolitan Municipality, Harran University, Health Directorate, Climate Change and Zero Waste Department, expert working group, stakeholder workshops. Vulnerable groups include elderly people, children, outdoor workers and low-income communities.*
Drought	*Low*	*Although irrigation networks exist, modern pressurized systems are incomplete, and canal losses remain high. Strong agricultural experience supports resilience. Nevertheless, decreasing precipitation, increasing evapotranspiration, and heavy dependence on artificial irrigation create significant vulnerabilities. Planned measures focus on irrigation efficiency and sustainable water management.*	*ŞUSKİ, DSİ, Provincial Directorate of Agriculture and Forestry, GAP Regional Development Administration, farmers, Harran University and expert groups through monthly meetings and workshops.*

The CLIMAAX Relative Drought workflow classified Şanlıurfa as having a high relative drought risk (4/5), with this level projected to persist through 2050. Climate projections indicate that annual

precipitation may decrease by approximately 30%, while reference evapotranspiration may increase by around 10%, further increasing artificial irrigation demand and pressure on already limited water resources.

Agricultural production represents one of the most climate-sensitive sectors in the region. Under conditions of insufficient irrigation, average yield losses by 2050 may reach approximately 60% for maize, 40% for cotton and pistachio, 25% for wheat, 27% for lentil, and 11% for chickpea. The associated annual economic losses under irrigation deficit conditions were estimated at approximately €968 million by 2050 (based on local productivity data and unit prices), highlighting the importance of improving irrigation efficiency, sustainable water allocation and crop diversification to prevent agricultural drought from escalating into broader socio-economic impacts.

Heatwaves in Şanlıurfa already exhibit extreme characteristics; with up to 80 days per year exceeding 34°C for at least three consecutive days; extreme heatwaves (Tmax > 39.5°C, Tmin > 25.4°C, 3 consecutive days) occurring 20 days per year; and 1–2 extreme heatwave events per year currently. The 2050 projection (RCP4.5) demonstrated that the number of heatwave days with temperatures exceeding 34°C is projected to increase from around 80 days to approximately 100 days per year by 2050. Extreme heatwave conditions (Tmax > 39.5°C, Tmin > 25.4°C, d=>3 days) will double (20 → 40 days/year). Extreme events increase from 1–2 to 4–5 per year, posing increasing risks to public health and urban systems. Vulnerable groups include children under five years of age, elderly populations, outdoor workers, and economically disadvantaged communities.

Overall, the Phase 2 assessment confirmed that heatwaves and drought represent the highest-priority climate risks for Şanlıurfa and demonstrated that the current resilience capacity is insufficient to address their projected impacts. These findings directly informed the Climate Risk Management objectives, adaptation measures, governance arrangements and monitoring framework presented in this deliverable, while also providing the evidence base for the Climate Resilience Strategy, Action Plan and Investment Plan prepared under the P2R programme.

2.2 Key implementation mechanisms and policy context for CRM

A combination of municipal planning instruments, regional development programmes, national sectoral mandates and European climate resilience initiatives shapes climate risk management in Şanlıurfa. The main implementation challenge is to connect the scientific evidence generated through CLIMAAX with the institutions and investment mechanisms that can reduce heatwaves and drought risks in practice.

At the **local level**, Şanlıurfa Metropolitan Municipality is the main coordinating institution for CRM. The Climate Change and Zero Waste Department provides the institutional entry point for integrating climate risk information into municipal planning. At the same time, other departments are responsible for implementation in their respective sectors. The Agricultural Services Department is relevant for drought resilience and climate-smart agriculture; the Parks and Gardens Department and Urban Planning Department are central for urban heat mitigation and green infrastructure; the Public Works Department is relevant for climate-sensitive infrastructure; and ŞUSKİ plays a key role in urban water supply, wastewater management, leakage reduction and water reuse. Together, these municipal institutions provide the primary implementation mechanism for CRM. They enable the scientific evidence generated through CLIMAAX to be translated into sector-specific planning and adaptation measures rather than remaining solely as technical assessment outputs.

The **Şanlıurfa Sustainable Energy and Climate Action Plan (SECAP)** provides an existing municipal policy framework for climate action. It is particularly relevant for linking heatwave and drought risks with urban greening, energy demand, water management and public awareness. However, the CLIMAAX and P2R processes showed that additional operational instruments are required, including a city-wide heat-health action plan, more systematic use of climate risk maps in spatial planning, and stronger monitoring indicators for water efficiency and vulnerable population protection.

The **Pathways2Resilience outputs** provide an important bridge between climate risk assessment and implementation. The Climate Resilience Strategy, Climate Resilience Action Plan and Climate Resilience Investment Plan developed for Şanlıurfa translate CLIMAAX risk findings into adaptation objectives, action pathways and financing priorities. These documents identify concrete adaptation priorities, including reducing urban heat exposure, improving water efficiency, strengthening drought resilience, protecting vulnerable populations and promoting integrated governance. They also establish investment priorities and implementation pathways, helping embed CLIMAAX findings into a broader municipal resilience planning framework.

At the **regional level**, the GAP Regional Development Administration and the GAP Strategy and Action Plan 2024–2028 are central to CRM in Şanlıurfa. Since the province is one of the key agricultural and irrigation regions in south-eastern Türkiye, GAP investments in irrigation expansion, smart farming, renewable energy, rural development and agricultural transformation are highly relevant for drought and water scarcity management. For CRM, the key challenge is ensuring that these investments are aligned with the climate risks identified by CLIMAAX. This includes reducing inefficient irrigation practices, protecting agricultural livelihoods and avoiding further dependence on water-intensive production systems.

The **State Hydraulic Works (DSİ)** is another critical regional and national implementation actor. DSİ's investment programmes in irrigation networks, water storage, drainage and flood protection directly affect Şanlıurfa's ability to manage drought and water scarcity[5]. The transition from traditional or inefficient irrigation practices towards closed-pressure irrigation networks and water-efficient systems is one of the most important structural mechanisms for reducing agricultural drought risk. Close coordination between Şanlıurfa Metropolitan Municipality, ŞUSKİ, DSİ and GAP is therefore essential. This will help ensure that future water infrastructure investments reflect projected climate risks rather than historical climate conditions.

At the **national level**, CRM in Şanlıurfa is influenced by Türkiye's climate adaptation agenda, the 2053 net-zero target, national strategies on water efficiency, agricultural modernization, disaster risk reduction and sustainable urban development. The Ministry of Agriculture and Forestry, the Turkish General Directorate of Meteorology (MGM), AFAD and relevant provincial directorates provide important mandates, data and implementation capacity. MGM climate projections were already used to strengthen the CLIMAAX assessment, while AFAD is increasingly relevant for linking climate risk assessment with emergency preparedness. The June 2026 coordination meeting between AFAD Headquarters and Şanlıurfa Metropolitan Municipality's Disaster Affairs and Risk Management Department demonstrated the growing opportunity to integrate heatwave and drought

[5] DSİ 2025 Investment and Implementation Plan
https://cdniys.tarimorman.gov.tr/api/File/GetFile/459/Sayfa/1340/1693/DosyaGaleri/dsi_2025_yili_yatirim_programi_ve_uygulama_plani.pdf

risks into disaster risk management. This cooperation also strengthens preparedness for vulnerable population groups.

At the **European level**, CLIMAAX and Pathways2Resilience provide methodological, technical and strategic support. CLIMAAX strengthens the evidence base through harmonised climate risk assessment workflows, while P2R supports the translation of risk information into strategy, action planning and investment readiness. Şanlıurfa's engagement with the Global Covenant of Mayors, CDP[6]Horizon Europe and EU Mission Adaptation frameworks also create opportunities for knowledge exchange, visibility, and future financing. These European frameworks are particularly important because many of Şanlıurfa's adaptation needs require investment beyond the regular municipal budget.

The **private sector** also has an important role in CRM, particularly through technology and investment. Priority areas include solar-powered irrigation, water-saving irrigation technologies, agri-solar applications, climate-smart agriculture, renewable energy, wastewater reuse and circular economy solutions. However, private sector engagement remains constrained by limited access to finance and a shortage of investment-ready projects. The Climate Resilience Investment Plan helps address these barriers by identifying priority investments and promoting public-private cooperation.

Overall, the policy and implementation context for CRM in Şanlıurfa is becoming stronger, but it remains fragmented across sectors and governance levels. The main opportunity for Phase 3 is to use CLIMAAX evidence to improve coordination between municipal departments, ŞUSKİ, DSİ, GAP, AFAD, agricultural institutions, academia and the private sector. The most important implementation mechanisms include integrating climate risk maps into municipal and sectoral planning, aligning irrigation and urban greening investments with climate priorities, strengthening governance and coordination platforms, and using the P2R Strategy, Action Plan and Investment Plan as a bridge between scientific assessment and long-term implementation.

2.3 Key actors and systems for CRM

Effective Climate Risk Management (CRM) in Şanlıurfa depends on strong cooperation among governmental institutions, public utilities, research organisations, regional authorities, the private sector and local communities. Throughout the CLIMAAX project, stakeholders were actively engaged in scoping, risk exploration, validation, and the identification of adaptation pathways. Monthly expert group meetings, stakeholder workshops and the Pathways2Resilience process strengthened institutional cooperation and supported the integration of climate resilience into long-term planning, governance and investment processes.

[6] CDP: https://www.cdp.net/en

Table 2-2 Main actors involved in climate risk management in Şanlıurfa and their role in CRM

Key actors	Role and responsibility	Motivation and needs	Opportunities related to their active involvement in CRM	Barriers related to their active involvement in CRM	Type of engagement
SMM (Climate Change and Zero Waste Department)	Overall coordination of CRM and integration of climate risks into municipal planning	Strengthen resilience and protect citizens and infrastructure	Strong institutional ownership, SECAP, P2R outputs provide a basis for implementation	Budget limitations and cross-sector coordination challenges	Scoping, risk exploration, monthly expert groups, stakeholder workshops and validation activities
ŞUSKİ	Water supply, wastewater management, water efficiency	Ensure long-term water security	Existing infrastructure and operational data	Increasing water demand and climate pressures	Risk exploration, technical consultations and stakeholder workshops
State Hydraulic Works (DSİ)	Irrigation infrastructure and water resources management	Sustainable water use and agricultural productivity	Large-scale investments and technical expertise	High investment requirements and institutional complexity	Technical consultations and expert discussions
GAP Regional Development Administration	Regional development and agricultural transformation	Promote sustainable development and reduce regional vulnerabilities	Access to regional programmes and financing mechanisms	Need for coordination across sectors and institutions	Scoping and stakeholder consultations
Provincial Directorate of Agriculture and Forestry	Agricultural adaptation and support to farmers	Protect agricultural production and livelihoods	Extension services and direct interaction with producers	Resource constraints and limited adaptive capacity among farmers	Agricultural drought assessment and stakeholder workshops
AFAD and Disaster Affairs and Risk Management Department	Disaster preparedness and emergency management	Reduce disaster losses and protect vulnerable populations	Growing integration of climate adaptation and disaster risk reduction	Limited experience with slow-onset climate risks	Stakeholder consultations and coordination meetings, including the June 2026 meeting with AFAD Headquarters
Provincial Health Directorate	Heat-health preparedness, public health surveillance and protection of vulnerable populations	Reduce heat-related health impacts and strengthen public health resilience	Existing healthcare network, health surveillance systems and public awareness capacity	Limited experience with climate-related health planning and heat-health action plans	Stakeholder workshops and expert consultations
Harran University	Scientific and technical support	Research, innovation and knowledge generation	Strong academic expertise and local knowledge	Dependence on project-based cooperation	Expert groups, validation activities and stakeholder workshops
Farmers and producer organizations	Implementation of agricultural adaptation measures	Maintain productivity and income security	Practical knowledge and willingness to adapt	Financial limitations and traditional practices	Stakeholder workshops and consultations
Vulnerable groups and citizens	Primary beneficiaries of adaptation measures	Protection of health, livelihoods and living conditions	Community awareness and local knowledge	Limited adaptive capacity and socio-economic constraints	Surveys, stakeholder consultations and representation through workshops

2.4 Lessons learned from past events

Heatwaves are an emerging disaster risk that requires greater attention in emergency management. The CLIMAAX assessment demonstrated that increasing frequency and duration of heatwaves pose growing risks to public health, particularly for elderly people, children and outdoor workers. Stakeholder consultations and coordination meetings, including the June 2026 meeting with AFAD Headquarters, highlighted that heatwaves are still relatively new within disaster risk management systems. Strengthening heat-health action plans, early warning systems and institutional preparedness should therefore become a priority.

Drought management requires preventive approaches. Past drought episodes highlighted the need for efficient irrigation, climate-resilient crops, improved soil-water management and stronger monitoring systems. Protecting agricultural livelihoods is essential for maintaining social and economic resilience.

Water security depends on institutional coordination. Effective management of drought and water scarcity requires close cooperation among ŞUSKİ, DSİ, the GAP Regional Development Administration, the Provincial Directorate of Agriculture and Forestry and local authorities.

Stakeholder engagement improves ownership and implementation. Monthly expert group meetings, stakeholder workshops and consultations carried out during CLIMAAX and P2R improved the quality of risk assessments and facilitated the identification of locally relevant adaptation measures.

Climate adaptation and disaster risk reduction should be addressed together. Strengthening cooperation between adaptation and emergency management institutions has become increasingly important. The June 2026 coordination meeting between AFAD Headquarters and SMM highlighted opportunities to improve preparedness and protect vulnerable populations.

Local data and scientific knowledge enhance decision-making. The integration of local datasets and stakeholder knowledge significantly improved the relevance and credibility of the assessment results and provided a stronger basis for climate risk management.

Multi-sectoral governance is essential for managing compound climate risks. Heatwaves, drought and water scarcity affect multiple sectors simultaneously. Effective climate risk management therefore requires coordination among municipal departments, water authorities, agricultural institutions, disaster management agencies, academia and local stakeholders.

External cooperation and knowledge networks are particularly important for Şanlıurfa. Limited institutional capacity, relatively low GDP per capita and a shortage of specialised climate experts underline the importance of cooperation with national institutions, universities and European initiatives. CLIMAAX and Pathways2Resilience demonstrated that peer learning and international cooperation can significantly accelerate climate adaptation and resilience planning in Şanlıurfa.

Synergies between CLIMAAX and P2R accelerated the transition from assessment to implementation. The scientific evidence generated through CLIMAAX provided the foundation for the Climate Resilience Strategy, Action Plan and Investment Plan developed under P2R. At the same time, Phase 3 of CLIMAAX created an opportunity to operationalise these outcomes further and strengthen long-term climate risk management in Şanlıurfa.

3 Climate risk management – phase 3

3.1 CRM objectives

The Climate Risk Management (CRM) objectives for Şanlıurfa build upon the climate risk assessment undertaken in Phase 2 and were further refined through the Pathways2Resilience (P2R) process. Together, they provide a strategic framework for reducing current and future climate risks while strengthening the municipality's long-term resilience.

The CRM objectives address the priority climate risks identified through the climate risk assessment, namely heatwaves, agricultural drought and relative drought, which are projected to intensify under future climate change scenarios. The assessment indicates increasing heatwave frequency, declining precipitation, increasing evapotranspiration, growing water stress, and significant potential agricultural yield losses under insufficient irrigation. These findings were used to define the Climate Risk Management objectives presented below and to identify indicative assessment indicators that can support future monitoring and evaluation of adaptation progress.

In addition to reducing climate risks, the CRM objectives promote sustainable development, protect critical livelihoods, improve public health, strengthen institutional capacity and support evidence-based decision-making. Particular attention is given to vulnerable populations and climate-sensitive livelihoods, including elderly people, young children, refugees, outdoor workers and agricultural communities, ensuring that climate adaptation contributes to equitable and inclusive resilience across Şanlıurfa.

Table 3-1 Primary Climate Risk Management objectives and indicative assessment indicators

Primary objectives	*Baseline information and indicative assessment indicators*
Reduce exposure and vulnerability to heatwaves	***Baseline:*** *Approximately 80 heatwave days (>34°C) per year, projected to increase to around 100 days/year by 2050.* ***Indicators:*** *Number of vulnerable people exposed; heat-related hospitalisations; urban green space per capita; number of cooling centres established.*
Strengthen water security and ensure sustainable water use	***Baseline:*** *Relative drought risk score: 4/5 (High).* ***Indicators:*** *Per capita water consumption; water losses in distribution systems (%); percentage of population with access to safe drinking water; volume of recycled water.*
Maintain agricultural productivity and protect farmers' livelihoods	***Baseline:*** *Projected yield losses under insufficient irrigation of up to 60% for maize, around 40% for cotton and pistachio, and approximately 25% for wheat.* ***Indicators:*** *Irrigated area (ha); area under efficient irrigation systems; annual agricultural revenue losses; number of farmers trained.*
Strengthen resilience to relative drought and land degradation	***Baseline:*** *Annual precipitation projected to decrease by around 30%, while evapotranspiration is projected to increase by approximately 10%.* ***Indicators:*** *Groundwater level; soil moisture indicators; water quality; area under sustainable land management.*

Table 3-2 Additional climate risk management objectives and indicative assessment indicators

Additional objectives	*Baseline information and indicative assessment indicators*
Public health	***Baseline:*** *Increasing exposure to extreme heat.* ***Indicators:*** *Heat-related illnesses and hospitalisations; number of heat-health awareness activities; implementation of Heat-Health Action Plan*

Social well-being	***Baseline:*** *Urban green space approximately 4.6 m²/person.* ***Indicators:*** *Accessibility of parks and public spaces; population benefiting from cooling infrastructure.*
Environmental quality	***Baseline:*** *Limited urban green infrastructure in densely built-up areas.* ***Indicators:*** *Number of trees planted; restored green and blue infrastructure; surface water and groundwater quality indicators.*
Institutional capacity and stakeholder engagement	***Baseline:*** *Two expert working groups established with monthly meetings.* ***Indicators:*** *Number of stakeholder workshops and training activities; inter-institutional coordination meetings.*
Justice and equity	***Baseline:*** *Elderly people, children, refugees, outdoor workers and low-income communities identified as priority vulnerable groups.* ***Indicators:*** *Number of adaptation measures targeting vulnerable groups; proportion of municipal adaptation projects explicitly addressing vulnerable populations.*
Knowledge and innovation	***Baseline:*** *Local datasets integrated with CLIMAAX methodology through cooperation University and national institutions.* ***Indicators:*** *Number of climate-related research p funding secured; updates of climate datasets and risk assessments.*

The proposed CRM objectives establish a comprehensive framework for reducing climate risks while supporting sustainable urban and regional development. The accompanying assessment indicators provide an initial basis for monitoring implementation, evaluating the effectiveness of adaptation measures and periodically reviewing climate resilience priorities. Together, they support an adaptive management approach that enables Şanlıurfa Metropolitan Municipality to continuously refine its climate risk management strategy as new climate information, socio-economic data and policy priorities emerge.

3.2 Supportive elements for effective CRM

Effective Climate Risk Management (CRM) in Şanlıurfa depends not only on understanding climate risks but also on the institutional, technical, financial and social capacities required to implement adaptation measures successfully. The climate risk assessment undertaken through CLIMAAX, together with the Pathways2Resilience (P2R) process, strengthened the municipality's understanding of priority climate risks and identified several enabling conditions that support the transition from risk assessment to practical climate adaptation. At the same time, the assessment highlighted areas where additional investments, data, and institutional capacity are required to strengthen long-term climate resilience further.

Table 3-3 Supportive elements for effective Climate Risk Management in Şanlıurfa

Supportive elements for effective CRM	*Description*
Knowledge and data *(institutional capacity, risk understanding)*	*The climate risk assessment significantly improved understanding of heatwave, agricultural drought, and relative drought risks through the integration of regional MGM climate projections, Terra ASTER night-time land surface temperature data, local crop coefficients, TÜİK agricultural productivity statistics, local market prices, and stakeholder knowledge. Institutional capacity has been strengthened through the Climate Change and Zero Waste Department, monthly expert working groups and cooperation with Harran University. Nevertheless, additional health, groundwater, soil degradation, ecosystem, and socio-economic datasets*

	are needed to improve future risk assessment implementation, bridge and adaptation planning.
Tech and infrastructure *(monitoring systems, irrigation systems, green and grey infrastructure)*	*Existing irrigation infrastructure developed under the GAP programme, water supply and wastewater systems managed by ŞUSKİ, and investments by DSİ provide an important foundation for climate adaptation. Future priorities include modern irrigation technologies, leakage reduction in water distribution systems, wastewater reuse, heat-health early warning systems, expanded urban green infrastructure and climate-resilient public infrastructure.*
Social-behavioural aspects *(awareness, trust and behavioural change)*	*Increasing awareness of heatwaves, drought and water scarcity among institutions, farmers and citizens supports the implementation of adaptation measures. However, behavioural changes related to water conservation, efficient irrigation practices and heat-health protection require further awareness-raising and capacity-building activities. The collaborative processes established through CLIMAAX and P2R have strengthened trust, knowledge exchange and social learning among participating stakeholders.*
Citizen engagement	*Stakeholder workshops, expert working groups and consultation surveys ensured that local knowledge was incorporated into the climate risk assessment and adaptation planning process. Continued participation of citizens, farmers, vulnerable groups, civil society organisations and the private sector will remain essential for increasing ownership, improving acceptance of adaptation measures and supporting long-term implementation.*
Finances and resources	*Municipal budgets, investments by ŞUSKİ, DSİ and the GAP Regional Development Administration, together with opportunities provided through European initiatives such as CLIMAAX and Pathways2Resilience, constitute important financial resources for adaptation. Nevertheless, the scale of future climate risks requires additional national and international funding, innovative financing mechanisms and stronger integration of climate adaptation into municipal investment planning.*
Governance arrangements and political leadership *(coordination mechanisms and mandate clarity)*	*Şanlıurfa Metropolitan Municipality coordinates climate adaptation through its Climate Change and Zero Waste Department. Implementation responsibilities are shared across municipal departments and external institutions, including ŞUSKİ, DSİ, AFAD, the Provincial Directorate of Agriculture and Forestry, and the Provincial Directorate of Meteorology. The Climate High Council established in 2024, together with the expert working groups and stakeholder platforms developed through CLIMAAX and P2R, provides an effective governance structure for improving coordination, strengthening political commitment and supporting evidence-based climate risk management.*

3.3 Potential CRM measures

Based on the climate risk assessment and the Climate Risk Management objectives presented in the previous sections, a portfolio of adaptation measures was developed to address Şanlıurfa's priority climate risks of heatwaves and drought. The proposed measures combine **structural, non-structural, nature-based, technological, social and governance approaches**, recognising that no single intervention is sufficient to manage increasingly complex climate risks. Instead, an integrated combination of prevention, preparedness, response and long-term resilience-building measures is required. The proposed measures were further refined through the Pathways2Resilience (P2R) process and prioritised using the results of stakeholder consultations and expert working group surveys. Their prioritisation considered not only their expected contribution to climate risk reduction but also their technical feasibility, implementation timeframe, institutional responsibilities, potential co-benefits and possible adaptation limits under future climate scenarios. Particular emphasis is placed on measures that generate multiple benefits across sectors. In addition to reducing climate risks, many of the proposed interventions contribute to improved public health, biodiversity conservation, sustainable water management, agricultural productivity, energy efficiency and social well-being. Special consideration has also been given to vulnerable population groups—including elderly people, children, refugees, outdoor workers and agricultural communities—to ensure that adaptation measures contribute to climate justice and equitable resilience across Şanlıurfa.

Figure 3-1 presents the prioritisation of adaptation measures based on the stakeholder consultation process undertaken with the Heatwave and Drought Expert Working Groups.

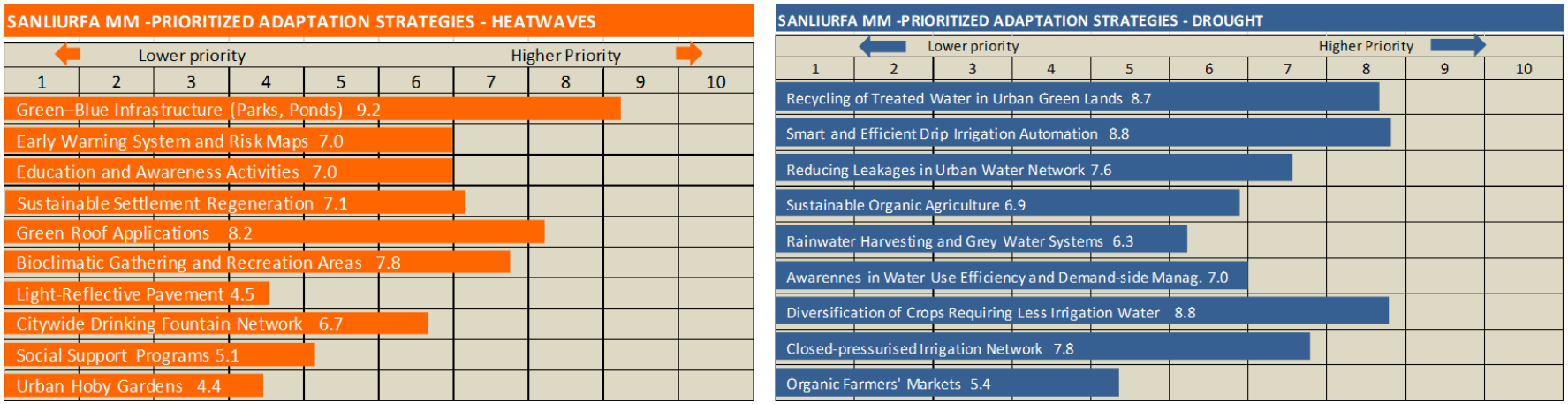


Figure 3-1 Survey results on prioritization of possible adaptation measures

Heatwave Risk

Heatwaves represent one of the most significant climate risks for Şanlıurfa and are projected to increase in both frequency and duration under future climate scenarios. The assessment identified particularly high exposure among elderly people, young children, refugees, outdoor workers and low-income communities, as well as within densely built urban areas affected by the Urban Heat Island effect. Consequently, the proposed measures combine emergency preparedness, climate-resilient urban planning, nature-based solutions, behavioural change and governance interventions to reduce heat exposure while strengthening long-term urban resilience. Particular priority is given to protecting vulnerable populations through targeted health measures, improved access to shaded public spaces and cooling centres, heat-health warning systems and awareness campaigns.

Table 3-4 Potential CRM measures for heatwaves in Şanlıurfa

Key climate risk	*CRM measure*	*Effectiveness / Risk reduction (high, medium, low)*	*Contribution to CRM objectives*	*Possible co-benefits*	*Timeline (short, medium, long term)*	*Responsible organisation*	*Possible adaptation limits*
Heatwaves	*Heat-health action plan*	High	Reduced heat-related illness and mortality, particularly among elderly people, children and other vulnerable groups; improved emergency preparedness	Better coordination between institutions	Short term	SMM, Health Directorate, AFAD	Requires continuous updating
Heatwaves	*Heat early warning systems*	High	Reduced exposure of vulnerable populations through timely warnings and targeted emergency response	Improved emergency management	Short term	MGM, AFAD, SMM	Limited effectiveness without awareness
Heatwaves	*Urban greening- improving blue-green ınfrastructure*	High	Reduced Urban Heat Island effect, particularly in densely populated and heat-vulnerable neighbourhoods	Improved air quality and biodiversity	Medium term	Parks and Gardens Department	Water availability constraints

Heatwaves	*Shaded public spaces and cooling centres*	Medium	Reduced heat exposure while improving access to cooling for vulnerable communities and outdoor workers	Social inclusion and public health benefits	Medium term	SMM	Increasing cooling demand
Heatwaves	*Climate-resilient building design and green roofs*	Medium	Reduced indoor heat stress	Energy savings	Long term	Urban Planning Department	Existing building stock
Heatwaves	*Awareness campaigns and public education*	Medium	Increased adaptive capacity	Improved risk awareness	Short term	SMM, NGOs	Behavioural barriers
Heatwaves	*Adaptation of working hours for outdoor workers*	Medium	Reduced occupational heat stress and improved health and safety for outdoor workers	Increased productivity and safety	Short term	Municipal departments, employers	Extreme heat may exceed safe thresholds
Heatwaves	*Expansion of urban green corridors*	High	Reduced heat exposure	Recreation and ecosystem services	Long term	SMM	Limited urban space

Drought Risk

Drought is one of the most significant long-term climate risks for Şanlıurfa due to declining precipitation, increasing evapotranspiration and growing pressure on water resources. The proposed measures focus on improving water-use efficiency, strengthening agricultural resilience, protecting water resources and supporting climate-smart farming systems. The portfolio combines infrastructure investments, technological innovation, ecosystem-based approaches, farmer capacity building and integrated water governance. Particular attention is given to protecting the livelihoods of smallholder farmers and ensuring equitable access to water resources, recognising that climate change disproportionately affects rural communities that depend directly on agriculture for their income.

Table 3-5 Potential CRM measures for drought risk in Şanlıurfa

Key climate risk	*CRM measure*	*Effectiveness / Risk reduction (high, medium, low)*	*Contribution to CRM objectives*	*Possible co-benefits*	*Timeline (short, medium, long term)*	*Responsible organisation*	*Possible adaptation limits*
Drought	*Efficient irrigation systems*	*High*	*Reduced water consumption while protecting agricultural productivity and farmers' livelihoods*	*Improved water productivity*	*Medium term*	*DSİ, Provincial Directorate of Agriculture*	Severe water shortages
Drought	*Smart and digital irrigation technologies*	*High*	*Increased irrigation efficiency*	*Energy savings*	*Medium term*	*DSİ, farmers*	Investment costs
Drought	*Solar-powered irrigation systems*	*Medium*	*Improved energy efficiency*	*Reduced emissions*	*Medium term*	*Farmers, private sector*	High initial investment
Drought	*Farmer training and advisory services*	*Medium*	*Strengthened adaptive capacity of farmers, particularly smallholders and vulnerable rural communities*	*Knowledge transfer*	*Short term*	*Provincial Directorate of Agriculture*	Limited uptake
Drought	*Crop diversification for less irrigation req.*	*High*	*Reduced yield losses*	*Food security*	*Medium term*	*Research institutions, farmers*	Market acceptance
Drought	*Soil conservation practices*	*Medium*	*Increased water retention*	*Reduced erosion*	*Medium term*	*Farmers*	Behavioural barriers
Drought	*Expansion of climate-smart*	*High*	*Improved long-term resilience, farm income stability and food security*	*Income diversification*	*Long term*	*Provincial Directorate of Agriculture*	Financial constraints

	and organic agriculture						
Drought	*Drought monitoring and advisory systems*	*Medium*	*Better preparedness*	*Improved decision-making*	*Short term*	*MGM, Agriculture Directorate*	Data availability
Drought	*Crop diversification*	*Medium*	*Reduced dependence on water-intensive crops*	*Increased resilience*	*Medium term*	*Farmers*	Economic viability
Drought	*Leakage reduction in water distribution systems*	*High*	*Improved water security and more equitable access to water resources*	*Reduced operational costs*	*Medium term*	*ŞUSKİ*	Ageing infrastructure
Drought	*Wastewater reuse and recycling*	*High*	*Reduced freshwater demand*	*Circular economy benefits*	*Medium term*	*ŞUSKİ*	Public acceptance
Drought	*Integrated water resources management*	*High*	*Improved coordination*	*Reduced conflicts between sectors*	*Long term*	*ŞUSKİ, DSİ, SMM*	Institutional complexity
Drought	*Water conservation campaigns*	*Medium*	*Reduced water demand through inclusive public awareness and behavioural change*	*Increased awareness*	*Short term*	*SMM, ŞUSKİ*	Behavioural barriers

Overall, the proposed CRM measures provide a balanced portfolio of structural, non-structural, nature-based, technological, social and governance interventions that together strengthen Şanlıurfa's resilience to heatwaves and drought. Their implementation will not only reduce climate risks but also generate wider environmental, economic and social co-benefits, including improved public health, increased water security, enhanced biodiversity, more resilient agricultural systems and strengthened institutional cooperation. At the same time, the assessment recognises that certain adaptation measures may face physical, financial, technological or institutional limits under more severe climate change scenarios. Continuous monitoring,

stakeholder engagement and periodic review of adaptation priorities will therefore be essential to ensure that the Climate Risk Management strategy remains effective and responsive to future climate conditions.

3.4 Integration into planning and decision making

The Climate Risk Assessment undertaken through CLIMAAX provides a robust evidence base for integrating climate resilience into municipal planning, investment decisions and sectoral policies in Şanlıurfa. The assessment supports the systematic incorporation of climate risk considerations into existing strategic documents, including the Sustainable Energy and Climate Action Plan (SECAP), the Climate Change Action Plan, disaster risk management plans, spatial and land-use planning, water resource management strategies and agricultural development policies. It also provides technical evidence for climate-proofing future municipal investments, ensuring that new infrastructure, public buildings, urban regeneration projects, irrigation systems and water supply networks incorporate appropriate climate adaptation measures throughout their design and implementation.

Building on the CLIMAAX assessment, the Pathways2Resilience (P2R) programme further strengthens climate risk management by supporting the preparation of a **Climate Resilience Strategy**, an **Climate Resilience Action Plan** and an **Climate Resilience Investment Plan** for Şanlıurfa. Together, these documents provide a structured pathway for translating climate risk assessments into prioritised adaptation actions, financing strategies and long-term implementation mechanisms. The resilience pathways developed through P2R also encourage adaptive management by enabling climate actions to be periodically reviewed and adjusted as new information, technologies and funding opportunities become available.

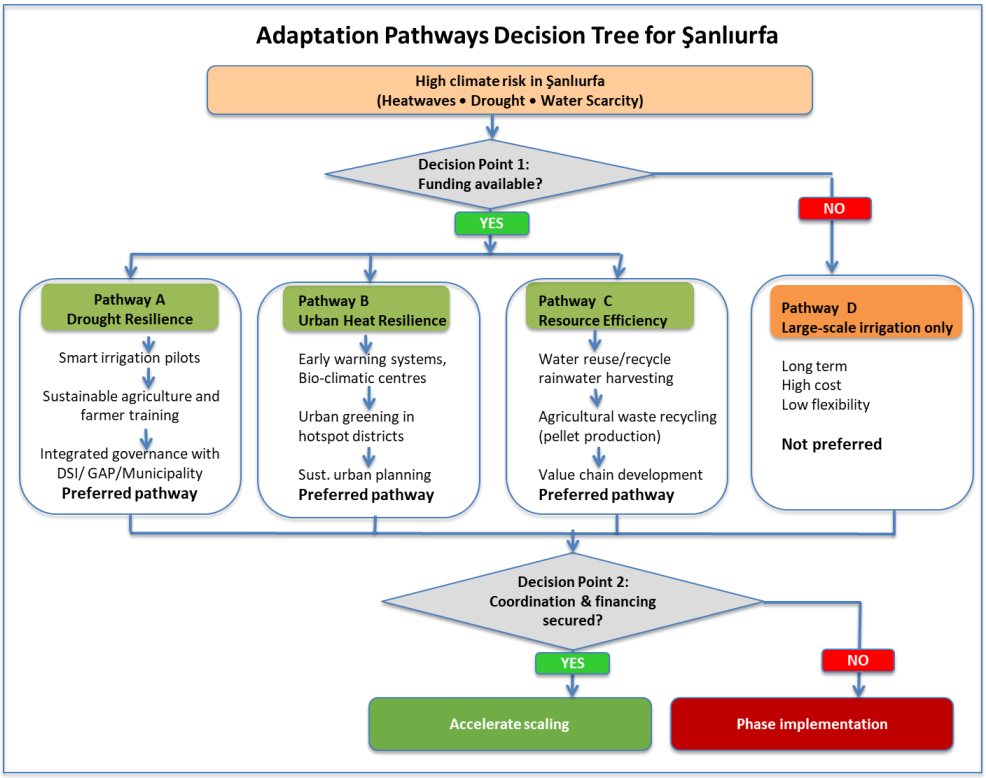


Figure 2-2 Adaptation Pathways Decision Tree for Şanlıurfa

Figure 3-2 illustrates an example of a resilience pathway for Şanlıurfa. The pathway recognises heatwaves, drought and water scarcity as the municipality's primary climate risks and identifies complementary adaptation pathways focusing on drought resilience, urban heat resilience and

resource efficiency. Progress along these pathways depends on the availability of financial resources, institutional coordination and stakeholder cooperation. Where funding or implementation capacity is limited, priority actions may need to be introduced gradually through phased implementation until sufficient resources become available for wider scaling.

Strong synergies have been established through cooperation between Şanlıurfa Metropolitan Municipality, district municipalities, Harran University, ŞUSKİ, DSİ, AFAD, the Provincial Directorates, the Turkish General Directorate of Meteorology (MGM), civil society organisations and stakeholders engaged throughout the CLIMAAX and P2R processes. These partnerships have strengthened knowledge exchange, improved institutional coordination and supported evidence-based decision-making. Nevertheless, several challenges remain, including fragmented data sharing, overlapping institutional responsibilities, limited technical capacity and the need for stronger coordination across municipal, regional and national governance levels. Climate Risk Management can therefore be further strengthened through permanent inter-institutional coordination mechanisms, standardised data-sharing protocols, integrated investment planning and regular stakeholder engagement.

The CLIMAAX project has substantially improved the regional evidence base through high-resolution climate hazard, exposure and vulnerability assessments, while participation in the Carbon Disclosure Project (CDP) enables annual reporting on climate action and adaptation progress. However, additional information is still required to support future decision-making, particularly higher-resolution local climate observations, groundwater monitoring, water demand projections, ecosystem condition assessments, socio-economic vulnerability data, critical infrastructure datasets and sector-specific vulnerability analyses. Continued collaboration with universities, research institutions and national agencies will further improve climate services and support evidence-based adaptation planning.

Although Şanlıurfa already operates several monitoring mechanisms—including annual CDP reporting, SECAP implementation monitoring, municipal strategic performance indicators and monitoring activities under the Pathways2Resilience programme—a more integrated Climate Risk Management monitoring framework would strengthen long-term evaluation and adaptive management. Such a framework should include:

- periodic updates of the Climate Risk Assessment (every 3–5 years);
- annual monitoring of adaptation actions, implementation progress and municipal investment programmes;
- monitoring of climate-related indicators associated with the CRM objectives presented in Section 3.1;
- annual reporting through the Carbon Disclosure Project (CDP);
- regular evaluation of SECAP implementation under the Global Covenant of Mayors for Climate and Energy (GCoM);
- periodic review of the Climate Resilience Strategy, Climate Resilience Action Plan and Climate Resilience Investment Plan developed under the Pathways2Resilience programme;
- continuous stakeholder consultation and expert working group meetings to support adaptive management and evidence-based decision-making.

4 Project Evaluation

4.1 Usability of the results

The CLIMAAX project has substantially improved Şanlıurfa Metropolitan Municipality's understanding of climate risks by providing a comprehensive, evidence-based assessment of heatwaves, agricultural drought and relative drought using high-resolution climate, exposure and vulnerability datasets. Beyond producing a climate risk assessment, the project strengthened institutional capacity by introducing systematic risk analysis methods, improving data integration and supporting evidence-based decision-making across municipal departments.

The project results provide a scientific basis for updating the Sustainable Energy and Climate Action Plan (SECAP), the Climate Change Action Plan, disaster risk management plans, water resource management strategies, agricultural adaptation policies and urban development plans. They also support the prioritisation of climate adaptation investments by identifying areas where climate resilience should be incorporated into future infrastructure, public buildings, irrigation systems, urban regeneration projects and other municipal investments.

The climate risk maps, vulnerability analyses and Climate Risk Management recommendations can also support revisions of spatial planning and land-use policies by discouraging development in highly vulnerable areas, promoting nature-based solutions, protecting critical infrastructure and integrating climate resilience into future planning and investment decisions.

An important outcome of the project is that the CLIMAAX results now provide the technical foundation for the Pathways2Resilience (P2R) programme, under which Şanlıurfa is preparing its Climate Resilience Strategy, Climate Resilience Action Plan and Investment Plan. Consequently, the project has moved beyond risk assessment and is directly supporting long-term climate resilience planning, financing and implementation.

4.2 Lessons learned

Phase 3 demonstrated that translating climate risk assessments into effective Climate Risk Management requires not only scientific evidence but also strong institutional cooperation, stakeholder engagement and long-term governance arrangements. While the technical methodologies developed within CLIMAAX proved robust and transferable, one of the main challenges was coordinating multiple institutions with different responsibilities, priorities and data management practices. Clarifying institutional roles and strengthening cross-sectoral coordination emerged as important prerequisites for successful climate adaptation.

Stakeholders played a central role throughout the project by contributing local knowledge, validating datasets, identifying priority climate risks and proposing additional analyses relevant to local conditions, including irrigation requirements, agricultural productivity and heat-related vulnerabilities. The stakeholder workshops, surveys and expert working groups increased confidence in the assessment results and contributed to broad ownership of the Climate Risk Management recommendations.

Learning and capacity building were embedded throughout the project. All major outputs were prepared in Turkish to facilitate local use, training sessions on the CLIMAAX Handbook and assessment methodologies were organised, two thematic expert working groups were established,

and regular coordination meetings enabled continuous knowledge exchange between municipal departments, universities and national institutions. These activities significantly strengthened local institutional capacity for climate adaptation planning.

The final project results were communicated through stakeholder workshops, technical reports, GIS-based climate risk maps, presentations to municipal departments and discussions with regional and national stakeholders. The publication of datasets and deliverables also supports transparency, future research and wider application of the project's methodology.

The participatory approach, standardised CLIMAAX methodology and strong collaboration between municipal experts, academic institutions and national agencies proved particularly successful. At the same time, the project highlighted the importance of improving data harmonisation, expanding local monitoring networks, strengthening inter-institutional coordination and securing long-term financial resources for implementation.

Overall, the project made efficient use of available financial, technical and human resources by combining municipal expertise with scientific support from the CLIMAAX consortium. Rather than creating new institutional structures, the project strengthened existing capacities and established processes that can continue beyond the project lifetime.

Most importantly, the Climate Risk Management process has substantially improved Şanlıurfa's understanding of climate risks, strengthened evidence-based planning, increased institutional cooperation and enhanced the municipality's readiness to secure future climate adaptation funding. The continuation of this work through the Pathways2Resilience programme demonstrates that CLIMAAX has created a lasting foundation for long-term climate resilience planning and implementation.

5 Conclusions Phase 3

Phase 3 represents the transition from climate risk assessment to operational Climate Risk Management (CRM) in Şanlıurfa. Building on the scientific evidence generated during the previous CLIMAAX phases, it translated climate risk information into a practical framework that supports adaptation planning, governance, investment prioritisation and evidence-based municipal decision-making. Rather than producing an additional assessment, Phase 3 demonstrated how climate risk information can be systematically integrated into policy development and climate adaptation planning.

The project confirmed that heatwaves and drought remain Şanlıurfa's priority climate risks due to increasing temperatures, declining precipitation, increasing evapotranspiration and growing pressure on water resources. These hazards threaten public health, agriculture, water security, ecosystems and vulnerable groups, including elderly people, children, refugees, outdoor workers and farming communities. In response, Phase 3 established clear CRM objectives, measurable indicators, supportive implementation mechanisms and a portfolio of structural, nature-based, technological, social and governance-related adaptation measures.

A key achievement was the development of an integrated Climate Risk Management framework that links scientific evidence with practical implementation. The project demonstrated how climate resilience can be incorporated into the Sustainable Energy and Climate Action Plan (SECAP), Climate Change Action Plan, spatial planning, disaster risk management, water resource management, agricultural policies and future municipal investments through climate-proof infrastructure and resilient land-use planning.

The close alignment between CLIMAAX and the Pathways2Resilience (P2R) programme provides a clear pathway from climate risk assessment to implementation. While CLIMAAX established the evidence base and CRM framework, P2R supports the preparation of a Climate Resilience Strategy, Climate Resilience Action Plan and Investment Plan, enabling Şanlıurfa to move towards long-term adaptation, financing and adaptive management.

Phase 3 also demonstrated that successful Climate Risk Management depends not only on scientific knowledge but equally on institutional cooperation, stakeholder participation and effective governance. Collaboration among municipal departments, ŞUSKİ, DSİ, AFAD, Harran University, the Provincial Directorate of Agriculture and Forestry, MGM and other stakeholders strengthened the quality of the assessment, improved local ownership of the proposed adaptation measures and enhanced institutional capacity through regular workshops, expert meetings and training activities.
Despite these achievements, important challenges remain. Fragmented institutional responsibilities, limited coordination, inconsistent data sharing, financial constraints and insufficient long-term monitoring continue to affect implementation. Additional improvements in climate observations, groundwater monitoring, socio-economic datasets and sector-specific vulnerability assessments will further strengthen evidence-based decision-making and adaptive management.

Overall, Phase 3 has established the foundations of a comprehensive Climate Risk Management system for Şanlıurfa. By connecting scientific evidence, stakeholder participation, governance, planning and investment priorities, the project has significantly strengthened the municipality's capacity to manage current and future climate risks. Continued implementation through the Pathways2Resilience programme, together with regular updates of the climate risk assessment,

strengthened coordination and sustained stakeholder engagement, will help ensure Şanlıurfa's long-term transition towards climate resilience.

Key findings

- Phase 3 successfully transformed the CLIMAAX Climate Risk Assessment into a practical Climate Risk Management framework linking scientific evidence with planning, governance and investment decisions.
- Heatwaves and drought remain Şanlıurfa's highest-priority climate risks and require integrated structural, nature-based, technological, social and governance-related adaptation measures.
- The CRM framework provides clear objectives, monitoring indicators and prioritised adaptation measures that support evidence-based municipal decision-making.
- Climate resilience can be systematically integrated into SECAP, spatial planning, water management, agricultural policies and future municipal investments.
- The strong complementarity between CLIMAAX and Pathways2Resilience creates a clear pathway from climate risk assessment to strategy development, investment planning and implementation.
- Stakeholder participation strengthened data quality, institutional cooperation and local ownership of the Climate Risk Management process.
- Future progress will depend on stronger governance coordination, improved climate and socio-economic data, sustainable financing and continuous monitoring and adaptive management.

6 Progress evaluation

6.1 Project outputs

The activities planned in the Individual Follow-up Plan (IFP) were successfully completed during the implementation of the CLIMAAX project. The project achieved the planned technical outputs by completing the three project phases, including the climate risk assessment, the refined local risk assessment and the development of the Climate Risk Management framework. The project also exceeded several dissemination and stakeholder engagement objectives through workshops, expert group meetings, scientific dissemination and continued implementation under the Pathways2Resilience (P2R) programme.

Table 6-1 Overview key performance indicators

Key performance indicators	*Progress*
2 climate risk assessment workflows successfully implemented at NUTS3 level	Achieved. Two CLIMAAX workflows (Heatwaves and Relative/Agricultural Drought) were implemented using local datasets and high-resolution climate information.
4 vulnerable sectors and populations identified	Achieved. Priority sectors include agriculture, water resources, public health and urban areas. Vulnerable groups include elderly people, children, refugees, outdoor workers and farming communities.
150 stakeholders engaged through dissemination and training	Exceeded. More than 150 stakeholders participated through workshops, expert group meetings, surveys, consultations and dissemination events conducted during the three project phases.

Key performance indicators	*Progress*
7 local decision-makers provided with actionable climate risk information	Achieved. Climate risk assessment results were shared with municipal departments, Harran University, DSİ, AFAD, Provincial Directorates, ŞUSKİ and other regional institutions to support climate adaptation planning.
8 communication actions implemented	Exceeded. Communication included stakeholder workshops, technical meetings, presentations, reports, publications, CLIMAAX dissemination events, website publications and international conference participation.
5 neighbouring municipalities informed and engaged	Achieved. Project results were disseminated through regional cooperation activities and knowledge exchange with neighbouring municipalities and regional institutions.
3 regional media articles or public mentions	Achieved. Project activities were communicated through municipal communication channels, regional dissemination activities and public awareness initiatives.

Table 6-2 Overview milestones

Milestones	*Progress*
M1 – Document review and initial data collection completed	Completed. European, national and local datasets were collected, reviewed and integrated into the CLIMAAX methodology.
M2 – Initial risk assessment completed and Deliverable 1 submitted	Completed. Initial multi-risk assessment successfully delivered using the CLIMAAX methodology.
M3 – High-resolution local data integrated	Completed. Local climate, land surface temperature, agricultural, socio-economic and vulnerability datasets were incorporated into the refined assessment.
M4 – Refined risk assessment completed and Deliverable 2 submitted	Completed. Refined assessment incorporating local datasets and comparison with Phase I results successfully completed.
M5 – Adaptation strategies identified and proposed	Completed. CRM objectives, indicators, supportive elements and adaptation measures were developed through stakeholder engagement and expert consultations.
M6 – Final deliverable prepared and disseminated	Completed. Climate Risk Management framework completed and communicated through workshops, reports, stakeholder meetings and integration with the Pathways2Resilience programme.

Overall, the project successfully achieved the objectives and outputs defined in the Individual Follow-up Plan. Beyond delivering the planned climate risk assessments and Climate Risk Management framework, the project strengthened institutional capacity, stakeholder cooperation and the integration of climate resilience into municipal planning. The continuation of this work through the Pathways2Resilience programme demonstrates that the CLIMAAX project has generated impacts extending beyond its original scope and has established a solid foundation for long-term climate adaptation in Şanlıurfa.

7 Supporting documentation

This section provides an overview of the documentation supporting Phase 3 of the CLIMAAX project for Şanlıurfa Metropolitan Municipality. To ensure transparency, reproducibility and long-term accessibility, all relevant outputs have been organised and uploaded to the project's Zenodo repository in accordance with the CLIMAAX data management and dissemination requirements. The repository includes the final Climate Risk Management report together with the technical assessment outputs, datasets, maps, figures and workflow documentation developed during Phase 2 and updated where necessary to support Phase 3. It also contains stakeholder engagement and communication materials produced throughout the project. As many stakeholder engagement, communication and dissemination activities were conducted at the local level, several supporting documents (e.g. workshop presentations, meeting minutes, questionnaires, brochures, press releases and website content) are available only in Turkish.

Supporting files and outputs

The supporting documentation is organised in the same order as it appears in the Zenodo repository:

1 Sanliurfa_Heatwave_Hazard_Assessment.zip
Heatwave hazard assessment, workflow outputs, maps and supporting analyses.
2 Sanliurfa_Heatwave_Risk_Assessment.zip
Heatwave exposure, vulnerability and risk assessment results.
3 Sanliurfa_Relative_Drought_Hazard_and_Risk_Assessment.zip
Relative drought hazard and risk assessment outputs.
4 Sanliurfa_Agricultural_Drought_2025_Hazard_and_Risk_Assessment.zip
Agricultural drought assessment for the baseline period.
5 Sanliurfa_Agricultural_Drought_2050_Hazard_and_Risk_Assessment.zip
Future agricultural drought assessment under climate change scenarios.
6 Communication_Outputs.zip
Presentations, workshop materials, dissemination products and communication outputs developed during the project.
7 Data_Sets.zip
Supporting datasets, input data and processed data used throughout the climate risk assessment and Climate Risk Management process.
8 Main Report: Deliverable Phase 3 – Climate Risk Management – CRAS – Şanlıurfa, Türkiye.pdf
Final Phase 3 Climate Risk Management Report for Şanlıurfa Metropolitan Municipality.

Data availability: The complete supporting documentation—including workflow notebooks, analytical outputs, datasets, maps, communication materials and figures—is archived in the project's Zenodo repository and follows the thematic structure presented above to facilitate transparency, reproducibility and future reuse.

Zenodo repository: https://doi.org/10.5281/zenodo.21641408 (10.5281/zenodo.21641408)

Interactive spatial outputs developed during the project, including the heatwave, relative drought and agricultural drought maps for Şanlıurfa Metropolitan Municipality, are available through the CLIMAAX GeoNode platform.

CLIMAAX GeoNode: https://climaax.kajoservices.com/catalogue/#/map/170

8 References

1. Şanlıurfa Metropolitan Municipality (2022). Climate Change Risk and Vulnerability Assessment Report, Climate Change and Zero Waste Department
https://www.sanliurfa.bel.tr/uploads/2024/20240925064813-36184-90200.pdf

2. Şanlıurfa Metropolitan Municipality (2024). Sustainable Energy and Climate Action Plan Report. (Revision II). Şanlıurfa, Türkiye: Climate Change and Zero Waste Department
https://www.sanliurfa.bel.tr/uploads/2024/20240930103339-32137-48344.pdf

3. Turkish Ministry of Environment, Urbanization and Climate Change (2024), Climate Change Adaptation Strategy and Action Plan (2024-2030), Ankara
https://iklim.gov.tr/db/turkce/icerikler/files/Uyum.pdf

4. GAP Regional Development Administration (2024), Strategy and Action Plan (2024-2028)
https://www.gap.gov.tr/Yayin/Dosya/www.gap.gov.tr_391_DE7I44GX.pdf

5. Turkish State Meteorological Service (TSMS) (2023). Regional Climate Data for South-eastern Anatolia. TSMS Publications, Ankara, Türkiye.

6. The Ministry of Agriculture and Forestry- Turkish Agricultural Research Center (TAGEM), Crop Coefficients and Irrigation Requirements of Crops In Turkey,
https://www.tarimorman.gov.tr/TAGEM/Belgeler/yayin/Tu%CC%88rkiyede%20Sulanan%20Bitkilerin%20Bitki%20Su%20Tu%CC%88ketimleri.pdf

7. Carbon Disclosure Project-
https://myportal.cdp.net/guidance/questionnaire?tags=&outputType=REPORTING&type=CSTAR&locale=en