ŞANLIURFA METROPOLITAN MUNICIPALITY

Climate Change Risk and Vulnerability Assessment Report

Şanlıurfa Metropolitan Municipality

Climate Change and Zero Waste Department

October 2022

SANLIURFA METROPOLITAN MUNICIPALITY

Climate Change Risk and Vulnerability Assessment Report

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ŞANLIURFA- October 2022

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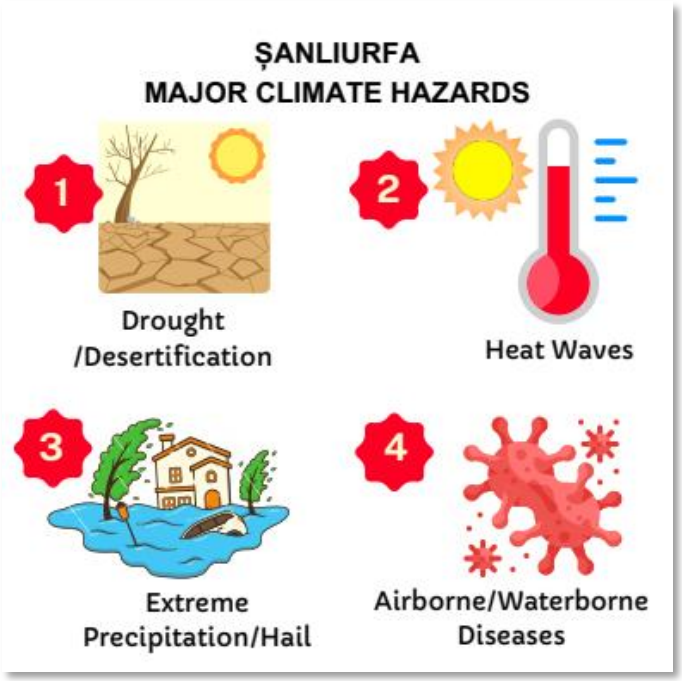
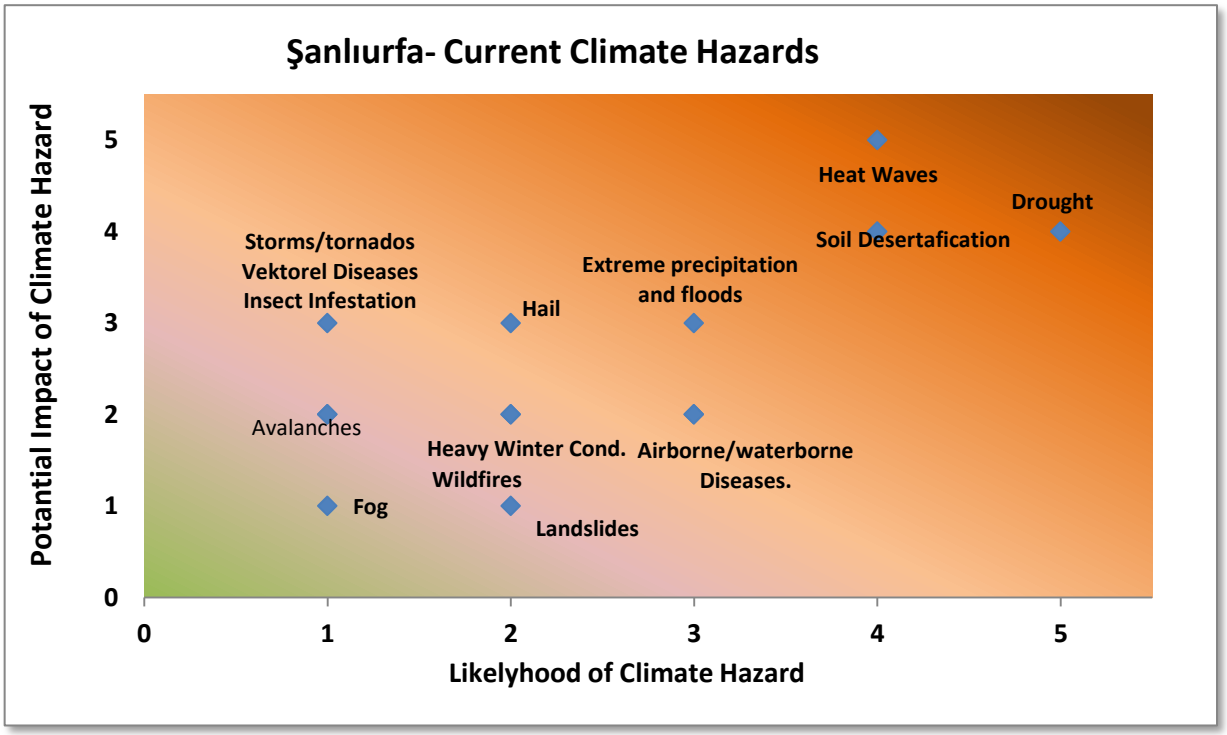
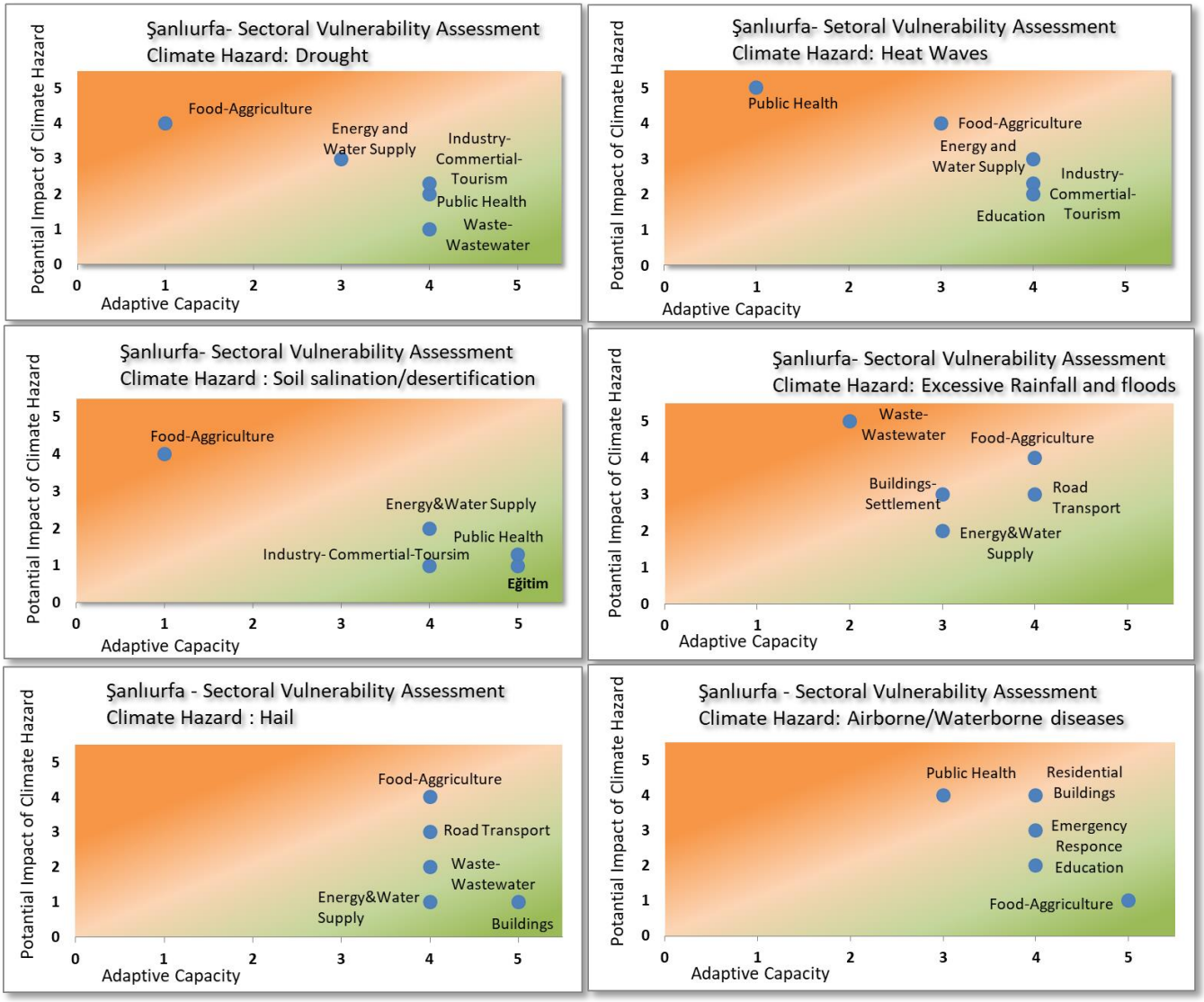
Climate Hazards, Risk and Vulnerability Analysis

Climate Hazards, Risk and Vulnerability assessment has been performed by means of surveys to define the climate hazards which have the most serious potential impact to the city services and inhabitants.





Services or sectors with low adaptive capacity to potential future climate impacts in Şanlıurfa are shown in the chart below. In the chart; red areas indicate **vulnerable services** or sectors, and green areas indicate **resilient services** or sectors.

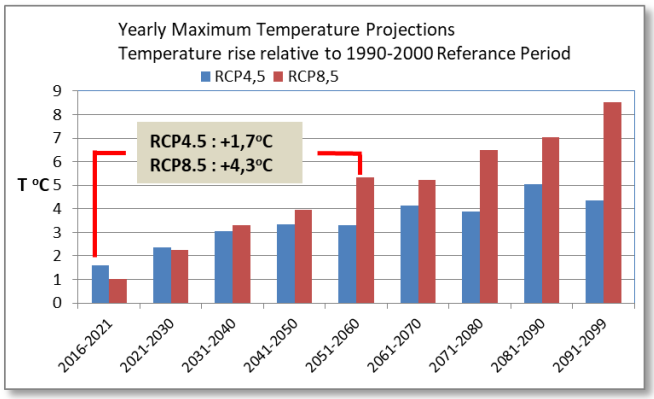


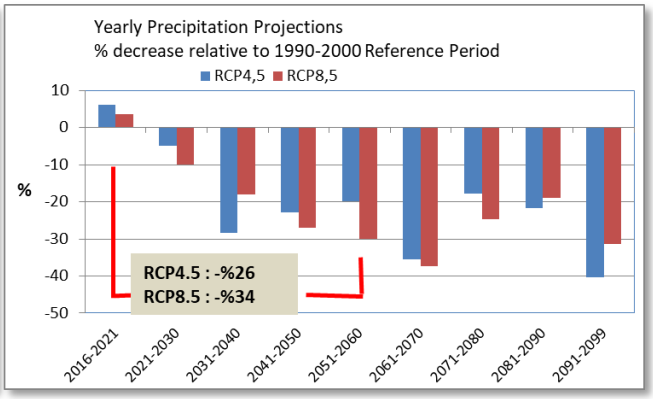
Climate Projections

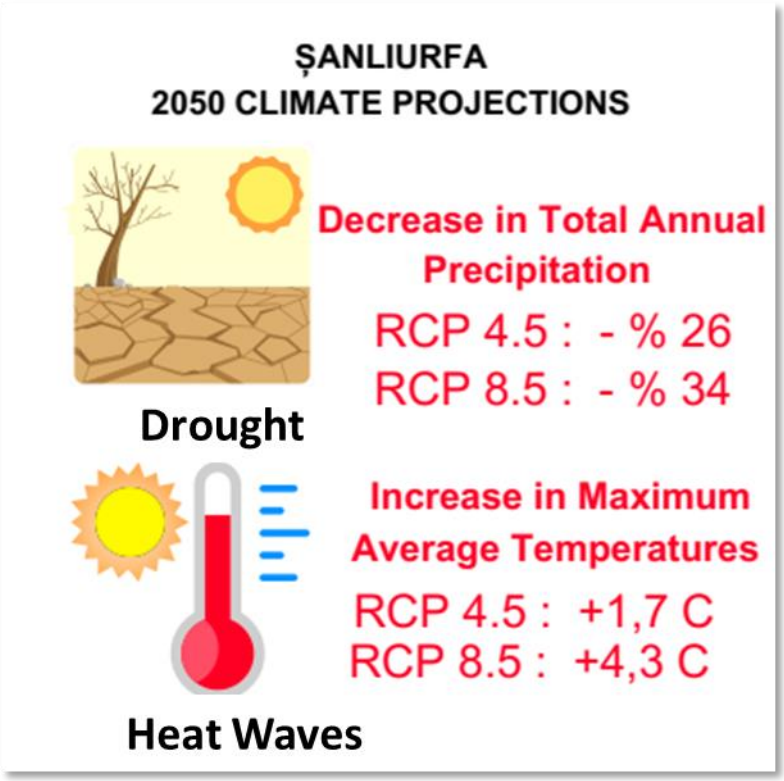
In order to evaluate the future situation of drought and heat waves during the preparation of Şanlıurfa Climate Change Action Plan; HadGEM2-ES global data set family and RegCM4.3.4. regional climate model and Representative Concentration Pathways (RCP) scenarios were used. Among these scenarios, RCP 4.5 refers to the medium level of radiative forcing and global warming. RCP8.5 refers to the highest possible radiative forcing and the worst global warming scenario to be encountered in the future.

According to these projections; temperature increases of 2.1 - 2.7 ^{o}C in the average monthly highest temperatures between 2050-2060, are expected, in line with the RCP4.5-RCP8.5 scenarios (according to the 2016-2021 base period). In the highest temperatures of the year, temperature rise will be around **1.7 - 4.3 ^{o}C**. These situations will increase the

frequency and severity of heat waves. if no adaptation action programme is implemented, heat waves may result catastrophic impacts on many sectors, especially on public health. According to the RCP 4.5- RCP 8.5 scenarios, a decrease of **26% - 34%** is expected in the annual total precipitation. Decrease in the amount of precipitation may lead to increase drought hazard in the GAP region. Soil salinization may reach even more serious levels in the region if efficient irrigation systems are not implemented. Excessive irrigation will also increase the water consumption and energy needs.







1. Climate Change Action Plan and City Context

1.1 Structure and Organization of CCAP Management

The preparation process of the Şanlıurfa Climate Change Action Plan (CCAP) began in February 2022 with CCAP Working Group training and was completed in October 2022 after an 8-month effort.

The CCAP Working Group has been involved in all stages of the process and has managed the project. They have played roles in data collection for the greenhouse gas inventory, communication with stakeholders, conducting surveys for risk and vulnerability analyses, and organizing the stakeholder consultation workshop.
The CCAP Report, prepared by Şanlıurfa Metropolitan Municipality with contributions from all city stakeholders and includes:

- The base year greenhouse gas inventory
- Risk and vulnerability assessment of current and future climate hazards
- Greenhouse gas and climate projections
- Mitigation scenario analyses
- Adaptation and mitigation action programs

The Greenhouse Gas Inventory studies were completed in April 2022, with inventory calculations performed separately for the years 2018, 2019, 2020, and 2021 using the GPC Protocol and CIRIS calculation tool. The detail level of the inventory is Basic+, and 2021 was chosen as the base year for the inventory.

For risk and vulnerability analyses, three separate surveys were conducted using the analysis method recommended by the Global Covenant of Mayors (GCoM).

In the climate projections study, maximum temperatures and total annual precipitation parameters were obtained from the Turkish State Meteorological Service for the reference period covering 1970-2000 and the projection period covering 2016-1998.

During the two-day stakeholder consultation meeting held in May, greenhouse gas inventory and climate risk and vulnerability analyses were evaluated, and action proposals for mitigation and adaptation were developed. A total of 152 mitigation action proposals and 75 adaptation action proposals were submitted by 94 stakeholder representatives from 37 different institutions.

Table 1 - CCAP Stakeholder Consultation Meeting Results

Şanlıurfa CCAP Stakeholder Engagement Workshop			
Workshop Roundtable Group	**Number of Participants**	**Mitigation Proposals**	**Adaptation Proposals**
Climate-Resilient Settlements and Living Spaces	14	33	15
Healthy Urban Life	13	6	5

Efficient Agriculture and Food Security	14	43	13
Clean Energy-Green Industry	13	7	7
Sustainable Water and Waste Management	13	24	6
Energy Efficient Carbon Zero Buildings	13	8	12
Green and Smart Urban Transportation	14	31	17
Total	**94**	**152**	**75**

Figure 1 - Şanlıurfa CCAP Stakeholder Workshop - May 2022

A new organizational change was made to manage the CCAP processes within the Şanlıurfa Metropolitan Municipality, establishing the Climate Change Branch under the Department of Climate Change and Zero Waste.

1.2 City Information

General city data related to CCAP processes are provided in the table below:

Table 2 - General Inventory Information of Şanlıurfa

City	ŞANLIURFA
Region	South-eastern Europe
Inventory Year	2021
Geographical Boundary	Geographical Boundaries of Şanlıurfa Province
City Area	19.220 km^2
Population[3]	2.143.020

Gross Domestic Product (GDP)[3]	42.770.000.000 TL (2020) ; 6,22 billion USD; 2901 $/capita
Economic Structure of the City[3]	Industry (19%), Services (17%), Agriculture (26%), Public (26%)
Land Use (Share of Turkey)	65% Agricultural Land (4.5% of Turkey's total)
City's Climate Classification[1]	Csa (Hot-summer Mediterranean climate)
Heating Degree Days (HDD)[2]	(2021) HDD = 1138 (T≤15^{o}C)
Cooling Degree Days (CDD)[2]	(2021) CDD = 1270 (T>22^{o}C)

(1) Source: Updated Köppen-Geiger climate map of the World (https://people.eng.unimelb.edu.au/mpeel/koppen.html)

(2) Source: Turkish State Meteorological Service (https://www.mgm.gov.tr)

(3) Source: TÜİK - Turkish Statistical Institute

2. Climate Hazards Risk and Vulnerability Assessment

2.1 Applied Methodology

The Global Covenant of Mayors for Climate and Energy - Common Reporting Framework was used for assessing climate risks.

The Global Covenant of Mayors for Climate and Energy (GCoM) is the world's largest alliance of cities and local governments with a shared long-term vision to combat climate change and promote voluntary actions towards a low-emission, climate-resilient future.

Three surveys were conducted to assess potential climate hazards, current and future potential climate risks, their sectoral impacts including vulnerable populations. The survey forms were sent to the CCAP Working Group, all departments of the Metropolitan Municipality, and participants of the CCAP Stakeholder Workshop (online via Google Forms). The results were initially evaluated by the CCAP Working Group and subsequently at the CCAP Stakeholder Workshop held on May 25-26.

The survey studies have aimed at the following objectives:

Survey 1: Şanlıurfa Climate Hazards: Identification of current and potential future climate hazards.

Survey 2: Climate Impacts: Evaluation of the adverse effects of climate hazards on urban service sectors and vulnerable community segments.

Survey 3: Vulnerability Analysis: Assessment of future climate hazards identified as critical for Şanlıurfa; adverse effects on service sectors, existing adaptive capacity, and sectoral vulnerabilities.

According to the survey results, risk and vulnerability analysis is presented in Tables 1, 2, and 3.

Climate Hazards and Impacts

Climate Hazards and Impacts Taking into account past events related to numerous climate hazards, potential risks for Şanlıurfa have been identified, excluding less probable hazards such as sea level rise, monsoon rains, and typhoons.

Evaluated Climate Hazards: Drought, Water stress, Increased water demand, Fire weather (risk of wildfires), Urban flooding, River flooding, Coastal flooding (incl. sea level rise), Hurricanes, cyclones, and/or typhoons, Extreme wind, Storm, Heavy precipitation, Mass movement, Biodiversity loss, Loss of green space/green cover, Soil degradation/erosion, Other forms of climate-induced landscape shift/degradation, Infectious disease

Evaluated Sectors or Services: Agriculture, Forestry, Fishing, Mining and quarrying, Manufacturing, Electricity, gas, steam and air conditioning supply, Water supply, Sewerage,

waste treatment and remediation activities, Waste management, Administrative and support service activities, Public administration and defence; compulsory social security, Conservation, Construction, Wholesale and retail trade; repair of motor vehicles and motorcycles, Transportation and storage, Accommodation and food service activities, Information and communication, Financial and insurance activities, Real estate activities, Professional, scientific and technical activities, Education, Human health and social work activities, Arts, entertainment and recreation

Evaluated Vulnerable Community Segments: Women and girls, Children and youth, Elderly, Indigenous peoples, Marginalized/minority communities, Vulnerable health groups, Low-income households, Outdoor workers, Frontline workers, People with disabilities, migrants, small-scale producers

Efforts have been made to determine the potential impacts of these hazards on sectors and vulnerable community segments.
The potential impacts of evaluated climate hazards are described in the following table.

Table 3 - Climate Hazards and Potential Impacts

Climate-Related Hazards	Impact Description	Most Exposed Sectors	Vulnerable Population Groups Most Exposed
Extreme Rainfall and Floods	Submersion of transportation lines, residential areas, and agricultural lands due to surface flooding caused by excessive rainfall	Food-Agriculture-Forestry, Transportation, Waste-Wastewater, Housing-Residential	Low-income households, Small-scale producers
Storms - Tornadoes	Roof damage to buildings due to excessive wind and storms. Damage to seedlings during flowering season	Transportation, Food-Agriculture-Forestry, Housing-Residential	Vulnerable health groups, Small-scale producers
Cold Wave / Frost Threat	Disruption of transportation due to severe winter conditions. Disruption in energy/water supply. Decrease in agricultural yield due to spring frosts	Food-Agriculture-Forestry, Transportation, Education, Public Health	Vulnerable health groups, Small-scale producers, Elderly
Extreme Heatwave / Heat Stress	Vital danger for chronic patients, elderly, and poor due to extreme heat. Forest fires due to extreme heat. Decrease in agricultural and livestock production	Food-Agriculture-Forestry, Public Health, Energy and Water Supply, Industry-Trade-Tourism	Elderly, Small-scale producers, Vulnerable health groups, Low-income households
Drought	Decrease in agricultural production, soil salinization due to excessive irrigation. Decrease in energy production and water reserves	Food-Agriculture-Forestry, Energy and Water Supply, Public Health, Industry-Trade-Tourism	Elderly, Vulnerable health groups , Small-scale producers, Low-income households
Soil	Decrease in agricultural yield.	Food-Agriculture-	Small-scale producers,

Degradation / Desertification	Excessive fertilizer consumption	Forestry, Energy and Water Supply, Industry-Trade-Tourism	Low-income households, Small-scale producers
Insect Infestation	Decrease in agricultural yield due to locust infestation	Food-Agriculture-Forestry, Public Health, Housing-Residential	Small-scale producers, Low-income households
Air and Waterborne Diseases	Vital danger for chronic patients and elderly due to diseases transmitted through air or water	Public Health, Food-Agriculture-Forestry, Emergency Management, Education	Elderly, Vulnerable health groups
Vector-borne Diseases	Vital danger for chronic patients and elderly due to diseases transmitted by insects and flies	Public Health, Emergency Management, Food-Agriculture-Forestry	Elderly, Vulnerable health groups
Wild Fires	Decrease in forest areas. Fire and vital danger for settlements near forests. Decrease in bee and other insect populations. Vital danger for wild animals	Food-Agriculture-Forestry, Emergency Management, Energy and Water Supply, Housing-Residential	Vulnerable health groups
Hail storms	Impact on fruit and vegetable production during flowering season due to excessive hail. Damage to vehicles due to excessive hail	Food-Agriculture-Forestry, Transportation	Small-scale Producers, Low-income households
Fog	Interruption of air traffic due to excessive fog	Transportation	Vulnerable health groups
Landslides	Disruption of transportation. Risk of collapse for buildings in landslide-prone areas	Buildings-Residential	Low-income households
Avalanches	Vital danger for residents or tourists. Disruption of transportation	Transportation, Tourism, Buildings-Residential	People with Disabilities

2.2 Climate Hazards and Current Risk Assessment

The potential climate hazards and their current risks in Şanlıurfa have been assessed through Survey 1. Accordingly, Drought, Extreme Heat Waves / Heat Island Effect, Soil Salinization / Desertification, Heavy Rainfalls and Floods, Hailstorms, and Airborne and Waterborne Diseases have been identified as the first priority climate hazards with serious or very serious impacts.

Table 4 - Climate Hazards Risk Assessment

Climate Hazards	Current Impact	Hazard Severity (m: 1-5)	Hazard Probability (p: 1-5)	Risk (m x p)

• **Heavy Rainfalls and Floods**	Currently affecting the city	3 - Moderate	3 - Moderate	(9) Significant/Moderate
• **Storms and Tornadoes**	Not currently affecting, potential future impact	2 - Low	1 - Low	(2) Not Serious/Low
• **Cold Wave / Frost Threat**	Not currently affecting, potential future impact	2 - Low	2 - Low	(4) Not Serious/Low
• **Heat Wave / Heat Island Effect**	Currently affecting the city	4 - High	5 - Very high	(20) Very Serious/High
• **Drought**	Currently affecting the city	5 - Very high	4 - High	(20) Very Serious/High
• **Soil Salinization / Desertification**	Currently affecting the city	4 - High	4 - High	(16) Very Serious/High
• **Insect Infestation**	Not currently affecting, potential future impact	3 - Low	1 - Low	(3) Not Serious/Low
• **Airborne and Waterborne Diseases**	Currently affecting the city	2 - Low	3 - Moderate	(6) Significant/Moderate
• **Vector-borne Diseases**	Not currently affecting, potential future impact	3 - Moderate	1 - Very low	(3) Not Serious/Low
• **Fires**	Not currently affecting, potential future impact	2 - Low	2 - Low	(4) Not Serious/Low
• **Hailstorms**	Currently affecting the city	3 - Moderate	2 - Low	(6) Significant/Moderate
• **Fog**	Not currently affecting, unlikely future impact	1 - Very low	1 - Very low	(1) Not Serious/Low
• **Landslides**	Not currently affecting, unlikely future impact	2 - Low	1 - Very low	(2) Not Serious/Low
• **Avalanches**	Not currently affecting, unlikely future impact	1 - Very low	2 - Low	(2) Not Serious/Low

Climate hazards have been assessed considering their severity and probability, and the assessment results are shown in the graph below.

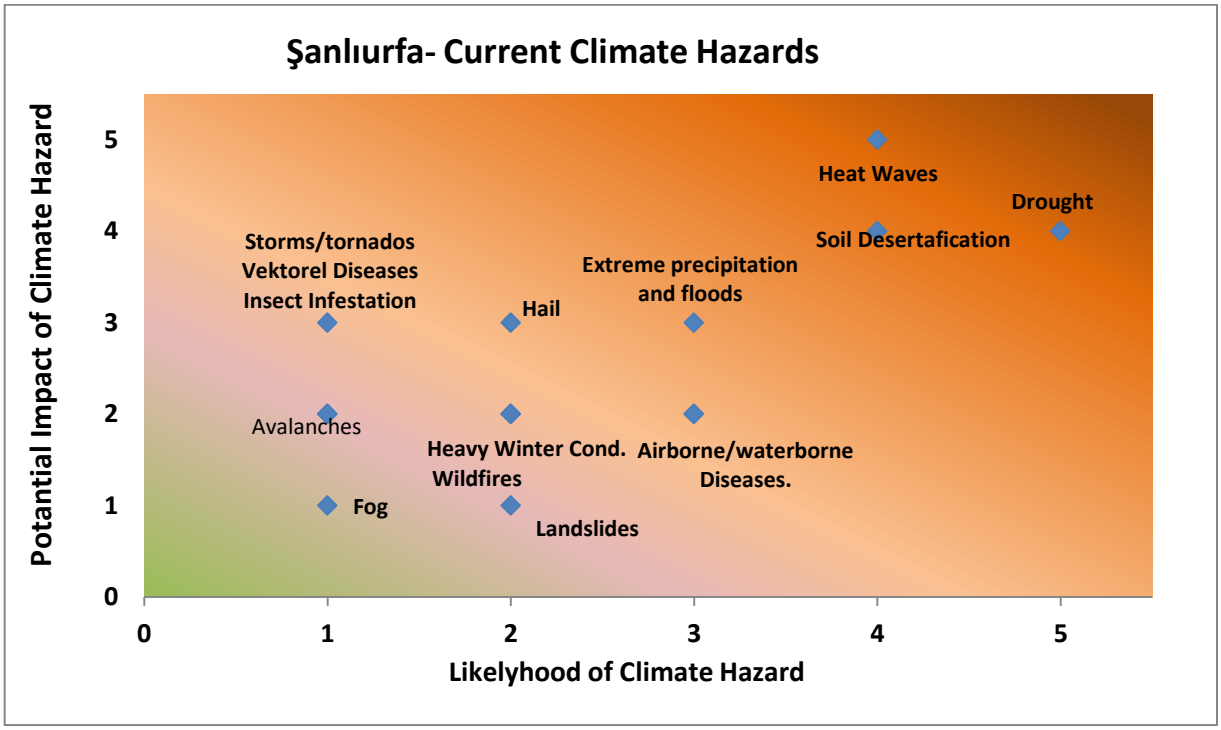


Figure 2 - Current Status Climate Hazards Graph

2.3 Future Risk Assessment of Climate Hazards

The future status of climate hazards and their impacts on service sectors have been evaluated through Survey 1 and Survey 2 studies. The extent to which the primary climate hazards could affect service sectors is shown in the table below.

Table 5- Sectoral Impacts of Climate Hazards

Primary Climate Hazards	Future Status of Hazard Severity	Future Status of Hazard Likelihood	Probable Time Scale of Hazard	Top 5 Most Affected Sectors	Future Potential Impact Severity
Drought	Expected to Increase	Expected to Increase	Medium-term (2026-2050)	Food, Agriculture, Forestry	Very Severe/High
				Energy and Water Supply	Severe/Medium
				Public Health	Not Severe/Low
				Industry-Trade-Tourism	Not Severe/Low
				Waste-Wastewater	Not Severe/Low
Extreme Heat Waves / Heat Island Effect	Expected to Increase	Expected to Increase	Medium-term (2026-2050)	Public Health	Very Severe/High
				Food, Agriculture, Forestry	Very Severe/High
				Energy and Water Supply	Severe/Medium

				Industry-Trade-Tourism	Not Severe/Low
				Education	Not Severe/Low
Soil Salinization / Desertification	Expected to Increase	Expected to Increase	Medium-term (2026-2050)	Food, Agriculture, Forestry	Very Severe/High
				Energy and Water Supply	Not Severe/Low
				Industry-Trade-Tourism	Not Severe/Low
				Public Health	Not Severe/Low
				Education	Not Severe/Low
Heavy Rainfalls and Floods	Expected to Increase	Expected to Stay the Same	Medium-term (2026-2050)	Food, Agriculture, Forestry	Severe/Medium
				Transportation	Severe/Medium
				Waste-Wastewater	Severe/Medium
				Energy and Water Supply	Severe/Medium
				Housing-Settlements	Severe/Medium
Hail storms	Expected to Increase	Expected to Stay the Same	Medium-term (2026-2050)	Food, Agriculture, Forestry	Severe/Medium
				Transportation	Severe/Medium
				Waste-Wastewater	Not Severe/Low
				Energy and Water Supply	Not Severe/Low
				Housing-Settlements	Not Severe/Low
Airborne and Waterborne Diseases	Expected to Increase	Expected to Stay the Same	Medium-term (2026-2050)	Public Health	Severe/Medium
				Housing-Settlements	Severe/Medium
				Emergency Management	Severe/Medium
				Food, Agriculture, Forestry	Not Severe/Low
				Education	Not Severe/Low

Sectoral Vulnerability Analysis Against Climate Hazards

The adaptive capacities of service sectors against primary (major) climate hazards were evaluated through Survey 3. Sectors resilient or vulnerable to these prioritized hazards were identified and shown in the table and chart below. The assessment was based on the potential future impacts (PI) of climate hazards on the service/sector and the current adaptive capacity (AC) of the service or sector. The evaluation criteria are defined as follows:

Potential Impact (PI)

- **PI1** - Very Low: Sector/Service is Not Affected.
- **PI2** - Low: Sector/Service May interrupt Temporarily
- **PI3** - Medium: Sector/Service Shows Tendency to Deteriorate.
- **PI4** - High: Sector/Service Disrupt.
- **PI5** - Very High: Sector/Service Collapse. Unmanageable.

Adaptive Capacity (AC)

- **AC1** - Very High: No Improvement Needed for Adaptation.
- **AC2** - High: Additional Improvement May Be Necessary.
- **AC3** - Medium: Additional Investment Required for Adaptation.
- **AC4** - Very Low: High Investment Required for Adaptation.
- **AC5** - None: Very High Investment Required for Adaptation.

Table 6 – Sectoral Vulnerability Analysis

Primary Climate Hazards	Most Affected 5 Sector/Service	Potential Impact on Sector PI1 - PI5 (Low - High)	Sector's Adaptive Capacity AC1 - AC5 (Low – High)
Drought	Food, Agriculture, Forestry	PI3 - Sector/Service Shows Tendency to Deteriorate.	AC5 – Very High investment required.
	Energy and Water Supply	PI3 - Shows a tendency to deteriorate.	AC2 - Additional investment needed for adaptation.
	Public Health	PI2 - Low: Sector/Service May interrupt Temporarily	AC2 - Additional improvements may be necessary.
	Industry-Trade-Tourism	PI2 - Sector/Service May interrupt Temporarily	AC2 - Additional improvements may be necessary.
	Waste-Wastewater	PI1 - Service not affected.	AC2 - Additional improvements may be necessary.
Heatwaves / Heat Island	Public Health	PI5 - Service stops. Unmanageable.	AC4 - High investment required.
	Food, Agriculture, Forestry	PI4 - High: Sector/Service Disrupt.	AC3 - Additional investment needed for adaptation.

	Energy and Water Supply	PI3 - Shows a tendency to deteriorate.	AC2 - Additional improvements may be necessary.
	Industry-Trade-Tourism	PI2 - Low: Sector/Service May interrupt Temporarily	AC2 - Additional improvements may be necessary.
	Education	PI2 - Low: Sector/Service May interrupt Temporarily	AC4 - Additional improvements may be necessary.
Soil Salinization / Desertification	Food, Agriculture, Forestry	PI4 - High: Sector/Service Disrupt.	AC4 - High investment required.
	Energy and Water Supply	PI2 - Low: Sector/Service May interrupt Temporarily	AC2 - Additional improvements may be necessary.
	Industry-Trade-Tourism	PI1 - Sector not affected.	AC2 - Additional improvements may be necessary.
	Public Health	PI1 - Service not affected.	AC1 - No need for improvement.
	Education	PI1 - Service not affected.	AC1 - No need for improvement.
Heavy Rainfall (rain / snow) and Floods	Waste-Wastewater	PI5 - Service stops. Unmanageable.	AC4 - High investment needed for adaptation.
	Food, Agriculture, Forestry	PI4 - High: Sector/Service Disrupt.	AC2 - Additional improvements may be necessary.
	Transportation	PI3 - Shows a tendency to deteriorate.	AC2 - Additional improvements may be necessary.
	Energy and Water Supply	PI2 - Low: Sector/Service May interrupt Temporarily	AC3 - Additional investment needed for adaptation.
	Residential Areas	PI3 - Shows a tendency to deteriorate.	AC3 - Additional investment needed for adaptation.
Hail	Food, Agriculture, Forestry	PI4 - High: Sector/Service Disrupt.	AC2 - Additional improvements may be necessary.
	Transportation	PI3 - Shows a tendency to deteriorate.	AC2 - Additional improvements may be necessary.
	Waste-Wastewater	PI2 - Low: Sector/Service May interrupt Temporarily	AC2 - Additional improvements may be necessary.
	Energy and Water Supply	PI1 - Service not affected.	AC2 - Additional improvements may be necessary.
	Residential Areas	PI1 - Service not affected.	AC1 - No need for improvement.
Airborne and Waterborne Diseases	Public Health	PI4 - High: Sector/Service Disrupt.	AC3 - Additional investment needed for adaptation.
	Residential Areas	PI4 - High: Sector/Service Disrupt.	AC2 - Additional improvements may be necessary.
	Emergency Management	PI3 - Shows a tendency to deteriorate.	AC2 - Additional improvements may be necessary.

	Methods		
	Food, Agriculture, Forestry	PI1 - Sector not effected.	AC1 - No need for improvement.
	Education	PI2 - Low: Sector/Service May interrupt Temporarily	AC2 - Additional improvements may be necessary.

The low adaptation capacity (vulnerable) services or sectors to future potential climate impacts in Şanlıurfa are shown in the following graph. In the graph, red areas represent **vulnerable** services or sectors, while green areas indicate **resilient** services or sectors.

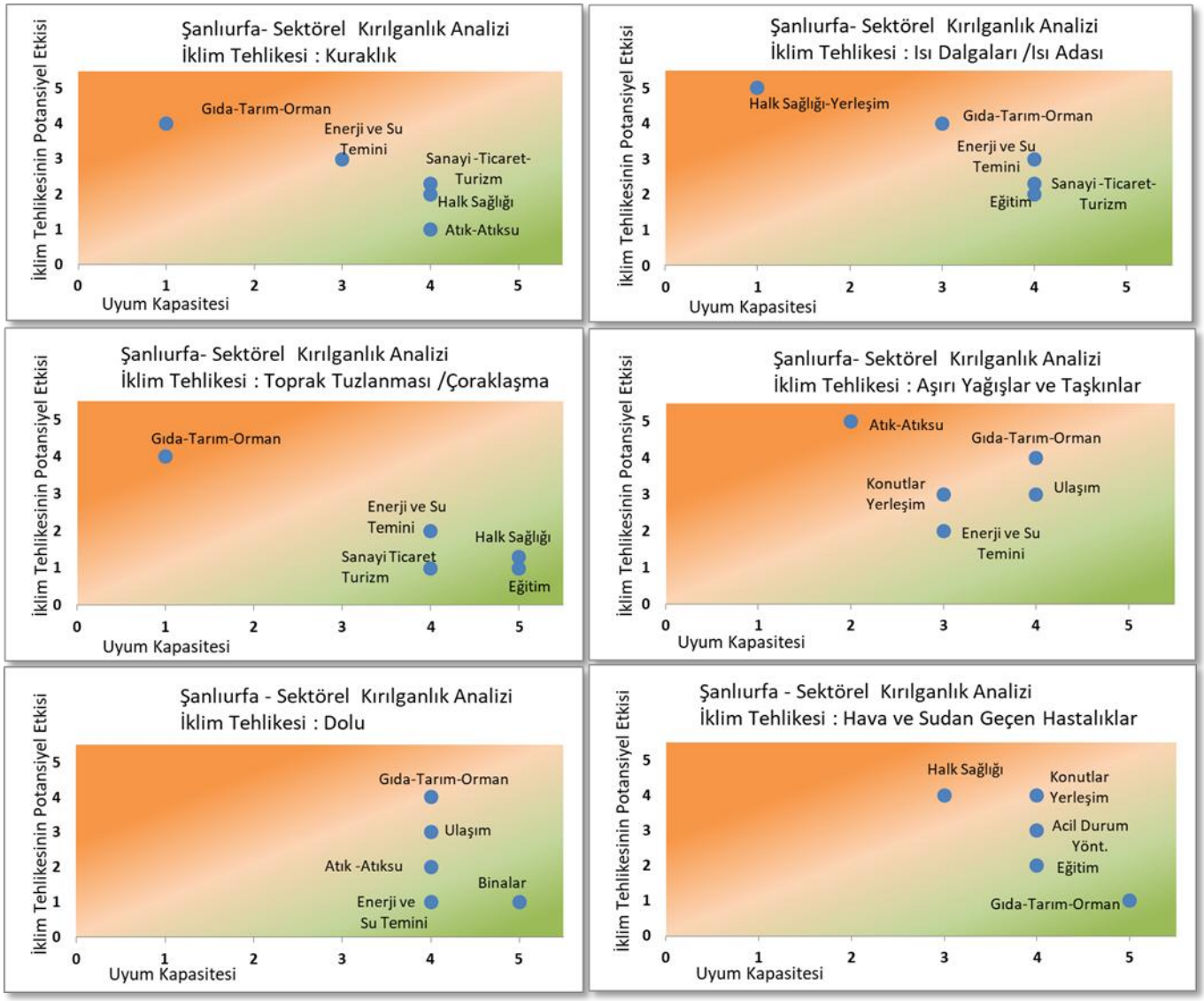


Figure 3 - Sectoral Vulnerability Graphs

2.4 Şanlıurfa Climate Projections

To be prepared for the consequences of climate change and to minimize its adverse effects, it is essential to predict how observed changes and trends in climate will unfold in the future, and to determine their impacts on natural and human systems. Understanding observed and past climates and forecasting future climates involves utilizing models that mathematically represent components of the climate system, their interactions, and feedbacks.

In preparing the Şanlıurfa Climate Action Plan, data from the HadGEM2-ES global dataset family, along with the RegCM4.3.4 regional climate model and Representative Concentration Pathways (RCP) scenarios, were used to evaluate future conditions of drought and heat waves. Among these scenarios, **RCP4.5** represents moderate radiative forcing and global warming levels, while **RCP8.5** represents the highest likely radiative forcing and worst-case global warming scenario.

For climate projection, data were obtained from the General Directorate of Meteorology according to the following scope:

Dataset:

- Global Climate Model: HadGEM2-ES
- Regional Climate Model: RegCM4.3.4
- Scenario: RCP4.5, RCP8.5

Parameters:

- Maximum Temperature (°C)
- Total Precipitation (mm)

Period:

- 2016-2098 (Future Period)
- 1971-2000 (Reference Period)

The averages of model data for a total of 48 coordinate points within the boundaries of Şanlıurfa province are shown in the table below:

Table 7 – Climate Projection Data for Reference Period and Future Period

Reference Period Parameter Data			
Reference Period	**Monthly Average Max. Temperatures,T °C**	**Highest Temperatures of the Year, T °C**	**Annual Total Precipitation, mm**
1971-1980	21,07	41,27	465,7
1981-1990	21,28	41,16	384,2
1991-2000	21,50	41,46	471,6

Future Period Parameter Data						
Future Period	Monthly Average Max. Temperatures, T °C		Highest Temperatures of the Year, T °C		Annual Total Precipitation, mm	
	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5
2016-2021	22,38	22,64	43,07	42,47	500,7	489,1
2021-2030	23,14	23,25	43,81	43,71	401,0	424,6
2031-2040	23,97	24,15	44,51	44,78	337,9	386,9
2041-2050	24,17	24,74	44,80	45,42	363,9	344,9
2051-2060	24,45	25,38	44,78	46,78	377,7	329,9
2061-2070	25,15	26,50	45,59	46,67	304,4	295,9
2071-2080	24,91	26,83	45,33	47,97	387,1	355,5
2081-2090	25,18	27,47	46,52	48,50	369,3	382,4
2091-2099	25,57	28,27	45,81	50,00	281,1	323,7

Table 8 – Climate Projections

1990-2000 Period Projections (Increase or Decrease)						
Future Period	Increase in Average Monthly Maximum Temperatures T °C		Increase in Annual Maximum Temperatures T °C		Decrease in Annual Total Precipitation %	
	RCP4,5	RCP8,5	RCP4.5	RCP8.5	RCP4.5	RCP8.5
2016-2021	+0,88 °C	+1,14 °C	+1,61 °C	+1,01 °C	+% 6,2	+%3,7
2021-2030	+1,64 °C	+1,75 °C	+2,35 °C	+2,25 °C	-%15,0	-%10,0
2031-2040	+2,47 °C	+2,65 °C	+3,05 °C	+3,32 °C	-%28,4	-%18,0
2041-2050	+2,67 °C	+3,24 °C	+3,34 °C	+3,96 °C	-%22,8	-%26,9
2051-2060	+2,95 °C	+3,88 °C	+3,32 °C	+5,32 °C	-%19,9	-%30,0
2061-2070	+3,65 °C	+5,00 °C	+4,13 °C	+5,21 °C	-%35,5	-%37,3
2071-2080	+3,41 °C	+5,33 °C	+3,87 °C	+6,51 °C	-%17,9	-%24,6
2081-2090	+3,68 °C	+5,97 °C	+5,06 °C	+7,04 °C	-%21,7	-%18,9
2091-2099	+4,07 °C	+6,77 °C	+4,35 °C	+8,54 °C	-%40,4	-%31,4

The modelling study shows projections for temperature and precipitation parameters between the Reference Period 1991-2000 and the Future Period, as presented in Table 7 and Table 8

According to these projections, between 2050-2060, average monthly maximum temperatures are expected to increase by **2,1 – 2,7°C** under **RCP4.5** and **RCP8.5** scenarios compared to the 2016-2021 period. Similarly, annual maximum temperatures are projected to increase by **1,7 – 4,3°C**. These temperature increases are likely to significantly increase the frequency and intensity of heat waves, potentially leading to severe adverse

effects across various sectors, particularly public health, if no preventive measures are taken.

In terms of annual total precipitation, a decrease of approximately **26% - 34%** is expected under **RCP 4.5** and **RCP 8.5** scenarios. This reduction in precipitation could exacerbate the risk of drought in the Sanliurfa region, lead to a greater need for irrigation, transition to efficient irrigation systems, and escalate the seriousness of soil salinization and desertification due to less water availability. Moreover, it may further increase water consumption and energy demand.

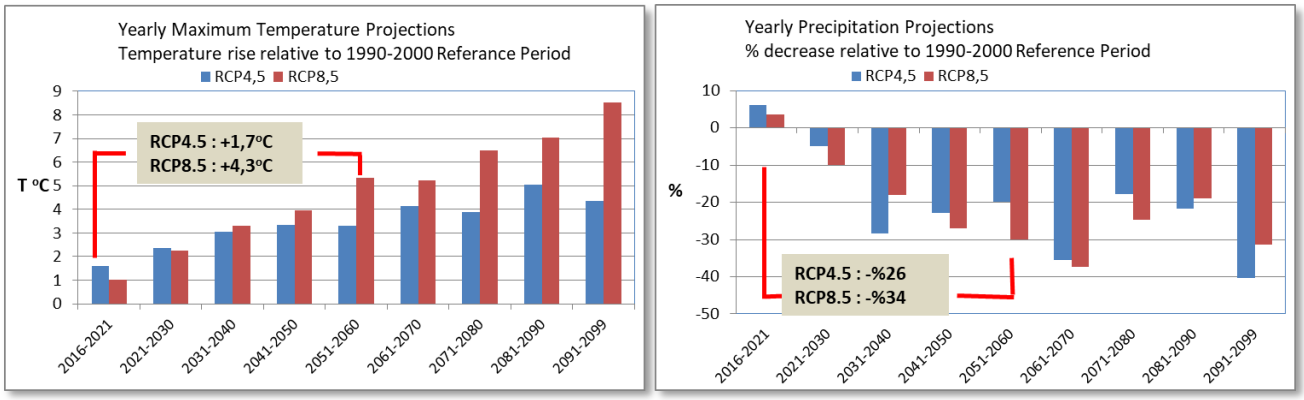


Figure 4 - Extreme Temperature and Drought Projections

3. Adaptation Strategies and Objectives

ŞANLIURFA ADAPTATION STRATEGIES
Strategy 1 – Climate-Resilient Settlements and Healthy Urban Living
Strategy 2 – Combating Drought and Sustainable Agriculture

Strategy 1 – Climate-Resilient Settlements and Healthy Urban Living
Objective 1.1 - Disaster Risk Reduction and Protection Programs
Objective 1.2 - Climate-Resilient Urban Development and Planning
Objective 1.3 - Protection of Vulnerable Community Segments and Healthy Urban Living

Objective 1.1 – Disaster Risk Reduction and Protection Programs	
GOALS	
2035	2050
Capacity increase and renovation investments in all rainwater collection channels across the city to match the 100-year rainfall intensity	Making city infrastructure and existing structures resilient against climate extremes through zoning regulations and urban transformation efforts
Action 1.1.1 - Emergency Preparedness and Response Program for Climate Disasters	
Action 1.1.2 - Capacity Development Program for Surface Flood Prevention Structures and Systems	
Action 1.1.3 - Development of Proactive Systems Against Surface Floods	

Objective 1.2 – Climate-Resilient Urban Development and Urban Planning	
GOALS	
2035	2050

Increasing urban green space per capita by 100%, from 4.6 m^2 to 9 m^2	Establishing accessible green areas and parks in every neighbourhood with a minimum area of 0.5 hectares to achieve a homogeneous distribution across the city, and increasing green space per capita to 15 m^2

Action 1.2.1 - Increasing Urban Green Spaces to International Standards

Action 1.2.2 - Urban Planning for Climate-Resilient Cities

Objective 1.3 – Protection of Vulnerable Population Segments and Healthy Urban Living

GOALS	
2035	**2050**
Implementation of physical and social protection mechanisms against the devastating effects of heatwaves on the vulnerable population living in Şanlıurfa	-

Action 1.3.1 - Protection and Support of Vulnerable Population Segments against Climate Hazards

Action 1.3.2 - Preservation of Air Quality

Action 1.3.3 - Preventive Activities against Climate-Related Diseases

Action 1.3.4 - Strengthening of urban infrastructure and facilities against mass migration from neighbouring regions

Strategy 2 – Combatting Drought and Sustainable Agriculture

Objective 2.1 – Conservation, Development, and Efficient Demand Management of Water Resources

Objective 2.2 – Drought and Desertification Combat and Prevention Program

Objective 2.3 – Sustainable Agriculture and Food Security from Field to Table

Objective 2.1 – Conservation, Development, and Effective Supply and Demand Management of Water Resources	
GOALS	
2035	**2050**
- Increase the population served by wastewater treatment services from 48% to 95%. - Reduce network water leakage by 50%.	Reuse of treated water, rainwater harvesting, and greywater systems to be widely adopted throughout the city.
Action 2.1.1 - Develop solutions for reducing water leaks and effective demand management.	
Action 2.1.2 - Develop systems for water recovery and reuse.	
Action 2.1.3 - Oversight of preventive activities for the conservation of water resources.	

Objective 2.2 - Drought and Desertification Prevention and Mitigation Program	
GOALS	
2035	**2050**
• Implementation of educational activities and administrative regulations containing sanctions aimed at eliminating wild irrigation within city limits • Completion of rehabilitation investments with drainage channels in agricultural areas experiencing rising groundwater and desertification	• Completion of necessary investments for the transformation of open system fields into closed pressurized systems in currently open systems within city limits • Widespread adoption of technological applications such as subsurface and surface drip irrigation, soil moisture measurement, automation, remote control, and monitoring throughout the province
Action 2.2.1: Prepare and implement a structural transformation program to increase irrigation efficiency.	
Action 2.2.2: Prepare and implement a research and rehabilitation program to prevent desertification in agricultural lands.	
Action 2.2.3: Conduct education, awareness, and consciousness-raising activities on the adverse effects of drought and over-irrigation.	

Sanliurfa Metropolitan Municipality

Department of Climate Change and Zero Waste

October 2022, ŞANLIURFA

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