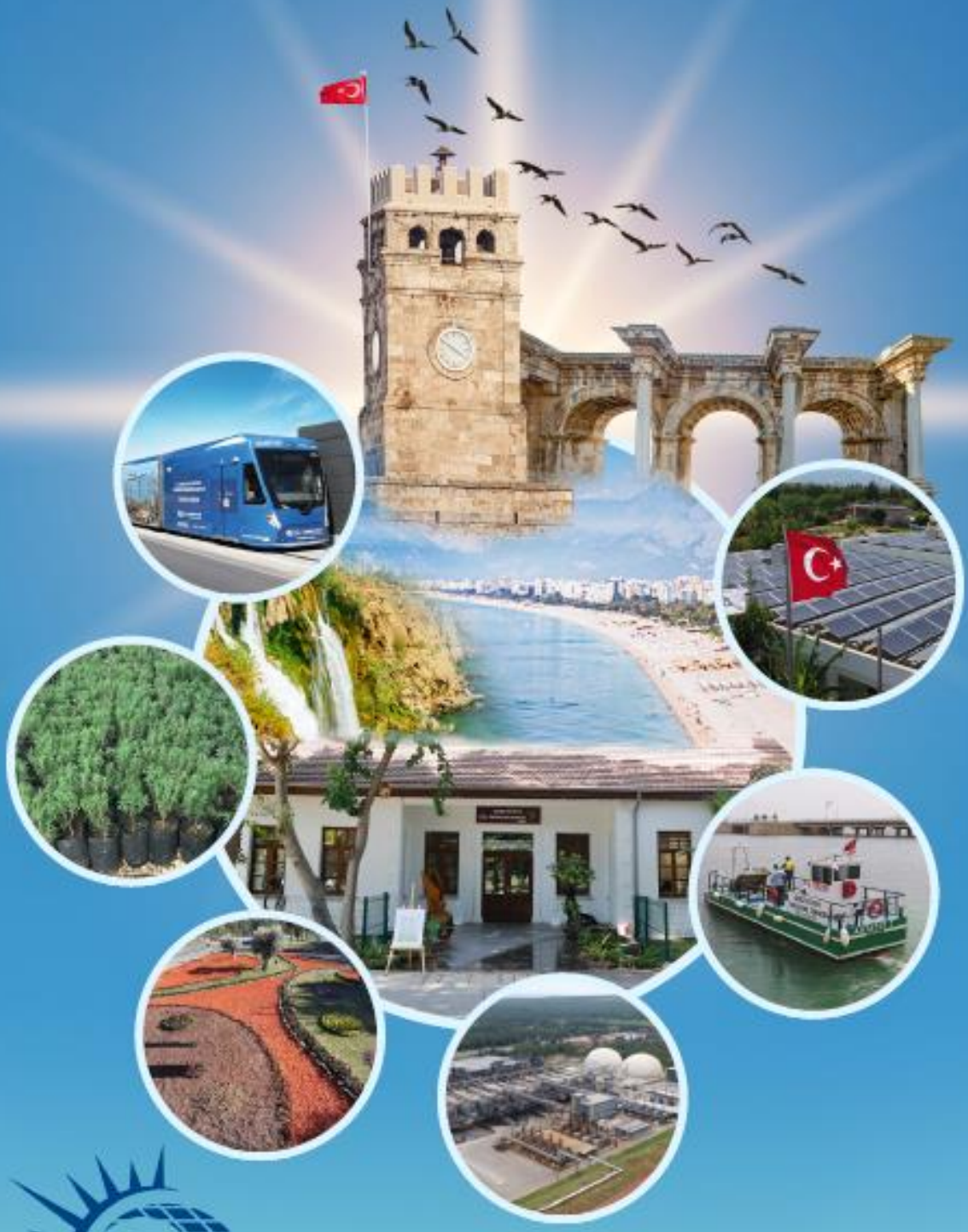


SECAP

SUSTAINABLE ENERGY AND CLIMATE ACTION PLAN

2022

ANTALYA **METROPOLITAN** MUNICIPALITY

TOMORROW'S NATURE IS CREATED FROM TODAY

M. Atatürk

FOREWORD

The increase in global temperature triggers an increase in the frequency of extreme weather events such as droughts, floods and tornadoes, and the effects of climate change are strikingly seen as the core reasons of problems such as wars, hunger, migration, etc. One of the most important agenda items of our country, which is located in one of the geographies that will be most affected by climate change, will be the disasters caused by climate change and the struggles in this field. Foreseeing the negative effects of climate change to take appropriate measures to prevent or minimize the damage it may cause and take advantage of the opportunities that may arise is gaining more importance. We are determinedly continuing our efforts to make Antalya, the capital of agriculture and tourism and the 5th largest city with a population of approximately 2.5 million, an environment and nature-friendly city. As Antalya Metropolitan Municipality, we continue to carry out not short-term, day-saving projects, but planned, rule-based, technique and science-based continuous environmental projects that take into account the rights of future generations, with a city vision and common sense. The 14 environmental awards we have received at local, national and international level during our tenure with the projects and practices we carry out on behalf of all the people of Antalya are proof of our sensitivity to the environment. We started this endeavour with our Municipality in our efforts to become a neutral carbon city for climate-friendly Antalya. The work we started in our service building, placed us as the first municipality and even the first official institution to receive the Climate Friendly Organization Certificate issued by TSE. Antalya Metropolitan Municipality is a member of the Covenant of Mayors (CoM), which guides local governments and their stakeholders to fight together against global warming. We are the first metropolitan municipality in Turkey to prepare the Sustainable Energy Action Plan Report by adopting the fight against climate change. We continue to carry out and disseminate exemplary practices in many areas such as landscaping, agriculture, transportation, energy management, environmental health, water management, marine pollution and control, environmental education and awareness-raising throughout the city. We have prepared SECAP - Sustainable Energy and Climate Action Plan, as a result of long and detailed studies, that will provide guidance for our Antalya's goal of becoming a climate-friendly city. We will continue our work with determination and confident steps, but it should not be forgotten that the full implementation of the action plan will be possible with the support of our people and you, our valuable stakeholders. I would like to thank everyone who contributed to the preparation of the Sustainable Energy and Climate Action Plan, and I am grateful for your sensitivity and support during the implementation of the plan.

With love and respect.

M.Böcek

Muhittin BÖCEK

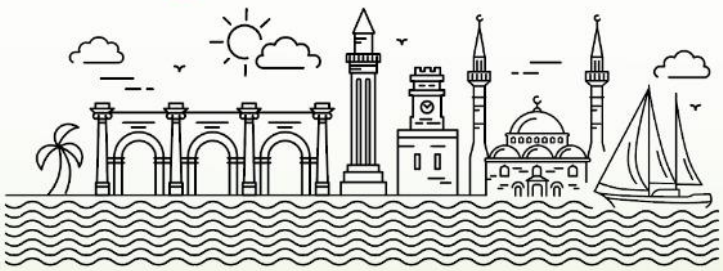
Antalya Büyükşehir Belediye Başkanı

ANTALYA'S NEUTRAL CARBON TARGET

- ECO-FRIENDLY FARMERS CARD
- SMART CROSSROADS
- SUSTAINABLE WATER MANAGEMENT
- CAMPAIGN AGAINIST GHOST NETS
- FIGHTING FOREIGN INVASIVE SPECIES
- WASTE TRAPS
- SEA SWEEPER
- CONSERVING BIODIVERSITY
- XERISCAPING
- RENEWABLE ENERGY
- AFFORESTATION
- CLOSED CIRCUIT IRRIGATION
- SMART AGRICULTURE
- ELECTRONIC SHIP CONTROL SYSTEM
- ENVIRONMENTAL EDUCATION AND INNOVATION CENTER
- CLIMATE FRIENDLY ORGANIZATION

ANTALYA METROPOLITAN MUNICIPALITY

We are working for Antalya



ANTALYA METROPOLITAN MUNICIPALITY

CONTRIBUTORS TO THE STUDY

Antalya Metropolitan Municipality

Av. Cansel TUNCER	Secretary General	
Mustafa GÜRBÜZ	Assistant Secretary General	
Lokman ATASOY	President Advisor	
M. İnanç ARGUN	Head of Environmental Protection and Control Department	
Melike KİREÇCİBAŞI	Climate Change and Clean Energy Branch Manager	
Özden AKKAYA	Energy Systems Engineer	Climate Change and Clean Energy Branch Directorate
Elif SARI	Mechanical engineer	Climate Change and Clean Energy Branch Directorate
Özlem KILIÇARSLAN	Environmental engineer	Climate Change and Clean Energy Branch Directorate
Ceren UÇAR	Architect	EU Relations and Projects Branch Office
Emine YİĞİT	Biologist	EU Relations and Projects Branch Office
Neşe ÖZÇANDIR	Architect	EU Relations and Projects Branch Office

Consultants and Technical Experts: Demir Energy

Dr. Baha KUBAN	Senior advisor	Demir Energy
Esra DEMİR	Senior Business Engineer	Demir Energy
Caner DEMİR	Senior Mechanical Engineer	Demir Energy
Oya TABANOĞLU	Senior Urban Planner	Demir Energy
Melda KARADEMİR	Senior Environmental Engineer	Demir Energy
Gonca AKGÜL	Senior Urban Planner	Demir Energy

Consultant Company Information:

DE SÜRDÜRÜLEBİLİR ENERJİ VE İNŞAAT SANAYİ TİC. LTD. ŞTİ.
Koşuyolu mahallesi, Halili sokak, No:7, 34718, Kadıköy / İSTANBUL
Telephone: +90 (216) 428 76 69
E-mail: bilgi@demirenerji.com
Internet address: www.demirenerji.com

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ABBREVIATIONS

Abbreviation:	Description
EU:	European Union
ABB:	Antalya Metropolitan Municipality
USA:	United States of America
AFAD:	Disaster and Emergency Management Presidency
AKTOB:	Mediterranean Touristic Hoteliers and Operators Association
ANSİAD:	Antalya Industrialists and Businessmen Association
R&D:	Research and Development
ASAT:	Antalya Water and Wastewater Administration
ASBAŞ:	Antalya Free Zone Founder and Operator Inc.
A.Ş.:	Joint Stock Company
BAKA:	Western Mediterranean Development Agency
BAU:	Continuation of the Status Quo Unchanged
ICT:	Information Communication Technologies
UN:	United Nations
GIS:	Geographic Information Programs
CH_4:	Methane
Cm:	Centimeter
CO_2:	Carbon dioxide
CO_2e:	Carbon dioxide equivalent
CDP:	Carbon Disclosure Project
CoM:	Covenant of Mayors
COP:	Conference of the Parties
ÇEVKO:	Environmental Protection and Packaging Waste Recovery Foundation
ÇDP:	Environmental Plan
da:	Decar
dk:	Minute
DSİ:	State Hydraulic Works
GES:	Solar Energy Systems
GHG:	Greenhouse Gas
GDP:	Gross Domestic Product
GW:	Gigawatt
ha:	Hectare
hm^3:	Cubic hectometer
ICT:	Computer-based
IFRC:	International Federation of Red Cross and Red Crescent Societies
INDC:	Intended Nationally Determined Contribution
IPCC:	Intergovernmental Convention on Climate Change
CBCC:	Climate Change Coordination Board

Abbreviation:	Description
İRAP:	Provincial Disaster Risk Reduction Plan
km:	Kilometer
km²:	Square kilometer
KSS	Small Industrial Site
kWh:	Kilowatt Hour
MGM:	General Directorate of Meteorology
m²:	Square meter
m:	Meter
mm:	Millimeter
Mt:	Million Tons
mton:	Million Ton
MW:	Megawatt
MWh:	Megawatt Hour
N_2O:	Nitrous oxide
OECD:	Organization for Economic Cooperation and Development
OSB:	Organized Industrial Zone
Average:	Mean
Example:	Example
sa:	Hour.
SEGE:	Socioeconomic Development
SEAP:	Sustainable Energy Action Plan
SECAP:	Sustainable Energy and Climate Action Plan
SEİEP:	Sustainable Energy and Climate Action Plan (Turkish)
SES:	Socioeconomic Status
SCADA	Centralized System Controlling and Monitoring Sites
NGO:	Civil Society Organization
TAMP:	Turkey Disaster Response Plan
tCO_2e:	Tons of Carbon Dioxide Equivalent
TL:	Turkish Lira
TSE:	Turkish Standards Institute
TÜİK:	Turkish Statistical Institute
TÜRÇEV:	Turkish Environmental Education Foundation
UEVEP:	National Energy Efficiency Action Plan
UNESCO:	United Nations Educational, Scientific and Cultural Organization
UNFCCC:	United Nations Framework Convention on Climate Change
WWF:	Worldwide Fund for Nature
WEI:	Water Use Index
°C:	Degree Celsius

EXECUTIVE SUMMARY

The exponential increase in the use of fossil fuels, which started with the Industrial Revolution, has caused the harmful gases emitted from these fuels to increase at the same rate. For this reason, the effects of climate change have been causing negative consequences in the world since the 1990s. According to the Intergovernmental Panel on Climate Change (IPCC) Report on the Physical Science Basis of Climate Change (2013), warming in the global climate is certain. However, many of the changes in climate since the 1950s have been unprecedented until the last millennium. Each decade of the past 30 years has been warmer than all decadal periods of global surface temperatures recorded on Earth since 1850. Carbon dioxide emissions from human activities, particularly fossil fuel consumption since the industrial revolution, are increasing much faster than the oceans and forest areas can absorb. It is projected that the continuation of societies' current habits will have serious climate change consequences, leading to massive environmental destruction and possible mass deaths, as well as associated humanitarian disasters.

The presence of harmful gases that cause climate change and their increasing proportion in the atmosphere brings to the forefront the need for global decision-making on this issue. The general framework for cooperation against climate change was first laid with the United Nations Framework Convention on Climate Change (UNFCCC) of 1992. The Paris Agreement, which was adopted in 2015 and entered into force in November 2016, is a turning point in climate change, on which intensive international efforts have been carried out since then. Today, it has become a necessity to evaluate on the scale of climate change the production and consumption activities carried out in cities and to undertake rational planning and strategy development processes to ensure energy saving with due consideration of climate change. Since 2016, the Paris Agreement has been signed and ratified by almost 200 countries. Turkey ratified the Paris Agreement on October 7, 2021.

Sustainable Energy and Climate Action Plan (SECAP) Process

The Sustainable Energy and Climate Action Plan process has been prepared in accordance with the methodology of the Covenant of Mayors (CoM), to which more than 11 thousand local governments have been a party to date, and Antalya Metropolitan Municipality has been a member since 2013. Especially in the general contents related to climate change, direct quotations were made from the climate action plans previously written by the team preparing the report. The following basic steps were followed in the process carried out in accordance with the SECAP reporting template of the Covenant of Mayors and the accompanying methodology report:

a) Preparation of greenhouse gas emission inventory and assessment of the current situation
b) Reducing greenhouse gas emissions by at least 40% in 2030 compared to the base year 2019
c) Establishing actions for sustainable energy to reduce greenhouse gas emissions
d) Conducting risk and vulnerability assessment
e) Determination of compliance actions according to risks and vulnerabilities

Greenhouse Gas Reduction

The mitigation section of the Antalya Sustainable Energy and Climate Action Plan creates a roadmap for reducing emissions from energy consumption in different sectors determined with the participation of urban stakeholders. While creating this roadmap study, we started with the calculation of the current status greenhouse gas emission inventory of Antalya province in 2019. The inventory was prepared within the framework of the general principles and philosophy of the International Local Government Greenhouse Gas Emissions Analysis Protocol (IEAP), which was established by the Local Governments for Sustainability (ICLEI) based on IPCC guidelines and is valid for every local government.

a) Key Findings

When the emissions of Antalya including industry in 2019 are analysed, total energy consumption in the province is 28,623,531 MWh and greenhouse gas emissions are 10,683,551 tCO2e. Within the total inventory, emissions from fuel and electricity consumption of buildings (including industry) account for 47.1% (40.9% buildings and 6.1% industry), emissions from transportation account for 30.2%, emissions from agriculture and animal husbandry account for approximately 6%, emissions from energy generation account for 8.5% and emissions from solid waste and wastewater processes account for 8.2% (Figure 1).

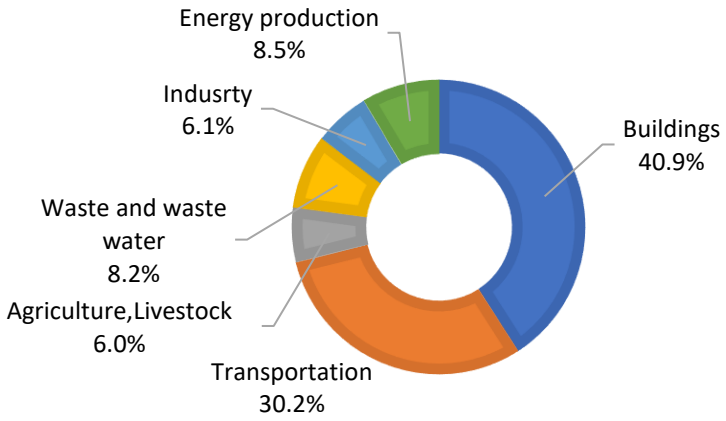


Figure 1: Antalya province sectoral greenhouse gas inventory

With the mitigation measures put forward in the sectors, it is concluded that a 40% reduction in Antalya's per capita emissions by 2030 can be achieved in 2030 compared to 2019. With the Continuation of the Current Situation (BAU) scenario of Antalya, the projections made by different institutions regarding population and sectoral growth have been evaluated, and 2030 emissions are calculated as 7,886,537 tCO_2e according to this scenario. By 2030, it is targeted to reduce 4,576,943 tCO_2e in the buildings sector, 2,009,046 tCO_2e in the transportation sector, 923,349 tCO_2e in other sectors including waste and wastewater actions and 377,208 tCO_2e through renewable energy.

Considering the growth rates of Turkish cities, it does not seem possible to talk about absolute emission reductions, at least for now. Therefore, it was decided to set per capita emission targets to the extent permitted by the Covenant of Mayors. According to the BAU scenario, per capita emissions are expected to increase from 3.28 tons CO_2e to 4.36 tons CO_2e from 2019 to 2030 with current strategies. With the mitigation actions specified in the Antalya Sustainable Energy Action Plan, it is envisaged that a reduction of approximately 40.12% can be achieved in the per capita emissions of Antalya province by 2030 compared to

the base year 2019. According to this result, it is aimed to reduce per capita emissions to 1.96 tons CO_2e /person in 2030 (Figure 2).

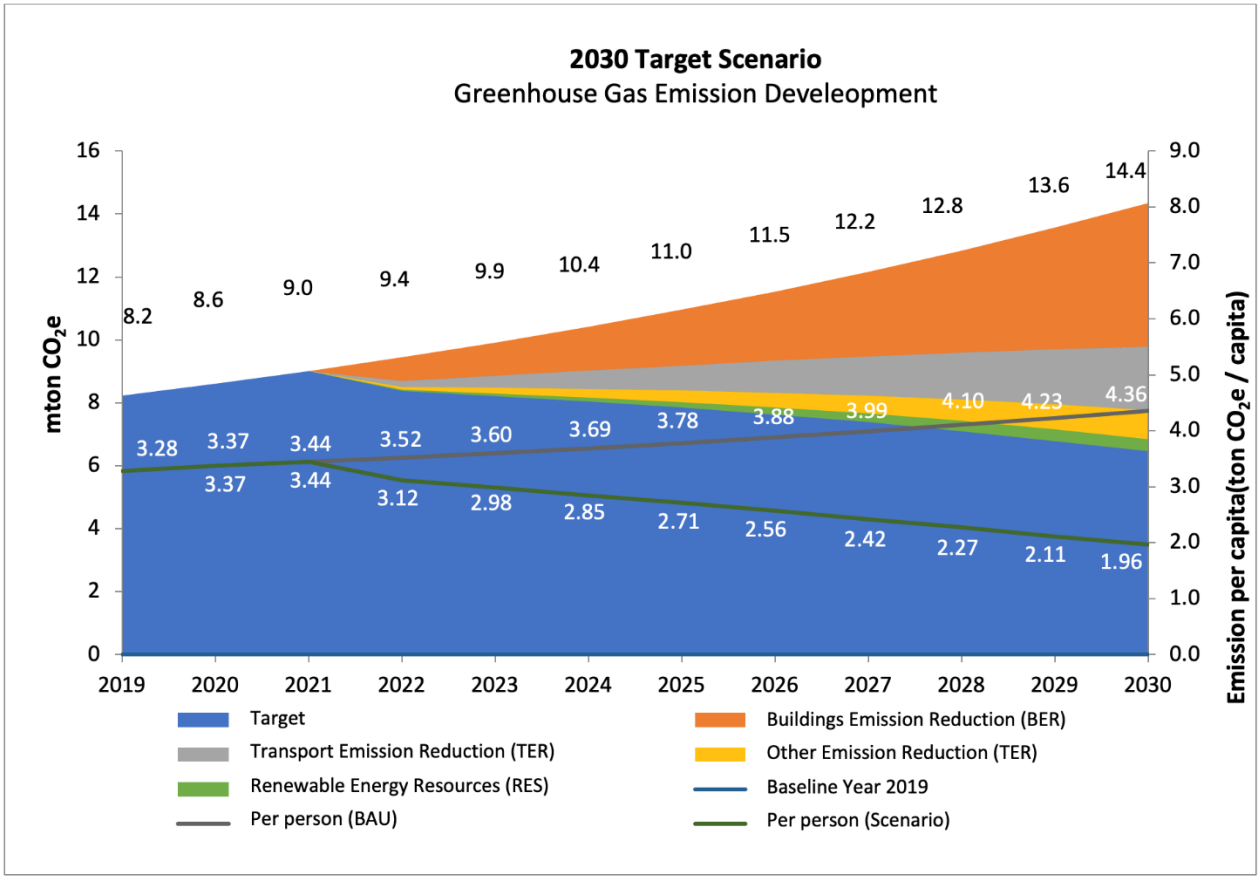


Figure 2: Antalya province greenhouse gas reduction scenario for 2030

a) Actions

Mitigation actions have been developed separately for buildings, energy, transportation, and other sectors to reduce energy consumption and GHG emissions. All actions have been analysed under the following headings: current situation/purpose, relation with existing plans, priority level, action steps, action type, amount of savings, responsible, stakeholders, contribution of the municipality, timing, and risks. As a result of these actions, energy consumption and greenhouse gas emission reductions are targeted in the amounts shown in the table below on a sectoral basis (Table 1).

Table 1: 2030 sectoral mitigation targets

	MWh Mitigation 2030	Ton CO_2e Mitigation 2030
Buildings Emission Mitigation	10.372.980	4.576.934
Renewable Energy Emission Mitigation	744.000	377.208
Transportation Emission Mitigation	8.849.734	2.009.046
Waste-Wastewater and Other Emission Mitigation	224.157	923.349
Total Mitigation	**20.190.870**	**7.886.537**

ANTALYA METROPOLITAN MUNICIPALITY

DEMOGRAPHIC FEATURES

In 2019, which is the base year in the greenhouse gases inventory of Antalya province, the total population was 2,511,700 people. In 2020, the total population reached 2,548,308 people, and all this show that there was an increase of 1.5% in a year.

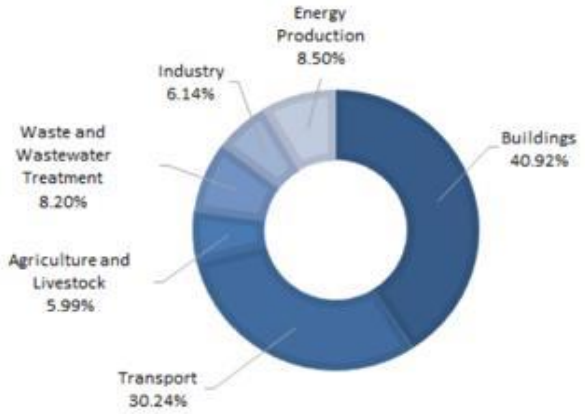
GEOGRAPHICAL FEATURES

Antalya province is a tourism center in the south of Turkey, with its center on the Mediterranean coast. The surface area of Antalya is 20,177 km2, which is 2.6% of Turkey's surface area. The length of the Antalya coast is 630 km in total. The province has a total of 19 districts.

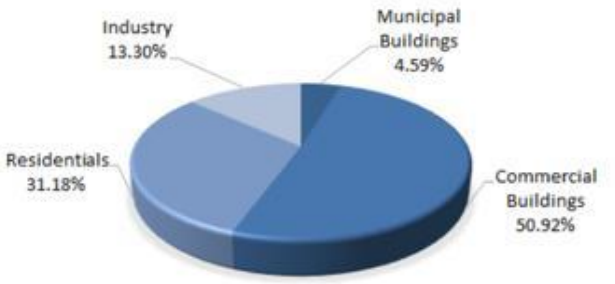
CLIMATIC FEATURES

In Antalya, which has a Mediterranean climate, winters are mild and rainy, and summers are hot and dry. The highest annual temperature recorded in the 1930-2020 period of the province is 45 degrees; The annual average precipitation is 1061.7 mm.

GREENHOUSE GASES INVENTORY, 2019



GHG EMISSIONS IN BUILDINGS, 2019



In Antalya province, greenhouse gases emissions in 2019 are 8,232,919 tCO2e, energy consumption is 21,493,229 MWh and per capita emissions are 3.28 tCO2e. By the end of 2030, Antalya aims to reduce its emissions by 40%.

EMISSIONS PER CAPITA	TOTAL EMISSION REDUCTION	TOTAL ENERGY REDUCTION
2030 **1.96** tCO2/per capita	**7,886,537** tCO2e	**20,190,870** MWh

Adaptation

The risks that Antalya faces in the context of climate change, the impacts of climatic events and adaptation actions are put forward as a result of a participatory process by using scientific assessment methods and taking expert opinions. In this direction, the main climatic findings of the city were investigated, and the risk and vulnerability assessment were completed by considering a participatory process.

Two different workshops were organized with the participation of experts from Antalya Metropolitan Municipality and the project team to identify adaptation actions. In the first workshop, the impact of heat and cold waves, excessive rainfall, overflow and floods, sea level rise, storms and tornadoes, water scarcity and drought, forest fires and infectious diseases for Antalya were discussed. Due to its geographical structure and location, it is understood that the risk of storms and tornadoes is quite high in Antalya. In addition, the risk of floods and overflows caused by sudden rainfall and inadequate infrastructure should also be taken into account. The need to ensure the sustainability of water resources and the increased risk of forest fires at high temperatures are other issues that need attention. Therefore, it is emphasized that adaptation actions aiming to be prepared against climate hazards should be handled in an integrated manner with both emergency action plans for disasters and other plans.

Adaptation actions identified according to Antalya's risk and vulnerability assessment were also evaluated in terms of implementation. Within the scope of adaptation actions, main issues such as adapting infrastructure systems to reduce the city's climate change risks, increasing active green areas, increasing adaptation efforts by paying more attention to neighbourhoods with fragile population density, and ensuring water management were emphasized. It is clear that Antalya, one of Turkey's leading cities in tourism and agriculture, will benefit from tackling climate change not only on an urban scale but also on a national scale. Therefore, it was stated that the central government, universities, commercial institutions, educational institutions, and non-governmental organizations should work together on climate change adaptation and that it is one of the most important requirements in the fight against climate change.

1. INTRODUCTION

In the early 21st century, it is now definitely stated by climate scientists that global warming is occurring due to carbon dioxide and equivalent greenhouse gases from the intensive use of fossil fuels. It is predicted that maintaining the current consumption habits of societies will significantly increase the negative consequences of climate change, resulting in massive environmental destruction, mass deaths and other humanitarian disasters. These consequences can be observed in the increase in extreme natural events that we encounter today. Since the industrial revolution, it has been proven that carbon dioxide emissions from human activities, especially from fossil fuel consumption, have increased much faster than the oceans and forest areas can absorb. This dangerous reality, clearly demonstrated by climate science, has led the world to focus more on this issue and have mobilized cities.

Local governments have become increasingly involved in this problem, which closely concerns the quality of life and health of people. Unlike the decision-making process of governments, local governments' dominance in solving regional problems and their ability to utilize the advantages of being local in process management have made the position of local governments indispensable in the face of the negative impacts of climate change, and local governments and the associations and coalitions they form have shown that they can start to play important roles in the fight against climate change by setting more advanced goals than their governments since the early 2000s .

Antalya Metropolitan Municipality signed the Covenant of Mayors (CoM) in 2013, established by the European Commission to promote and support urban mitigation plans to reduce greenhouse gas emissions in cities and to encourage the use of clean energy sources. This process, which covers 2020 targets, has been updated to 2030 and even 2050 targets with the initiatives of the European Union and the Covenant of Mayors. Antalya Metropolitan Municipality has declared a 40% reduction target for 2030. For 2050, there is a neutral Antalya target.

In order to minimize or eliminate the impacts and risks of inevitable climatic hazards as well as mitigating the effects of climate change, the city needs to be climate compatible. In this context, this study will be the first study prepared by Antalya Metropolitan Municipality on climate adaptation. The climate adaptation section, which should be considered as a guide, needs to be developed and elaborated with scientific data and studies and integrated into all plans of the city.

1.1 STRUCTURE OF THE REPORT

Antalya Sustainable Energy and Climate Action Plan basically consists of five chapters.

Chapter 1 "Introduction": This section provides an overview of the SECAP process and sheds light on the objectives and strategy areas of national and local plans on sustainable energy and adaptation of climate change to the city. In this context, a relationship is established with the SECAP prepared for Antalya.

Chapter 2 "Climate Change": This chapter examines climate change scenarios, climatic disasters, and climate change policies at global, national, and local scales. Climate change scenarios and climatic disasters are examined in detail in the global, national, and urban context. The direct and indirect targets set in the Antalya

Metropolitan Municipality 2020-2024 Strategic Plan within the scope of greenhouse gas mitigation and reducing the negative impacts of climate change are examined and presented as a summary table at the end of this section.

Chapter 3 "Greenhouse Management": In the section where inventory findings are presented with sectoral breakdowns, information on the 2030 mitigation target and projection is provided. While mitigation activities are given on a sectoral basis, findings on the current status of the sector and its place in national and city strategies are also mentioned. In addition, in order to address the needs identified in the SECAP preparation process in the future, the mitigation roadmap is detailed with actions and the monitoring section is also presented.

Chapter 4 "Adaptation to Climate Change"": In this chapter, the current situation of Antalya in terms of adaptation to climate change, risk, and vulnerability assessment in the face of climatic events, identification of adaptation strategies and actions in this context, and adaptation monitoring are evaluated.

Chapter 5 "General Evaluation": In this section, the results achieved under the Antalya Sustainable Energy Action Plan are evaluated under two sub-headings: mitigation and adaptation.

1.2 SUSTAINABLE ENERGY AND CLIMATE ACTION PLAN (SECAP) STEPS

Six steps are basically followed in the preparation of SECAP. The process starts with the creation of a greenhouse gas inventory and is completed with the monitoring and reporting step after the action details related to mitigation and adaptation issues. Within the scope of this study, the methods and standards adopted by the Covenant of Mayors are utilized. The figure below shows the steps followed in the preparation process of the Sustainable Energy and Climate Action Plan.

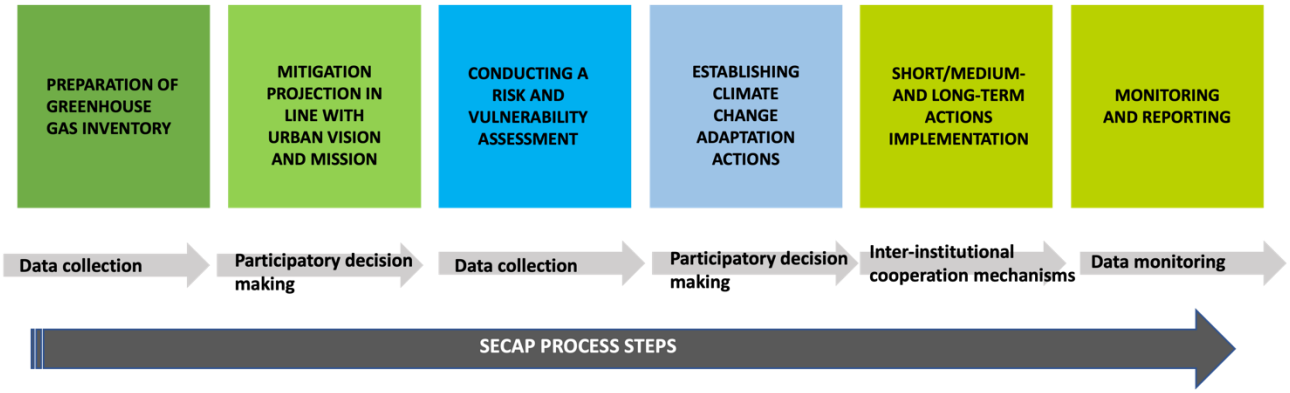


Figure 3: SECAP process steps[1]

a) **Preparation of Greenhouse Gas Inventory:** Collecting greenhouse gas sources consumption data of Antalya and determining the sources that emit the most greenhouse gas emission sources of the city
b) **Establishing Greenhouse Gas Mitigation Actions:** Establishing actions on buildings and energy, transportation, waste and wastewater management and agriculture in the greenhouse gas mitigation section of the Sustainable Energy and Climate Action Plan prepared for Antalya.
c) **Risk and Vulnerability Assessment:** Assessment of risks and impacts for Antalya in terms of heat and cold waves, excessive rainfall, floods, sea level rise, storms and tornadoes, water scarcity and drought, forest fires and infectious diseases.

[1] *SEIEP abbreviation is the Turkish version of SECAP abbreviation.*

d) **Establishment and Implementation of Actions:** Identifying climate adaptation actions according to risk and vulnerability assessment and implementing them in order of priority.

e) **Monitoring and Reporting:** Monitoring and reporting of GHG source and energy consumption changes and results of adaptation actions according to the determined base year.

1.3 GENERAL INFORMATION FOR ANTALYA

In this section, the geographical and climatic structure of Antalya as well as its socioeconomic structure and the characteristics of its districts will be examined. Understanding the basic characteristics of Antalya as a whole and its districts is very important in the context of climate change mitigation and adaptation.

1.3.1 Geographical and Climatic Features

The city of Antalya is located in southwestern Turkey in the Mediterranean Region. The city is bordered by Mersin, Karaman and Konya to the east, Isparta and Burdur to the north, and Muğla to the west. Antalya is the fifth largest province in Turkey with a surface area of 20.177 km^2.

The macroform structure of Antalya was generally determined by natural boundaries and urban elements over time. The star-shaped city is 77.8% mountainous, 10.2% plain and 12% hilly. Many peaks of the Taurus Mountains, which cover three quarters of the provincial area, exceed 2500-3000 meters. There are large plateaus and basins in the Teke region in the west. The topographical variability of the province creates different characteristics in terms of climate, agriculture, demography, and settlement. Most of the land of the province, except for the settlements, consists of plateaus covered with grain fields. The city is bordered by the Mediterranean Sea in the south, forests in the north, and agricultural areas in the northwest and northeast. In addition, there are port and free zone on the western border of the city, Organized Industrial Zone (OIZ) on the north, airport, and rural residential areas on the northeast. Antalya has developed organically due to its topographical structure, but the urbanization pressure that has occurred with the population growth rate in recent years is formed in the form of urban fringes according to geographical thresholds. The first development works for the city started in the 1950s. Kaleiçi, Balbey and Haşim İşçan areas in the centre are the oldest residential areas of the city. Today, these areas are still centrally located and have a mix of commercial, residential and tourism functions. In the coastal areas of the city, there are cultural facilities, tourism facility areas, recreational areas, secondary housing areas and residential areas [2].

Table 2: Meteorological statistics for Antalya province between 1930-2020 [3]

Months	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	Year
AVG temperature (°C)	10,0	10,7	12,9	16,4	20,6	25,3	28,5	28,4	25,2	20,5	15,5	11,6	18,8
AVG highest temperature (°C)	14,9	15,6	18,0	21,4	25,6	30,7	34,1	34,1	31,2	26,6	21,3	16,7	24,2
AVG lowest temperature (°C)	6,0	6,4	8,1	11,2	15,2	19,6	22,7	22,7	19,4	15,3	10,8	7,6	13,8
AVG sunshine duration (hours)	5,1	5,8	6,7	8,0	9,8	11,4	11,8	11,3	9,8	7,9	6,3	4,9	8,2
AVG number of rainy days	13,2	11,4	10,0	8,1	7,1	3,5	1,0	0,9	2,5	6,5	8,4	12,8	85,4
AVG monthly precipitation. (mm)	232,6	153,5	94,5	49,9	32,1	10,8	4,5	4,6	16,8	68,7	131,6	262,1	1061,7
Highest temperature (°C)	23,9	26,7	28,6	36,4	41,7	44,8	45,0	44,6	42,5	38,7	33,0	25,4	45,0
Lowest temperature	-4,3	-4,6	-1,6	1,4	6,7	11,1	14,8	13,6	10,3	4,9	0,0	-1,9	-4,6

[2] *Antalya UAP 2040, 2016.*

[3] *https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?m=ANTALYA, Date of access: May 2022.*

Antalya province is located in the Mediterranean climate zone with mild and rainy winters and hot and dry summers. Another factor affecting the climate of the city is the topographic structure of the city. The fact that the mountains are parallel to the sea and the elevation differences in the southern regions of the Taurus Mountains affect the precipitation and temperature values. In addition to climate change, the reason for the sudden and intense rainfall in the city is due to this topographic structure. Antalya's climate falls within the "Moderate Maritime and Warm Maritime Climate Class". The average temperature in summer is between 28 and 36 degrees. It is seen that the temperature exceeds 40 degrees at noon. Snow is very rare in the coastal areas (Table 2).

Heat waves arriving in the region where Antalya is located, undergo changes such as warming, descending, and rising, causing anomalies in the region, where the summers are hot and dry. This leads to an increase in the severity and duration of drought and a decrease in precipitation. For this reason, reductions in the amount of water will occur and cause serious problems. Another possible impact of climate change in and around Antalya is the damage of ecosystems. It is predicted that increasing drought will seriously threaten endemic species in the region. In addition, agricultural areas in and around the region will also be damaged, and it is possible that ecological, economic, and social policies that play a role in the development of the region may also be affected.

1.3.2 Demographic Structure and Socioeconomic Characteristics

According to 2021 TurkStat data, Antalya's population is 2,619,832 people and population density is calculated as 126 people / km^2. Antalya has 19 districts including Muratpaşa, Aksu, Döşemealtı, Kepez, Konyaaltı, Kemer, Serik, Akseki, Alanya, Demre, Elmalı, Finike, Gazipaşa, Gündoğmuş, İbradı, Kaş, Korkuteli, Kumluca, Manavgat. Among these districts, Muratpaşa, Konyaaltı, Kepez, Aksu, Döşemealtı are the central districts (Figure 4). The population information of the districts between 2016-2020 is shown in Table 3. According to the table, the districts in Antalya province with the largest increase in 2020 compared to 2016 are Döşemealtı with 18.6%, Konyaaltı with 15.1%, Alanya with 13.1%, Kepez with 13% and İbradı with 10%.

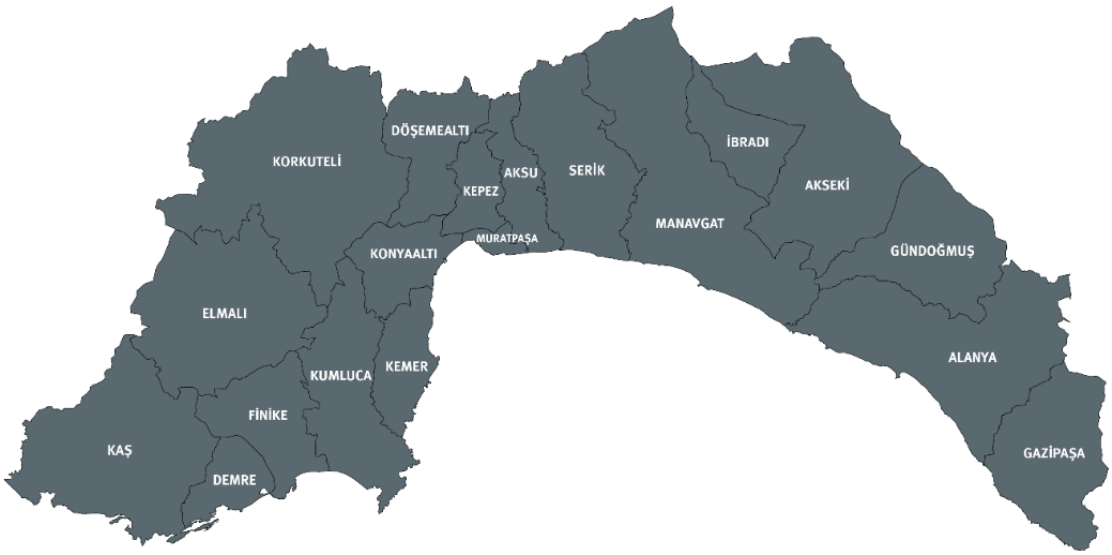


Figure 4: Districts map of Antalya

Table 3: The population of Antalya province between 2016-2020 [4]

District Name	2016	2017	2018	2019	2020
Akseki	10.729	10.471	13.084	11.484	10.957
Aksu	69.629	69.967	71.643	73.220	74.570
Alanya	294.558	299.464	312.319	327.503	333.104
Demre	25.959	25.928	25.893	26.362	26.896
Döşemealtı	58.451	59.948	63.186	65.794	69.300
Elmalı	38.623	38.651	39.254	38.972	39.365
Finike	47.498	48.948	48.131	48.534	49.307
Gazipaşa	49.207	49.555	50.003	50.555	51.555
Gündoğmuş	7.309	7.593	8.726	7.737	7.492
İbradi	2.678	2.646	3.618	3.032	2.947
Kaş	56.720	57.123	58.600	59.716	60.839
Kemer	41.925	42.568	43.226	46.143	45.082
Kepez	508.123	519.966	531.619	556.033	574.183
Konyaaltı	164.332	172.920	182.112	190.043	189.078
Korkuteli	53.347	53.610	55.712	55.352	55.588
Kumluca	67.605	67.942	68.610	70.423	71.931
Manavgat	224.664	226.394	230.597	241.011	242.490
Muratpaşa	486.408	488.670	495.688	510.368	513.035
Serik	120.790	122.032	124.335	129.418	130.589
TOTAL	2.328.555	2.364.396	2.426.356	2.511.700	2.548.308

According to the "Socioeconomic Development Ranking of Provinces and Regions (SEGE) 2017 Research published by the Ministry of Development, the TR61 Region (Antalya, Burdur, Isparta), which includes Antalya, ranks fourth among 26 level 2 regions. In the ranking by provinces, Antalya ranks 5th.[5]

Antalya's population started to increase rapidly after the 1990s. The population, which was 206,270 people in 1927, increased from 1,132,211 in 1990 to 1,719,751 in 2000. This situation, which is a faster increase than Turkey's population growth rate, has continued until today[6]. Especially in the central districts and Alanya, Gazipaşa, Manavgat and Serik districts, the population growth rate has been higher. On the other hand, according to the Transportation Master Plan Report (2016), the rural population of the city started to decrease rapidly after the 1980s, and in 2013, the entire population shifted to urban areas. This situation has led to a rapid decrease in rural areas and has also affected the macroform of the city. The city's population change between 2007 and 2021 is shown in Figure 5. In addition, Antalya has a young population. According to the 2020 population, 50.3% of the city is male and 49.7% is female. According to TurkStat data based on 2018 in AFAD's Provincial Disaster Risk Reduction Plan (IRAP) report (2021), the city's population projection in 2025 is calculated as 2,773,397.

[4] *TurkStat, 2021.*
[5] *Socioeconomic Development Ranking Research of Provinces and Regions, Ministry of Industry and Technology, 2017.*
[6] *Promice Digital Printing, Regional Development Dynamics: Antalya Model and 2023 Scenarios Project, 2015.*

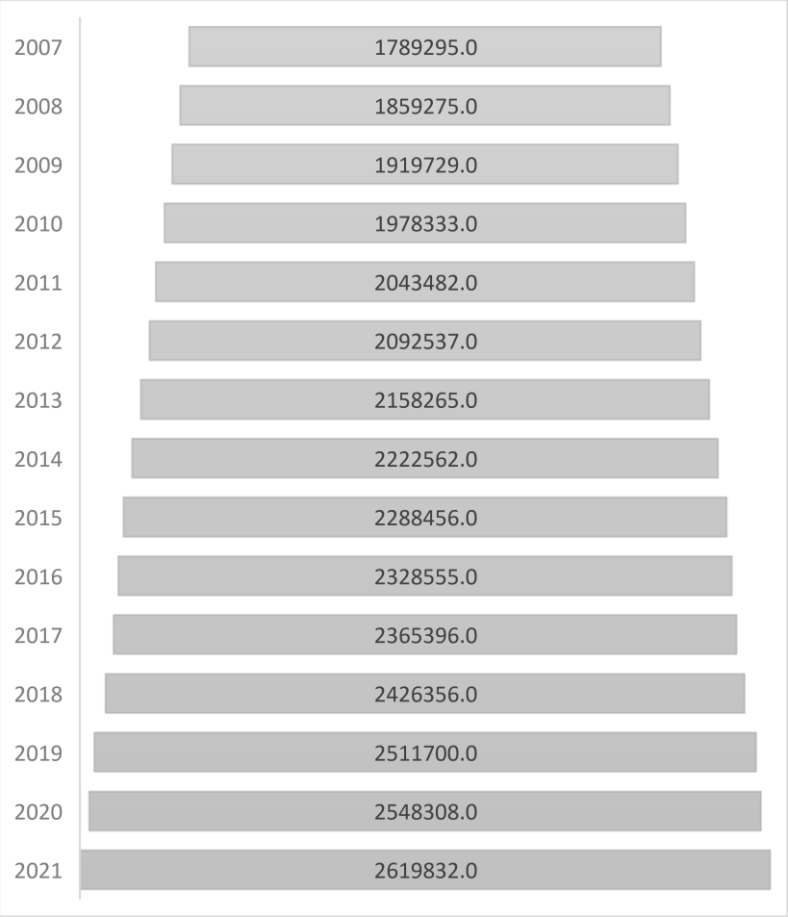


Figure 5: Population change of Antalya between 2007-2020

According to 2020 TurkStat data, 70% of Antalya's population is between the ages of 15-64, 21% between the ages of 0-14 and 9% between the ages of 65+ (Figure 6).

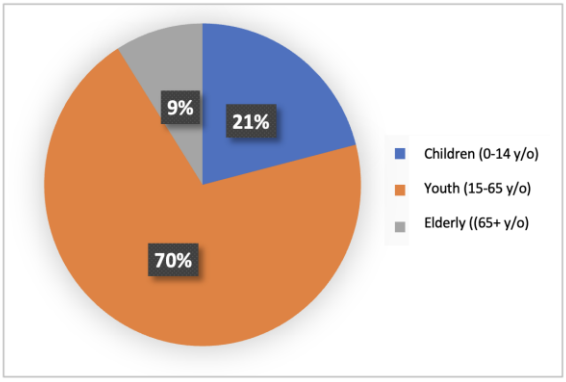


Figure 6: Population distribution of Antalya by age group

The population density map of Antalya based on 2020 population data is shown in Figure 7 and the education status map is shown in Figure 8[7]. It is seen that the population density is higher especially in the central districts. It is seen that the population density of Kepez and Muratpaşa districts is extremely dense, while the coastal districts are very dense and dense. However, as you move away from the sea and go inland, the population density in the city decreases. Although the effects of climate change will show its effects all over Antalya, areas with high urbanization pressure and population density, inadequate infrastructure systems and active green areas for the population, and low education levels will be more affected by climate change.

[7] *AFAD, İRAP, 2021.*

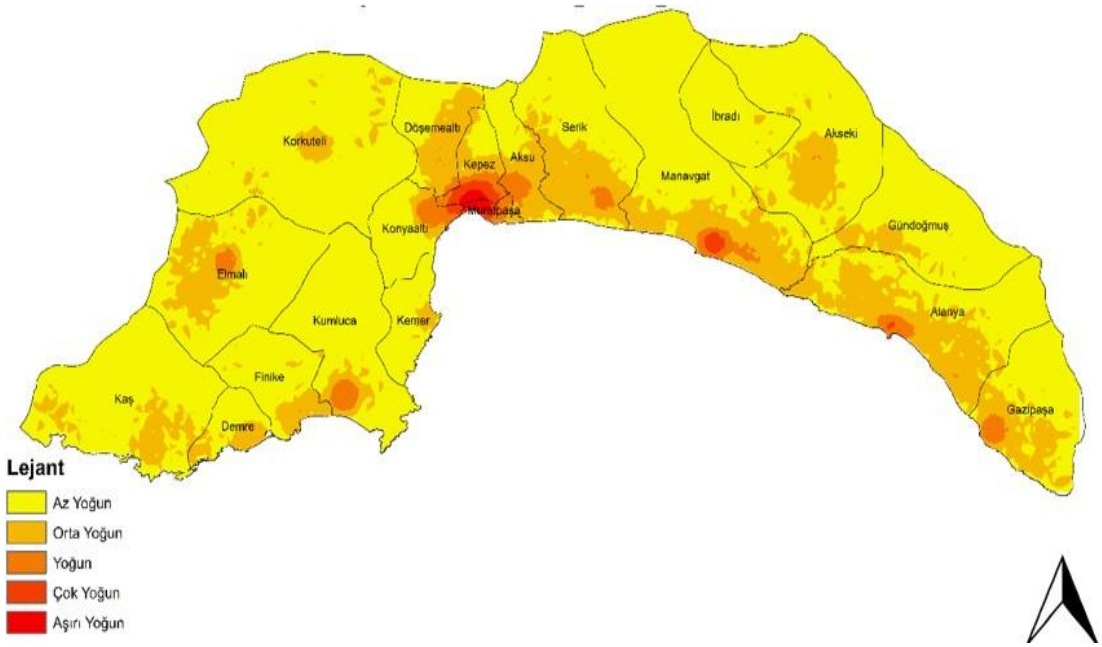


Figure 6: Density map of Antalya districts

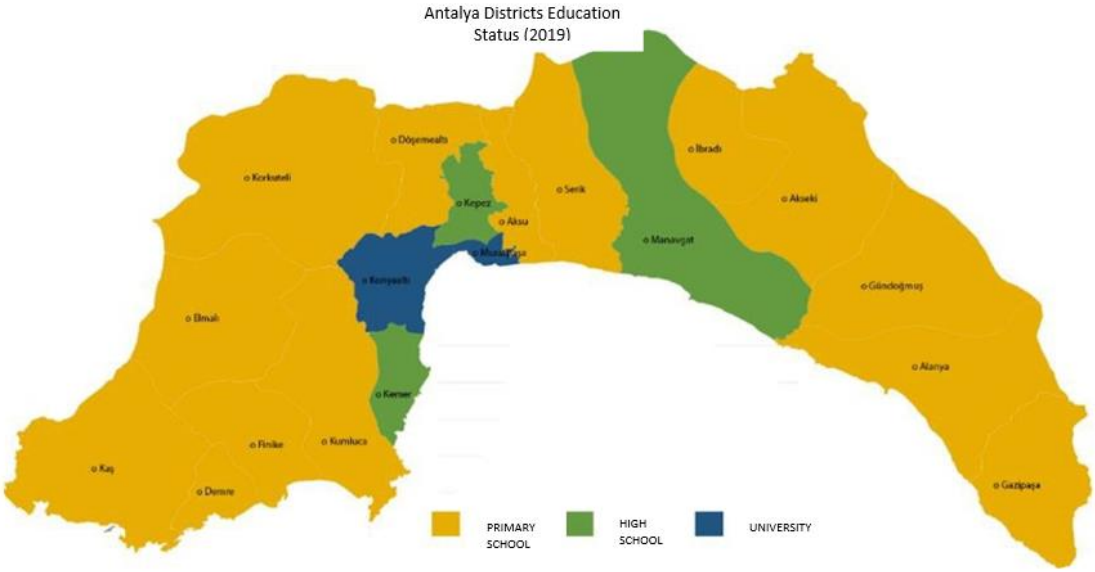


Figure 8: Education level map of Antalya districts

Antalya's economic structure is based on agriculture, tourism, and trade sectors. According to the information in AFAD's IRAP report (2021), the diagram showing the city's economic activity rates is shown in Figure 9. According to this diagram, professional, administrative and support, agriculture, forestry, fisheries, public administration and health, real estate, industrial facilities are the sectors with the largest proportion.

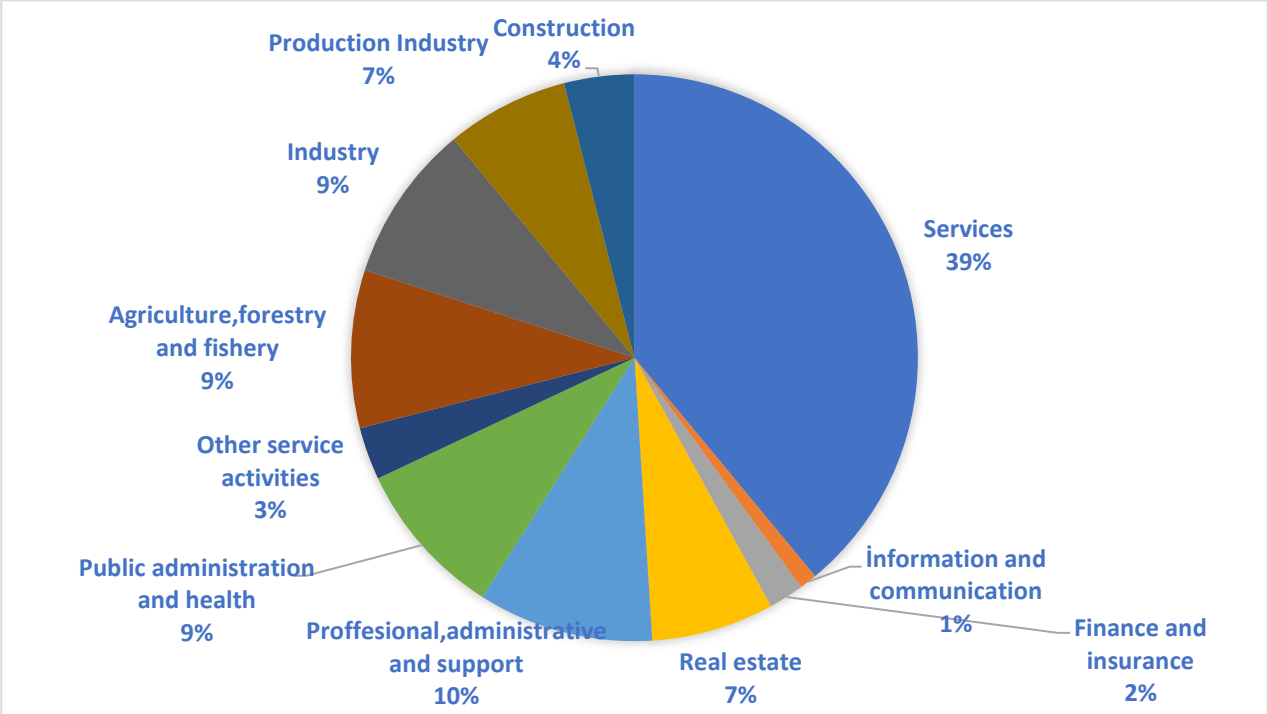


Figure 7: Economic activity rates of Antalya (2019) [8]

Considering the number of accommodation facilities, bed capacity and the number of foreign tourists in Turkey in the TR61 Level 2 Regional Plan (2013), Antalya ranks first among the provinces that made the TR61 Region known all over the world. Antalya ranks 3rd after Paris and London in the ranking of the most visited cities in the world with more than 10 million foreign tourists annually. Antalya hosts approximately one third of the foreign visitors entering Turkey. In addition to these, it is possible to talk about ecotourism as a viable alternative tourism type in the inner parts of Antalya and in the natural areas close to the settlements of Isparta and Burdur. In the 2023 Action Plan of the Turkish Tourism Strategy, Antalya province has been declared as an ecotourism and cultural tourism development region and it is aimed to develop alternative tourism types in these areas in a qualified manner. Ecotourism stands out as one of the most important tools that can be used to spread the tourism activities concentrated on the coasts of the Western Mediterranean Region towards the interior of the region.

1.3.3 District Tags of Antalya

In this section, the current situation of Antalya districts according to their socioeconomic status will be presented. Density, population, density of vulnerable population, socioeconomic development are the factors that will determine the level of impact of the regions in the city on climate change. For this reason, the socioeconomic structure of the city as a whole as well as its districts should be addressed. According to the Socioeconomic Development Ranking (SEGE) published by the Ministry of Industry and Technology in 2022, 3 of Antalya's 19 districts are in Level 1 (5 districts were in Level 1 in 2017), 7 in Level 2, 6 in Level 3, 2 in Level 4 and 1 in Level 5. 53% of the districts have a development level of 1st and 2nd level. It is observed that the city center and the districts that are centres of attraction in terms of tourism have high index values. Settlements such as Antalya-Manavgat, Antalya-Alanya, Antalya-Kemer, which are considered as important tourism centers of our country, are in this level. Kepez, Muratpaşa, Alanya and Manavgat districts are the

[8] *Taken from AFAD, IRAP, 2021 report. According to the report, the information is based on TURKSTAT data*

districts where the population is concentrated. Table 4 shows the development index ranking of Antalya districts according to certain criteria.

Table 4: Development index ranking of districts of Antalya [9]

Rank	District name	Score	Rank	District name	Score	Rank	District name	Score
1	Muratpaşa	3,173	8	Serik	0,852	14	Gazipaşa	-0,152
2	Konyaaltı	2,465	9	Kumluca	0,515	15	Korkuteli	-0,081
3	Alanya	1,676	10	Aksu	0,476	16	Elmalı	-0,150
4	Manavgat	1,538	11	Finike	0,315	17	Akseki	-0,182
5	Kemer	1,501	12	Kaş	0,203	18	İbradı	-0,264
6	Kepez	1,392	13	Demre	-0,180	19	Gündoğmuş	-0,815
7	Döşemealtı	1,216						

Central Districts:

There are 3 Small Industrial Sites (KSS) in Antalya city center. Among these industrial estates, Akdeniz KSS, which has over 1000 workplaces, is located in the northwest of the city center, while Antalya KSS (Old Industrial Site) serves in Muratpaşa district. Antalya OIZ is located in the north of the city on the D-350 Highway. In general, greenhouse areas increase as you move from the dense residential areas in the city centre to the periphery and the residential areas show a scattered structure. Greenhouse areas are seen in the periphery of Aksu district from east to north, in Döşemealtı district from west to north and in the north of Kepez district. Muratpaşa district has a population of 513,035 in 2020, with tourism and trade as the dominant sectors. Kepez district's population in 2020 is 574,173 and its dominant sector is trade. Konyaaltı district has a population of 189,078 in 2020, and its dominant sector is tourism and trade. The population of Döşemealtı district in 2020 is 69,300; the dominant sector is agriculture and livestock. Aksu district's population in 2020 is 74,570; the dominant sector is tourism and agriculture.

District:	**Akseki**				
Population (2020):	10.957	**Dominant Sector:**	Agriculture	**SEGE:**	3rd grade
Land Use:	62.84% of its surface area is covered by forest and heathland areas, 22% by non-agricultural areas, 8.45% by meadow-pasture areas, 5.47% by agricultural areas, 0.24% by water surface and 1% by urban built-up areas.				
The fact that the district has a geographically mountainous area has affected the development of its economy. There is one small industrial site in the district. The mountainous and high areas of the district is covered with forests. Due to this situation, the forestry sector is also developed in the district. Activities in hunting tourism, nature tourism, plateau tourism, cultural tourism, cave tourism, mountaineering and winter tourism are widely practiced in Akseki. Agriculture, trade and handicrafts are developed in the district. The settlement structure generally consists of low-density, split layout residential areas in the centre.					

[9] *Real Estate and Real Estate Investment Trust Association, Antalya Province Investment Areas Vision Report, 2017.*

District:	Alanya				
Population (2020):	333.104	Dominant Sector:	Agriculture, Tourism and services	SEGE:	1st grade
Land Use:	In Alanya district, which has a surface area of 1577 ha; 16.45% is agricultural areas, 6.26% is meadow and pasture areas, 65.48% is heathland and forest areas, 0.10% is water surface and 11.70% is non-agricultural areas and settled areas.				
Although the agriculture sector is the primary sector in the district, the district is also highly developed in terms of tourism. The urbanization pressure that emerged with the tourism activities in the district has also affected the construction. There are intensive tourism facilities especially in the coastal areas of Alanya. These areas include hotels, recreation areas and secondary housing areas. There are a total of 235 tourism and accommodation facilities in the district. The service sector has also developed in the district due to tourism. There are also 3 KSSs in Alanya.					

District:	Demre				
Population (2020):	26.896	Dominant Sector:	Agriculture	SEGE:	3rd grade
Land use:	11.30% of the district land is agricultural land, 0.10% is meadow-pastureland, 67.50% is forest land, 0.63% is water surface and 20.46% is non-agricultural land and urban settlement areas.				
The main sector in the district is agriculture. Livestock is practiced in the district, especially in high and mountainous areas. The coastal location of the district has also contributed to development of the fishing sector. The second sector in the district after agriculture is the services sector. The services sector, which develops depending on tourism, has not developed as much as in other districts of Antalya. The main reason for this situation is that in order to protect the agricultural areas in the district, the plan decisions prevent the misuse of agricultural lands. In addition, another issue is that there are dense greenhouse areas as you go to the inner parts of the district.					

District:	Elmalı				
Population (2020):	39.365	Dominant Sector:	Agriculture and Livestock	SEGE:	3rd grade
Land use:	Of the total surface area of the district, 36% is composed of agricultural areas, 14% of meadow-pasture areas, 31% of forest and heathland areas and 19% of non-agricultural areas and residential areas. 33% of the agricultural areas are irrigated.				
The main sector in the district is agriculture. The livestock sector, which is a branch of the agricultural sector, is also developed in the district. Unlike other regions in Antalya province, open crop cultivation is carried out in Elmalı district. Especially grain, cereals and fruits are grown in the district. Depending on the agricultural products produced in the district, agricultural industry is also developed. There are 2 KSSs in the district.					

District:	Finike				
Population (2020):	49.307	Dominant Sector:	Agriculture	SEGE:	3rd grade
Land use:	Finike plain, which is covered with alluvium, is covered with fertile soils where all kinds of agricultural plants can easily grow due to this feature. Agricultural areas constitute 10% of the total surface area of the district, meadow-pasture areas constitute 0.2%, forest-woodland areas constitute 77% and non-agricultural lands and settlement areas constitute 22.08%.				
The Finike Plain, formed by the tributaries of the rivers in the district, has fertile agricultural areas, so the main sector is agriculture. Citrus fruits and tropical-subtropical fruits are grown in the Finike Plain. Citrus fruits grown in the district constitute a significant portion of the country's production. The development of fruit growing in the district and international exports have led to the development of new sectors. Greenhouse cultivation also has an important share in the district economy.					

District:	Gazipaşa				
Population (2020):	51.555	Dominant sector:	Agriculture	SEGE:	3rd grade
Land use:	The coastline length of the district is approximately 50 km. There are low hills between the district centre and the seacoast. Of the total surface area of the district, 17.91% is agricultural areas, 12.37% is meadow-pasture areas, 66.55% is forest-chaparral areas and 3.2% is non-agricultural lands and settlement areas.				
The agricultural sector is a pioneer in the district. In addition, greenhouse vegetable production is also carried out in the district. Agricultural production is also carried out in the centre of Gazipaşa. The reason for this is to prevent the use of agricultural areas for non-agricultural purposes. In addition to agricultural production, livestock also has an important potential in the district. In addition, the fact that the district has a coast to the Mediterranean Sea has led to the development of the fishing sector in the district. Although Gazipaşa district is a coastal city, the settlement area is located inland due to geographical reasons. There are rural residences in the agricultural areas on the periphery of the city.					

District:	Gündoğmuş				
Population (2020):	7.492	Dominant sector:	Agriculture, Livestock and Hunting	SEGE:	4th grade
Land use:	Of the total surface area of the district, 7.81% is agricultural land, 4.76% is meadow-pastureland, 36.63% is forest-pastureland, and 51.79% is non-agricultural land and settlement areas				
Looking at the sectoral distribution of Gündoğmuş district, it is seen that the main sector is agriculture. The fact that the district has a mountainous area and the slope in agricultural areas is high; It has also led to the development of livestock and fruit growing in the district. In addition, the fact that the mountainous areas of the district are covered with forests has enabled the development of the forestry sector in Gündoğmuş.					

District:	İbradı				
Population (2020):	2.947	Dominant sector:	Hunting	SEGE:	3rd grade
Land use:	The district, which has an altitude of approximately 1100 meters, has a plateau characteristic with its geographical features. Forests are covered with pine, juniper and cedar trees. Of the total surface area of the district, 1.09% is agricultural areas, 1.38% is meadow-pasture areas, 37.08% is forest-chaparral areas and 60.44% is non-agricultural lands and settlement areas.				
All villages in İbradı district have the status of forest villages. Beekeeping is generally practiced in the district. İbradı stands out with its historical texture. The natural and cultural values of the district are İbradı mansions and cemeteries, monumental chestnut tree, Çukurviran Tomb Monument, Eryaman, Kargı and Tolga Inn and Altınbeşik-Düdensuyu Cave.					

District:	Kaş				
Population (2020):	60.839	Dominant sector:	Tourism	SEGE:	3rd grade
Land use:	Of the total surface area of the district, 12.07% is agricultural areas, 1.04% is meadow-pasture areas, 61.47% is forest- chaparral areas and 25.41% is non-agricultural lands and settlement areas.				
The main source of livelihood in the district economy is the tourism sector. In addition, the agricultural sector is also important in the district. Livestock is practiced especially in high areas. In addition, the fact that the district is neighbouring the Mediterranean Sea has also led to the development of fishing. The large forest areas has also enabled the development of the forestry sector in the district. The fact that the district has a seashore and there is a marina in the district, has led to the development of the tourism sector and therefore the services sector. Due to tourism, the construction sector has also developed in Kaş. Intensive construction is seen especially in the coastal areas. Various nature sports tourism is practiced in Kaş due to its geographical structure.					

District:	Kemer				
Population (2020):	45.082	Dominant sector:	Tourism	SEGE:	1st grade
Land use:	Of the total surface area of the district, 6.34% is agriculture land, 77.75%is forest-chaparral and 15.90% is non-agricultural and settlement areas.				
Kemer is located within the cultural and tourism protection and development zone. The district's economy is based on tourism, which mainly has accommodation facilities, secondary housing areas and recreation areas.					

District:	Korkuteli				
Population (2020):	55.588	Dominant sector:	Agriculture	SEGE:	3rd grade

Land use:	Of the total surface area of the district, 40.08% is agricultural land, 2.29% is meadow-pastureland, 35.82% is forest--chaparral, and 21.80% is non-agricultural land and settlement areas.

The main sector in the district is agriculture. Korkuteli plain plays a major role in the development of the agricultural sector in the district. The highest agricultural area in Antalya province is located in Korkuteli district. Grain and fruit cultivation is common in the district. In recent years, cut flower cultivation has also become widespread in the plateau. In addition, Korkuteli district has become a central position in the Turkish market in mushroom and compost production. Antalya province provides 50% of the compost used in the production of cultivated mushrooms throughout the country.

District:	**Kumluca**				
Population (2020):	71.931	**Dominant sector:**	Agriculture and Fishery	**SEGE:**	2nd grade
Land use:	Of the total surface area of the district, 12.07% is agricultural land, 1.04% is meadow-pastureland, 61.47% is forest-pastureland, and 25.41% is non-agricultural land and settlement areas.				

The main sector of Kumluca district is agriculture. Irrigated agricultural areas constitute 70% of the agricultural areas in the district. There are citrus groves and greenhouses in the agricultural areas in the district, and apple orchards and olive groves in the highlands. In addition, camellia type viticulture is practiced in the highland areas. Citrus groves and greenhouse areas are effective in the development of the agricultural sector in the district. In Antalya province, the highest amount of greenhouse product cultivation is carried out in Kumluca district. Animal husbandry, which is a part of the agricultural sector in the district, is also developed. Fishing is also developed in the district neighbouring the Mediterranean Sea.

District:	**Manavgat**				
Population (2020):	242.490	**Dominant sector:**	Agriculture and Tourism	**SEGE:**	1st grade
Land use:	Of the total surface area of the district, 18.92% is agricultural land, 4.78% is meadow-pastureland, 66.90% is forest-pastureland, and 32.45% is non-agricultural land and settlement areas.				

Manavgat is the district with the highest number of employees in Antalya province. The dominant sector in the district is agriculture. However, due to the seaside location of the district, the tourism sector and the services sector are also developed, and it is the second sector following the agricultural sector in the district. In the coastal part of the district, fishing is carried out depending on the geographical structure. Depending on the developing tourism sector in the district, the construction sector has also developed. One of the most important problems of the district is inappropriate construction. The construction sector both causes the destruction of the agricultural lands of the district and increases the environmental pollution of the district. The settlement pattern in the centre generally consists of medium and high-density split-layout residential areas. The areas in the south-east of the settlement are located within the irrigation project and along the Manavgat stream, which causes flood hazards.

District:	Serik				
Population (2020):	130.589	Dominant sector:	Agriculture and Tourism	SEGE:	2nd grade
Land use:	33.98% of the total surface area of the district consists of agricultural areas, 0.69% of meadow-pasture areas, 47.29% of forest and chaparral areas and 18.02% of non-agricultural lands and settlement areas.				
When the sectoral structure of the district is examined, the main sector is the agricultural sector. However, the tourism sector is also developed due to the seaside location of the district. Depending on the developing tourism sector in the district, the services sector is the second sector following the agricultural sector. Due to the tourism sector, the construction sector is also developed especially in the coastal areas. The fact that the district is under pressure of second housing keeps the construction sector alive, while causing environmental problems and the destruction of agricultural areas. The fact that the district is adjacent to the Mediterranean Sea due to its geographical structure has also led to the development of the fishing sector in the district.					

2. CLIMATE CHANGE

In this section, climatic events occurring at both global, national and urban scales in the context of climate change, the current situation caused by climate change and future scenarios based on projections are presented. Thus, the possible risks that Antalya will face in the process of combating climate change are also pointed out. In addition to these, policies implemented in the fight against climate change, important issues in international conventions, and national steps to combat climate change are other important issues covered in the chapter.

Both international and national sources have been utilized throughout the chapter. In particular, important and up-to-date sources such as IPCC have been consulted for research on the global impacts and scenarios of climate change. The current state of climate change in the global and national context has been created by quoting from the climate change action plan studies previously prepared by the consulting firm. In addition, relevant climate change reports, resources provided by Antalya Metropolitan Municipality, resources of the General Directorate of Meteorology, reports on Antalya and other online resources were carefully analysed in the chapter.

2.1 CLIMATE CHANGE SCENARIOS AND CLIMATIC DISASTERS

Climate science reveals that the earth's radiation balance started to deteriorate drastically especially in the 1990s and that the rate of this deterioration and the greenhouse gas effect caused by fossil fuels used for energy production has increased in the recent years. In addition, climate change, which is also a result of the production and consumption habits of societies, leads to climatic disasters. Climatic disasters are shown in Table 5 in the guidelines prepared by the Carbon Disclosure Project (CDP) for climate change.

Table 5: Climatic disasters according to CDP[10]

Rainstorm	Strong wind	Tropical storm	Cold wave
Land fire	Groundwater flooding	Ocean acidification	Rockfall
Monsoon	Hurricane	Lightning	Extremely cold days
Surface flooding	Storm surge	Collapse	Atmospheric CO_2 concentrations
Heavy Snowfall	Cyclone (typhoon)	Fog	Hot air wave
River Flooding	Permanent flooding	Landslide	Waterborne diseases
Hail	Extra tropical storm	Harsh winter conditions	Extremely warm days
Coastal flooding	Saltwater intake	Avalanche	Vector-borne diseases
Drought	Insect infestation	Forest fires	Airborne diseases

In addition, the impact of climate disasters on assets and service areas is shown in Table 6. It is necessary to say that these climatic disasters seen in various parts of the world cause negative effects in all critical areas and cause the normal flow of life to deviate. e. It is known that climate change-induced disasters cause

[10] *Climate Risk and Vulnerability Assessment Methodology Climate Risk and Vulnerability Assessment (CRVA) Methodology, https://toolkit.climate.gov/tools, Date of Access: Mart 2022.*

environmental and social destruction as well as mass extinctions. For this reason, international authorities and climate experts emphasize that the fight against climate change should be rapidly and urgently spread to all areas of life by putting forward various climate change scenarios by considering the past and current situation of the earth.

Table 6: Assets and services that may be affected by climate disasters according to CDP[11]

Energy	Waste management	Trade
Water resources and sanitation	Information and communication technologies	Residential areas
Transportation	Food and agriculture	Education
Environment	Industry	Public health
Society and culture	Laws and order	Disaster Management

2.1.1 Climate Change in a Global Context

The effects of climate change are observed differently at global, regional and local scales. Climatic events such as drought, unexpected extreme hot and cold weather, sudden and heavy rainfall causing floods and overflows, and excessive hail are the result of the human-induced greenhouse gas concentration in the atmosphere disrupting the radiation balance of the earth. However, this disruption also leads to an increase in social and economic irregularities. In the studies prepared by IPCC (2007), greenhouse gas emissions from agriculture, land use, industry, energy, and waste sectors increased by up to 70% between 1970 and 2004, leading to the warming of the earth. After 2004, increase accelerated, causing the earth's temperature to increase by 1.1^{o}C today.

Consequences of warming that will directly affect people have started to occur in various parts of the world. Precipitation patterns that deteriorate with the change in temperature led to floods, overflow disasters and droughts. The disruption of ecosystem balances in glacial regions and the melting of glaciers cause not only these regions but the entire globe to face negative consequences such as rising sea levels. Moreover, crises of access to safe food globally and unfavourable conditions in coastal regions are other factors that reveal the global seriousness of the issue. Failure to take serious measures globally to address climate change will exacerbate these negative impacts and lead to major disasters, causing many people to lose their lives. Therefore, it is of vital importance for the whole world to review all human-induced actions, to limit the current warming to the minimum level by reducing greenhouse gases, and to adapt societies and cities to the current and unchangeable new climate conditions.

2.1.1.1 Climatic Disasters

Climatic disasters have been occurring with increasing severity, frequency, duration and in different locations in recent years [12]. Looking at the world in general, approximately 1.3 million people lost their lives as a result of natural disasters that occurred between 1998 and 2017, and 4.4 billion people were directly affected by these disasters. It can be said that 91% of the disasters that occurred during this time period were caused by floods, storms, droughts, heat waves and other extreme weather events [13]. According to the latest World

[11] *Climate Risk and Vulnerability Assessment Methodology Climate Risk and Vulnerability Assessment (CRVA) Methodology, https://toolkit.climate.gov/tools, Date of access: Mart 2022.*
[12] *General Directorate of Meteorology, 2019 Meteorological Disaster Assessment Report, 2020.*
[13] *UNISDR&CRED, Economic Losses, Poverty & Disasters 1998-2017, 2018.*

Disaster Report (2020)[14] published by the International Federation of Red Cross and Red Crescent Societies (IFRC) covering the year 2019, there were 2850 natural disasters in 2010-2019, resulting in the death of more than 10 people and affecting more than 100 people. The vast majority of these were caused by climatic events such as floods, storms, and heat waves, with 83% in the period 1998-2017. These disasters have affected close to 1.8 billion people who have lost their lives, been injured, left homeless or faced livelihood difficulties in the decade alone. Disasters have also disrupted progress in sustainable development.

The IFRC report states that in 2019, there were 308 natural disasters, affecting 97.8 million people. In 2019, the most frequent disaster was floods, followed by storms, epidemics, earthquakes, and hydrologically related landslides. Extreme heat waves, forest fires and droughts were less frequent, while volcanic activity was rare (Figure 10).

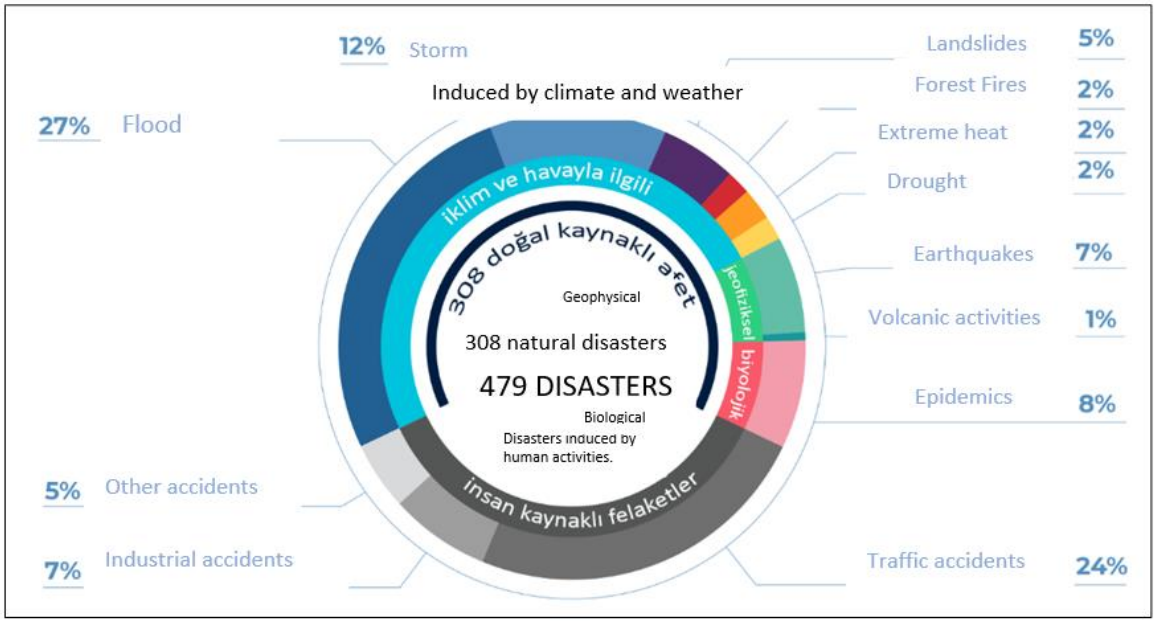


Figure 8: Disasters in 2019[15]

The same report states that more than 11,000 disasters triggered by natural hazards have been recorded since 1960. While in 1960 the total number of disasters per year was 33, this number was 441 in 2000. While disasters due to geophysical and biological hazards have been on the rise since the 1960s, they have remained relatively stable since the 1980s. In addition, epidemics have been on the rise since the 1060s, peaking between 1997 and 2002 (Figure 11). The new coronavirus pandemic that started at the end of 2019 has not yet been included in these studies.

[14] Freebairn, A., Hagon, K., Turmine, V., Pizzini, G., Singh, R., Kelly, T., Jaime, C., Scherer, N., Siahaan, K., Hartelius, J., Natoli, T., Lagdameo, D. M., Bachofen, C., Emery, G., Swithern, S., & Fisher, D. (n.d.). World disasters report 2020: come heat or high water.

[15] EM-DAT, FAO/FEWS NET, Translated into Turkish from Dartmouth Flood Observatory, ReliefWeb and IFRC GO. Percentages do not add up to 100 because fractional numbers are rounded to whole numbers.

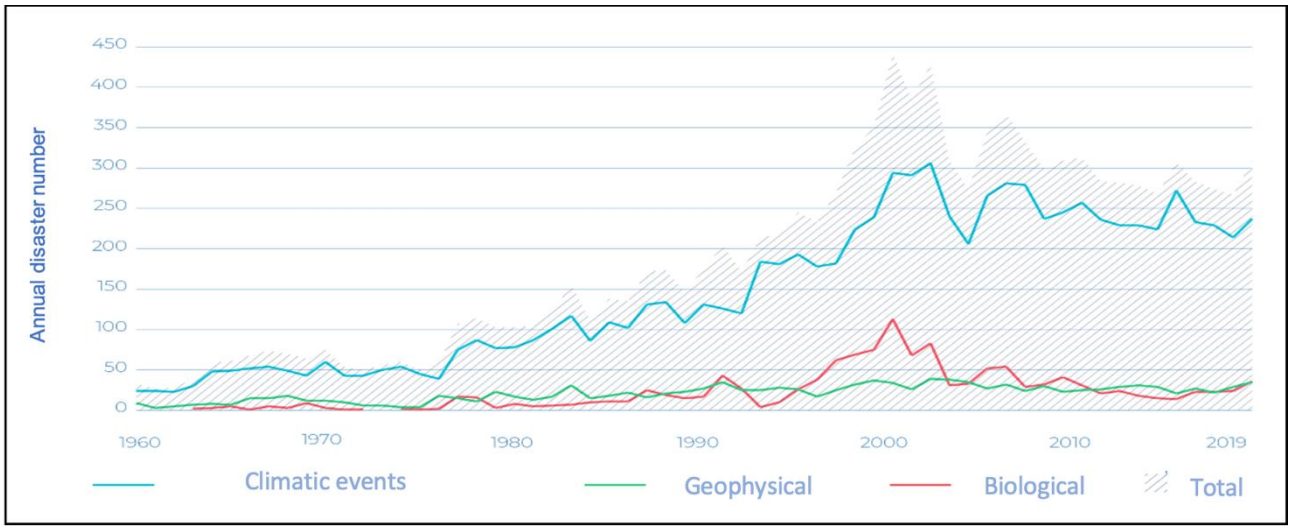


Figure 9: Number of disasters between 1960 and 2019 [16]

The total number of disasters triggered by climate and weather events and the significant increase since 1960 is shown in Figure 12. While 76% of the disasters reported in the 1960s were related to climate and weather events, this rate increased to 83% in the last decade between 2010-2019.

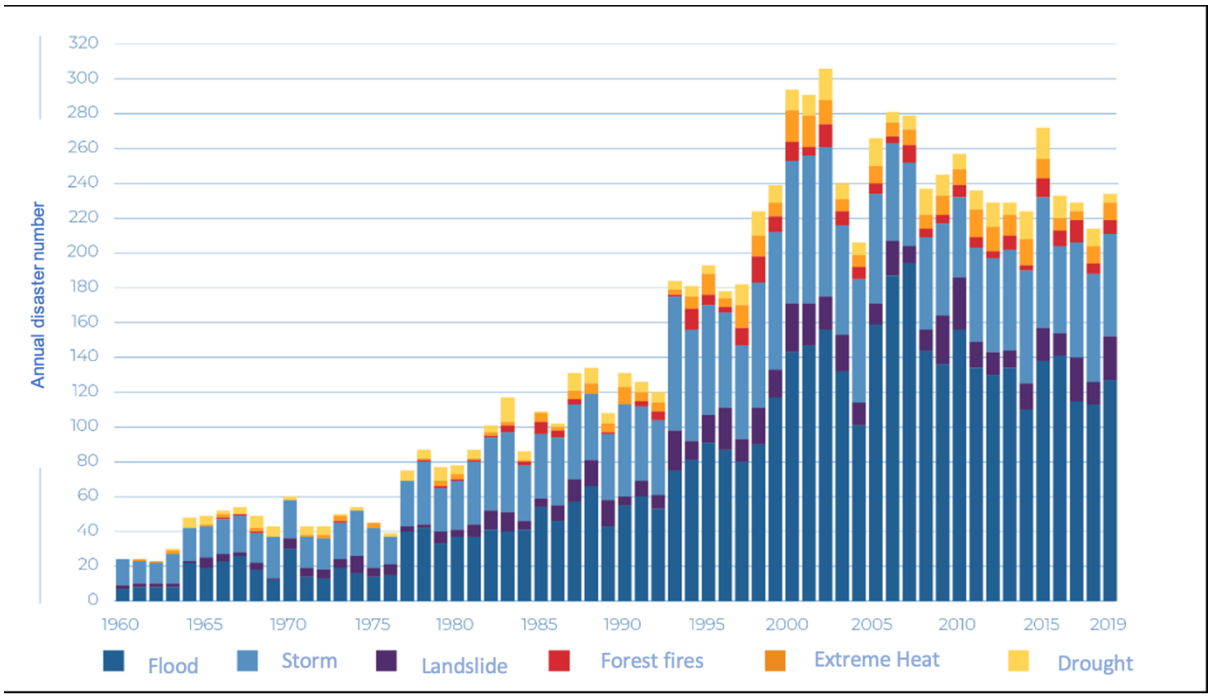
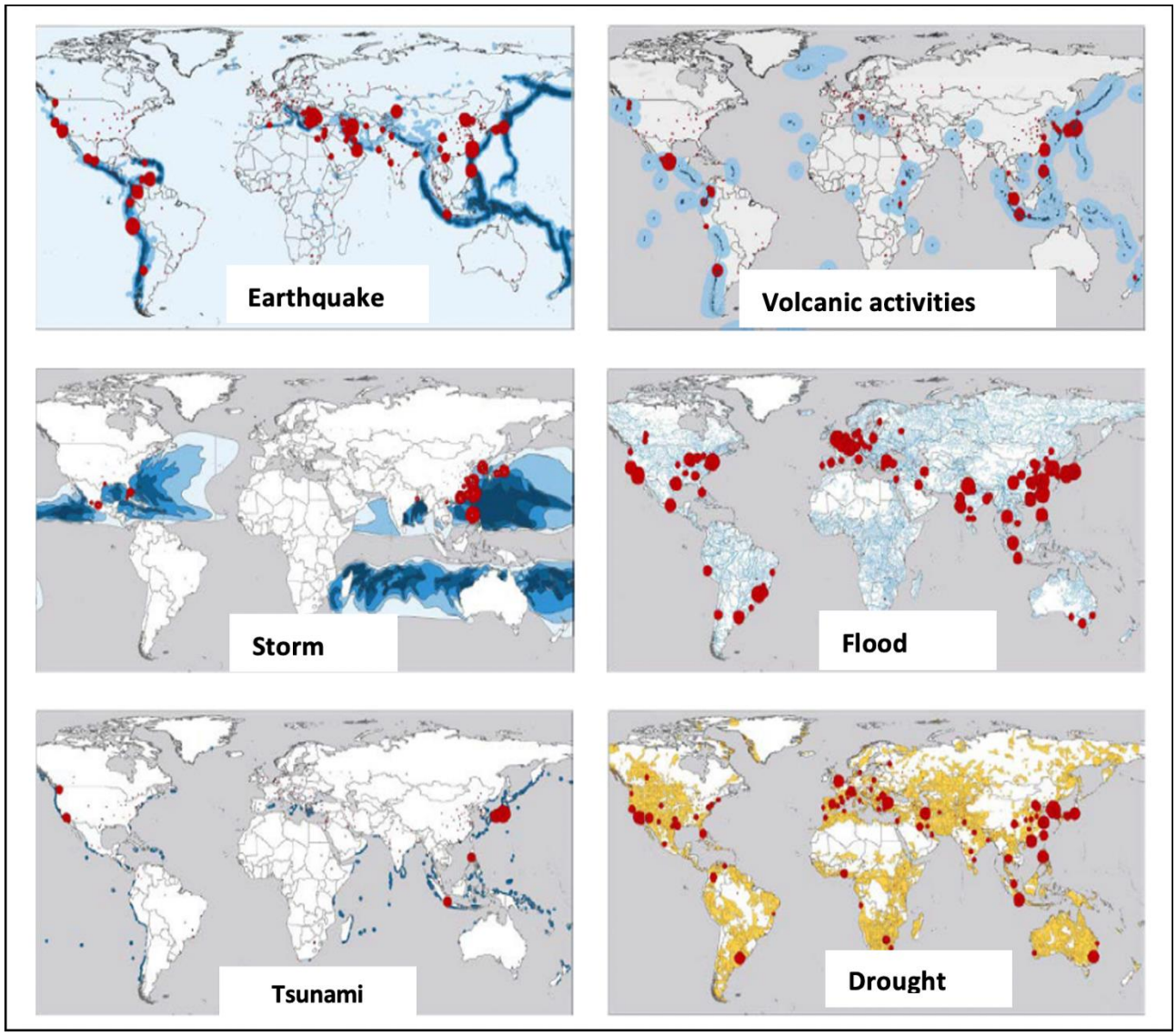


Figure 10: Annual disaster numbers caused by climate and weather events between 1960 and 2019 [17]

[16] *EM-DAT, FAO/FEWS NET, Translated into Turkish from Dartmouth Flood Observatory, ReliefWeb and IFRC GO*
[17] *EM-DAT, FAO/FEWS NET, Translated into Turkish from Dartmouth Flood Observatory, ReliefWeb and IFRC GO*



In addition to these, according to studies conducted by the Cambridge University Risk Research Centre, a risk map of natural and human-induced threats that may be encountered between 2015 and 2025 has been created. Istanbul and Turkey are also included in this risk study (Figure 13).

Figure 11: Cambridge world risk atlas examples: map of disasters threatening the world [18]

2.1.1.2 Climate Change Scenarios

In the 6th Assessment report of the IPCC published in 2021, it is stated that the global temperature has increased by 1.1°C compared to the years 1850-1900. While it is accepted that this increase will continue up to 1.5 °C, possible model studies have been put forward for amounts above this increase. e. Issues with high social response such as agricultural production, urbanization, economic and technological developments have been the basis of these models. Figure 14 shows the events that will be caused by possible temperature increases until 2100. Even a temperature increase of 1.1 °C today causes a decrease in snowfall, drought,

[18] *Cambridge Centre for Risk Studies, Cambridge Risk Atlas, Part II: Methodology Documentation," World Cities Risk 2015-2025", 2015.*

sudden and heavy rainfall, tropical cyclones, heat waves and sea level rise. The extent of the effects that will occur when this increase is 1.5 °C, 2 °C and 4 °C is clearly revealed.

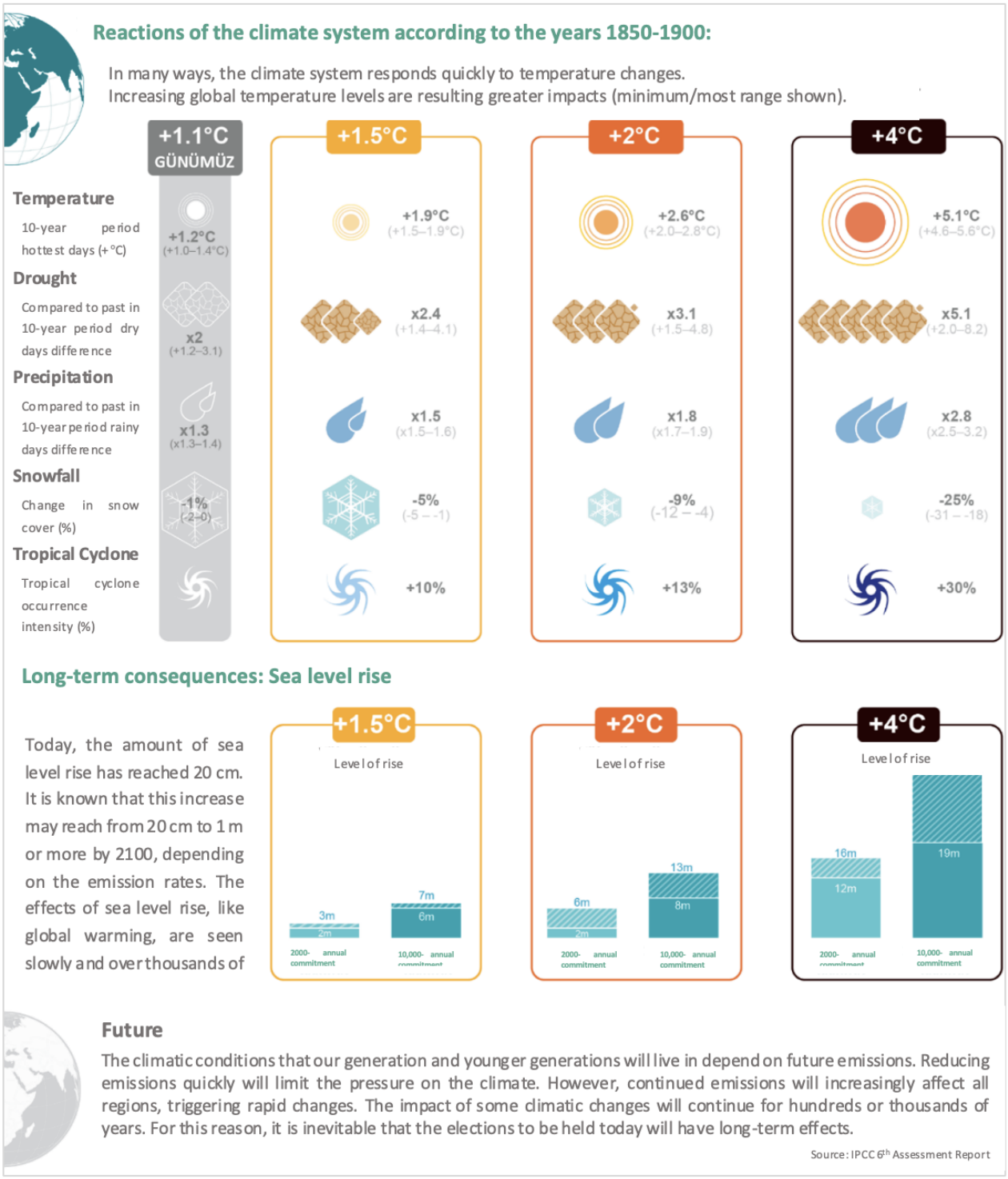


Figure 12: The climatic responses chart in the IPCC 6th Assessment Report [19]

The frequency of tropical cyclones will increase by 10% compared to the 1900s, as a result of the increase in the temperature of the earth not only by 1.1 °C, but by at least 1.5 °C.In this case, which is the best scenario, snowfall will decrease by 5%, the difference in rainy days will change 1.5 times compared to the previous ten

[19] *This chart, which is included in the IPCC 6th Assessment Report, has been translated directly into Turkish.*

years, and drought will increase 2.4 times in the same direction. At the same time, the temperature of the days in the decade would increase by 1.9 °C. In order to achieve this situation, which is the most optimistic scenario, the whole world has to make a cooperative effort. In case the temperature increase exceeds 1.5 °C, the possible situations to be encountered will lead to very bad effects: Increase in tropical cyclones by 13% and 30%, decrease in snowfall by 9%-25%, 1.8 to 2.8-fold increase in the difference between rainy days in a ten-year period, increase in the risk of drought by 3.1 to 5.1%, It has been calculated according to possible scenarios that the temperature of the days will increase between 2.6 °C and 5.1 °C in a ten-year period and finally the sea level will increase up to 5 times.

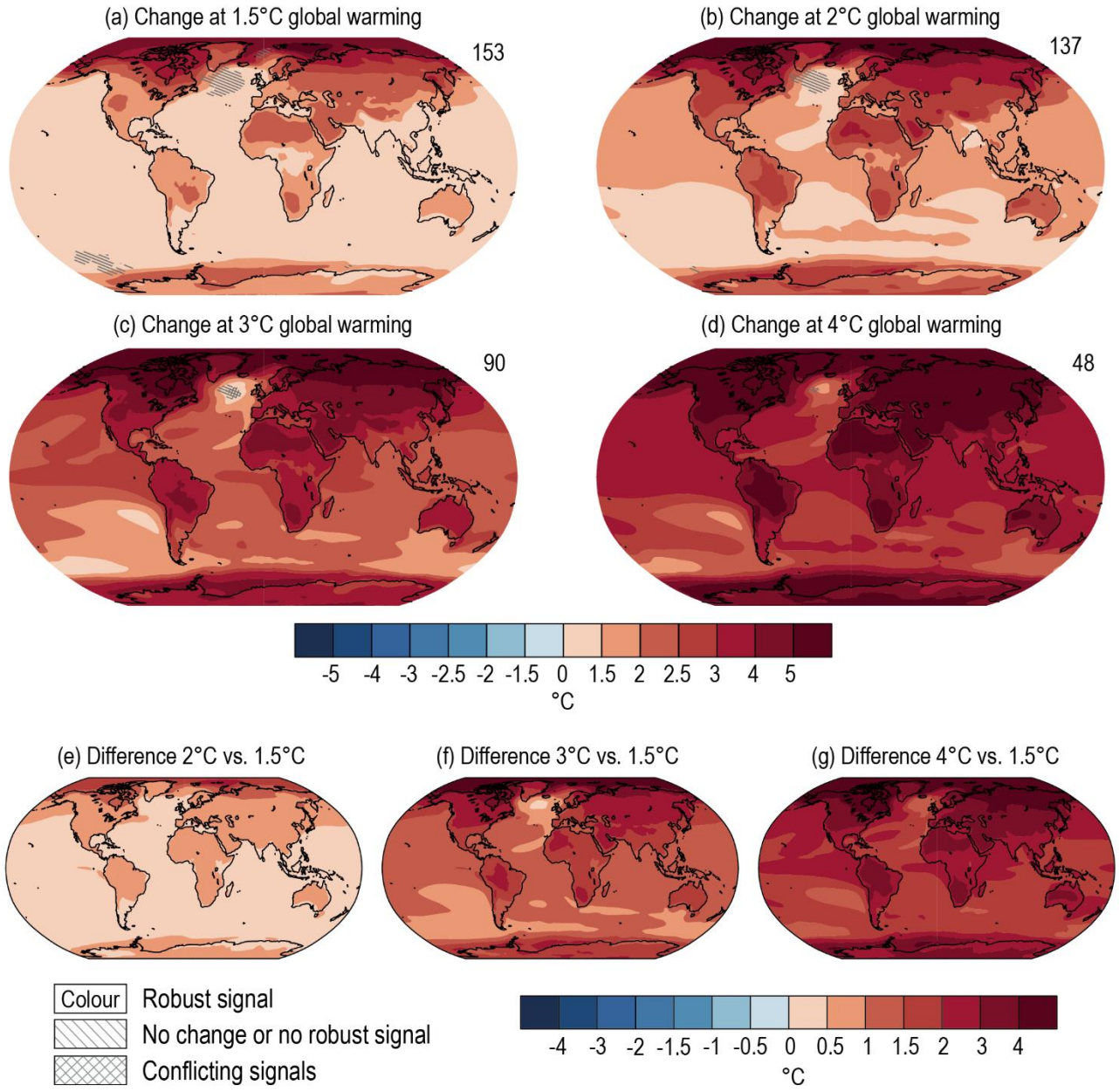


Figure 13:Map models showing temperature rise on a global scale [20]

[20] *This chart, which is included in the IPCC 6th Assessment Report, has been translated directly into Turkish.*

In addition, the impact of global temperature increase models by continents is shown in Figure 15. The dramatic differences between 1.5 °C, 2 °C, 3 °C and 4 °C increases reveal how serious a risk we face on a global scale. Figure 16 shows the rates of precipitation change on a global scale according to four different temperature increase scenarios. In all temperature increase scenarios, it is seen that Turkey, located in the Mediterranean Basin, is one of the countries that will be most affected by climate change. Since the incidence of other impacts, especially the risk of drought, will increase, it is essential to take measures rapidly at national and urban scales.

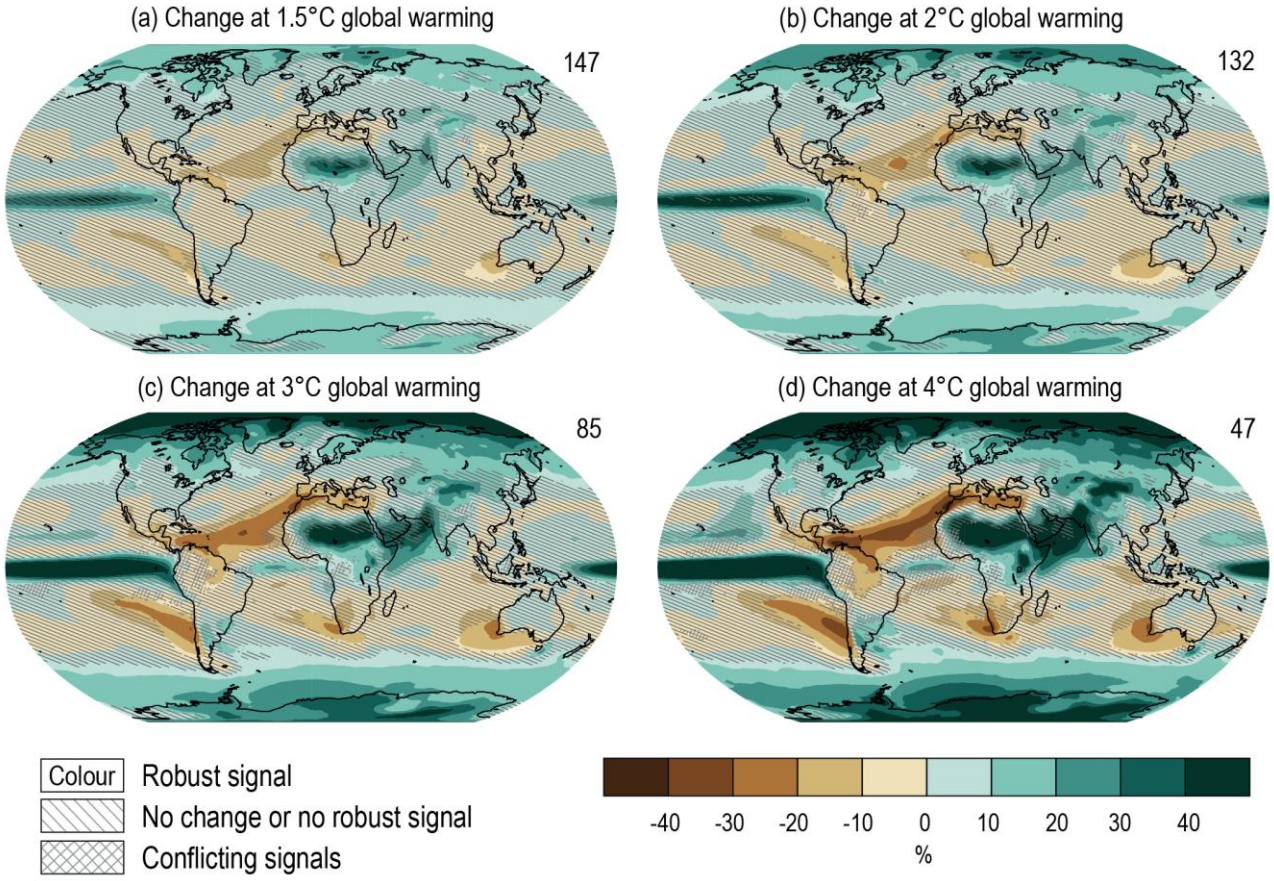


Figure 14: Precipitation models created according to the temperature increase on a global scale [21]

2.1.2 Climate change in national and regional context

Detailed studies addressing Turkey's climate change context are included in the most recently published Seventh National Communication of Turkey. It was prepared by the Ministry of Environment, Urbanization and Climate Change of the Republic of Turkey in 2018 within the scope of the United Nations Framework Convention on Climate Change (UNFCCC). Observations and research conducted by the General Directorate of Meteorology (MGM) are also included in this report. In this section, a summary of Turkey's climate change data will be presented.

According to the observations made by MGM in the Seventh National Communication, it is stated that precipitation decreases, and temperature increases in the summer months across Turkey. In studies on this

[21] *This chart in the IPCC 6th Evaluation Report has been translated directly into Turkish.*

subject, MGM calculated the average temperature between 1981 and 2021 as 13.5 °C, while the average temperature between 1971 and 2021 was calculated as 13.9 °C (Figure 17 and Figure 18).[22]

Apart from this, the highest temperature recorded in Turkey until 2021 was recorded in the summer of 2010. Both the summer and winter seasons of 2010 were warmer than other years. 2021 was calculated as the 4th hottest year.

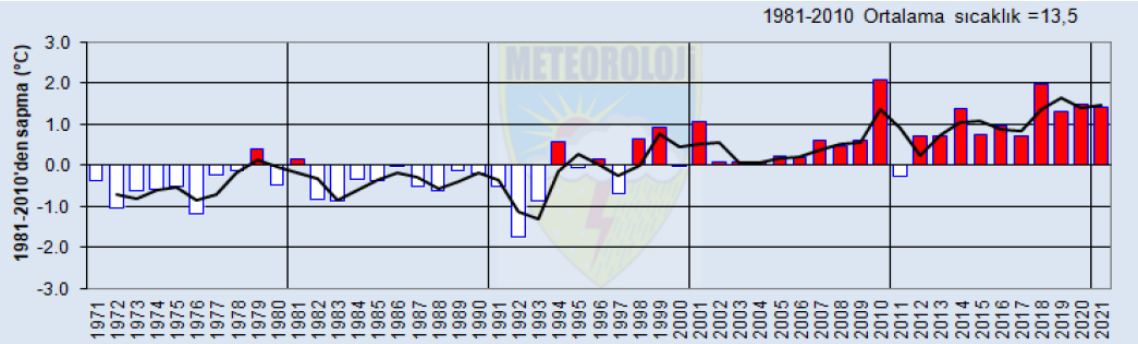


Figure 15: Distribution of Turkey's annual average temperature data between 1981-2021[23]

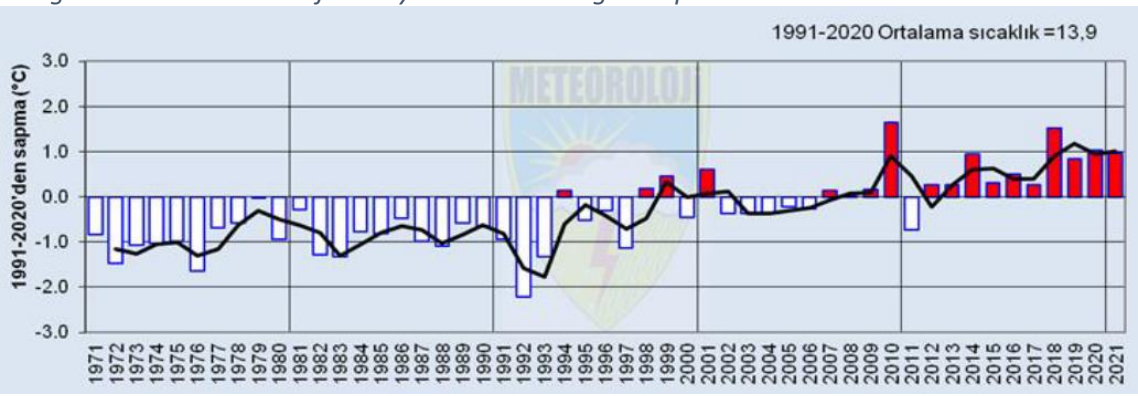


Figure 16: Annual average temperature anomaly of Turkey between 1971-2021[24]

Changes in precipitation patterns, which is another anomaly arising from climate change, has also been valid for our country. According to the data included in the paper and based on MGM observations, the total annual areal precipitation in Turkey was measured as 574 mm in the period between 1981 and 2010. According to MGM's Areal Precipitation Assessment report (2021), the areal precipitation in 2020 was 552.6 mm, while the precipitation in 2021 was 465.5 mm. This ratio is well below the average (Figure 19).

[22] *Turkey Seventh National Statement, 2018.*
[23] *Climate Assessment for 2021, MGM, 2022.*
[24] *Climate Assessment for 2021, MGM, 2022.*

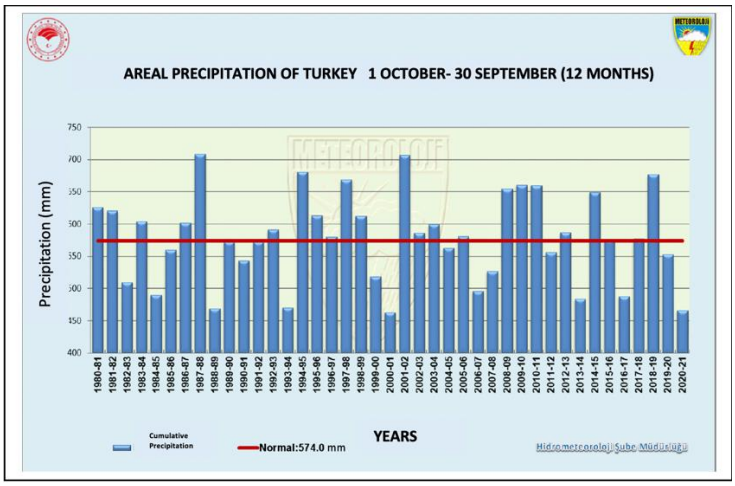


Figure17: 12-month areal precipitation values between 1980-2021 in Turkey[25]

In general, in the context of climate change, there is a trend affecting the maximum and minimum temperatures in the country. However, there are also irregularities in the patterns of precipitation changes. Although the average annual total precipitation decreases, there is an increase in the maximum amount of sudden rainfall. This occasionally results in floods and flood disasters.

In addition to these, Turkey's water use indicators prepared by the European Environment Agency also show us how serious a problem drought risk can be. Figure 20 shows Turkey's water use and the risk it poses to renewable water resources among European countries. In addition, Figure 21 shows the change in Turkey's water use from 1990 to 2017.

As a result, it is necessary to state that the risk of drought caused by urbanization pressure, decline in forestry, population growth and climate crisis is not a risk that is encountered after many years, but rather a great danger that is encountered today whose impact is brutally visible.

[25] *2021 Water / Agricultural Year Areal Precipitation Assessment, MGM, 2021.*

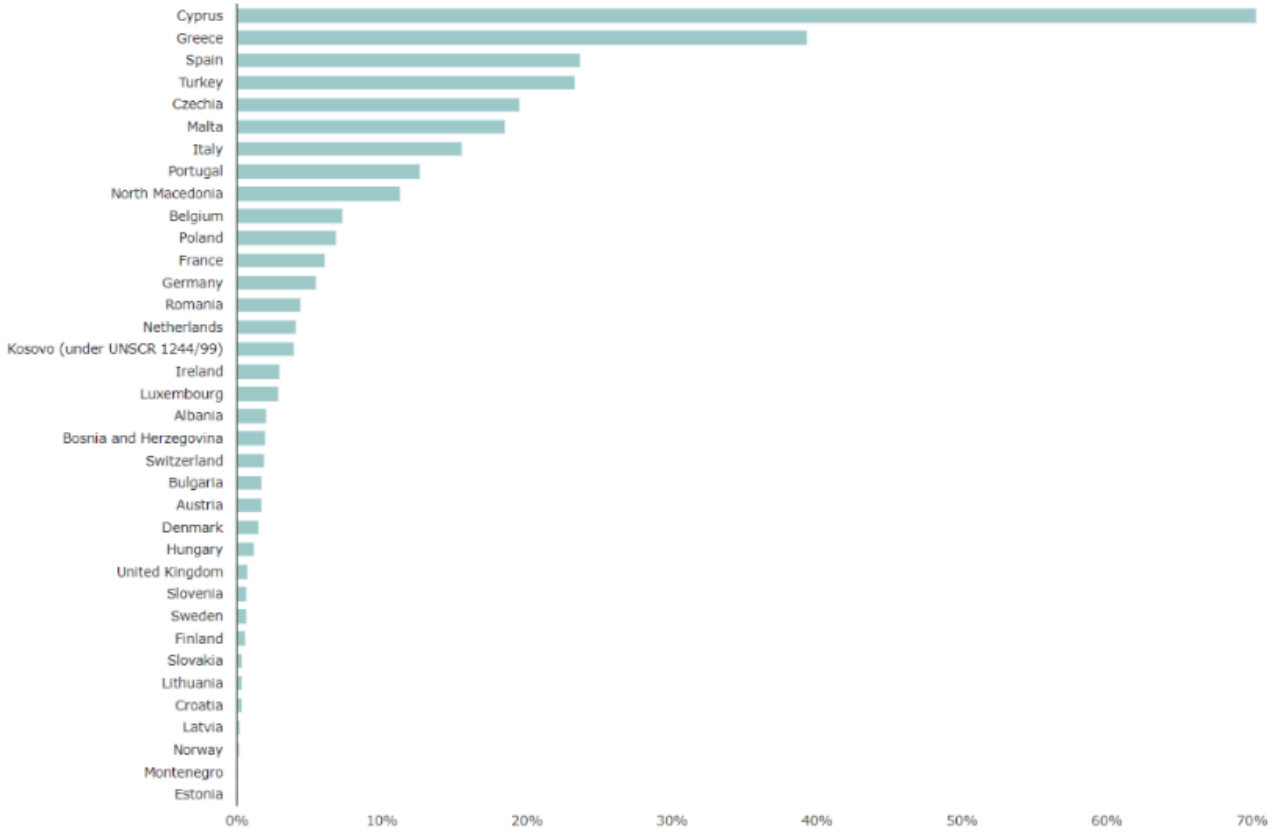


Figure 18: Turkey's indicator of water use among EU countries (which are under risk in terms of their water resources), 2017 [26]

[26] *https://www.eea.europa.eu/data-and-maps/indicators/use-of-freshwater-resources-3/assessment-4, Date of access: April 2022.*

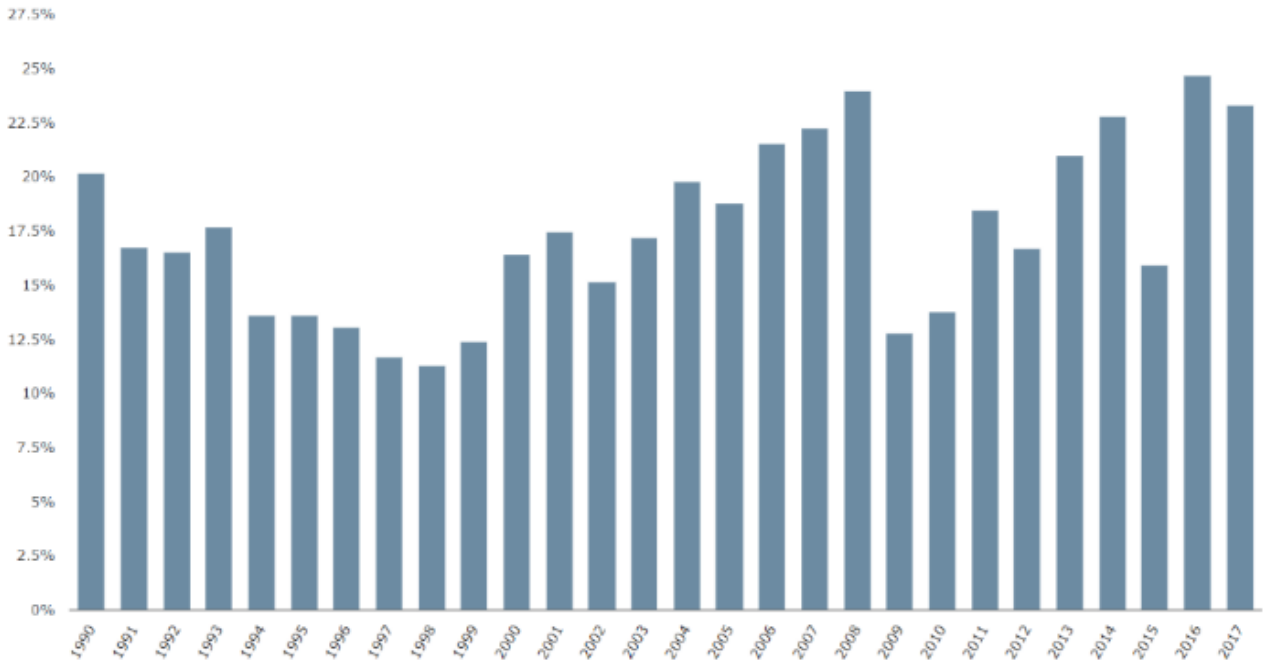


Figure 19: Indicator of the change in water use in Turkey over the years, 2017 [27]

2.1.2.1 Climatic disasters

In this section, the statistical information and studies in the Meteorological Disasters Assessment Report prepared by the General Directorate of Meteorology for 2021 are utilized to present the disaster situations in our country.

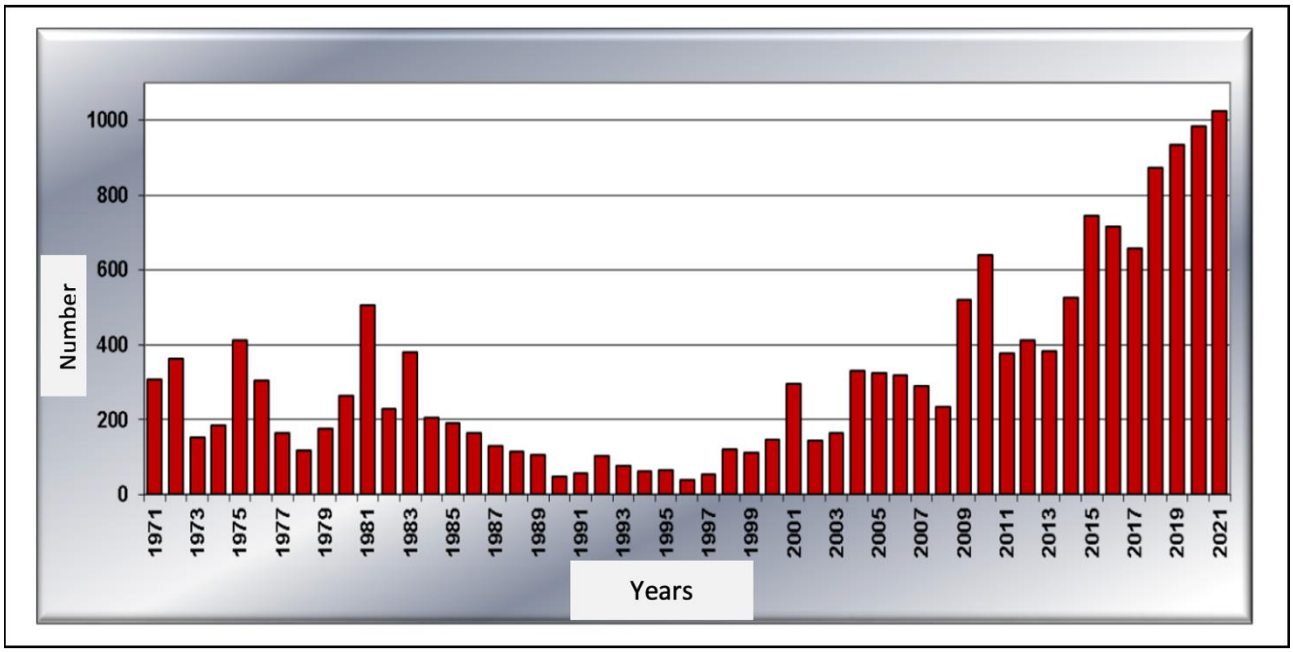


Figure 20: Annual distribution of natural disasters of meteorological character observed in Turkey in the 1940-2020 period

[27] *https://www.eea.europa.eu/data-and-maps/indicators/use-of-freshwater-resources-3/assessment-4, Date of access: April 2022.*

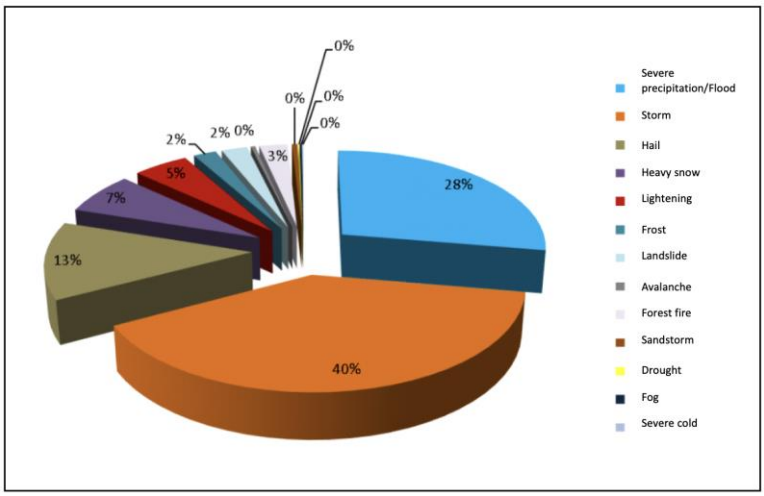


Figure 21: Percentages of natural disasters with meteorological character in 2021 in Turkey

Meteorological conditions cause direct and indirect disasters in our country. Floods caused by heavy rainfall, avalanches, sea and lake water rise, forest fires, drought and desertification, agricultural pest infestations are nature-induced disasters related to meteorological conditions. In our country, which has different geographical and climatic characteristics, there are many meteorological events that turn into disasters after severe weather events. According to the studies conducted by the General Directorate of Meteorology (MGM), meteorological disasters, especially floods, storms, hail, frost, snow and drought, occur frequently in our country. Due to the fact that cities are not equipped with adequate infrastructures and disasters induced by unexpected weather events, many lives and properties have been lost in our country. As seen in Figure 22, the frequency of disasters in our country started to increase dramatically after the 2000s. The years 2018, 2019, 2020 and 2021 are among the years with the highest number of disasters due to climate change and infrastructure deficiencies. 2021 was the year with the highest number of meteorological disasters. The most common meteorological and natural disasters in Turkey in 2021 are shown in Figure 23. The most common disaster was storm with 40%, flood with heavy rainfall with 28%, avalanche with 13% and heavy snowfall with 7%.

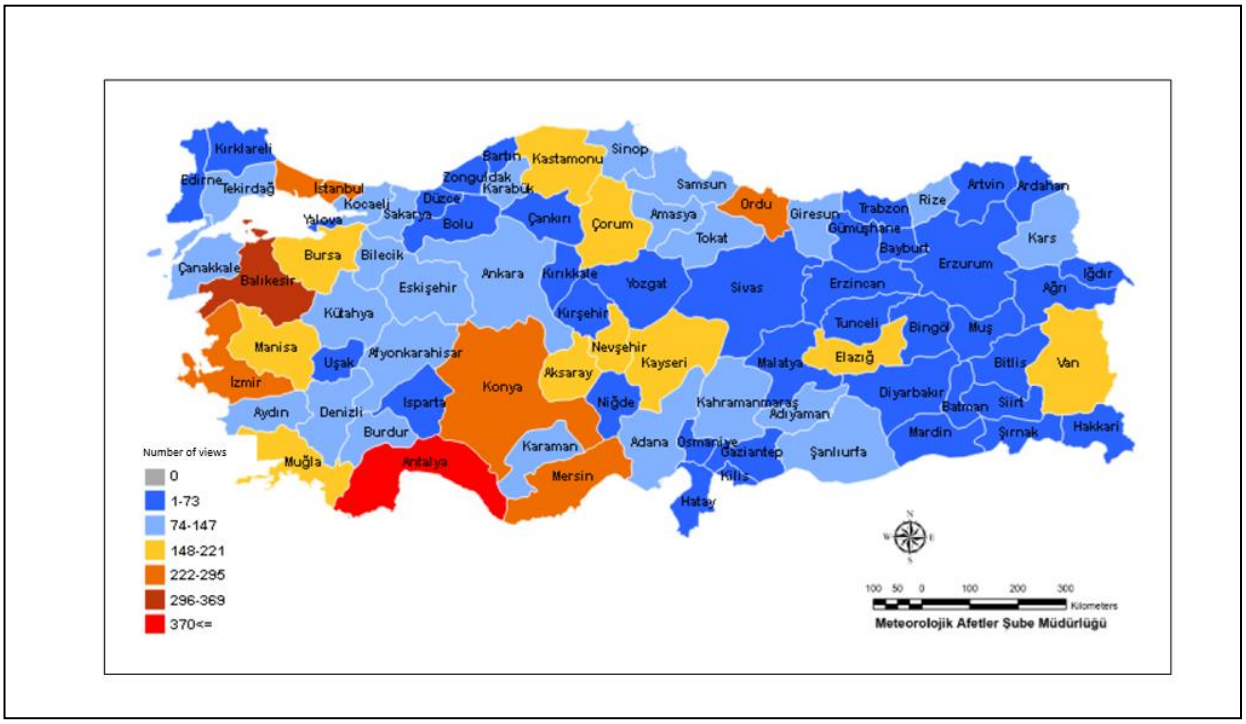


Figure 22: Distribution of meteorological disasters between 2010 and 2021 in Turkey by provinces

According to MGM records, the distribution of disasters in Turkey between 2010-2021 by cities is shown in the map in Figure 24. According to the map, Antalya is the province with the highest number of disasters. In addition, in the drought map for 2021, it is shown that the Mediterranean Region faces the risk of drought along with the country as a whole (Figure 25). Drought risk poses an extremely risk for Turkey, which is one of the countries that will be most affected by climate change. According to the drought map, Antalya and its surroundings are exposed to moderate, severe and very severe drought in different regions.

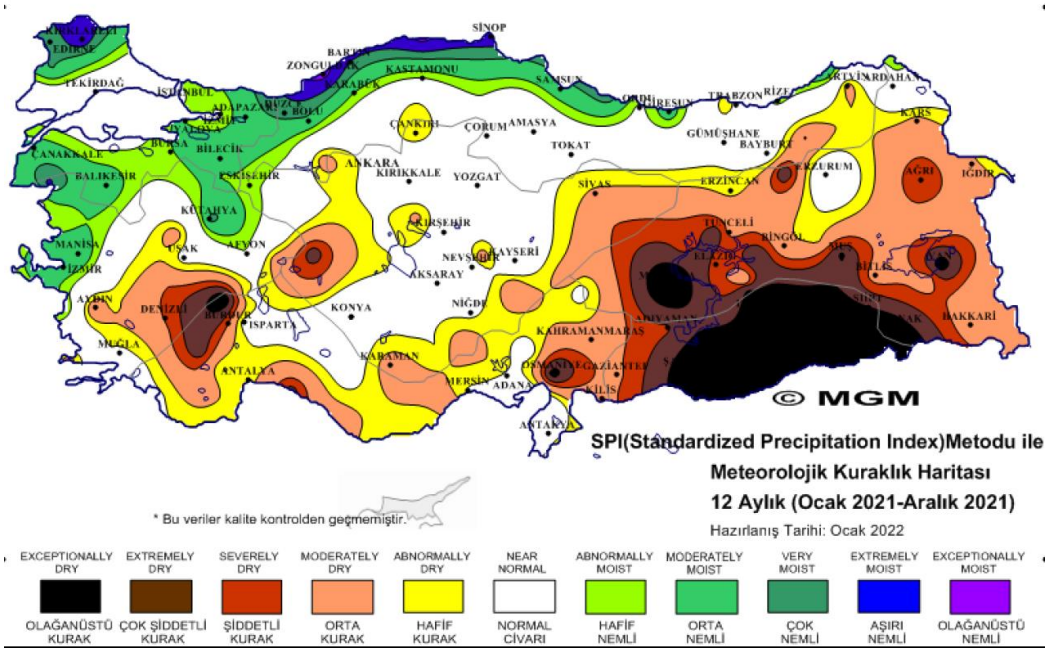


Figure 23: Drought map of Turkey according to the 2020 standard precipitation index

The annual average areal rainfall, which we directly associate with drought, was measured as 574 mm. For 2020, this amount was measured as 500.1 mm and for 2021 as 524.8 mm. Figure 26 shows the rainfall amounts from 1981 to 2021. According to the figure, it is seen that the amount of precipitation in 2020 has decreased dramatically. However, the years 2020 and 2021 remained below the average precipitation amount.

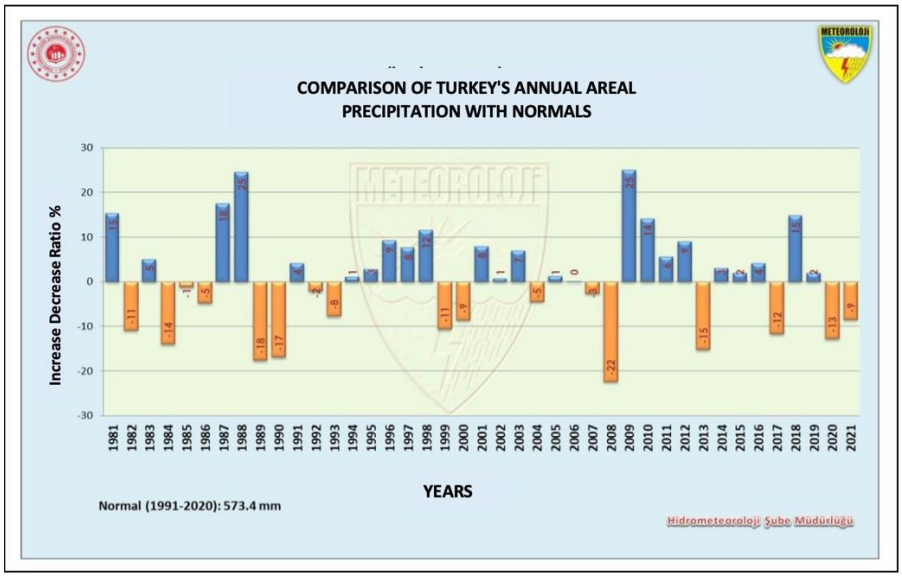


Figure24: Precipitation distribution of Turkey between 1981-2021

Table 7, which was created according to the 2020 studies of MGM, shows the comparison of the areal precipitation amounts of the regions by years. It is seen that the precipitation amount of the Mediterranean Region decreased by 23.9% compared to normal and by 30.2% compared to 2020. In this case, it is revealed that the Mediterranean Region is the 3rd region in the country with the highest decrease in precipitation compared to normal.

Table 7: Comparison of the region's normal in 2021 and last year's precipitation

AREAL PRECIPITATION CONDITIONS OF THE REGIONS (1 October 2020- 30 September 2021)					
REGIONS	**Year 2021 Precipitation (mm)**	**Normal (1981-2010) (mm)**	**Year 2010 Precipitation (mm)**	**Change from Normal (%)**	**Change by 2020 (%)**
Marmara	672.4	662.3	558.4	1.5 around normal	20.4 ↑
Aegean	484.3	592.2	508.1	-18.2 ↓	-4.7 ↓
Mediterranean	507.5	666.5	666.5	-23.9 ↓	-30.2 ↓
Central Anatolia	316.5	406.5	406.5	-22.1 ↓	-12.8 ↓
Black Sea	681.0	696.5	696.5	-2.2 ↓	7.4 ↑
Eastern Anatolia	379.4	558.3	558.3	-32.0 ↓	-30.0
South-eastern Anatolia	325.7	532.2	532.2	-38.8 ↓	-48.3 ↓

2.1.2.2 Climate change scenarios

Turkey is one of the countries that will be most affected by climate change due to its location and climatic characteristics. In this regard, the MGM has created regional climate projections based on the models preferred in the IPCC 5th Assessment Report. In the study, the years between 1971-2000 were taken as the reference period and the years between 2016-2040, 2041-2070, 2071-2099 were taken for projections. When the results of the regional climate model obtained in the reference period are compared with the results of the global models in the same period, it is seen that they are in great agreement, especially in summer and winter temperatures. In annual average temperatures, the regional model results are lower than the global model results and observations. In this context, the projection results in the national communication are quoted below (Figure 27 and Figure 28) [28]:

2016-2040 period

- The warming is expected to be limited to 2°C in general and 2-3°C in the Marmara and Western Black Sea regions in summer.
- While an increase in precipitation is observed in the Aegean coasts, Eastern Black Sea and Eastern Anatolia in winter, precipitation will decrease by around 20% in spring, except for the Aegean coasts and Eastern Anatolia.

2041-2070 period

- While the temperature increase is around 2-3°C in spring and fall, it is estimated to increase up to 4°C in summer.
- Winter precipitation is expected to decrease by around 20% in Eastern and South-eastern Anatolia and Central and Eastern Mediterranean regions.

[28] *Ministry of Environment, Urbanization and Climate Change, "Turkey's Seventh National Statement", 2018.*

- In the summer months, there will be a 30% decrease in precipitation in Eastern Anatolia, where precipitation is important.
- Fall precipitation is predicted to decrease except for the Aegean coasts and a small part of Central Anatolia.

2071-2099 period

- Temperatures are expected to increase by 2°C in winter and 3°C in spring and fall. In summer, temperature increases exceeding 4°C are predicted for the Aegean coast and South-eastern Anatolia.
- Spring precipitation will decrease by around 20% except for the Coastal Aegean, Central
- Black Sea and North-eastern Anatolia regions,
- Increases in winter precipitation by around 10%, especially along the coastline,
- Reductions of up to 40% in summer precipitation, except for the Aegean, Marmara and Black Sea coasts,
- Fall precipitation is expected to decrease almost throughout Turkey.

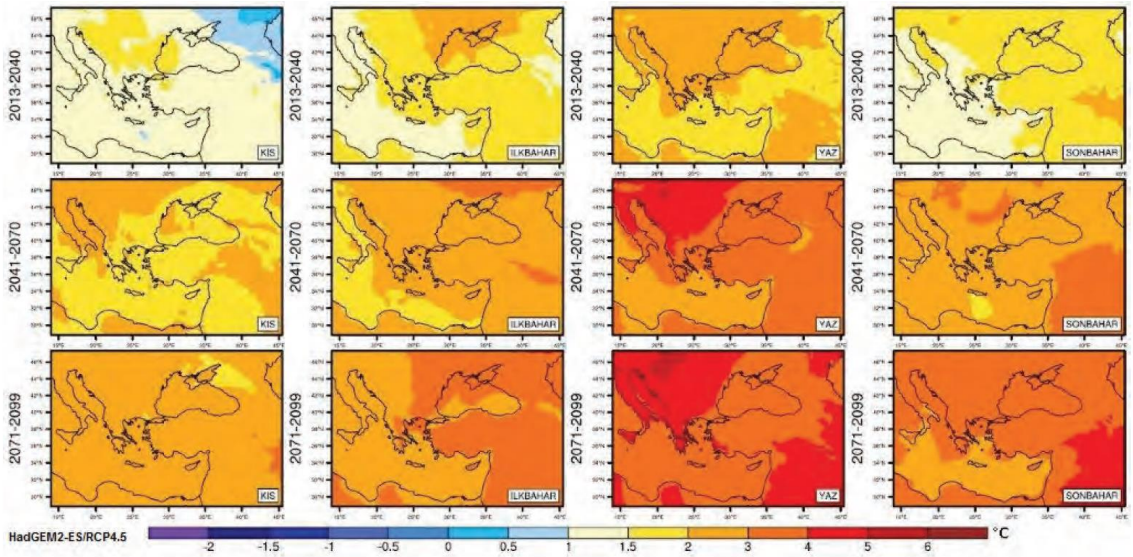


Figure 25: MGM temperature projections according to RCP4.5

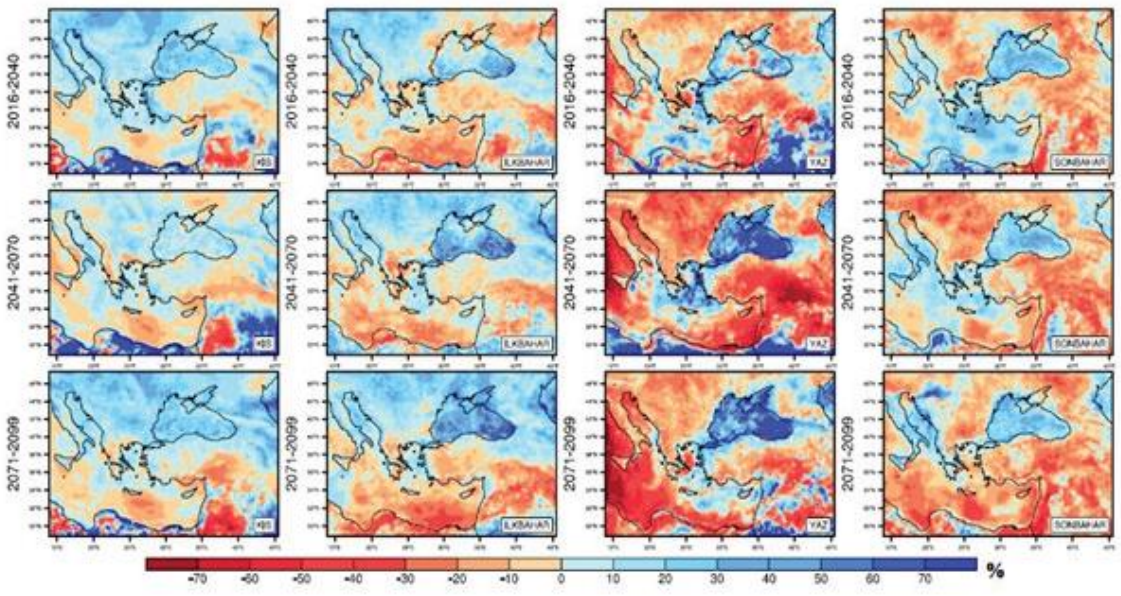


Figure 26: MGM precipitation projections according to RCP4.5

2.1.3 Climate change in the urban context

In this section, the changing climatic characteristics of Antalya from past to present are discussed. Due to the location and geographical structure of Antalya, it is possible to say that the effects of climate change may have a negative impact on many sectors. It is thought that climatic weather events such as storms, tornadoes, forest fires, heat waves, excessive rainfall and droughts may affect many sectors, especially tourism and agriculture. According to the spatial distribution of extreme events with meteorological characteristics, Antalya stands out as one of the cities with the highest number of weather events in 2017. Antalya's climatic events and their impacts are detailed in the Risk and Vulnerability Assessment (Section 4.3) section of the study.

In the IRAP report prepared by AFAD for Antalya in 2021, the average temperature values of the city between 1930-2019 are included (Table 8). In addition, monthly temperature averages are shown in Figure 29. Based on the city's temperature data, the average number of sunshine days between 1930-2019 is shown in Figure 30. According to this graph, it is stated that the city has sunbathing time in all months and the most sunbathing time is in the summer months.

Table 8: Antalya climate long-term (1930-2019) values [29]

Months	Average Temperature (°C)	Average Maximum Temperature (°C)	Average Lowest Temperature (°C)	Average Sunbathing Time (hours)	Average Number of Rainy Days	Average Monthly Total Rainfall (kg/m²)
January	10,0	14,9	5,9	5,0	12,5	242,1
February	10,6	15,5	6,4	5,7	10,4	154,4
March	12,8	17,9	8,0	6,7	8,5	97,2

[29] *AFAD, Provincial Disaster Risk Reduction Plan (IRAP), was formed based on the 2021 data of the 4th Regional Directorate of Meteorology, included in the 2021 report.*

Months	Average Temperature (°C)	Average Maximum Temperature (°C)	Average Lowest Temperature (°C)	Average Sunbathing Time (hours)	Average Number of Rainy Days	Average Monthly Total Rainfall (kg/m²)
April	16,3	21,3	11,2	7,9	6,4	50,4
May	20,5	25,5	15,2	9,6	5,0	32,1
June	25,3	30,7	19,6	11,3	2,4	10,9
July	28,4	34,0	22,7	11,5	0,6	4,5
August	28,3	34,0	22,7	11,2	0,5	4,6
September	25,1	31,1	19,4	9,7	1,7	18,1
October	20,5	26,5	15,2	7,8	5,4	72,1
November	15,4	21,2	10,7	6,3	7,4	133,6
December	11,6	16,6	7,6	4,8	11,7	265,3
Average/Total	18,7	24,1	13,7	97,5	72,5	1085,3

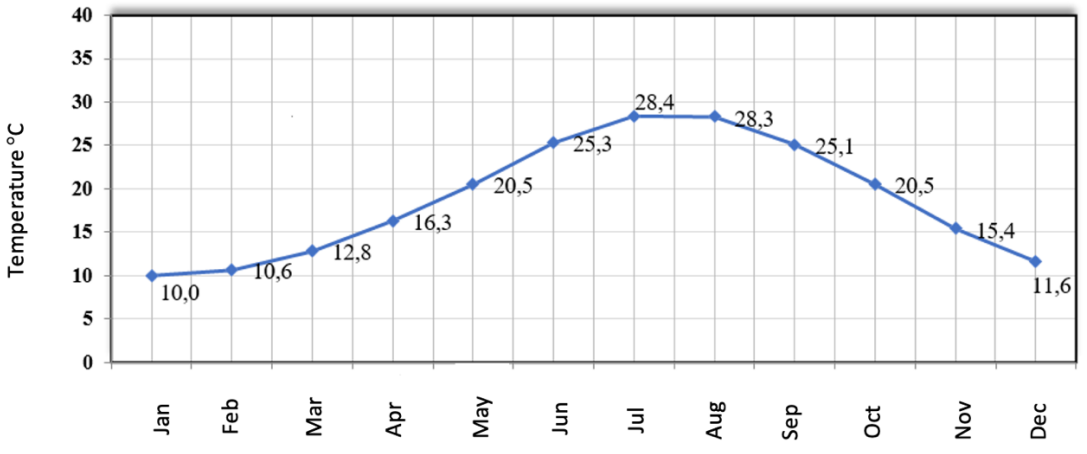


Figure 27: Monthly average temperature values of Antalya province (1930-2019)

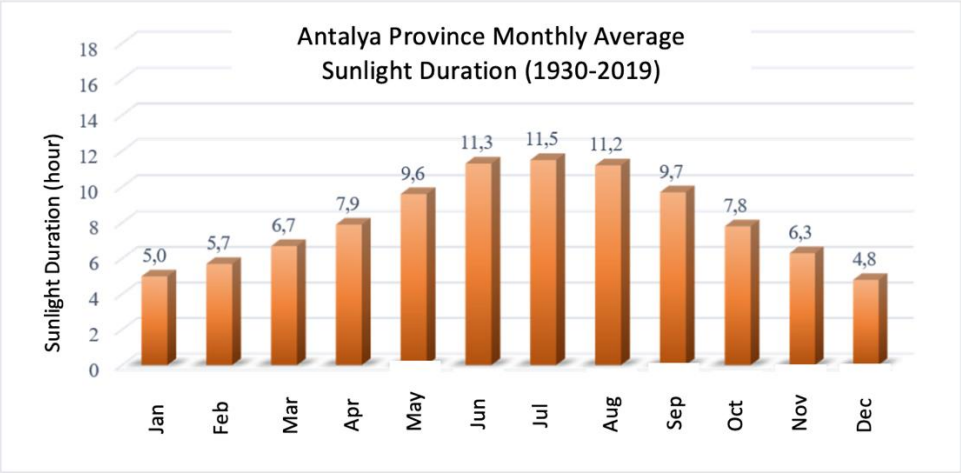


Figure 28: The variation of the sunshine duration of Antalya between 1930-2019 by months

The graph of average monthly precipitation durations in Antalya between 1930-2019 is shown in Figure 31. Although the city's average precipitation duration in August and July is less than 1, it is seen that all other months can receive more intense precipitation.

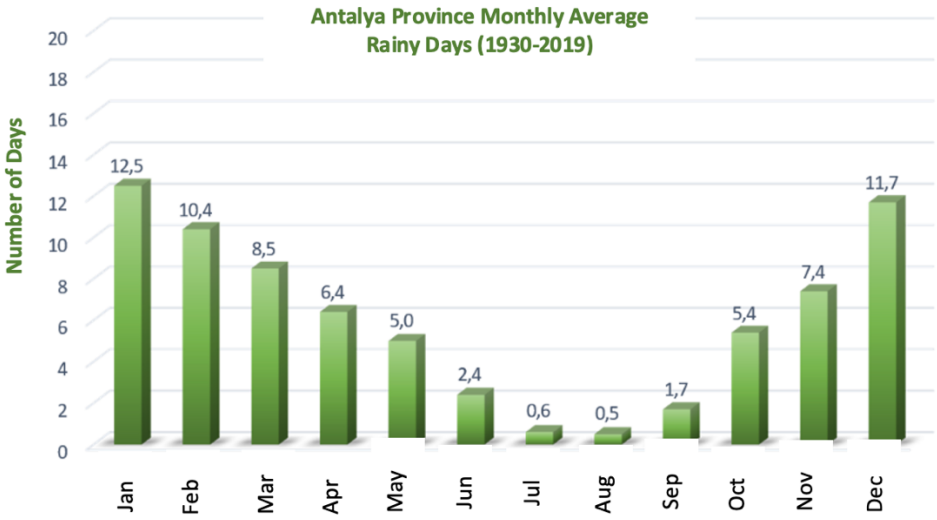


Figure 29: The change of the average precipitation period of Antalya between 1930-2019 by months

2.2 CLIMATE CHANGE POLICIES

This section provides details on global, national, and local policies on climate change. These policies aim to mitigate the negative impacts of climate change.

2.2.1 Global Policies and Activities

The general framework of cooperation against climate change was laid with the United Nations Framework Convention on Climate Change of 1992. The Paris Agreement, which was adopted in 2015 and entered into force in November 2016, is a turning point in climate change, on which intensive international efforts have been carried out since then. Today, it has become a necessity to evaluate the production and consumption

activities carried out in cities on the scale of climate change and to include them effectively in rational planning and strategy determination processes for energy saving. Since 2016, the agreement has been signed and ratified by nearly 200 countries. Turkey ratified the Paris Agreement on October 7, 2021 (Figure 32).

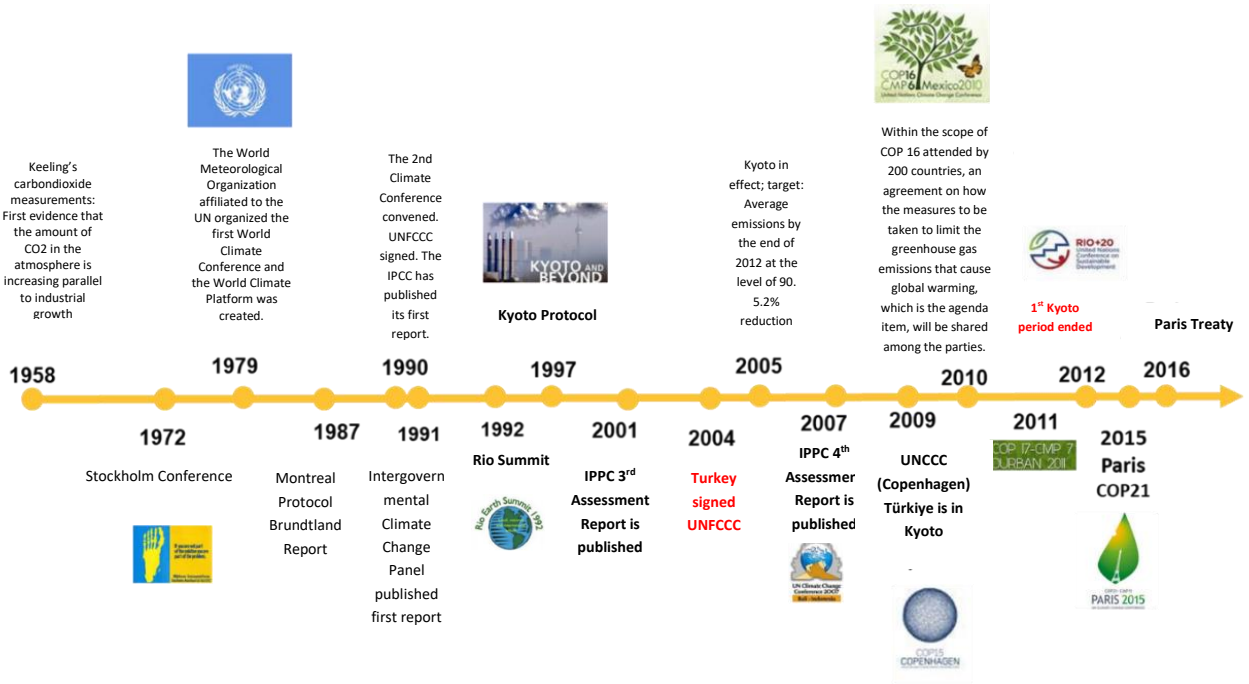


Figure 30:Summary of international climate change negotiations

The Paris Agreement has brought different approaches to the international climate cooperation model. The Agreement, which recognizes the primacy of countries' own climate policies in the global fight against climate change, is based on the "logic of nationally driven climate action". In this framework, from the Kyoto model, where mitigation obligations are determined at the international level and tied to strict rules and sanctions, the cooperation model consisting of voluntary contributions determined by the parties according to their national conditions has been shifted. Turkey's national statement of intent is detailed in the next section.

While previously the focus was on greenhouse gas reductions to mitigate climate change, after the Paris Agreement, the issue of adaptation to climate change has also entered the agenda of more countries. The impacts of climate change show regional and local differences in terms of floods, droughts, heat waves, etc. Therefore, the measures that can be applied everywhere are different. Local governments have an important role in infrastructure investments as well as determining intervention tools and methods. Organizations such as ICLEI, C40 and the Covenant of Mayors, which bring together local governments from different geographies of the world at different levels of development, offer an important opportunity for cooperation and experience sharing for local governments that want to take steps in this regard. However, it is not enough to identify methods appropriate to local conditions; local governments also need to have financial capacity and political decision-making power.

Since European cities' struggle against climate started much earlier than Turkish cities, both inventory determinations and mitigation strategies are more comprehensive. With its climate action plans, the European Union plans to become the first zero emission continent by gradually reducing its greenhouse gas impact and carbon emissions by 2050. It is aimed to reduce greenhouse gas emissions by at least 55% in 2030

compared to the 1990s. The target previously set for 2030 was 40% but was raised to 55% after the European Green Deal.

When the climate action plans in Turkey are examined; various strategies are developed on thermal insulation in existing buildings, ensuring the use of renewable energy and energy efficient lighting, expanding public transportation and rail systems, smart traffic management, education and awareness raising, increasing green areas, reducing the use of chemical fertilizers, and obtaining energy from waste.

Considering the impacts and examples above, it is clear that there is a need for active policies, actions and strategies in various fields ranging from transportation, construction, infrastructure, waste management and land use to combat climate change in cities.

2.2.2 National Policies and Actions

Turkey became a party to the United Nations Framework Convention on Climate Change (UNFCCC) in 2004. Before becoming a party to the UNFCCC, Turkey established the Coordination Board on Climate Change (CBCC) in 2001. After Turkey became a party to the UNFCCC, the CBCC was restructured in 2004 and its mandate was expanded to include new members in 2010.

Turkey has a different position from other countries included in Annex I of the Convention. At the 7th Conference of the Parties (COP7) meeting in Marrakech in 2001, Turkey's special circumstances were recognized, and it was decided to remain in Annex I and be removed from the Annex II list. This influenced the country's political decision to become a party to the Kyoto Protocol and accelerated the process. In 2009, five years after becoming part of the Convention, Turkey's entry into the Kyoto Protocol was documented and sent to the UN Secretary General. The ratification process of the Protocol was completed in August 2009. Turkey is not included in Annex B of the Protocol (no quantitative obligations to reduce greenhouse gas emissions).

In 2009, the "Climate Change Department" was established under the General Directorate of Environmental Management under the Ministry of Environment, Urbanization and Climate Change to address issues related to climate change.

Taking into account its specific circumstances and capacity, Turkey published a "National Climate Change Strategy" in May 2010 to contribute to global efforts to mitigate the impacts of climate change. The Strategy includes a series of targets related to transportation, industry, buildings, waste and agriculture to be implemented in the short term (within one year), medium term (within 1 to 3 years) and long term (to be launched in the next 10 years). The Strategy also includes measures such as:

- Cogeneration and district heating
- Utilization of local renewable energy sources as well as local coal
- Increasing the efficiency of buildings

In terms of legal duties and responsibilities, the regulations introduced by the Energy Efficiency Law cover all sectors of the economy as well as all individuals and institutions at national, regional and local levels. These regulations include new obligations, support and actions for industry, buildings and transportation sectors. The Regulation on Energy Performance in Buildings has also entered into force, making it mandatory to issue Energy Performance Certificates for new buildings as of 2011. The Regulation on Increasing Efficiency in the

Use of Energy Resources and Energy, issued under the same law, includes practical measures and some examples of these measures are given below;

- Establishing institutional structure and certification programs for the Energy Service Company sector
- Providing training and capacity building for all public and private sector stakeholders
- Establishing mechanisms to support energy efficiency projects
- Assignment of energy managers to the industrial sector and buildings

Regulation No. 28097 on Increasing Efficiency in the Use of Energy Resources and Energy also includes various incentives for those who voluntarily commit to reduce energy intensity by undertaking projects that increase energy efficiency. Legislation on the development of local renewable energy sources has made progress and Turkey has seen a significant increase in wind and solar installations. Some of the planned actions on energy efficiency and the use of new energy sources are as follows:

- Establishment of zero-emission energy generation technologies such as renewable energy sources and nuclear energy, on the condition of local content,
- Increasing the overall efficiency of existing thermal power plants,
- Reducing energy intensities to 2004 levels,
- Increasing the share of local renewable energy sources in total energy production to 25%,
- Maximizing energy efficiency potential in the industrial sector,
- Utilizing the energy efficiency potential of the built environment.

According to the Nationally Determined Intended Contribution (INDC) proposed by Turkey to the UNFCCC in 2015, it is recommended to reduce greenhouse gas emissions by 21% from the usual course. The revision of this target, which is considered insufficiently ambitious, is underway.

Figure 33 compares the reduction in emissions that would be achieved through these policies and plans with business as usual (BAU).

Turkey supports the INDC targets through a number of national climate change policies, including:

- 11th Development Plan
- Turkey Climate Change Strategy (2010-2023)
- Turkey's Climate Change Adaptation Strategy and Action Plan (2011-2023)
- Republic of Turkey Climate Change Action Plan (2011-2023)
- 2023 Industry and Technology Strategy
- Energy Efficiency Strategy Document (2012-2023)
- National Recycling Strategy Document and Action Plan (2014-2017)
- Regulation on Monitoring of Greenhouse Gas Emissions (2014)
- National Intelligent Transportation Systems Strategy Document (2014-2023) and Supplementary Action Plan (2014-2016)
- Turkey National Renewable Energy Action Plan (2014)
- National Energy Efficiency Action Plan (2017-2023)
- Ministry of Energy and Natural Resources Strategic Plan (2019-2023)

The plans and policies to be implemented for different sectors through INDC are summarized below.

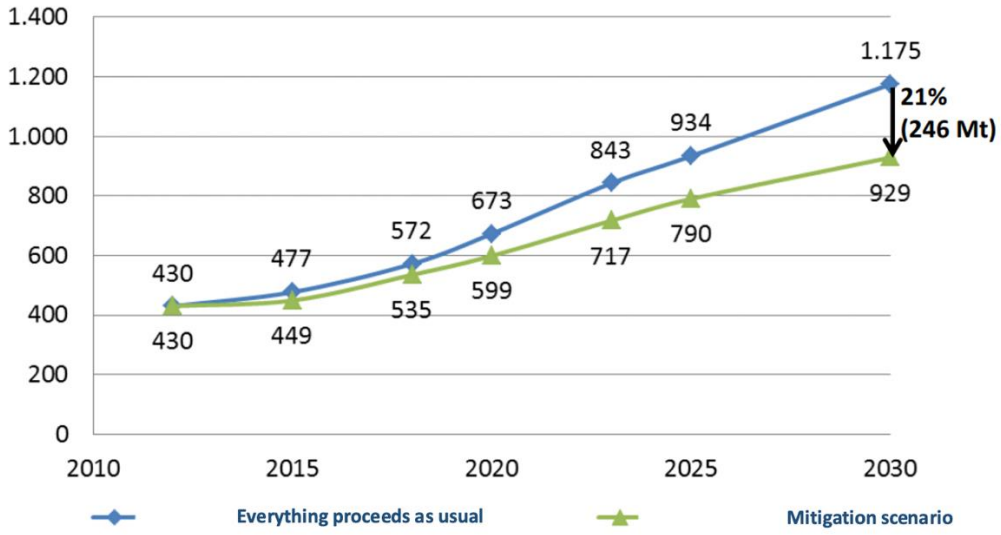


Figure 31: Turkey's Intended Nationally Determined Contribution (INDC) target

Buildings

The main INDC policy adopted to the buildings sector is to reduce primary energy demand in new and existing buildings. This will be achieved through incentives (such as loans and tax breaks) for design, technological equipment, building materials and the use of renewable energy sources. The following measures will be supported to reduce energy use and its negative impacts on climate:

- Passive energy and zero-energy home design to minimize energy demand and enable local energy production
- Energy-efficient construction of new residences and service buildings in accordance with the Regulation on Energy Performance in Buildings
- Establish Energy Performance Certificates for new and existing buildings to control energy consumption and greenhouse gas emissions and reduce energy consumption per square meter

Industry

The main areas of intervention in industry are energy efficiency and waste. The implementation of the Energy Efficiency Strategy Paper and the National Energy Efficiency Action Plan aims to reduce emission intensity and increase energy efficiency in industrial facilities and provide financial support for energy efficiency projects. Efforts to increase the use of waste as alternative fuel in appropriate sectors is another issue that will ensure sustainability and circularity in the industrial sector.

Energy

Renewable energy investments will be supported to increase electricity generation capacity from solar and wind energy. The target is to increase solar power capacity to 10 GW and wind power to 16 GW by 2030. By 2030, electricity transmission and distribution losses are targeted to be reduced to 15 percent and public power generation plants upgraded. Other initiatives that can be mentioned for the energy sector include utilizing the full hydroelectric potential in electricity generation, micro generation, cogeneration systems and on-site generation.

Transportation

The strategic objective of the transport sector is to promote sustainable modes of transport such as walking, cycling and using public transport. Targets aligned to this objective include:

- High speed rail system projects
- Increasing urban rail systems
- Encouragement to increase the use of sea and rail transport instead of road transport for both freight and passenger transportation

Energy use of the transportation sector is another strategy area for INDC. Targets include promoting alternative fuels and environmentally friendly vehicles, reducing fuel consumption and road transport emissions through the National Intelligent Transport Systems Strategy Paper (2014-2023) and its annex Action Plan (2014-2016), and achieving fuel savings and phasing out old vehicles through tunnel projects. Policies are in place to ensure energy efficiency, including green port and green airport projects, as well as excise tax exemptions for maritime transport, buildings, and urban regeneration.

Wastes

National policies to ensure the circularity of the waste sector include sending solid waste to managed landfills, reducing waste while recovering secondary raw materials and using them as energy sources. Energy can be recovered from waste through an industrial symbiosis approach. For this, processes such as the following can be utilized:

- Material recycling
- Biological drying
- Biological methanization
- Compost production
- Advanced thermal processes or recovery of gas from incineration and landfills
- Use of industrial wastes as an alternative raw material or fuel in other industrial sectors

Other policies for the waste sector include utilizing waste from livestock and poultry farms, rehabilitating unmanaged waste sites and ensuring that waste is taken to managed landfills.

Biodiversity

Key national policies on sustainability have been developed to achieve fuel reductions through land consolidation in agricultural areas, improve grazing land, control fertilizer use, adopt modern agricultural practices and support reduced tillage in land management. Together, these policies will help reduce direct and indirect emissions from agriculture and livestock, mitigate negative impacts on soil, water and air quality, and promote healthier ecosystems. National policies on forest areas include increasing sinks and preventing land degradation, implementing the Action Plan for Rehabilitation of Forests and the National Afforestation Campaign.

The actions proposed in the Antalya Sustainable Energy and Climate Action Plan have been prepared in line with the 11th Development Plan (2019-2023), National Energy Efficiency Action Plan, Turkish Climate Change Strategy 2010-2023, 2019-2023 Strategic Plan of the Ministry of Energy and Natural Resources, Turkish

Transportation and Communication Strategy 2023, National Intelligent Transportation Systems Strategy Document (2014-2023).

2.2.3 Local Policies and Actions

In Antalya Metropolitan Municipality's Strategic Plan for 2020-2024, under the objective of "A livable and healthy city with a sustainable environment will be designed for all living things", the target of "The city's carbon emissions will be managed on a district basis with new technologies." has been set. Table 9 shows the goals and targets in the strategic plan related to the Sustainable Energy and Climate Action Plan mitigation section.

Table 9: Strategic goals and objectives associated with Antalya climate change mitigation actions

Sector	Plan Name	Strategic Purpose	Strategic Target
Buildings	Antalya Metropolitan Municipality 2020-2024 Strategic Plan	**A4.** Increasing the quality of urban living spaces	**H4.3** To use renewable energy sources and technological lighting elements in buildings and facilities under the responsibility of the Metropolitan Municipality
Energy	Antalya Metropolitan Municipality 2020-2024 Strategic Plan	**A11.** Planning infrastructure works to increase the quality of urban life	**H11.6** Developing and diversifying renewable energy sources
Transportation	BAKA TR61 Level 2 Regional Plan (2014-2023)	**Priority 2.** Ensuring effective use of airlines	**Measure 2.1.** Attempts will be made to increase the number of scheduled flights at Antalya airport
		Priority 3. Development of maritime transport	**Measure 3.1.** Studies will be carried out for the effective use of Antalya port
	Antalya Metropolitan Municipality 2020-2024 Strategic Plan	**A13.** Considering the population density of the city in the future, to provide planned, rational, high quality, safe and integrated public transportation service with the rail system.	**H13.1** Increasing public transportation and increasing citizen satisfaction by increasing service quality
			H13.2 To ensure the integration of the rail system network with other types of public transportation
			H13.3 Developing environmentally friendly transportation services and projects
			H13.4 Developing and improving pedestrian and bicycle transport
			H13.6 Strengthening transport infrastructure and smart transport systems
			H13.7 Expanding the rail network

Sector	Plan Name	Strategic Purpose	Strategic Target
Waste	Antalya Metropolitan Municipality 2020-2024 Strategic Plan	**A3.** Making Antalya an environmentally and nature-friendly city	**H3.1**Implementing an environmentally friendly waste management
Agriculture	Antalya Metropolitan Municipality 2020-2024 Strategic Plan	**A8.** Realizing the local development model	**H8.3** To implement projects that will increase agricultural production, to raise awareness and support the producers
		A12. Planning and developing agricultural infrastructure services, increasing agricultural production, making rural living areas livable and aesthetic with its infrastructure and superstructure.	**H12.2** Protecting, planning, improving agricultural resources and increasing producer awareness
Green Areas	Antalya Metropolitan Municipality 2020-2024 Strategic Plan	**A3.** Making Antalya an environmentally and nature-friendly city	**H3.3** Protecting and increasing green areas
		A10. Creating a green and healthy city that respects nature	**H10.1** Maintaining and increasing the amount of green areas
Disaster Management	Antalya Metropolitan Municipality 2020-2024 Strategic Plan	**A9.** To ensure the formation of a planned, modern aesthetic and liveable city by directing the social and economic development of the city in accordance with the natural, historical and cultural texture of the city.	**H9.5** Planning and carrying out activities against disasters and earthquakes that may occur throughout the city
Public Health	Antalya Metropolitan Municipality 2020-2024 Strategic Plan	**A10.** Creating a green and healthy city that respects nature	**H10.2** To protect the environment and human health, to create a city with a high quality of life and to activate and spread social awareness in this area
			H10.3 Increasing social awareness for a clean and healthy city, activating waste management
			H10.4 To make necessary analyzes and inspections related to public health, to develop them in line with accreditation processes

3. GREENHOUSE GAS MANAGEMENT

In this section, GHG inventory calculations will be presented for the formulation of Antalya's climate change mitigation strategies.

3.1 CLIMATE CHANGE MITIGATION STEPS

Within the scope of the mitigation section of the Antalya Sustainable Energy and Climate Action Plan, the methods and standards adopted from the Covenant of Mayors are utilized. Figure 34 shows the steps followed in the climate change mitigation process.

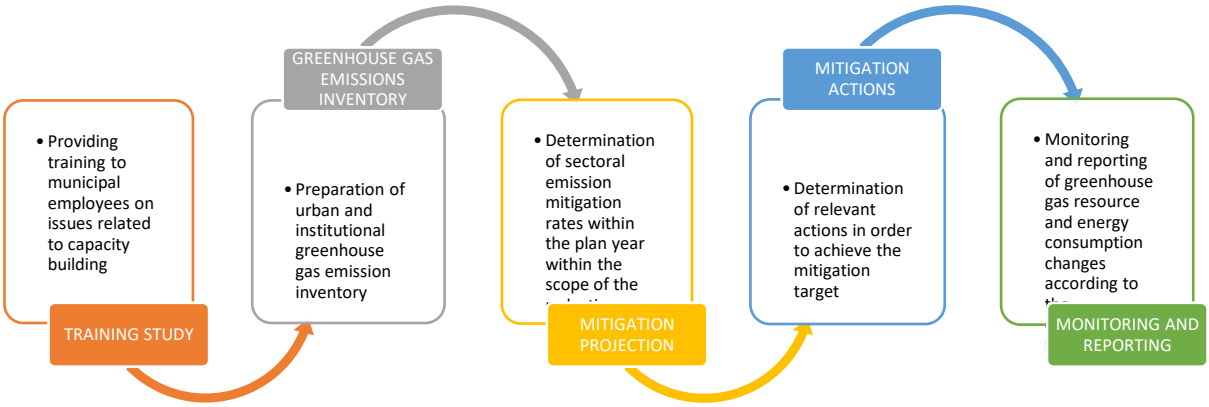


Figure 32: Climate change mitigation steps

f) Training Study: Providing training to municipal employees to increase institutional capacity

g) **Greenhouse Gas Inventory:** Collection of greenhouse gas sources consumption data of Antalya province and preparation of greenhouse gas inventory by determining the highest greenhouse gas emission sources of the city

h) **Mitigation Projection:** Establishing actions on buildings and energy, transportation, waste and wastewater management and agriculture in the greenhouse gas mitigation section of the Sustainable Energy Action Plan prepared for Antalya

i) **Mitigation Measures:** Implementation of the actions in the Sustainable Energy Action Plan

j) **Monitoring and Reporting:** Monitoring and reporting of changes in greenhouse gas source and energy consumption amounts according to the determined base year

The findings of the prepared greenhouse gas inventory were shared with Antalya Metropolitan Municipality units and other stakeholders in the city at a workshop held on March 17, 2021. Due to the Covid-19 pandemic, the workshop, where inventory findings were shared and mitigation measures were discussed, was held online via "Microsoft Teams". Stakeholders from different institutions such as Antalya Metropolitan and district municipalities, universities, Provincial Directorate of Environment, Urbanization and Climate Change participated in the workshop. Within the scope of the workshop, mitigation measures were discussed under four main working groups. Mitigation activities to be implemented within the scope of SEAP and their priority levels were determined within the scope of the following working groups:

- Buildings and Energy
- Transportation
- Waste and Wastewater
- Agriculture and Livestock

Multi-Criteria Assessment (MCA) Analysis was used to prioritize mitigation activities. Within the scope of the assessment, a series of criteria including environmental, economic, social, and institutional were taken into consideration in GHG mitigation activities prepared with the main objectives of supporting the transition to sustainable energy and reducing GHG emissions (Figure 35). The criteria in the four main categories were determined by Antalya Metropolitan Municipality by considering the strategic objectives. The criteria to be used in the Multi-Criteria Assessment analysis was determined through a joint assessment with the relevant units under the leadership of the project coordinator.

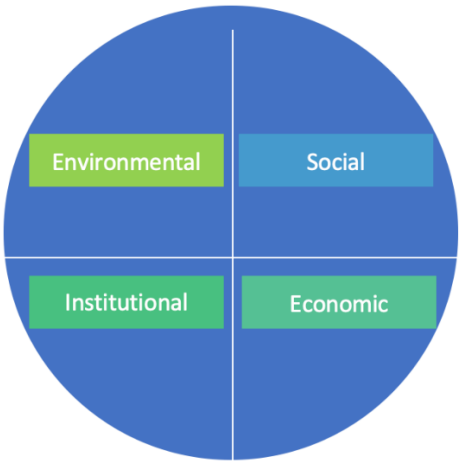


Figure 33: Categories of criteria used in the Multi-Criteria Evaluation Analysis

Within the scope of the workshop, mitigation measures were discussed by the participants. In the online workshop, the prioritization of activities was carried out by the participants using interactive tools. The priority levels of the activities were determined as high, medium, and low according to the criteria in question. Afterwards, the feasibility of the prioritized mitigation activities was discussed and assessed by the participants. In the feasibility assessment of the activities, issues such as institutional capacity, authority and financial resources were taken into consideration in order to realize the implementation. Figure 36 shows the screenshot of the workshop working group created for transportation in the mitigation workshop held interactively with online tools.

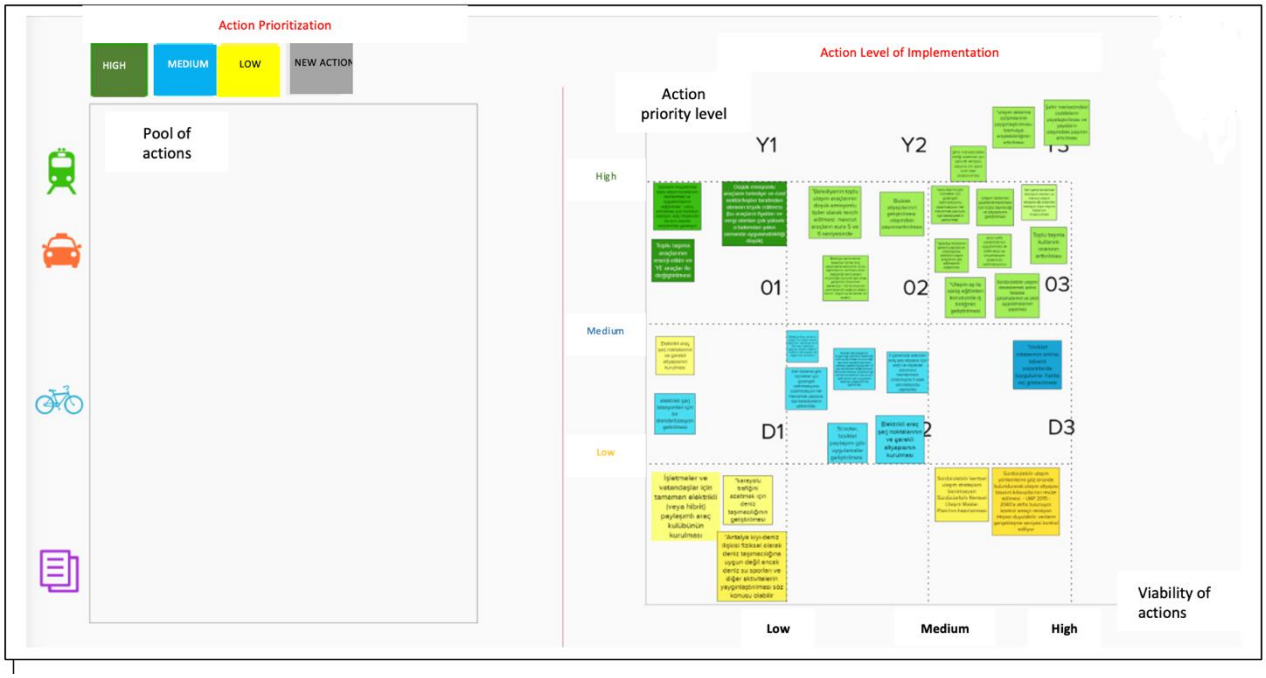


Figure 34: Interactive greenhouse gas mitigation workshop with online tools transport working group screenshot

After the workshop, energy consumption and greenhouse gas emission projections were created by taking into account the growth dynamics of the city. Based on these projections and taking into account the solution proposals expressed at the workshop, the mitigation potential for each measure was determined and sectoral and total final and per capita reduction targets for 2030 were determined.

3.2 GREENHOUSE GAS CALCULATION METHODOLOGY

The Covenant of Mayors initiative allows municipalities who are new to the process to develop a mitigation action plan that fits their local circumstances. allows municipalities that have already established energy and climate actions to develop a mitigation action plan without major changes in their approach. With this principle in mind, the Covenant develops a multi-option methodology based on or adapted from existing standards and methods. The different options, some of which are interdependent, are related to the choice of base year, emission inventory approach, GHGs included, emission factors and the definition of reduction targets.

Base Year

The base year is the reference year against which the emission reduction target will be compared to monitor the results of the proposed activities. When determining this year, it is requested to choose a year in which the most reliable data is available and there are no extraordinary events (pandemic, etc.). In this context, the baseline year for Antalya is 2019.

Scope

The sectors selected within the borders of Antalya Metropolitan Municipality are buildings, energy, transportation, waste and wastewater, and GHG calculations were also made for the industrial sector. Antalya Metropolitan Municipality does not have any sanctioning authority over the industrial sector, which can be characterized as largely private sector. For this reason, industrial greenhouse gases were excluded from the scope while setting mitigation targets.

Method

The direct and indirect GHG emissions of each energy carrier were calculated by multiplying the final energy consumption by the corresponding emission factor. In addition, CH_4 and N_2O emissions from waste, wastewater treatment, agriculture and animal husbandry were calculated and converted to CO_2e.

In the preparation of the baseline Emissions Inventory, the activity-based approach most commonly used by cities was used. In this approach, all CO_2e (or GHG) emissions from direct (through fuel combustion) or indirect (through electricity consumption) energy consumption in Antalya are included. Most GHG emissions are CO_2 emissions, while CH_4 and N_2O emissions are of secondary importance for combustion processes in the residential and transportation sectors. All CO_2, CH_4 and CO_2 emissions are calculated for all fuel types along with their global warming potential (GWP) using IPCC emission factors from the Fifth Assessment Report (AR5). One of the reasons for including emissions other than CO_2 is that Antalya calculates emissions from waste (CH_4), wastewater (CH_4, N_2O), enteric fermentation of livestock (CH_4) and chemical fertilizers used in agriculture (N_2O).

Within the defined boundaries of Antalya Metropolitan Municipality, GHG calculations are based on IPCC, SCOPE-1 and SCOPE-2 methodology. Accordingly, the following formulas and variables were used in the calculations according to the types of Scope-1, Scope-2 and Scope-3 greenhouse gas sources:

Emissions GHG, fuel = CO_2 emissions, fuel+ CH_4 emissions, fuel + N_2O emissions, fuel+…
CO_2 emissions, fuel= Fuel consumption x Emission FactorCO_2, fuel

Assumptions

GHG emission assumptions for the targeted year 2030 have been made by taking into account the population growth rate, the growth rate of the building and service sector, energy consumption trends in the last decade and legislative changes in the jurisdiction of Antalya Metropolitan Municipality. The assumptions on which we calculate the city's GHG development if the sector-based current situation continues are listed below. Assumptions regarding reductions are stated separately in the content of each activity.

a) Population projection

Population projection for the year 2030 was made according to the average of the population growth rate between 2010 and 2020 for Antalya province. The population has always continued to increase in the analyzed year interval. While making the population projection, the population projection data of TurkStat for the provinces until 2025 are also taken into consideration and an average annual population increase of approximately 3% is foreseen in Antalya province. With this rate, it is estimated that the population residing in Antalya will reach 3.294.015 people in 2030.

b) Buildings

GHG emissions related to buildings have been increased with assumptions based on the following building typologies.

i. Residential buildings: Energy consumption is considered to be directly proportional to population growth and the growth rate is taken as 3% per year. Determining an increase rate in energy consumption by considering the change in previous years leads to an unreliable assessment as issues such as infrastructure changes, increase in natural gas penetration rate will radically affect this increase rate. Therefore, a change in direct proportion to population growth is envisaged. In order to elaborate the mitigation calculations, residential electricity consumption has been disaggregated with some assumptions based on the consumption habits prevailing in Turkey. It is assumed that 50% of residential electricity consumption is for cooling, 10% for heating, 20% for other electrical appliances and 20% for lighting.

ii. Non-residential buildings: Energy consumption increases have been determined by taking into account the trends in the last 5 years and the development status of the service sector. Assumptions are as follows:
    1. Natural gas: Natural gas consumption growth is projected at 5%.
    2. LPG: 3% is projected based on the average annual increase in the last 5 years.
    3. Fuel: 3% projected based on the average annual increase in the last 5 years.
    4. Electricity: 3% is projected based on the average annual increase in the last 5 years.

iii. Municipal buildings: The following assumptions have been made regarding the energy consumption of municipal buildings, taking into account the increase in the number and size of service points and the stable course to be achieved after the transition to new service points:
    1. Natural gas: An annual increase rate of 3% is projected.
    2. Electricity: An annual increase rate of 3% is projected..

c) Transportation

In the transportation sector, the current situation and number of vehicles in the municipality and the private vehicle situation in the city have been considered separately. While the number of vehicles in the city is projected to increase similar to the population growth, the decrease in fuel consumption of the renewed vehicles with the developing technology has also been evaluated. The rates of increase in fuel consumption and greenhouse gas emissions in the transportation sector are as follows:

i. Municipal vehicle fleet:
    1. Diesel An annual increase rate of 1% is foreseen.
    2. Gasoline: No annual percentage increase is foreseen.

ii. Special Vehicles
    1. Diesel Special vehicles: An annual increase rate of 5% is foreseen.
    2. Gasoline Private vehicles: An annual increase rate of 2% is foreseen.
    3. LPG: No annual percentage increase is foreseen.

d) Waste and wastewater

Waste and wastewater related emissions are increased at 3% annual population growth rate as they are directly linked to citizen activities.

e) Agriculture and Livestock

Releases related to agriculture and animal husbandry are projected to increase by 1% per year, taking into account the change in livestock population in the province.

3.3 IDENTIFYING CLIMATE CHANGE ACTIONS

The actions including GHG mitigation measures targeted to be implemented within the scope of SEAP have been identified through a series of studies. The general content of these studies is mentioned in the methodology section and the findings of these studies are presented in this section. In order to identify SEAP mitigation actions, a number of criteria, including environmental, social, economic and institutional, have been identified in order to select these actions. A pool of criteria was created and the criteria that match ABB's strategies at the highest level were selected from this pool.

A total of 13 criteria were selected from a pool of 23 criteria. In the prioritization of mitigation activities, the 13 criteria in Figure 37 were taken into consideration in the Multi-Criteria Assessment. In the Multi-

Criteria Assessment, a four-point Likert scale was used for each criterion.

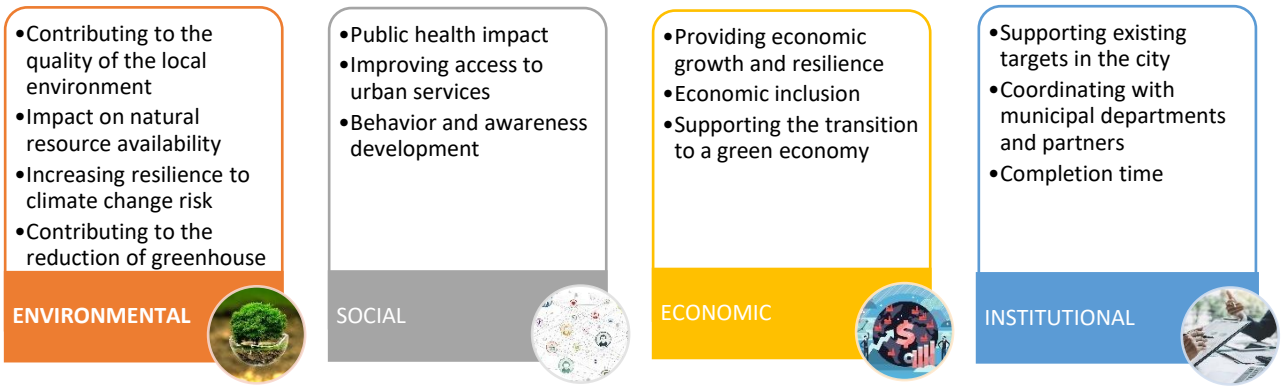


Figure 35: Criteria used in the multi-Criteria Evaluation analysis

In the multi-stakeholder workshop organized to identify activities through a participatory process, participants proposed activities under working groups and a prioritization study was carried out for all proposed activities, taking into account the criteria in question. Table 10 shows how each activity was addressed within the scope of the criteria.

Table 10: Scope of evaluation of criteria used in action prioritization

Category	Criteria	Evaluation Content of the Criterion
Environmental	Contributing to the quality of the local environment	Impact on air quality, water quality (sea and drinking) and/or land/soil quality
	Impact on natural resource availability	Increasing the availability of water resources, green space, biodiversity and ecosystems
	Increasing resilience to climate change risk	Contributing to increasing the resilience of the city against the risk of climate change
	Contributing to the reduction of greenhouse gas emissions	Developing projects to reduce the city's greenhouse gas emissions
Social	Impact on public health	Reducing public health problems by improving water quality, air quality, resilience to climate hazards
	Improving access to urban services	Improving service availability, access to services and wastewater services
	Behaviour and awareness development	It will affect behaviour change and raise citizen awareness
Economic	Providing economic growth and resilience	Contributing to GDP, providing employment and/or increasing economic resilience to climate change impact
	Economic inclusion	Promote economic inclusion across the entire population through access to skills and jobs, access to finance, and entrepreneurship and/or economic opportunities, and access to services
	Supporting the transition to a green economy	Lead to reductions in carbon emissions and pollution, increased energy and resource efficiency, and/or

		prevention of loss of biodiversity and ecosystem services
Institutional	Supporting existing targets in the city	Support and assist the municipality in achieving its current goals
	Coordinating with municipal departments and partners	Promoting inclusion through stakeholder engagement
	Completion time	Implementation and execution within time frames (short-medium-long)

3.4 STAKEHOLDER ENGAGEMENT IN ANTALYA PROVINCE

Ensuring stakeholder participation is an important element in the creation of the Sustainable Energy Action Plan. In the preparation of the action plan, a greenhouse gas mitigation assessment was carried out on March 17, 2021, in order to identify priority areas in combating climate change and to obtain important locally specific information.

A workshop was held with the relevant units of the municipality and external stakeholders to support the transition to sustainable energy and to understand how greenhouse gas emissions can be reduced. The workshop, where inventory findings were shared and mitigation measures were discussed due to the Covid-19 pandemic, was held online via "Microsoft Teams". With the workshop, it was emphasized that the evaluation of all stakeholders is important, and the activities and priorities in the action plan were created by evaluating with stakeholders with different expertise.

3.5 GREENHOUSE GAS REDUCTION

Greenhouse gas inventory for 2019 was calculated to determine the current situation before determining GHG mitigation actions.

3.5.1 Greenhouse Gas Emission Inventory

The current situation emission inventory was prepared using the data of Antalya Metropolitan Municipality for 2019. The 2019 inventory covers the building, transportation, waste and wastewater treatment, agriculture, forestry, and livestock sectors. During the preparation of the Sustainable Energy Action Plan, the short and long-term strategic plans of Antalya Metropolitan Municipality, the opinions of academics, chambers of industry and commerce, public institutions, provincial directorates, and professional organizations were taken into consideration. The 2019 baseline greenhouse gas emission inventory calculated for SECAP is shown in Table 11 and Table 12.

Table 11: Antalya greenhouse gas emissions, 2019 (including industry)

Sector	MWh	tCO_2e	%
Total (Antalya Greenhouse Gas Inventory)	**28.623.531**	**10.683.551**	**100,0**
Buildings, Equipment/Field	**11.746.115**	**5.028.308**	**47,1**
Municipal Buildings & Affiliates	440.575	226.396	2,1

Sector	MWh	tCO_2e	%
Tertiary Buildings Outside the Municipality / Sahalar	6.078.367	2.511.844	23,5
Residences	3.512.897	1.538.127	14,4
Street Lighting	186.214	95.714	0,9
Industry	1.528.062	656.228	6,1
Transport	**12.222.104**	**3.230.777**	**30,2**
Municipal Vehicle Fleet	2,144	563	0,0
Public Transportation (Municipal Buses)	148.177	40.156	0,4
Public Transport (Electric Systems)	13.184	6.777	0,1
Urban Vehicles	10.714.886	2.829.551	26,5
Transit-Bus Station	396.785	107.529	1,0
Civil Airport	946.927	246.201	2,3
Other Emissions	**180.281**	**1.516.034**	**14,2**
Solid Waste Disposal		565.361	5,3
Wastewater Treatment Plant		310.902	2,9
Wastewater Treatment Process CH_4		*254.740*	*2,4*
Wastewater Treatment Process CO_2		*43.291*	*0,4*
Wastewater Treatment Process Nit./Denit. N_2O		*3.753*	*0,0*
Wastewater Treatment Process not Nit./Denit.		*311*	*0,0*
Wastewater Treatment Process N_2O		*8.808*	*0,1*
Fugitive Emissions		24	0,0
Agriculture, Livestock and Fertilizer Management		547.082	5,1
Agricultural Irrigation	180.281	92.665	0,9
Energy production	**4.475.032**	**908.431**	**8,5**
Fuel Consumption for Electricity Generation	4.475.032	908.431	8,5

As seen in Table 11, for 2019, Antalya province's energy consumption including industry was calculated as 28,623,531 MWh and greenhouse gas emissions as 10,683,551 tCO_2e. According to the table, the share of emissions from fuel and electricity consumption of buildings in total emissions is 47.1%. Greenhouse gas emissions from transportation account for 30.2%. GHG emissions from solid waste and wastewater treatment account for 8.2%, while emissions from electricity generation account for 8.5% and emissions from agriculture and animal husbandry account for 6%.

Table 12: Antalya greenhouse gas emission amount, 2019 (excluding industry)

Sector	MWh	tCO_2e	%
Total (Antalya Greenhouse Gas Inventory)	**21.493.229**	**8.232.919**	**100,0**
Buildings, Equipment/Field	**10.218.053**	**4.372.081**	**53,1**
Municipal Buildings/Fields	440.575	**226.396**	2,7
Tertiary Buildings Outside the Municipality / Fields	6.078.367	2.511.844	30,5
Residences	3.512.897	1.538.127	18,7

Street Lighting	186.214	95.714	1,2
Transport	**11.275.176**	**2.984.575**	**36,3**
Municipal Vehicle Fleet	2.144	563	0,0
Public Transportation (Municipal Buses)	148.177	40.156	0,5
Public Transport (Electric Systems)	13.184	6.777	0,1
Urban Vehicles	10.714.886	2.829.551	34,4
Transit-Bus Station	396.785	107.529	1,3
Other Emissions		**876.263**	**10,6**
Solid Waste Disposal		565.361	6,9
Wastewater Treatment Plant		310.902	3,8
Wastewater Treatment CH_4		254.740	*3,1*
Wastewater Treatment CO_2		*43.291*	*0,5*
Wastewater Treatment Nit./Denit. N_2O		*3.753*	*0,0*
Wastewater Treatment not Nit./Denit.		*311*	*0,0*
Wastewater Treatment N_2O		*8.808*	*0,1*

Antalya province's energy consumption excluding industry is calculated as 21,493,229 MWh and greenhouse gas emissions as 8,232,919 tCO_2e (Table 12). According to the calculations, 53.1% is from buildings, 36.3% from transportation and 10.6% from solid waste and wastewater emissions.

3.5.2 Target

Considering the sectoral GHG mitigation and energy saving actions detailed in the following chapters of the Antalya Sustainable Energy Action Plan, the effects of the above-mentioned targets can be observed with the graph below, which includes the current situation, BAU scenario and mitigation scenarios.

Table 13 shows Antalya's sectoral greenhouse gas and energy reduction targets for 2030. According to the table, 10,372,980 MWh energy savings and 4,576,934 tCO_2e greenhouse gas reduction in buildings, 744,000 MWh energy savings and 377,208 tCO_2e greenhouse gas reduction with renewable energy, 8,849,734 MWh energy savings in transportation, and 224,157 MWh energy savings and 923,349 tCO_2e greenhouse gas reduction targets for other sectors including waste-wastewater and agriculture and livestock sector.

As shown in Figure 38, GHG emissions per capita in Antalya province are projected to decrease to 1.96 tCO_2e /person in 2030 with the use of buildings and transportation sectors as well as waste-wastewater, other sectors including agriculture and renewable energy.

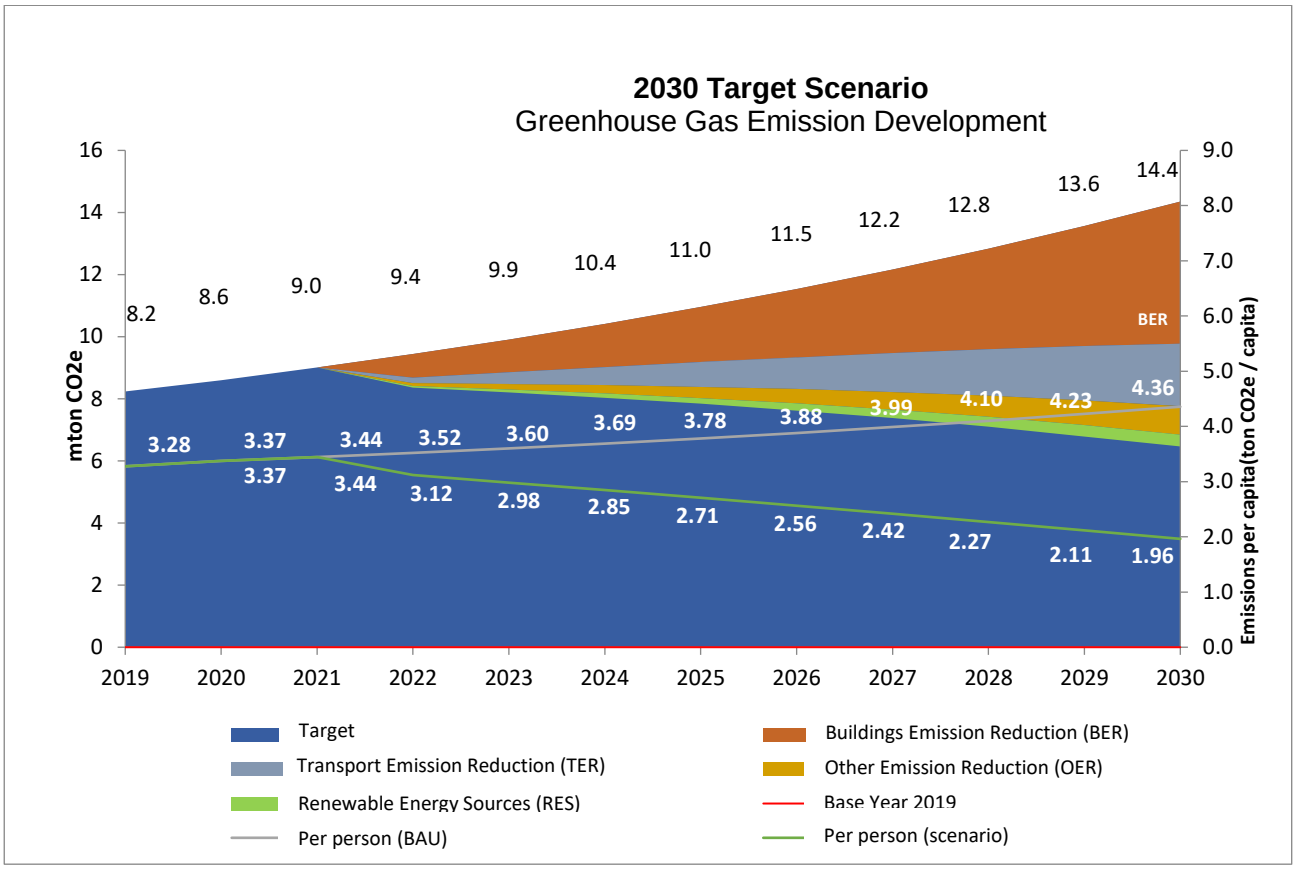


Figure 36: Antalya 2030 greenhouse gas reduction scenario

Table 13: Antalya 2030 sectoral reduction targets

	MWh Mitigation2030	Tone CO_2e mitigation 2030
Buildings Emission Reduction	10.372.980	4.576.934
Renewable Energy Emission Reduction	744.000	377.208
Transportation Emission Reduction	8.849.734	2.009.046
Waste-Wastewater and other Emission Reduction	224.157	923.349
Total Reduction	**20.190.870**	**7.886.537**

3.5.3 Mitigation Actions

In this section, mitigation actions are detailed by sector. Each action is also aligned with the Antalya Metropolitan Municipality Strategic Plan, which includes the municipality's defined targets for 2020- 2024.

Action Types

Activities within the scope of SEAP are categorized as follows:

- **Investment projects:** Infrastructure investments to be undertaken by Antalya Metropolitan Municipality either with its own resources or with the support of donor organizations.
- **Policy measures:** New legislation or policies enacted to conduct more environmentally friendly activities.

- **Plans and strategies:** Provide a more detailed roadmap for improving performance in a specific sector or region (e.g., Climate Action Plan).
- **Behavioural:** Measures that seek to shift a community's behaviour in a particularly targeted direction (e.g., towards greater use of public transport). While policy measures may have a behavioural component, activities in this category focus specifically on behavioural change, such as organizing awareness campaigns.
- **Training:** Activities aimed at capacity building through the exchange of information.
- **Enforcement and sanctioning:** Measures that seek to improve compliance with policies and regulations through monitoring and potential penalties.

3.5.3.1 Buildings and Energy

Buildings Current Status

There are several national strategic plans and regulations in the buildings sector, including the Ministry of Environment and Urbanization's Energy Efficiency Strategy Document (2012-2023) and National Energy Efficiency Action Plan (2017-2023), the Turkish Energy Efficiency Law and the EU Energy Performance of Buildings Regulation for the building sector. In order to help mitigate the impacts of this sector on global climate change, particularly through measures aimed at reducing greenhouse gas emissions and resource consumption, Antalya province is undertaking several activities. These activities cover municipal buildings, non-residential buildings, and residential buildings.

In the Antalya Metropolitan Municipality 2020-2024 Strategic Plan, Target 4.3 of the strategic goal "A4. To increase the quality of urban living spaces" includes the statement "To use renewable energy sources and technological lighting elements in buildings and facilities under the responsibility of the Metropolitan Municipality".

The buildings sector is the most important driver for GHG emission reductions, and it is important to take effective actions in this regard. However, limited data on buildings makes it difficult to estimate the scale of improvement that can be achieved. The last detailed survey for all existing buildings was conducted in 2000. It is now significantly out of date, especially given the changes that have occurred as a result of the urban transformation initiatives implemented by the Ministry in response to the 1999 earthquake disaster in Gölcük (see "Law No. 6306 on the Transformation of Areas under Disaster Risk"). There has been significant construction (and demolition) in Turkish cities over the last 20 years and the process is still ongoing. While this may create some opportunities for large-scale energy efficiency gains, especially where there are demolished and reconstructed properties, it will also be important to reduce the impacts of the construction process itself, taking into account issues such as circular economy and embedded carbon. Figure 39 shows the breakdown of residential emissions by type of energy consumption source.

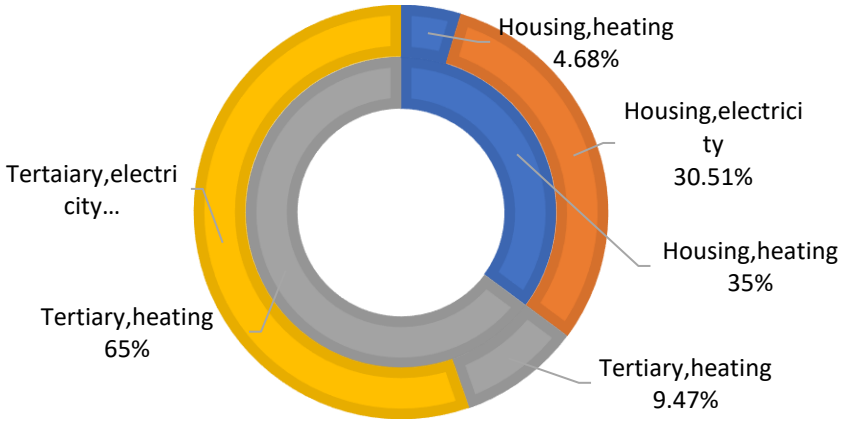


Figure 37: Breakdown of greenhouse gas emissions from heating and electricity consumption of residential and commercial buildings

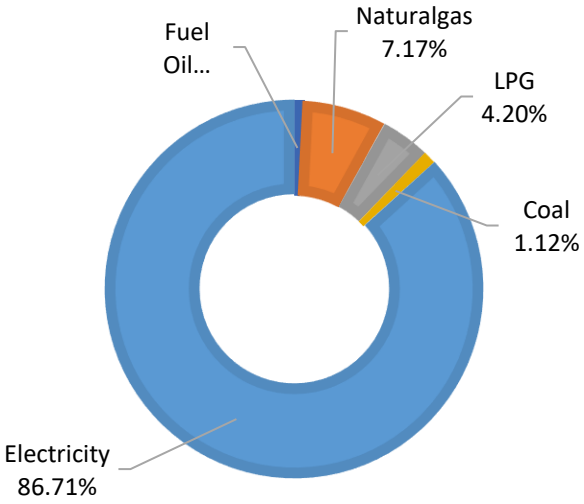


Figure 38: Breakdown of greenhouse gas emissions by fuel type in residences

The breakdown of greenhouse gas emissions by fuel in residential buildings shows that natural gas is used the most after electricity. Emissions are in the order of LPG, coal and fuel oil (Figure 40).

Energy Current Status

According to the 11th Development Plan (2019-2023), the share of renewable resources in electricity generation is targeted to increase to 38.8% by 2023 and the amount of CO_2 emissions avoided by newly established renewable power plants is targeted to reach 18 million tons (cumulatively) from 2018 to 2023.[30] According to the 2019-2023 Strategic Plan of the Ministry of Energy and Natural Resources, the first target is to increase the ratio of electricity installed capacity based on domestic and renewable energy resources to total installed capacity from 59% to 65%. In this context, the national target for 2023 is 56,804 MW of power based on renewable energy sources, including 10,000 MW in solar energy, 11,883 MW in wind energy, 32,037 MW in hydroelectricity, and 2,884 MW in geothermal and biomass.[31] According to the Turkish Climate Change Strategy 2010-2023, the share of renewable energy in total electricity generation is envisaged to

[30] *https://www.sbb.gov.tr/wp-content/uploads/2019/11/ON_BIRINCI_KALKINMA-PLANI_2019-2023.pdf, Erişim tarihi: Kasım 2021.*
31 https://sp.enerji.gov.tr/ETKB_2019_2023_Stratejic_Plan.pdf, Date of access: November 2021.

increase to 30% by 2023. In this framework, all of our technical and economic hydraulic potential will be utilized, while 20,000 MW of wind and 600 MW of geothermal electricity generation capacity will be reached. Electricity generation from solar energy will be encouraged.[32]

Looking at the total solar radiation data of Antalya province, the average value of 1600-1650 kWh/m2 -year is higher than the Turkish average of 1527 kWh/m2 -year.[33] The implementation and development of unlicensed and building-scale distributed solar energy systems in Antalya, especially for self-consumption, is of key importance in reducing emissions from building energy consumption. In this regard, it is important to carry out coordinated studies with all sector stakeholders, especially universities and academic institutions.

When evaluated as a renewable energy potential in Antalya, solar energy comes to the forefront. When the solar energy potential atlas below is examined, Antalya province is in an advantageous position compared to the average of Turkey in terms of sunshine duration and solar radiation level (Figure 41 and Figure 42)[34].

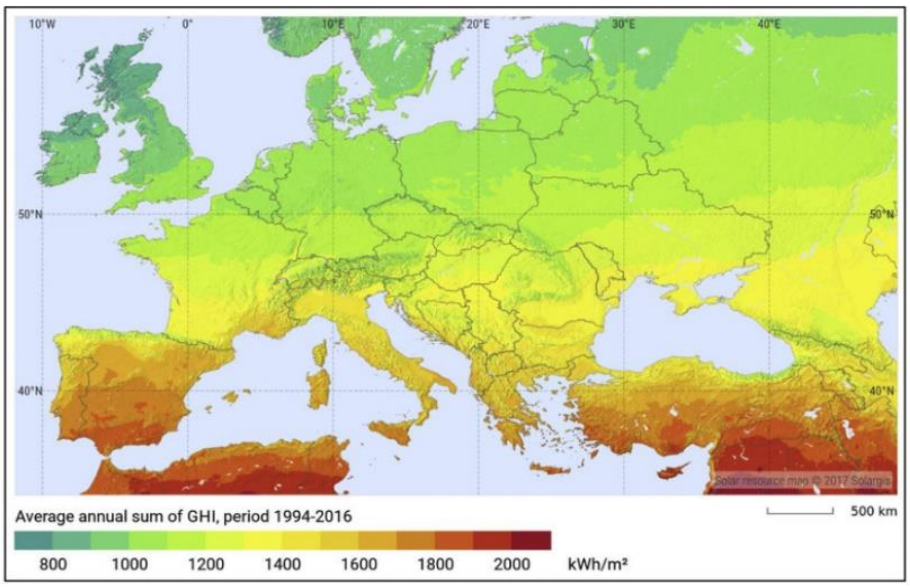


Figure 39: Europe solar radiation map

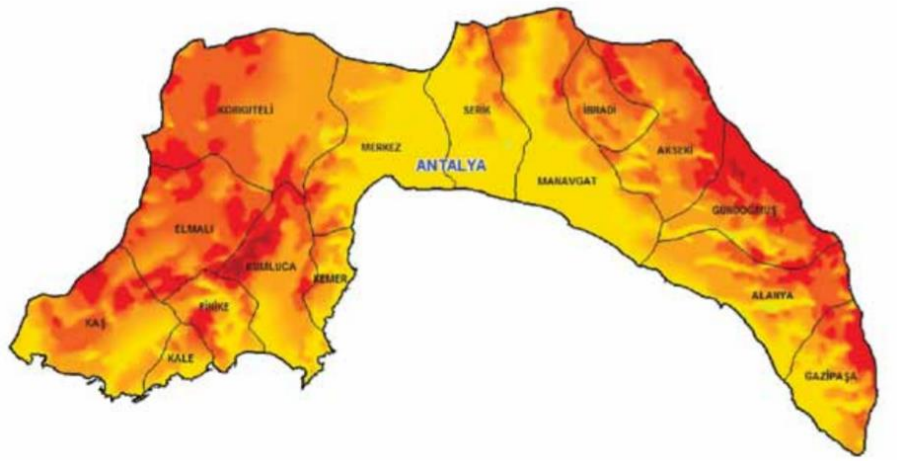


Figure 40: Antalya solar radiation map

32 https://www.gmka.gov.tr/dokumanlar/yayinlar/Turkiye-Iklim-Degisikligi-Stratejisi.pdf, Date of access: November 2021.
33 solargis.com, Date of access: October 2021.
34 http://baka.gov.tr/uploads/1303486512GUNES-TURKCE-KATALOG.pdf Date of access: November 2021.

Regarding energy, the Antalya Metropolitan Municipality 2020-2024 Strategic Plan defines Target 11.6 "Developing and diversifying renewable energy sources" under the strategic objective "A11.

Sector Target

Improving the energy efficiency of existing and future buildings and supporting the widespread adoption of sustainable construction techniques and the use of environmentally friendly materials can be said to be the sector's goal. In addition, some of the electricity consumption in residential and tertiary buildings can be provided from renewable sources, especially with solar energy systems to be installed integrated on roofs. The target year for buildings and energy for 2030 is 4,954,142 tons of CO_2e greenhouse gas reduction and 11,116,980 MWh energy efficiency.

Activity Details

Action 1.1.	**Implement renewable energy practices in municipal buildings and commit the municipality to low energy consumption in all new public buildings**
Current Situation/Purpose	According to the greenhouse gas inventory, municipal buildings account for 2.3% of buildings. With this action, it is aimed to implement renewable energy applications in municipal buildings as well as to commit the municipality to low energy consumption in all new public buildings.
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 4.3
Priority Level	High
Action Steps	• Efficiency analysis and feasibility studies of fuels used in municipal buildings • Ensuring that the fuels and lighting used in municipal buildings are replaced with more energy efficient systems • Ensuring the charging of electric transportation vehicles with photovoltaic systems to be built on the roofs of municipal buildings
Action Type	Investment (public)
Amount of Savings	In 2030, a total of 142,119 tCO_2e greenhouse gas emission reduction and 277,400 MWh energy savings are targeted in public buildings
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Environment and Urbanization, Ministry of Energy and Natural Resources, Antalya Provincial Directorate of Environment and Urbanization, financial institutions
Municipality's Contribution	Implementer
Cost	-
Timing	2022-2030
Risks	High investment cost, lack of human resources

Action 1.2.	**Utilization of efficient and smart HVAC systems in buildings**
Current Status/Purpose	Improvement works to be carried out for buildings emphasize the use of more efficient systems. With this action, it is aimed to carry out studies for the use of efficient and smart HVAC (Heating, Ventilation and Air Conditioning) systems

Relationship with Existing Plans	11th Development Plan Article 377.1
Priority Level	High
Action Steps	• Identifying priority districts in Antalya where the HVAC system will be implemented • Improvement works on heating, ventilation and air conditioning in buildings located in pilot areas to be selected in priority districts
Action Type	Investment (public & private)
Amount of Savings	No forecasts have been made.
Responsible	Antalya Metropolitan Municipality, property owners
Stakeholders	Ministry of Environment and Urbanization, Antalya Provincial Directorate of Environment and Urbanization, financial institutions
Municipality's Contribution	Practitioner and guide
Cost	-
Timing	2025-2030
Risks	Lack of cooperation between organizations, lack of support at national level, high investment cost

Action 1.3.	**Energy efficient urban transformation and renewable energy integration in housing**
Current Status/Purpose	In the greenhouse gas inventory, residential buildings constitute 35.2% of the buildings excluding industry. With this action, it is aimed to carry out energy efficient urban transformation and thermal insulation and renewable energy integration in existing dwellings
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 11.6
Priority Level	High
Action Steps	• Determination of performance criteria in urban transformation • Increasing urban transformation efforts, prioritizing districts with high fuel and electricity consumption in Antalya • Implementing energy efficient practices in buildings to be constructed within the scope of urban transformation • Ensuring the integration of renewable energy applications in existing and new buildings
Action Type	Investment (public & private)
Amount of Savings	In 2030, a total of 508,516 tCO_2e greenhouse gas emission reduction and 1,242,674 MWh energy savings are targeted
Responsible	Property owners
Stakeholders	Antalya Metropolitan Municipality, Ministry of Environment and Urbanization, Ministry of Energy and Natural Resources, Antalya Provincial Directorate of Environment and Urbanization, financial institutions
Municipality's Contribution	Pathfinder
Cost	-

Action 1.3.	**Energy efficient urban transformation and renewable energy integration in housing**
Timing	2022-2030
Risks	High investment cost, lack of human resources

Action 1.4.	**Making interventions with the priority principle of energy efficiency in commercial buildings**
Current Status/Purpose	When the greenhouse gas inventory is analyzed, commercial buildings have the largest share in buildings with 57.5%, excluding industry. With this action, it is aimed to ensure energy efficiency in commercial buildings
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 4.3
Priority Level	High
Action Steps	• Efficiency analysis of fuels used in commercial buildings • Ensuring the replacement of fuels and lighting in commercial buildings with more energy efficient systems
Action Type	Investment (public & private)
Amount of Savings	By achieving energy efficiency in its commercial buildings, the Company aims to reduce greenhouse gas emissions by 1,561,465 tCO_2e and save 4,163,433 MWh of energy in 2030
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Environment and Urbanization, Ministry of Energy and Natural Resources, Antalya Provincial Directorate of Environment and Urbanization, financial institutions
Municipality's Contribution	Implementer
Cost	-
Timing	2022-2030
Risks	High investment cost, lack of human resources

Action 1.5.	**Energy efficient renovations in existing tertiary buildings**
Current Status/Purpose	In the greenhouse gas inventory, the largest share of buildings, excluding industry, belongs to commercial buildings with 57.5%. With this action, it is aimed to make energy efficient renovations in existing tertiary buildings
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 11.6
Priority Level	High
Action Steps	• Conducting feasibility studies for energy efficient renovations in tertiary buildings • Realization of energy-efficient renovations with nature-based solutions • Encouraging nature-based solutions such as green roofs in existing tertiary buildings
Action Type	Investment (public & private)
Amount of Savings	In 2030, a total of 2,394,194 tCO_2e greenhouse gas emission reduction and 4,657,965 MWh energy savings are targeted

Responsible	Antalya Metropolitan Municipality, property owners
Stakeholders	Ministry of Environment and Urbanization, Ministry of Energy and Natural Resources, Antalya Provincial Directorate of Environment, Urbanization and Climate Change, financial institutions
Municipality's Contribution	Implementer and mentor
Cost	900 € / kWp
Timing	2022-2030
Risks	Lack of cooperation between organizations, lack of support at national level, lack of awareness, high investment cost

Action 1.6.	**Increasing high efficiency heat pump applications in buildings**
Current Status/Purpose	Buildings account for 43.6% of the total greenhouse gas inventory. With this rate, it can be said that it has the largest share in terms of greenhouse gas emissions among other sectors. This action aims to increase the use of high efficiency heat pumps
Relationship with Existing Plans	NEEAP 2017-2023 Action B5
Priority Level	Medium
Action Steps	• Conducting technical and economic feasibility studies on the feasibility of heat pump applications in buildings for Antalya • Determining the priority districts in Antalya where the heat pump system can be applied, especially those with high fuel and electricity consumption • Identification of buildings where high efficiency heat pump systems will be installed • Implementation of high efficiency heat pump applications in buildings in pilot areas to be selected in priority districts
Action Type	Investment (public & private)
Amount of Savings	Total greenhouse gas emission reduction of 126,061 tCO_2e and energy savings of 245,254 MWh are targeted in 2030
Responsible	Antalya Metropolitan Municipality, property owners
Stakeholders	Ministry of Environment and Urbanization, Ministry of Energy and Natural Resources, Antalya Provincial Directorate of Environment, Urbanization and Climate Change
Municipality's Contribution	Implementer and mentor
Cost	-
Timing	2022-2030
Risks	Lack of cooperation between organizations, high investment cost

Action 1.7.	**Use low carbon emission materials throughout the supply chain of embedded carbon assessments in all new public buildings** **Ensuring the charging of electric transportation vehicles with photovoltaic systems to be built on the roofs of municipal buildings**
Current Status/Purpose	With this action, it is aimed to use low carbon emission materials throughout the supply chain of embedded carbon assessments in all new public buildings

Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 4.3
Priority Level	Medium
Action Steps	• Investigating low carbon emission materials in buildings • Conducting feasibility studies for the use of low carbon emission materials in all new public buildings built or to be built in Antalya and creating a road map on this issue
Action Type	Plan/Strategy
Amount of Savings	No forecasts have been made
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Environment and Urbanization, Antalya Provincial Directorate of Environment and Urbanization
Municipality's Contribution	Implementer and mentor
Cost	No forecasts have been made
Timing	2025-2030
Risks	High investment cost

Action 1.8.	**Use of efficient and healthy water installations in new buildings**
Current Status/Purpose	This action aims to promote the use of efficient and healthy water installations in new buildings
Relationship with Existing Plans	UEVEP 2017-2023 Action B5
Priority Level	Medium
Action Steps	• Research to create an action plan on drilling and unlicensed drilling • Identifying priority districts for buildings where sustainable and efficient water installation systems will be implemented • Establishing efficient and healthy water installations in new buildings
Action Type	Investment (private)
Amount of Savings	No forecasts have been made
Responsible	Property owners
Stakeholders	Antalya Metropolitan Municipality, Ministry of Environment and Urbanization, Antalya Provincial Directorate of Environment, Urbanization and Climate Change, ASAT
Municipality's Contribution	Mentor and facilitator
Cost	-
Timing	2025-2030
Risks	High investment cost

Action 1.9.	**Raising awareness through certification studies on energy efficiency**
Current Status/Purpose	With this action, it is aimed to raise awareness through certification studies on energy efficiency

Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 11.6
Priority Level	Medium
Action Steps	• Developing incentive mechanisms for certification of Metropolitan Municipality jurisdictions • Conducting certification studies on energy efficiency • Examination of property owners' awareness levels • Establish a communication strategy to raise awareness and provide information about incentives • Organizing seminars etc. to raise awareness on energy efficiency
Action Type	Behavioural
Amount of Savings	Total greenhouse gas emission reduction of 221,787 tCO_2e and energy savings of 530,254 MWh are targeted in 2030
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Environment and Urbanization, Antalya Provincial Directorate of Environment and Urbanization
Municipality's Contribution	Creating the necessary incentive mechanism through awarenessraising activities
Cost	-
Timing	2022-2030
Risks	Unwillingness to change negative behaviours on energy efficiency

3.5.3.2 Transportation

The National Energy Efficiency Action Plan lists measures to be taken in the transportation sector. The National Energy Efficiency Action Plan can serve as a guide for the main measures that are planned to be implemented in the National Energy Efficiency Action Plan and that Antalya Metropolitan Municipality can implement in the transportation sector. The general actions of the plan related to the transportation sector are shared below:

- Encouraging energy efficient vehicles
- Development of a comparative study on alternative fuels and new technologies
- Development and Improvement of Cycling and Pedestrian Transportation
- Reducing automobile use to alleviate traffic congestion in cities
- Expansion of public transportation

In addition, the published Turkish Transportation and Communication Strategy 2023 and National Intelligent Transportation Systems Strategy Document (2014-2023) contain articles that support the National Energy Efficiency Action Plan. BAKA TR61 Level 2 Regional Plan (2014-2023) includes the statement "Priority 2. Ensuring effective use of airlines". In Priority 3, "Improving maritime transportation" is targeted and as Measure 3.1, "Studies will be carried out for the effective use of Antalya port."

In the Antalya Metropolitan Municipality 2020-2024 Strategic Plan, under the strategic objective A13 "To provide planned, rational, high quality, safe and integrated public transportation services with the rail system, taking into account the future population density of the city", H13.1 "To expand public transportation and increase citizen satisfaction by increasing service quality", H13.2 "To ensure the integration of the rail system network with other types of public transportation", H13.3 "To develop environmentally friendly

transportation services and projects", H13.4 "To develop and improve pedestrian and bicycle transportation", H13.6 "To strengthen transportation infrastructure and smart transportation systems" and H13.7 "To expand the rail system network".

The distribution of transportation-related greenhouse gases in Antalya province GHG inventory is shown in Figure 43 and Figure 44. The share of transportation related GHG emissions in the total inventory corresponds to 30.24% as seen in the graph. However, when industrial and industrial process emissions and fuel consumption for electricity generation (for their own consumption), which cannot be intervened by the local government, are excluded from the inventory, the share of transportation in the total inventory rises to 36.3%. Measures to be taken regarding transportation are expected to have a high impact on reducing the inventory of Antalya province. The share of diesel consumption in the district is 70.8% when public transportation is included. There is no data on the presence of electric vehicles in the city.

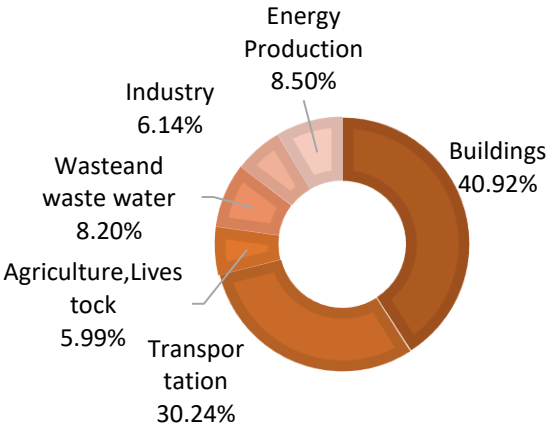


Figure 41: Antalya greenhouse gas inventory breakdown, 2019, %

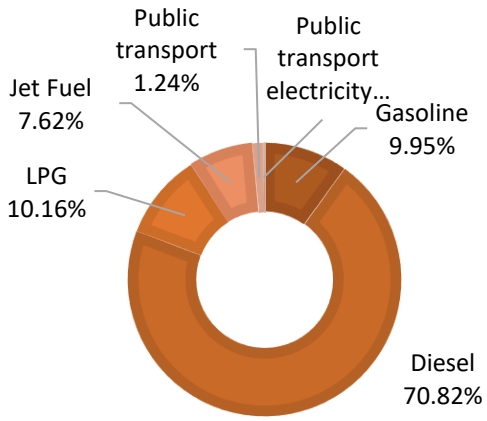


Figure 42: Distribution of greenhouse gas inventory in transportation, 2019

Sector Objective: For the transportation sector with integrated and efficient solutions, public transportation, pedestrianization studies by increasing the rate of bicycle use, replacement of municipal and service vehicles with low-carbon alternatives, smart signaling and optimization studies, smart parking, etc., studies for shared vehicle use and electric vehicle incentives, replacement of public transportation with energy-efficient vehicles, and providing behavioural change to reduce fuel consumption by providing training to drivers who primarily drive actively on economic driving techniques. In 2030, the target year for transportation is 2,009,046 tons of CO_2e greenhouse gas reduction and 8,849,734 MWh energy efficiency.

Details of the Action

Action 2.1.	**Pedestrianization of the streets in the city centre and increasing the share of pedestrians in transportation**
Current Status/Purpose	With this action, it is aimed to pedestrianize the streets in the city centre and increase the share of pedestrians in transportation
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 9.2
Priority Level	High
Action Steps	• Identification of streets to be pedestrianized in the city centre

	• Creating incentive mechanisms to increase the share of pedestrians in transportation
Action Type	Investment (public) and Plan/Strategy
Amount of Savings	In 2030, a total of 384,831 tCO_2e greenhouse gas emission reduction and 1,479,242 MWh energy savings are targeted
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure 6th Regional Directorate, Bank of Provinces, financial institutions, citizens
Municipality's Contribution	Making roads more pedestrian-friendly, closing certain routes to traffic, making them more preferred by pedestrians and bicycle users
Cost	The cost per km of bicycle path varies according to the material to be used and the topographic structure
Timing	2022-2030
Risks	Citizens not preferring roads, need for financial resources, difficulty in changing passenger habits

Action 2.2.	**2.Increase the rate of public transportation use by creating park & ride to reduce traffic in the city centre**
Current Status/Purpose	The Integrated Urban Development Strategy and Action Plan prepared by the Ministry of Development includes the phrase "making public transportation systems environmentally sensitive" under Action 5.5.3. Bursa Metropolitan Municipality 2020-2024 Strategic Plan includes the target of "improving public transportation systems" under Objective 2 "making transportation faster, safer and more comfortable with smart solutions". With this action, it is aimed to increase the rate of public transportation usage by creating park & ride to reduce traffic in the city centre
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 9.1
Priority Level	High
Action Steps	• Identifying districts with low public transportation usage and high traffic density • Ensuring the implementation of park & ride applications in pilot areas to be selected in priority districts • Developing incentive mechanisms to reduce the use of private vehicles and encourage the use of public transportation
Action Type	Investment (public & private) and Plan/Strategy
Amount of Savings	Total greenhouse gas emission reduction of 401,813 tCO_2e and energy savings of 1,512,698 MWh are targeted in 2030
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure 6th Regional Directorate, Iller Bank, Antalya Transportation Inc., financial institutions, citizens
Municipality's Contribution	Mentor and facilitator
Cost	-
Timing	2022-2030

Action 2.2.	**2.Increase the rate of public transportation use by creating park & ride to reduce traffic in the city centre**
Risks	Implementation failure due to financial constraints, disruptions in transportation and traffic formation during the period of making the necessary arrangements, failure to change passenger behaviour patterns

Action 2.3.	**Establishing feeder public transportation lines between the existing transportation network and new development/urban transformation areas, increasing accessibility to the tramway and expanding transportation transfer systems**
Current Status/Purpose	With this action, it is aimed to establish feeder public transportation lines between the existing transportation network to new development/transformation areas and to increase accessibility to the tram and to expand transportation transfer systems
Relationship with Existing Plans	BKGSEP Action 5.5.3 Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 9.1
Priority Level	High
Action Steps	• Identification of new development/urban transformation areas in the medium term • Creating feeder public transport lines between the existing transportation network • Conducting feasibility studies to increase accessibility to the tramway • Gradual expansion of transportation transfer systems
Action Type	Investment (public)
Amount of Savings	In 2030, a total of 230,898 tCO_2e greenhouse gas emission reduction and 887,545 MWh energy savings are targeted
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure 6th Regional Directorate, Iller Bank, General Directorate of Highways, Antalya Transportation Inc., financial institutions, citizens
Municipality's Contribution	Implementer
Cost	The variety of features to be preferred and the variety of vehicle manufacturers to be contracted make cost forecasting difficult
Timing	2022-2030
Risks	High initial investment costs, very limited best practices in the current situation

Action 2.4.	**Optimization of traffic flow and signaling system through the implementation of smart traffic methods**
Current Status/Purpose	The importance of using traffic lights with sensors is emphasized by stating that frequently positioned traffic lights cause an increase in greenhouse gas emissions from vehicles. In addition, at intersections where there is a lack of signalization, this situation poses a problem in terms of both safety and fuel consumption. In the Intelligent Transportation Systems Strategy Document, under the title of "intelligent transportation systems mobile communication tools sensing technologies traffic management systems", "adaptation of Intelligent Transportation Systems information and communication technologies to transportation due to citizens' search for comfort, speed, low cost and safety in transportation" comes to the forefront. With this action, it is aimed to

	ensure optimization of traffic flow and signaling system with the implementation of smart traffic methods.
Relationship with Existing Plans	İDEP 2011-2023 Target U2.2, U4.1 UEVEP 2017-2023 Action U4 Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 9.2
Priority Level	High
Action Steps	• Conversion of the existing signalling system to smart signalling • Intersection planning and creating smart intersections • Contribution to horizontal and vertical traffic marking works
Action Type	Investment (public) and Plan/Strategy
Amount of Savings	In 2030, a total of 321,451 tCO_2e greenhouse gas emission reduction and 1,210,158 MWh energy savings are targeted
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Transportation and Infrastructure 6th Regional Directorate, General Directorate of Highways
Municipality's Contribution	Implementer and mentor
Cost	Establishing a smart traffic management system: 2.000.000 ₺
Timing	2022-2030
Risks	Communication infrastructure problems, lack of qualified personnel, high investment costs

Action 2.5.	**Conducting feasibility studies and pilot applications to support sustainable transportation**
Current Status/Purpose	With this action, it is aimed to carry out feasibility studies and pilot applications to support sustainable transportation
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 9.2
Priority Level	High
Action Steps	• Revise transport infrastructure design guidelines, taking into account sustainable modes of transport • Preparation of a Sustainable Urban Transportation Master Plan adopting a sustainable urban transportation strategy • Establishment of an all-electric (or hybrid) shared car club for businesses and citizens • Cooperation with universities for pilot studies on sustainable transportation
Action Type	Plan/Strategy
Amount of Savings	No forecasts have been made
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure 6th Regional Directorate, Ministry of Environment and Urbanization, Antalya Provincial Directorate of Environment and Urbanization, universities
Municipality's Contribution	Implementer and mentor
Cost	-

Action 2.5.	**Conducting feasibility studies and pilot applications to support sustainable transportation**
Timing	2022-2030
Risks	Difficulty in implementation due to the need for financial resources, very limited sample applications in the current situation

Action 2.6.	**Providing economic driving trainings and developing cooperation with Antalya Ulaşım AŞ on driving trainings**
Current Status/Purpose	Providing training on economical driving techniques to public transportation vehicle drivers, taxis, all commercial vehicles and private vehicle owners can reduce fuel consumption of vehicle users. Various studies have concluded that economic driving training can save up to 10% of vehicle fuel consumption. With this action, it is aimed to provide economic driving trainings to municipal service vehicle personnel and to ensure cooperation with Antalya Ulaşım A.Ş. on driving trainings.
Relationship with Existing Plans	İDEP 2011-2023 Target U4.1
Priority Level	High
Action Steps	• Providing preliminary information to municipal service vehicle personnel, public transportation, minibus, taxi and logistics vehicle drivers • Organizing these trainings in conference/meeting halls to be allocated or through online platforms
Action Type	Behavioural
Amount of Savings	In 2030, a total of 209,762 tCO_2e greenhouse gas emission reduction and 1,507,868 MWh energy savings are targeted.
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of National Education, vehicle drivers
Municipality's Contribution	Implementer and mentor
Cost	The cost of training in economic driving techniques across Turkey is approximately 250 TL/person. (Source: interviews with private training institutions) It is planned that approximately 10,000 drivers will be trained by the public sector, starting with municipality, minibus, shared taxi, and shuttle drivers using public transportation. The private sector can also provide training especially for drivers using logistics vehicles.
Timing	2022-2030
Risks	Inability to allocate time for trainings, failure to change citizen behaviour patterns

Action 2.7.	**Increasing the share of bicycles in transportation by developing bicycle infrastructures** **Displaying bicycle routes on web-based systems** **Developing applications such as scooter and bicycle sharing**
Current Status/Purpose	Article 703 of the 11th Development Plan includes the phrase "construction of new bicycle roads". With this action, it is aimed to increase the share of bicycle infrastructure in transportation, to display bicycle routes in online-based systems (application, map, etc.) and to develop applications such as mobliet (scooter) and bicycle sharing.

Relationship with Existing Plans	Plans11th Development Plan Articles 703.3 and 703.4 İDEP 2011-2023 Target U1.3, U3.1, U3.2 ve U4.1 UEVEP 2017-2023 Action U3 ve U4 Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 9.2
Priority Level	High
Action Steps	• Carrying out studies to increase the opportunities to use public transportation by bicycle • Making arrangements for the structuring of the bicycle transportation network to be displayed with web-based systems • Positioning of road signs and road markings at relevant locations • Providing necessary incentives for scooter and bicycle sharing
Action Type	Investment (public)
Amount of Savings	In 2030, a total of 384,831 tCO_2e greenhouse gas emission reduction and 1,479,242 MWh energy savings are targeted
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Transport and Infrastructure, İller Bank, financial institutions, citizens
Municipality's Contribution	Implementer and mentor
Cost	The cost per km of bicycle path varies according to the material to be used and the topographic structure
Timing	2022-2030
Risks	Need for financial resources, difficulty in changing passenger habits

Action 2.8.	**Preferring low emission vehicles in municipal vehicles**
Current Status/Purpose	The use of low-carbon vehicles in municipal vehicle fleets is important in encouraging the local population. With this action, it is aimed to prefer low emission vehicles in municipal vehicles.
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 9.1
Priority Level	High
Action Steps	• Carrying out studies for the substitution of official vehicles used by the Municipality with low-carbon vehicles • Encouraging the public to prefer low-emission municipality vehicles
Action Type	Investment (public & private) and Plan/Strategy
Amount of Savings	Total greenhouse gas emission reduction of 137 tCO_2e and energy savings of 525 MWh are targeted in 2030
Responsible	Antalya Metropolitan Municipality
Stakeholders	Iller Bank, vehicle manufacturers, vehicle maintenance companies
Municipality's Contribution	Implementer and mentor
Cost	The cost varies due to the envisaged cooperation with the private sector.
Timing	2022-2030
Risks	High investment costs, failure to change citizen behaviour patterns

Action 2.9.	**Determining and ensuring the implementation of public transportation rules in extraordinary situations such as pandemics**
Current Status/Purpose	With this action, it is aimed to ensure that public transportation rules are determined and implemented in extraordinary situations such as pandemics
Relationship with Existing Plans	High
Priority Level	• Preliminary work for public transportation rules in extraordinary situations • Preparation of an action plan on public transportation to be implemented in extraordinary situations such as pandemics • Creating the necessary announcements and incentive mechanisms for citizens to comply with the prepared action plan
Action Steps	Plan/Strategy
Action Type	No forecasts have been made
Amount of Savings	Antalya Metropolitan Municipality
Responsible	Provincial Directorate of Health, citizens
Stakeholders	Implementer and mentor
Municipality's Contribution	It varies according to the extraordinary situation
Cost	2022-2030
Timing	Failure to change citizen behaviour patterns, insufficiency of vehicles within the scope of the limitation on the number of passengers per vehicle

Action 2.10.	**Replacement of public transportation vehicles with energy efficient and renewable energy vehicles**
Current Status/Purpose	In the "Integrated Urban Development Strategy and Action Plan" prepared by the Ministry of Development, the phrase "making public transportation systems environmentally sensitive" is included under Action 5.5.3. With this action, it is aimed to replace public transportation vehicles with energy efficient and renewable energy vehicles
Relationship with Existing Plans	BKGSEP Action 5.5.3 Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 9.1
Priority Level	High
Action Steps	• Identification of public transportation vehicles with high vehicle age • Gradual transition of vehicles to electric and biofuel-consuming vehicles • Ensuring necessary cooperation to replace public transportation with energy efficient vehicles
Action Type	Investment (public)
Amount of Savings	In 2030, a total of 8,894 tCO_2e greenhouse gas emission reduction and 32,835 MWh energy savings are targeted
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Transportation and Infrastructure, Antalya Ulaşım A.Ş., TCDD
Municipality's Contribution	Implementer and mentor

Action 2.10.	**Replacement of public transportation vehicles with energy efficient and renewable energy vehicles**
Cost	The cost of electric buses is decreasing as they become more widespread and the price difference with their diesel counterparts is decreasing. It is seen from different local government experiences that agreements are made with very advantageous prices in collective purchases. The cost of 1 electric charging station is approximately 40.000 ₺
Timing	2022-2030
Risks	High initial investment costs, very limited best practices in the current situation

Action 2.11.	**Determining the land and capacity increase for electric vehicle charging infrastructure throughout the city, establishing the necessary infrastructure for electric vehicle charging points and ensuring a standardization for electric charging stations**
Current Status/Purpose	The fact that many European cities have taken the goal of not allowing the entry of other fossil fuel vehicles into their centers in the short and medium term, and the successive statements of vehicle manufacturers that they will restrict the production of diesel vehicles come to the fore that this issue will enter the agenda of Turkey in the near future, if not immediately. The fact that the domestic automobile, the production of which will start in a few years, will also be an electric vehicle gives important clues in this regard. Within the scope of the MAtchUP Project, which is supported by the European Union Horizon 2020 Smart Cities and Communities program H2020- SCC-2017 call, 5 electric charging stations are planned. With this action, it is aimed to determine the land and capacity increase for electric vehicle charging infrastructure throughout the city, to establish electric charging points and to ensure a standardization for electric charging stations.
Relationship with Existing Plans	İDEP 2011-2023 Target U4.1 and U4.2 UEVEP 2017-2023 Action U1
Priority Level	Medium
Action Steps	• Conducting feasibility studies to identify suitable areas for electric vehicle charging in the city • Ensuring the establishment of the necessary infrastructure of the designated electric vehicle charging points • Initiating the necessary work to introduce a standardization for electric charging stations in the city
Action Type	Investment (public & private) and Plan/Strategy
Amount of Savings	Total greenhouse gas emission reduction of 66,429 tCO_2e and energy savings of 739,621 MWh are targeted in 2030
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Transportation and Infrastructure 6th Regional Directorate, Ministry of Energy and Natural Resources, Bank of Provinces, vehicle manufacturers, vehicle maintenance companies, e-charging station operators
Municipality's Contribution	Implementer and mentor
Cost	Cooperation with the private sector is envisaged. Operating e-charging station companies have different membership conditions and working methods.
Timing	2022-2030

Action 2.11.	**Determining the land and capacity increase for electric vehicle charging infrastructure throughout the city, establishing the necessary infrastructure for electric vehicle charging points and ensuring a standardization for electric charging stations**
Risks	Limited case studies, high costs, lack of confidence in vehicle ranges

Action 2.12.	**Developing a strategy and related incentives to reduce emissions from licensed taxi vehicles**
Current Status/Purpose	With this action, it is aimed to develop a strategy and related incentives to reduce emissions from licensed vehicles.
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 9.1
Priority Level	Medium
Action Steps	• Identifying the districts in the city where taxi use is high • Collaboration with universities to reduce emissions from licensed taxi vehicles • Developing exemplary projects in cooperation with the university where a strategy and incentive mechanism is established in priority districts to reduce the emissions of taxi vehicles
Action Type	Plan/Strategy
Amount of Savings	No forecasts have been made.
Responsible	Taxi vehicle owners
Stakeholders	Antalya Metropolitan Municipality, vehicle maintenance companies, universities
Municipality's Contribution	Mentor
Cost	-
Timing	2025-2030
Risks	Failure to cooperate with licensed taxi vehicle owners

Action 2.13.	**Development of maritime transportation to reduce road traffic**
Current Status/Purpose	With this action, it is aimed to develop maritime transportation to reduce road traffic
Relationship with Existing Plans	BAKA TR61 Level 2 Regional Plan Measure 3.1
Priority Level	Low
Action Steps	• Preparation of an online survey by the municipality to determine the segment that will use maritime transportation instead of road transportation • According to the results of the survey, planning of maritime routes, especially in the districts where the people who will use maritime transportation live densely • Developing incentive mechanisms for logistics companies that use road transportation to prefer maritime transportation
Action Type	Plan/Strategy
Amount of Savings	No forecasts have been made.
Responsible	Antalya Metropolitan Municipality

Action 2.13.	Development of maritime transportation to reduce road traffic
Stakeholders	Ministry of Transport and Infrastructure, General Directorate of Maritime Affairs, Antalya Transportation Inc.
Municipality's Contribution	Implementer
Cost	-
Timing	2025-2030
Risks	Passengers do not prefer maritime transportation

3.5.3.3 Waste and Wastewater

In the Antalya Metropolitan Municipality 2020-2024 Strategic Plan, the target of H3.1 "Realizing an environmentally friendly waste management" is stated in line with the strategic objective A3 "Making Antalya an environment and nature friendly city". Antalya Metropolitan Municipality has 5 sanitary landfills (Alanya, Manavgat, Kızıllı, Patara, Kumluca) within its territorial boundaries. Domestic solid waste intake to Kumluca Landfill Facility was stopped in 2019 due to the capacity of the facility and the construction of Kumluca Transfer Station was completed and domestic solid wastes generated in Kumluca and Finike districts are transferred from Kumluca Transfer Station to Kızıllı Integrated Waste Evaluation, Recycling and Disposal Facility for disposal by vehicles belonging to Antalya Metropolitan Municipality (Antalya State of Environment Report, 2019, p.64). The distribution of wastes collected in Antalya is shown in Table 14.[35]

Table 14: Waste composition collected in Antalya province, 2019

Waste Composition	Distribution of collected waste (%)
Kitchen waste	55,02
Paper	8,78
Cardboard	1,38
Bulk Carton	1,22
Plastic	13,90
Pine	6,04
Metal	0,66
Bulky Metal	0,12
Waste Electrical and Electronic Equipment	0,14
Dangerous waste	0,84
Park and Garden Wastes	1,40
Other Non-Combustibles	0,32
Other Combustibles	9,54
Other Combustible Bulky Wastes	0,28
Other non-combustible bulky wastes	0,10
Others	0,30

[35] *Antalya Environmental Status Report, 2019, s.64-65.*

In 2019, an average of 300-400 tons of sludge is generated daily in all facilities from the domestic wastewater treatment plant operated by Antalya Metropolitan Municipality ASAT General Directorate. The amount and ratio of waste and wastewater sector in the city inventory is shown in Figure 45.

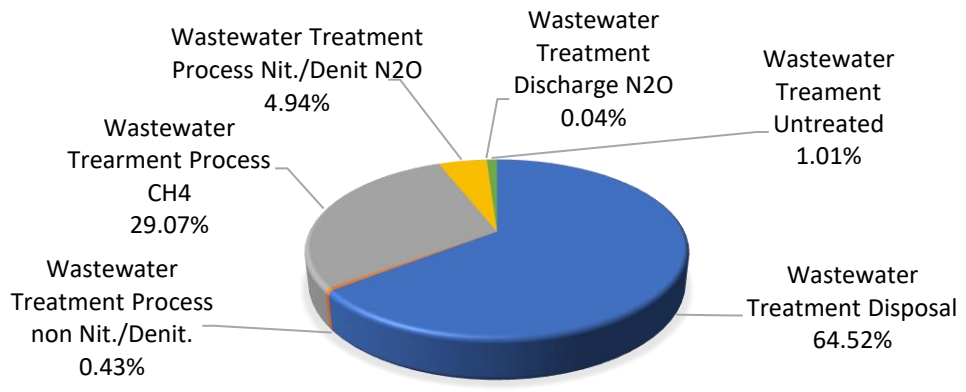


Figure 43: Greenhouse gas emissions from solid waste disposal and wastewater treatment in Antalya province, 2019

Target of the Sector: Waste sector targets are generally aimed at identifying waste collection potential in local enterprises and measures to improve waste management, improvement of wastewater treatment facilities and awareness raising activities. Waste and wastewater activities are targeted to reduce 792,155 tons of CO_2e GHG for the target year 2030.

Details of the Action

Action 3.1.	**Encourage local businesses to reduce single-use plastics and ban their use in the municipality** **Making separate collection of materials with high recycling rates mandatory**
Current Status/Purpose	This action aims to encourage local businesses to reduce single-use plastics and to ban their use in the municipality and to make separate collection of materials with high recycling rates mandatory
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 3.1
Priority Level	High
Action Steps	• Identifying businesses that use single-use plastics intensively in Antalya • Create an incentive mechanism to reduce single-use plastics in local businesses • Reducing the use of single-use plastics in municipal buildings • Making separate collection of materials with high recycling rates mandatory
Action Type	Plan/Strategy
Amount of Savings	No forecasts have been made
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Environment and Urbanization, Provincial Directorate of Environment and Urbanization, district municipalities
Municipality's Contribution	Mentor, implementer
Cost	-
Timing	2022-2030

Risks	Difficulty in changing behaviour

Action 3.2.	**Carrying out studies for the separation of waste through recycling and disposal through composting** **Promotion and presentation of communal or home composting tanıtılması** **Investigating the potential of waste collection services for the food sector (restaurants, hotels, etc.)**
Current Status/Purpose	With this action, it is aimed to carry out studies for the separation of waste through recycling and disposal through composting, to encourage and promote compost production and to investigate the potential of waste collection services for the food sector
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 3.1
Priority Level	Medium
Action Steps	• Separation of waste through recycling • Encouraging the citizens about the wastes that can be converted into compost and organizing activities for composting by the municipality • Investigating the potential of waste collection services for the food sector
Action Type	Behavioural
Amount of Savings	No forecasts have been made
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Environment and Urbanization, Provincial Directorate of Environment and Urbanization, food business operators, citizens
Municipality's Contribution	Pathfinder
Cost	-
Timing	2022-2030
Risks	Difficulty in changing behaviour

Action 3.3.	**Implementing pilot projects for sustainable and innovative waste management** **Smart route planning for waste collection and transfer vehicles**
Current Status/Purpose	With this action, it is aimed to carry out pilot projects for sustainable and innovative waste management and to carry out smart route planning studies for waste collection and transfer vehicles
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 3.1
Priority Level	Medium
Action Steps	• Developing pilot projects with universities for sustainable and innovative waste management • Preliminary study for smart route planning for waste collection and transfer vehicles
Action Type	Plan/Strategy
Amount of Savings	In 2030, a total of 9,564 tons of CO_2e greenhouse gas emission reduction is targeted by making improvements in wastewater treatment
Responsible	Antalya Metropolitan Municipality

Action 3.3.	**Implementing pilot projects for sustainable and innovative waste management** **Smart route planning for waste collection and transfer vehicles**
Stakeholders	Ministry of Environment and Urbanization, Provincial Directorate of Environment and Urbanization, Provincial Directorate of Zoning and Urbanization, financial institutions, universities
Municipality's Contribution	Implementer
Cost	-
Timing	2025-2030
Risks	Difficulty in implementation due to high costs

Action 3.4.	**Developing a penalty and reward system for solid waste disposal for enterprises and industrial facilities** **Introducing a "waste disposal tax" to increase recycling and recovery and create new business opportunities**
Current Status/Purpose	With this action, it is aimed to develop a penalty and reward system for solid waste disposal for enterprises and industrial facilities and to introduce a "waste disposal tax" to create new business opportunities due to increasing recycling and recovery
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 3.1
Priority Level	Medium
Action Steps	• Conducting feasibility studies for the development of a penalty and reward system for solid waste disposal for enterprises and industrial facilities • Creating incentive mechanisms to increase recycling and recycling and organizing activities in this regard • Putting the Waste Disposal Tax on the agenda and conducting research for spreading it throughout the province, especially for facilities and enterprises with high waste production
Action Type	Plan/Strategy
Amount of Savings	No forecasts have been made
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Environment and Urbanization, Provincial Directorate of Environment and Urbanization
Municipality's Contribution	Implementer
Cost	-
Timing	2025-2030
Risks	Failure to improve waste management by enterprises and industrial facilities, inadequate increase in recycling and recovery rates

Action 3.5.	**Cooperation with relevant institutions to identify and invest in needed recycling infrastructures; Planning investments in waste sorting and recycling facilities**
Current Status/Purpose	With this action, it is aimed to identify the recycling infrastructures needed and to cooperate with the relevant institutions for investment, as well as to plan investment projects for waste sorting and recovery facilities
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 3.1
Priority Level	Medium
Action Steps	• Identification of the recycling infrastructure needed in the province of Antalya • Cooperation with relevant institutions for investment in recycling • Developing projects together with universities to plan investments in waste separation and recycling facilities
Action Type	Plan/Strategy
Amount of Savings	It is aimed to reduce greenhouse gas emissions by 782,592 tons CO_2e in total through improvements to be made in solid waste facilities in 2030
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Environment and Urbanization, Provincial Directorate of Environment and Urbanization, financial institutions, universities
Municipality's Contribution	Implementer and mentor
Cost	-
Timing	2022-2030
Risks	Difficulty in implementation due to high costs

3.5.3.4 Agriculture

The mission of the 2019-2023 Strategic Plan of the Ministry of Agriculture and Forestry is defined as "to ensure economic security, food supply security and human health by mobilizing Turkey's ecological resources in an effective, efficient and sustainable manner with a development model perspective and securing economic security, food supply security and human health through ecological, plant and animal added value". The vision of "a model ecological resource management on a global scale" is defined in the Plan. The objectives stated in the plan are listed as follows:[36]

- Increasing welfare in rural areas, ensuring stable food supply by increasing productivity and quality in agricultural production
- To ensure food and feed safety from production to consumption, to take necessary measures for plant and animal health and welfare
- Protecting fisheries and aquaculture resources and ensuring their sustainable operation
- Ensure sustainable management of soil and water resources
- To effectively combat climate change, desertification and erosion
- To protect biological diversity and ensure its sustainable management
- Developing institutional capacity

[36] *Ministry of Agriculture and Forestry, 2019-2023 Strategic Plan, Sf: 4-5.*

In the Antalya Metropolitan Municipality 2020-2024 Strategic Plan, H8.3 "Implementing projects to increase agricultural production, raising awareness and supporting producers" is adopted for the strategic objective A8 "Realizing the development model from the local level". Under another strategic objective A12. "To plan and develop agricultural infrastructure services, increase agricultural production, make rural living areas livable and aesthetic with its infrastructure and superstructure", the objective H12.2 "To protect, plan, improve agricultural resources and increase producer awareness" is presented.

Table 15: Antalya province livestock statistics, TurkStat

Animal Type		2018 (number)	2019 (number)	2020 (number)
Cattle	Pure + Culture	104,051	113.687	114.031
	Culture Hybrid	69,301	65.855	64.329
	Local	12,227	12.418	12.251
Horse		1,185	1.073	928
Mule		1168	1.084	871
Donkey		1,400	1.288	1.104
Sheep (native)		493,910	520.826	542.162
Goat (hair and others)		751,741	752.809	770.652
Chicken		489,499	534.248	532.839
backyard chicken		-	-	-
Turkey		27,364	23.388	11.569
Duck + Goose		13,719	9.498	14.238
Camel		160	171	112
Pig		861	820	394
Buffalo		254	77	76
Total		**1.966.840**	**2.037.242**	**2.065.556**

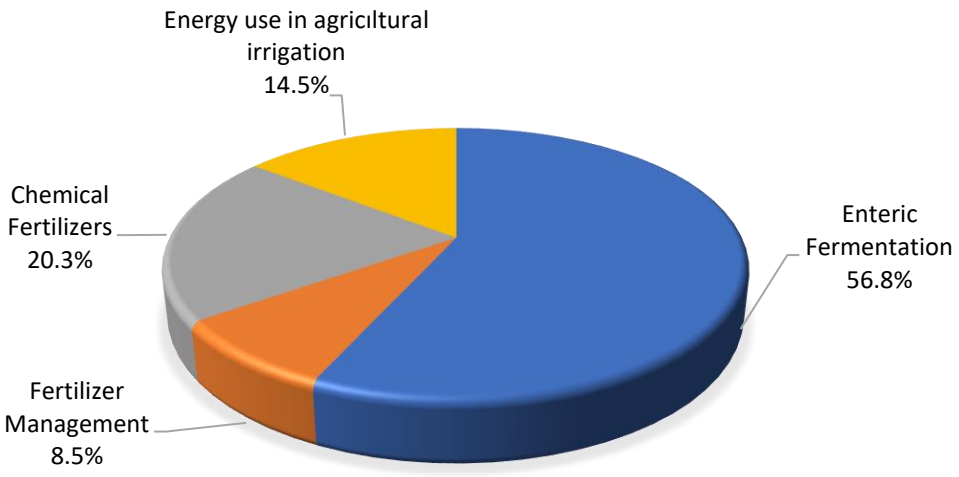


Figure 44: Antalya province agriculture and livestock greenhouse gas emissions, 2019

Looking at the province of Antalya, it is found that the largest share in agriculture and animal husbandry is from enteric fermentation with 56.8%. The share of emissions from chemical fertilizer use is 20.3%, while the share of emissions from energy use in agricultural irrigation is 14.5% and the share of fertilizer management is 8.5%. In 2030, the target year for agriculture is to achieve a total of 131,193 tons of CO_2e GHG reduction and 224,157 MWh energy efficiency (Figure 46). In addition, the city's livestock statistics are shown in Table 15.

Details of the Action

Action 4.1.	**Increasing the use of organic fertilizers instead of chemical fertilizers in agriculture**
Current Status/Purpose	With this action, it is aimed to promote the use of organic fertilizers instead of chemical fertilizers in agriculture
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 8.3 and Target 12.2
Priority Level	High
Action Steps	• Informing farmers about the problems caused by the use of chemical fertilizers in agriculture • Phased transition from the use of chemical fertilizers to the use of organic fertilizers or less nitrogen in 2022 and beyond
Action Type	Investment Project (private)
Amount of Savings	Total greenhouse gas emission reduction of 43,403 tCO_2e is targeted in 2030
Responsible	Farmers
Stakeholders	Antalya Metropolitan Municipality, Antalya Provincial Directorate of Agriculture and Forestry, various international funding organizations, institutions providing green financing opportunities
Municipality's Contribution	The municipality provides guidance to citizens on the subject, network connection, and communication with producers
Cost	-
Timing	2022-2030

Risks	Inadequate incentives for farmers using chemical fertilizers, lack of information

Action 4.2.	**Increasing the use of renewable energy in agricultural irrigation**
Current Status/Purpose	With this action, it is aimed to increase the use of renewable energy in agricultural irrigation.
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 12.2
Priority Level	High
Action Steps	• Identifying priority districts for energy efficient transformation in agricultural irrigation in Antalya • Conducting feasibility studies to design agricultural irrigation projects in priority districts by utilizing solar energy from renewable energy sources • Expanding the use of photovoltaic systems in order to reduce energy consumption in agricultural irrigation in Antalya province
Action Type	Investment project (private)
Amount of Savings	In 2030, a total of 57,608 tCO_2e greenhouse gas emission reduction and 224,157 MWh energy savings are targeted
Responsible	Agricultural landowners
Stakeholders	Antalya Metropolitan Municipality, Antalya Provincial Directorate of Agriculture and Forestry
Municipality's Contribution	PV (PHOTOVOLTAIC SYSTEM) applications in agricultural irrigation, grid connection, guidance on communicating with producers
Cost	It is estimated to fall below €1. While there is a great deal of uncertainty in the PV system installation market, these values are likely to be well below the calculated value due to recent price drops. The payback period is currently just over 8 years.
Timing	2022-2030
Risks	Difficulty changing behaviour, lack of knowledge

Action 4.3.	**Conducting innovation/ R&D studies in existing agricultural practices** **Development of good agricultural practices with smart systems** **Expanding water-free landscaping practices throughout the city**
Current Status/Purpose	It is aimed to develop good agricultural practices with smart systems, to carry out innovation or R&D studies in existing agricultural practices, and to expand water-free landscaping practices throughout the city
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 8.3 and Target 12.2
Priority Level	High
Action Steps	• Developing R&D projects with innovative approaches in existing agricultural practices • Preparing the ground for developing projects in cooperation with the municipality and the university to improve existing agricultural practices • Conducting feasibility studies for the development of agricultural practices integrated with smart systems • -Identifying the areas where waterless landscaping applications can be made throughout the province of Antalya and carrying out dissemination studies
Action Type	Plan/Strategy

Amount of Savings	No forecasts have been made
Responsible	Antalya Metropolitan Municipality
Stakeholders	Ministry of Agriculture and Forestry, Provincial Directorate of Agriculture and Forestry, Universities
Municipality's Contribution	Mentor, implementer, and facilitator
Cost	-
Timing	2025-2030
Risks	Difficulty in implementation due to high costs

Action 4.4.	**Providing training on low carbon emission agricultural techniques and raising awareness on sustainable management**
Current Status/Purpose	With this action, it is aimed to raise awareness on sustainable management by providing training on low carbon emission agricultural techniques.
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 8.3 and Target 12.2
Priority Level	High
Action Steps	• Providing informative trainings to farmers in schools or in the place to be allocated by the municipality with the support of academicians who give education on sustainability in agriculture in agricultural high schools or in agriculture-related departments of universities • Promotional joint campaigns that can be organized with the support of agricultural cooperatives
Action Type	Behavioural
Amount of Savings	No forecasts have been made
Responsible	Antalya Metropolitan Municipality
Stakeholders	Farmers, Ministry of Agriculture and Forestry, Provincial Directorate of Agriculture and Forestry, universities
Municipality's Contribution	Implementer (costs related to various organizations, information points, awareness raising promotion activities), mentor, facilitator
Cost	-
Timing	2022-2030
Risks	Failure to change citizen behaviour patterns

Action 4.5.	**Promote low carbon agricultural practices** **Promotion of bioenergy crops for biomass combustion plants**
Current Status/Purpose	This action aims to promote low-carbon agricultural practices and the use of bioenergy crops for biomass combustion plants
Relationship with Existing Plans	Antalya Metropolitan Municipality 2020-2024 Strategic Plan Target 8.3
Priority Level	Medium

Action Steps	• Organizing an information meeting for farmers on low carbon agricultural practices and promotion of bioenergy crops by the municipality. • Organizing an event to raise awareness of farmers on low-carbon agricultural practices on May 14, World Farmers Day. • Carrying out encouraging joint campaigns that can be organized with the support of agricultural cooperatives.
Action Type	Behavioural
Amount of Savings	A total of 30,182 tCO_2e greenhouse gas emission reductions are targeted in 2030
Responsible	Antalya Metropolitan Municipality
Stakeholders	Farmers, Ministry of Agriculture and Forestry, Provincial Directorate of Agriculture and Forestry, universities, agricultural cooperatives
Municipality's Contribution	Implementer (various organizations, costs related to information points, awareness promotion activities), mentor, facilitator
Cost	-
Timing	2022-2030
Risks	Failure to change citizen behaviour patterns

3.6 MITIGATION MONITORING PLAN

This section is based on the targets for reducing emissions from energy consumption in different sectors determined that were identified by the stakeholders at the workshop. In order to successfully implement climate change mitigation policies and activities, it is important to develop clearly articulated assessment and reporting requirements and to develop monitoring methods that will enable performance assessments. In order for cities to achieve their greenhouse gas reduction target set with the goal of mitigating the impacts of climate change, they should carefully consider the efforts to measure the progress in the implementations and the teams that will carry out studies on this issue should work in harmony with different departments, organizations, NGOs, the private sector and citizens. Having standardized tools for establishing a monitoring system for performance measures is important for policy evaluation and performance.

The most important bases of this report, which is a greenhouse gas inventory on the scale of Antalya province, are the reports prepared or commissioned by the Antalya Metropolitan Municipality or different institutions, and the visions put forward by the city stakeholders for the future of the city which constitutes the starting point of this action plan.

Promoting the better development of urban climate policy networks, especially by engaging regional and local civil society stakeholders at various stages of policy progress, can deepen local scientific knowledge and integrate local perspectives in the design and implementation of coordinated and integrated greenhouse gas reduction strategies.

This report sets out the targets for reducing emissions from energy consumption in different sectors, determined with the participation of provincial stakeholders. The starting point of this report is the Antalya province-scale greenhouse gas inventory, and the most important pillars of this report are the reports prepared or commissioned by the Antalya Metropolitan Municipality and different institutions on the future of Antalya province, and the visions of the city stakeholders for the future of Antalya province.

Encouraging the better development of urban climate policy networks, especially by engaging regional and local civil society stakeholders at various stages of policy progress, can deepen local scientific knowledge and integrate local perspectives in the design and implementation of coordinated and integrated greenhouse gas mitigation strategies.

The performance assessment process should include examining and monitoring data sources for inventory calculation. Considering that data quality is crucial for the monitoring process, Table 16 outlines some of the required data.

Table 16: Some datasets to follow in the monitoring process

Sector	Required Data	Responsible Unit (Data, Mitigation)	Data Collection Frequency	Areas for Improvement
Buildings and Facilities				
Municipal Buildings/Facility	All fuel and electricity	Antalya Metropolitan Municipality (ABB) Environmental Protection and Control Department, ABB Support Services Department	Annual	Regular data can be collected by creating templates for data collection from units.
Tertiary Building	All fuel and electricity	ABB Department of Environmental Protection and Control, ABB Department of Urban Aesthetics, ABB Department of Reconstruction and Urbanization	Annual	More information on building stock (Year of construction, building features, m^2, fuel type, etc.)
Residential	All fuel and electricity	ABB Environmental Protection and Control Department, ABB Department of Urban Aesthetics	Annual	More information on building stock (Year of construction, building features, m^2, fuel type, etc.) Uncertainty about solid fuel consumption is high
Street Lighting	Electric	ABB Environmental Protection and Control Department, ABB Support Services Department, ABB Parks and Gardens Department	Annual	The number of lighting poles and the amount of change
Transportation				
Municipal Fleet	All fuel and electricity	ABB Environmental Protection and Control Department, ABB Transportation Planning and Rail System Department	Annual	A system for data collection and storage can be implemented within ABB.
Public transport	All fuel and electricity	ABB Environmental Protection and Control Department, ABB Transportation Planning and Rail System Department	Annual	-

Sector	Required Data	Responsible Unit (Data, Mitigation)	Data Collection Frequency	Areas for Improvement
Special vehicles	All fuel and electricity	ABB Environmental Protection and Control Department, ABB Department of Transportation Planning and Rail Systems	Annual	-
Other Resources				
Solid waste	Waste amount	ABB Environmental Protection and Control Department	Annual	-
Wastewater	Wastewater amount	ABB Environmental Protection and Control Department, ASAT	Annual	-
Agriculture	Animal stock, manure, irrigation	ABB Environmental Protection and Control Department, ABB Rural Services Department	Annual	-
Local energy generation	Solar, wind, biogas, geothermal, etc.	ABB Environmental Protection and Control Department	Annual	Production quantities can be requested from the distribution company Licensed and unlicensed installations can be requested from EPDK

4. ADAPTATION TO CLIMATE CHANGE

In this section, the current situation of Antalya in terms of adaptation to climate change is examined and risk and vulnerability assessment is completed. According to the results of the risk and vulnerability assessment, priority actions were identified, and a guide was obtained to increase the city's resilience to climate change. In this process, the results of the workshop organized with internal and external stakeholders of Antalya Metropolitan Municipality were used as data.

4.1 METHODOLOGY

Antalya Metropolitan Municipality became a party to the Covenant of Mayors in 2013 for the preparation of climate change mitigation and adaptation action plans and implementation of actions. Accordingly, risk and vulnerability assessment and identification of adaptation strategies have been developed according to the methodology of the Covenant of Mayors. In addition, examples of good practices within the scope of the CoM and in the US and Europe were also examined. During both the risk and vulnerability assessment and the identification of climate adaptation actions, workshops were organized with the participation of internal and external stakeholders to raise public awareness on climate change and to benefit from expert opinions. As a result of the workshops, climatic risks and impacts that may arise according to the current situation of Antalya were discussed and actions that will minimize these risks and are suitable for the climate were put forward. The process of risk analysis and identification of adaptation actions in the chapter was carried out as a result of two different workshops, using various online tools, with the contributions of the participants. It is clear that these steps, which should be considered as preliminary preparations within the scope of

Antalya's climate adaptation plan, should be handled in much more detail in the following processes. Therefore, risk and vulnerability assessment should be carried out by teams with scientific competence by examining and processing both quantitative and qualitative values, as well as utilizing geographic information system data and tools. Following this, adaptation actions that should be implemented according to the current situation and climatic scenarios should be detailed by experts and implementation areas should be specifically identified and implemented. It should be kept in mind that this study is preliminary research and should be elaborated through advanced scientific methods.

4.2 KEY FINDINGS FOR ANTALYA IN THE CONTEXT OF ADAPTATION

In this section, the current situation of Antalya in the context of climate change will be examined under six main headings. These topics are built environment, infrastructure systems, transportation and waste management, green infrastructure, biodiversity and forest areas, water resources and management, agricultural areas, cultural and natural heritage, public health, and disaster management. The content of the chapter includes a compilation of brief and general information on the topics. During this compilation, resources such as previous studies on Antalya, the IRAP report prepared by AFAD in 2021, the Environmental Plan Report prepared in 2019, the Transportation Master Plan Report prepared in 2016, and online resources were used. In addition to these, in the sections related to areas in the context of climate change, direct quotations were made from the climate change action plan reports that the contributing organization had previously worked on.

4.2.1 Built Environment, Infrastructure Systems, Transportation and Waste Management

All investments in the context of built environment, buildings, energy, critical infrastructure, and transportation are long-term investments and have a nature that will affect cities for decades. These sectors, which should not be handled only within provincial borders, should be meticulously evaluated in terms of both disaster risks and sustainability, and should be made climate resilient. It should not be overlooked that the cost of making such infrastructure systems resilient with nature-based, flexible, and innovative approaches may be less costly than traditional approaches.

Urban Heat Island Effect

Buildings, roads, and other infrastructure systems absorb more of the sun's heat than natural areas such as green spaces, forests, and bodies of water. Urban areas, where these structures are very dense and green areas are limited, become islands that reach higher temperatures than other areas. Islands that absorb heat so much are called urban heat islands. The urban heat island effect, on the other hand, is the differentiation of climatic characteristics on a local or regional scale by changing meteorological parameters.

The reduction of natural landscape areas in urban areas, the intensive use of urban materials, the geometric structure of cities, human density and activities, and climate and geographical features cause the formation of urban heat islands.

Global research shows that the benefits of investing in urban resilience far outweigh the damages in a disaster scenario or risk.[37]

Although climate change is a global phenomenon, most of its impacts are more severe at the local scale. Therefore, it is crucial to assess all infrastructure systems and investments in cities in a climatic context in order to reduce vulnerability to climate change and adapt to changes. However, infrastructure systems also have an important role in strategies to manage risks and minimize the negative impacts of climate change. Physical impacts such as temperature increases due to climate change, changing rainfall patterns, increased intensity and frequency of extreme weather events, and rising sea levels affect all types of infrastructure. Therefore, infrastructure systems should be prepared in anticipation of changing climatic conditions and designed and built to adapt to new climatic conditions. In addition, as countries' long-term GHG emission improvement strategies are advanced and emission reduction targets are implemented, there is likely to be greater clarity on potential infrastructure-related adaptation needs and investment items.

It is necessary to evaluate the current state of the city's infrastructure and investments not only within the borders of Antalya but also within the borders of the region. Because it is clear that the sustainability of some infrastructure systems can be ensured by upper scale decisions. In this respect, the main action to adapt these systems to climate change is to introduce legal regulations that will encourage practices that will make existing and planned infrastructure systems and structures resilient to climate change. Measures to reduce urban heat island effects, especially in areas with high building density, are particularly important in the context of climate change adaptation. In addition, effective and timely investments in infrastructure sectors will reduce climate change risks and determine the direction of adaptation actions and strategies. The impact of such catastrophic climatic events on infrastructure systems is shown in Table 17.

Table 17: Impact of climate change on infrastructure[38]

<table>
<tr><th rowspan="2">Affected Sectors</th><th colspan="4">Climate Change Impacts</th></tr>
<tr><th>Temperature Changes</th><th>Sea Level Rise</th><th>Changing Precipitation Patterns</th><th>Changing Storm Patterns</th></tr>
<tr><td rowspan="3">Transport</td><td>Melting of road surfaces and buckling railway lines</td><td rowspan="3">Submersion of coastal infrastructures such as ports, roads, or railways</td><td>Traffic disruption due to flooding</td><td>Damage to assets such as bridges</td></tr>
<tr><td>Damage to roads due to seasonal frost or permafrost</td><td rowspan="2">Changing water levels disrupt transmission in inland waterways</td><td rowspan="2">Disruptions at ports and airports</td></tr>
<tr><td>Changing port demands for new sea routes due to melting Arctic glaciers</td></tr>
<tr><td>Energy</td><td>Decreased efficiency of solar panels</td><td>Submersion of coastal infrastructure systems such as generation,</td><td>Decreased output in hydropower generation</td><td>Damage to assets such as wind farms, distribution networks</td></tr>
</table>

[37] *OECD. (2018). Climate-resilient Infrastructure. Policy Perspectives. OECD Environment Policy Paper No. 14. 14.*
[38] *OECD. (2018). Climate-resilient Infrastructure. Policy Perspectives. OECD Environment Policy Paper No. 14. 14.*

Affected Sectors	Climate Change Impacts			
	Temperature Changes	Sea Level Rise	Changing Precipitation Patterns	Changing Storm Patterns
	Lower efficiency from thermal power plants due to limitations in cooling water temperatures	transmission, and distribution	Cut-off of energy supply due to flooding	Increasing economic losses due to power cuts
	Increasing demand for cooling		Insufficient cooling water	
Telecom	Increasing need for cooling for data centres	Submersion of coastal infrastructure such as telephone exchanges	flooding the infrastructure	Damage to infrastructure systems such as radio masts
			Damage to infrastructure due to collapse	
Urban Development	Increasing demand for cooling	Increased risk of flooding and overflow	Increased risk of drought	Damage to buildings
	Decreased heating demand	Changes in land use due to displacement of people living in vulnerable areas	Increased risk of flooding	Increasing deaths and injuries
Water	Increased need for treatment	Submersion of flooded coastal infrastructure	Increased need for water storage capacity	Increased damage to assets
	Increased evaporation in reservoirs	Increasing need for salinization of water resources	Increased risk of crossing riverbanks	Inadequate standard of flood protection systems
		Decline in the coastal protection standard		

Although transportation infrastructure, which directly affects the greenhouse gas emission rates of cities, is at the forefront in terms of climate change mitigation activities, the issue should also be evaluated in the context of adaptation. Increasing walking paths, providing incentives for clean energy transportation vehicles, providing eco-driving techniques training to drivers working in the corporate structure, transforming public transportation into rail systems are practices that facilitate adaptation to climate change indirectly, even though they are considered within the scope of greenhouse gas mitigation targets. Transportation infrastructure affected by climatic disasters not only disrupts the provision of urban services but also causes economic damage. Since the transportation network constitutes a large part of the built surfaces in the city, it is important to increase the permeable surfaces. The use of permeable materials in transportation infrastructure will mitigate the vulnerability and damages from extreme rainfall events. For this reason, it is very important to integrate transportation into the development plans of cities in the context of climate change impacts, to organize land use decisions according to transportation principles, and to improve existing transportation systems.

Developing disaster-resilient infrastructure systems for Antalya indirectly affects public health and welfare. In order to eliminate and minimize the risks in a possible scenario, Antalya's current situation should be analysed, appropriate actions should be determined and implemented.

Waste management, one of the key services provided by every local government, is also affected both directly and indirectly by climate change. Inappropriate waste infrastructure not only complicates the ability to cope with climatic disasters, but also negatively affects the adaptive capacity and climate resilience of the city. For example, drainage systems clogged by waste during heavy rainfall can exacerbate flooding. For this reason, all existing and new waste systems should be handled in a way that is resilient to climate change. The impact of climatic events caused by climate change on waste management is shown in Table 18. This table shows the impacts on waste management of temperature change, flooding, sea level rise, storms and winds, which Antalya also faces frequently, and which are predicted to increase in frequency. In addition, all areas such as transportation, infrastructure and public health are exposed to these impacts.

In addition, one of the most vital issues in waste management is wastewater systems. Wastewater systems provide a critical service to society and are critical to public health, vulnerability of vulnerable populations and clean water supply in direct response to the impacts of climate change. The impacts of climate change on wastewater systems are many and varied. According to a study by Hughes et al. (2020), three main climate change impact themes are identified for wastewater networks. These impacts are severe flood seepage and odour, deterioration of water quality due to increased uncontrolled discharges, and damage to infrastructure systems. Immediate and long-term impacts arising from these impacts are also likely to occur in social, economic, cultural, and environmental spheres[39]. Therefore, making wastewater infrastructure climate resilient is extremely important both in terms of environmental sensitivity and public health.

Table 18: Impact of climatic events on waste management [40]

Climatic events	Impact of climatic phenomena on the waste process		
	Waste collection	**Waste treatment process**	**Waste disposal**
Temperature	* Frequency of waste collection increases as odor and pest activity increase. * Vehicles are damaged due to overheating of collection vehicles.	* Overheating of separating equipment may occur	* Waste decomposition rates can affect. * Maintenance and construction costs may increase due to changes in the soil. * The risk of fire in landfills may increase, especially in drought conditions.
	* Workers are more exposed to flies, which are the main cause of infectious diseases (Flies breed faster in hot weather and are attracted to organic waste.)		
Flooding	* Flooding of collection routes and storage access roads makes them inaccessible * Stress increases on collection vehicles and workers due to waste. * Wastes thrown out for collection flow into streets and waterways	* The need for closed or semi-closed sorting facilities increases.	* Flood risk increases in and around waste facilities. * Increasing leachate that needs to be collected and treated. * Due to heavy rain, the rate of leakage and leakage in landfills increases.

[39] Hughes, J., Cowper-Heays, K., Olesson, E., Bell, R., & Stroombergen, A. (2021). Impacts and implications of climate change on wastewater systems: A New Zealand perspective. In Climate Risk Management (Vol. 31). Elsevier B.V. https://doi.org/10.1016/j.crm.2020.100262.

[40] *https://www.c40knowledgehub.org/s/article/Reducing-climate-change-impacts-on-waste-systems?language=en_US. Erişim tarihi: Mart, 2022.*

Sea level rise	* Waste collection routes can be narrowed. * People moving their living spaces from urban areas to higher altitudes, potentially causing an increase in waste in a dense area.	* Processing facilities close to sea level are damaged. * Increasing need for sorting and recycling to minimize waste storage needs.	* Deterioration of impermeable lining occurs * Water seepage occurs into the pit leading to possible waste overflow
Storms and wind	* Collection, processing and disposal infrastructure can be permanently submerged. *Highways, railroads and ports for waste collection, separation and disposal may overflow and temporarily reduce access to them. *Facilities may closed due to infrastructure damage. *Waste can be dispersed from collection areas and vehicles, processing areas and landfills. *Access to collection and storage roads is reduced due to damage and debris. *Significant waste generation may occur due to damage, debris, and emergency response (tent, disposable etc.). *Extreme events also pose a risk by affecting the other infrastructure system to which a waste facility or system is connected. Example: Electricity is needed to monitor computer-based (via ICT) processes such as waste collection and access to facilities. If the electrical infrastructure is damaged, these processes are interrupted.		

As a result, waste management and waste infrastructure are issues that need to be systematically improved and developed both in terms of limited consumption of natural resources, generating energy from waste, and making waste systems climate-resilient. It is also essential for society to determine minimum waste policies in homes, workplaces and institutional structures. It is also important for local municipalities to create campaigns and practices in terms of social motivation. As a result of all these, both public health will be protected and in the event of a possible disaster, if the adaptation process is realized, repairs can be provided at less cost as less danger will be encountered. In addition, with the energy produced in waste facilities, depletion of natural resources and energy consumption costs can be reduced.

Key Findings for Antalya

Since Antalya has experienced a rapid population growth especially after the 1980s, the adaptability of the city's infrastructure systems and transportation to the effects of climate change is an issue that needs to be investigated. According to the Antalya Transportation Master Plan, the city's population increased 68 times from 1920 to 2010. This has caused the settlements to expand 120 times. Between 1990 and 2018, maps showing the change of the city according to Corine data are shown in Figure 47 and Figure 48.

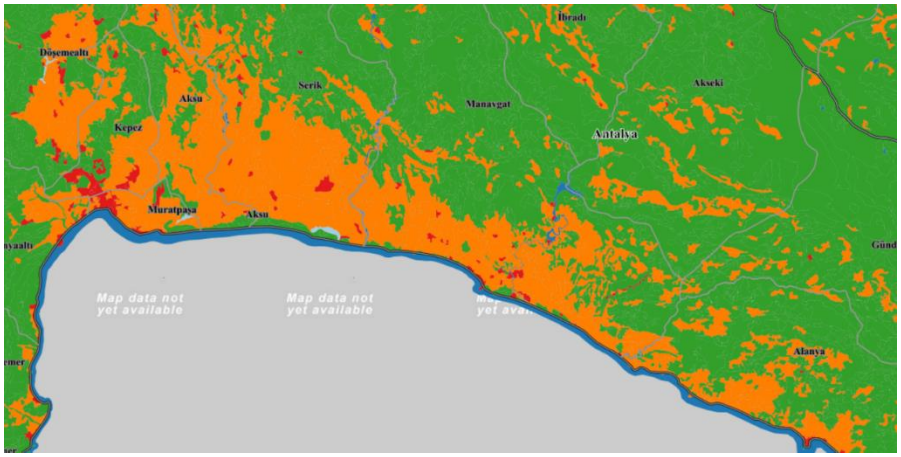


Figure 45: The view of Antalya in 1990 according to Corine data

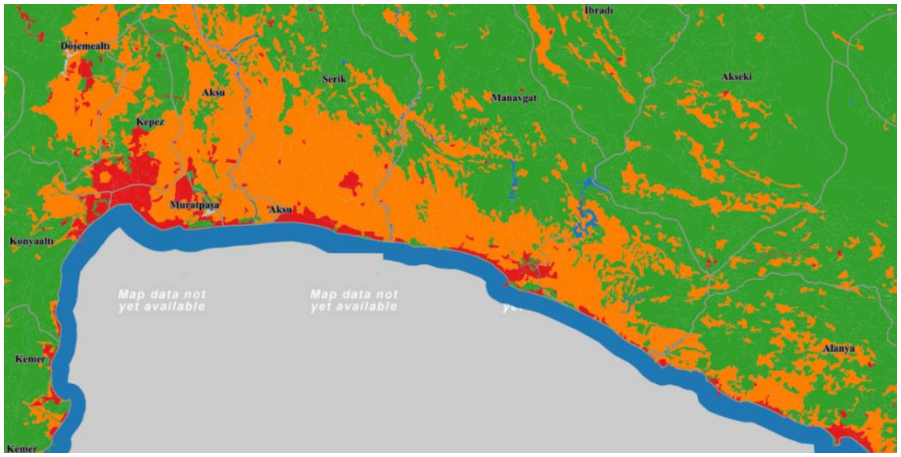


Figure 46: The view of Antalya in 2018 according to Corine data

With the rapid population growth in Antalya, dense construction has occurred in the city. Since most of the city's building stock was built before the 1999 earthquake, it is possible to say that the city is under risk both in terms of earthquake and energy supply. According to the IRAP report prepared by AFAD in 2021, 21,392 independent sections, including 10,831 in the city center of Antalya, were declared risky. 10,473 buildings were demolished. Indicators related to risky areas in the city are shown in Table 19. In addition, the distribution of risky buildings in the city by districts is shown in Table 20. According to this table, it is possible to say that the riskiest districts in the city are Kepez, Muratpaşa, Manavgat, Alanya and Serik. In a possible earthquake hazard, the risk that these districts will face will be much higher than other areas.

Table 19: Indicators of risky areas in Antalya[41]

(Law No. 6306) Number of Risky Areas	4
(Law No. 5393) Urban Rev. And Number of Development Areas	4
Total Risk Area	185,66 hectare
Total Urban Transformation and Development Area	1.457,64 hectare
Total Number of Neighbourhoods	12
Total Population Number	38.155 person
Total Number of Independent Sections	12.308
Total Number of Buildings	9.431
(Law No. 6306) Number of Reserve Building Areas	4
Total Reserve Building Area	49,50 hectare
Total Number of Neighbourhoods	4
Total Number of Real Estate	1.068 piece

Table 20: Distribution of risky structures by districts in Antalya[42]

District	Number of applications	Under review/check over	Feedback given	Out of scope	Declared at risk
Aksu	19				19

[41] *AFAD, İRAP, 2021.*
[42] *AFAD, İRAP, 2021.*

District	Number of applications	Under review/check over	Feedback given	Out of scope	Declared at risk
Alanya	405	18	1	27	359
Döşemealtı	109			2	107
Elmalı	30			1	29
Finike	26			1	25
Gazipaşa	47			5	42
Kaş	12				12
Kemer	57				57
Kepez	7785	45	12	122	7606
Konyaaltı	61			2	59
Korkuteli	151	1			150
Kumluca	48				48
Manavgat	711	2		5	704
Muratpaşa	1423	5	1	20	1397
Serik	219			2	217
GENERAL	**11103**	**71**	**14**	**187**	**10831**

Old building stocks not only pose risks in terms of earthquakes, but also cause difficulties in terms of saving energy. For this reason, the transformation of the building stock is very important in the context of climate change mitigation and climate adaptation strategies. The fact that Antalya is both in an earthquake zone and has a high population density reveals the urgency of this transformation.

In addition to building stock information, the city's infrastructure systems should also be analysed in a climatic context. In this context, natural gas distribution in Antalya started in 2006. According to 2020 data, natural gas can be distributed to Aksu, Kepez, Konyaaltı, Muratpaşa, Serik and Döşemealtı districts in the city. The total length of these lines is 2006 km[43]. Based on this information, it is possible to say that the rest of the city's heating needs are met by electricity and coal. Therefore, it is very important to expand the energy infrastructure and spread renewable and clean energy throughout the city.

There are regional directorates of communication companies in Antalya. According to Türk Telekom Antalya Regional Directorate data, fiber optic cable routes are located in the coastal area of the city and in certain areas (Figure 49). In order to ensure accessibility to fast internet, these lines should be extended throughout the city.

[43] *AFAD, İRAP, 2021 (sf:58).*

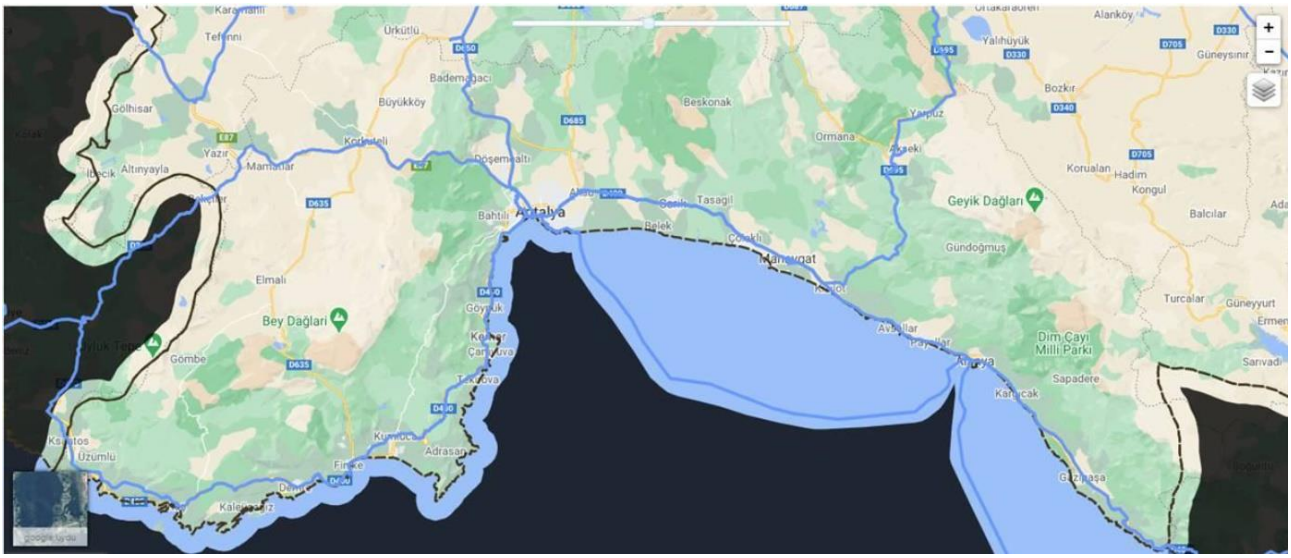


Figure 47: Antalya fiber optic cable route map [44]

In addition to these infrastructure systems, wastewater infrastructure systems and waste management in the city should also be examined in the context of climate change. In this context, as of 2019, the number of wastewater facilities in the city has reached 32. While the capacity of the domestic and industrial wastewater treatment plant in Antalya Organized Industrial Zone is 20,000 m³/day, its actual capacity is 11,457 m³/day. The capacities of the facilities located in industrial areas in Antalya should be increased and uncontrolled discharges should be prevented. Waste systems especially in mining areas should be meticulously examined and the spread of these wastes to agricultural areas should be prevented.

According to Antalya's 2019 State of the Environment Report, domestic wastewater generated in the city reaches the treatment plant where there is a sewerage system. In some areas without sewerage systems (e.g., Manavgat Örenşehir and Kızılot), disposal of domestic waste is problematic and causes environmental pollution. For this reason, wastewater systems should be developed in accordance with the climate and should be expanded throughout the city. In addition, agricultural pollution should be prevented in the city where open field and cover-plus agriculture is quite common. According to the State of the Environment Report (2019), awareness-raising activities are ongoing. Finally, regarding solid waste, there are Kumluca Solid Waste Landfill, Patara Solid Waste Landfill, Manavgat Solid Waste Landfill, Alanya Solid Waste Landfill, Kızıllı Solid Waste Landfill within the borders of the ABB [45].

Another issue that needs to be examined in the context of the city's adaptation to climate change is transportation. Although transportation has a major role in direct climate change mitigation activities, making transportation systems climate compatible is very important for Antalya. Transportation to the city from outside Antalya can generally be provided by road and air. Although Antalya is a coastal city, the reason why maritime transportation is not widespread between cities and within the city is due to the geographical structure of the coastal area. In addition, there are ports operating internationally in Antalya. Ships carrying passengers who want to visit for touristic purposes and commercial ships carrying cargo use these ports.

[44] *AFAD, İRAP, 2021.*
[45] *Türkiye Cumhuriyeti Antalya Valiliği Çevre ve Şehircilik İl Müdürlüğü, Antalya İli 2019 Yılı Çevre Durum Raporu, Antalya 2020.*

Public transportation in the city is widely provided by buses, minibuses, and trams. The map showing the main transportation arteries of the city is shown in Figure 50.

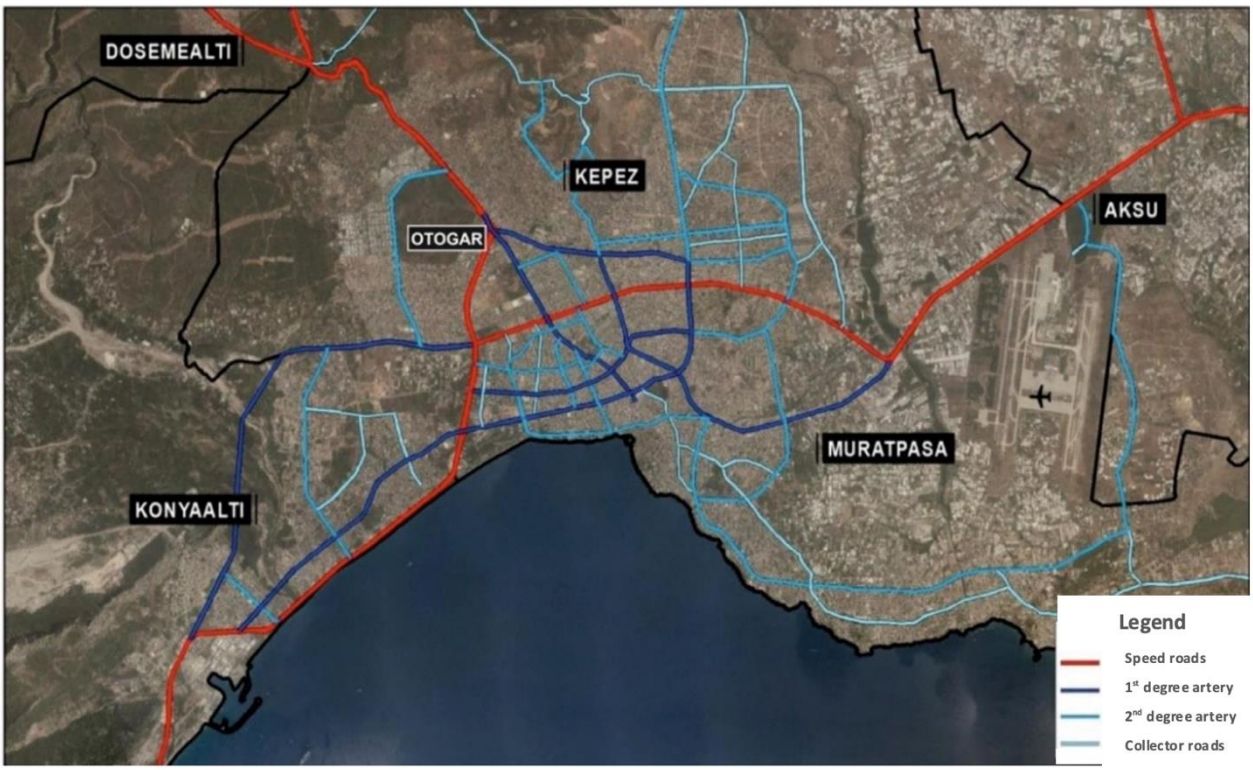


Figure 48: Transportation network stratification, Antalya Transportation Master Plan, 2016[46]

In terms of adaptation to climate change, it is very important to increase light rail systems, bicycle path and pedestrian routes. In this context, it is possible to say that the squares and green areas in and around the historic Kaleiçi increase the potential for pedestrian transportation. Within the scope of the Antalya Transportation Master Plan 2040[47] study completed in 2016, it was determined that 40.6% of the daily trips in the city are pedestrian trips and 0.96% are bicycle trips. ABB Antbis Smart Bicycle System is used for bicycle rental, especially in the central area. However, in view of the cycling rates, it is clear that there is a need for uninterrupted bicycle lanes and incentives for cycling in the city.

[46] *Antalya UAP 2040, 2016.*

[47] *Since the current version of the Antalya Transportation Master Plan is in the process of being prepared, the UAP, which was prepared in 2016, was used in this study.*

Figure 49: Antalya City Centre bike paths

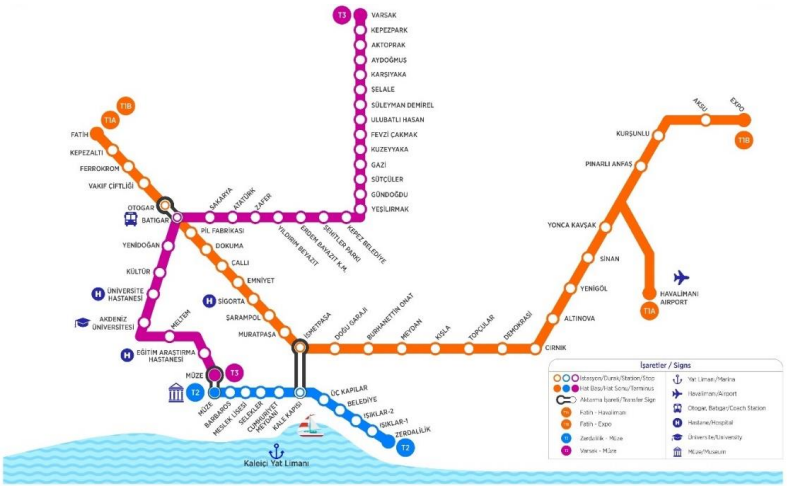


Figure 50: Map of Antalya tram line and stops[48]

According to 2016 data, the map showing the bicycle lanes and light rail systems in the city centre is shown in Figure 51.[49]. Figure 52 shows the schematic of the tram line as of 2022. The tram line is a very important transportation system for Antalya. In order to reduce vehicle traffic, it is very important to extend the tram line throughout the city centre and combine it with green areas.

As a result, the current situation of the city in terms of infrastructure systems, transportation and waste management should be examined with more comprehensive studies in the climatic context and the determination of deficiencies against climatic risks should be carried out according to climate projections.

[48] https://www.antalyaulasim.com.tr/Hizmetlerimiz/Antray, *Erişim tarihi: Ağustos 2022.*
[49] *Antalya UAP 2040, 2016.*

4.2.2 Green Infrastructure and Forest Areas

Green infrastructure includes practices based on spatial planning and regional development strategies for the protection and enhancement of the natural environment and natural processes. Green infrastructure is designed to provide a wide range of ecosystem services in both rural and urban areas and can be expressed as a network of planned natural and semi-natural areas with environmental management features. Moreover, unlike the grey infrastructure approach, which is designed and built to serve a single purpose, green infrastructure aims for multifunctionality. It aims to provide a multitude of valuable ecosystem services and products for climate change adaptation and mitigation, while benefiting biodiversity conservation in social, economic, and environmental contexts. As a result, green infrastructure creates ecosystem services such as materials, clean water, clean air, pollination, climate regulation, flood, and flood prevention. The benefits of these ecosystem services are particularly important in densely populated, urban areas and their peripheries[50]. Therefore, green infrastructure systems are an issue that must be emphasized when analysing the current situation of the city in the context of climate change and determining adaptation strategies.

In this case, urban green spaces, parks, nature-based solutions, green ecosystems in the city can be considered as green infrastructure. In this context, urban green spaces are very useful in terms of society and the environment, as well as contributing to the aesthetics of the city. Urban areas consisting of natural and semi-natural areas planned with the green infrastructure system are integrated with the environment and lead to an increase in the welfare levels of the people living in them. In addition, urban green spaces and green infrastructure systems purify the air and water by absorbing the effects of extreme weather events. Green infrastructure practices also contribute to adaptation to climate change by reducing noise.[51]

One of the biggest impacts of climate change in cities is the urban heat island effect, which is the result of dense construction, urbanization effect and lack of green space. Therefore, while developing strategies to reduce the urban heat island effect, it is necessary to develop a new approach with green infrastructure systems and nature-based solutions, taking into account the land use change of the city. In Antalya, where there is dense construction and urbanization pressure is increasing day by day, it is very important to increase actively used green areas. Land use decisions in the entire city should be made with the principle of climate change adaptation. In addition, it is a necessity to implement green infrastructure practices in areas with dense construction and high population. Another important consideration is to ensure that practices such as green roofs, green walls, rain gardens and rain retention ponds are implemented in commercial areas and set an example.

Nature Based Solutions

Are the practices that used to protect, sustainably manage, and restore natural and modified ecosystems, providing biodiversity benefits; and increase human well-being by addressing social challenges effectively and harmoniously.

[50] *https://www.eea.europa.eu/themes/sustainability-transitions/urban-environment/urban-green-infrastructure/what-is-green-infrastructure, Date of access: May 2022.*

[51] *Tabanoğlu, O., Climate Change Adaptation Strategies Proposal for Antalya, Istanbul Technical University, Master Thesis, 2018, sf:77.*

Forest areas are one of the most important natural areas that will mitigate the impacts of climate change and ensure climate adaptation. Forest areas are instrumental in keeping the earth's temperature below 2°C and contribute to 30% of climate solutions. Forest areas have the ability to absorb greenhouse gases that cause climate change. However, it should not be forgotten that the trees destroyed by forest fires and the gases released into the atmosphere with the fire will increase the effects of climate change. Therefore, prevention of forest fires is very important. Sustainable forest management, improved land use, protecting and restoring natural areas are valuable strategies to preserve forests as a natural climate solution. These solutions positively affect the economy, biodiversity and society. The use of technological tools together with forest monitoring data facilitate the implementation of these solutions.[52].

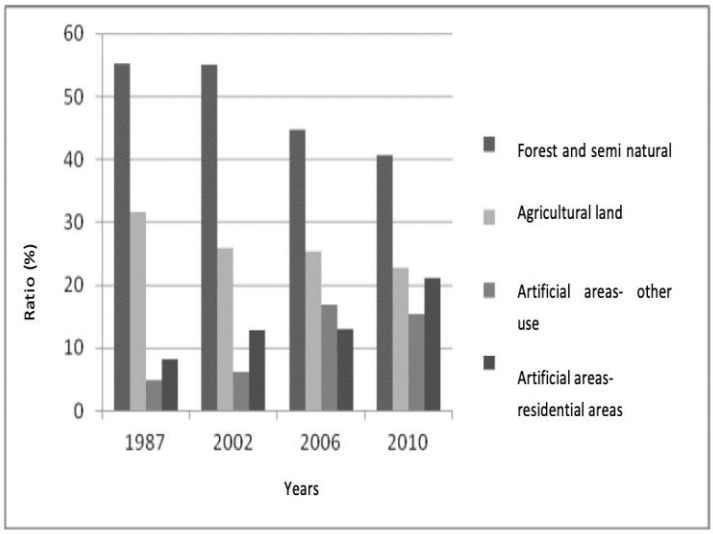


Figure 51: Change of land cover between 1987-2010

Key Findings for Antalya

As one of the most important tourism cities in Turkey, the pressure and demand for tourism in Antalya has led to the shrinkage of green and natural areas in the city over time. The historical texture, cliffs, recreational areas, Kaleiçi District and marina in the center of the city reveal the identity of the city. However, it is seen that this texture has been destroyed by the pressure of urbanization over time. According to the study conducted by Manavoğlu and Ortaçeşme in 2015, while the rate of settlement in the center was 13.2% in 1987, this rate increased to 36.6% in 2010 (Figure 53)[53].

According to the Antalya Metropolitan Municipality annual report (2021), in Antalya, grass mowing, pruning, flower planting, etc. works are carried out in fixed parks with a surface area of 1,650,000 m² and in streets and boulevards with a surface area of approximately 1,850,000 m². However, the amount of active green space per capita in the areas under the responsibility of ABB is calculated as 4m2 for 2021. Although the amount of green space per capita is important within the scope of planning studies, another important issue is the ease of access of citizens to active green areas and the distribution and capacity of green areas within the city. In this direction, the fact that there is so little active green space in Antalya and that the existing green space is not integrated with water systems poses a serious climatic risk.

Antalya ranks first in Turkey in terms of forest cover. According to the IRAP report prepared by AFAD (2021) and data from the Regional Directorate of Forestry, the city's forest cover accounts for 5.4% of the country's forests. Forests along the southern slopes of the Taurus Mountains are distributed along a line of

[52] https://www.globalforestwatch.org/topics/climate/#intro,July 2022.

[53] *Manavoğlu, E., Ortaçeşme, V., Multi-criteria analysis of green areas in the city of Antalya and development of planning strategies, Akdeniz University Journal of the Faculty of Agriculture (2015) 28(1):11-19*

approximately 630 km. Figure 54 shows the forest cover map of the city. In addition, the forest cover of the city is presented in Table 21. Of the city's forest areas, 57% are productive and 43% are unproductive forests.

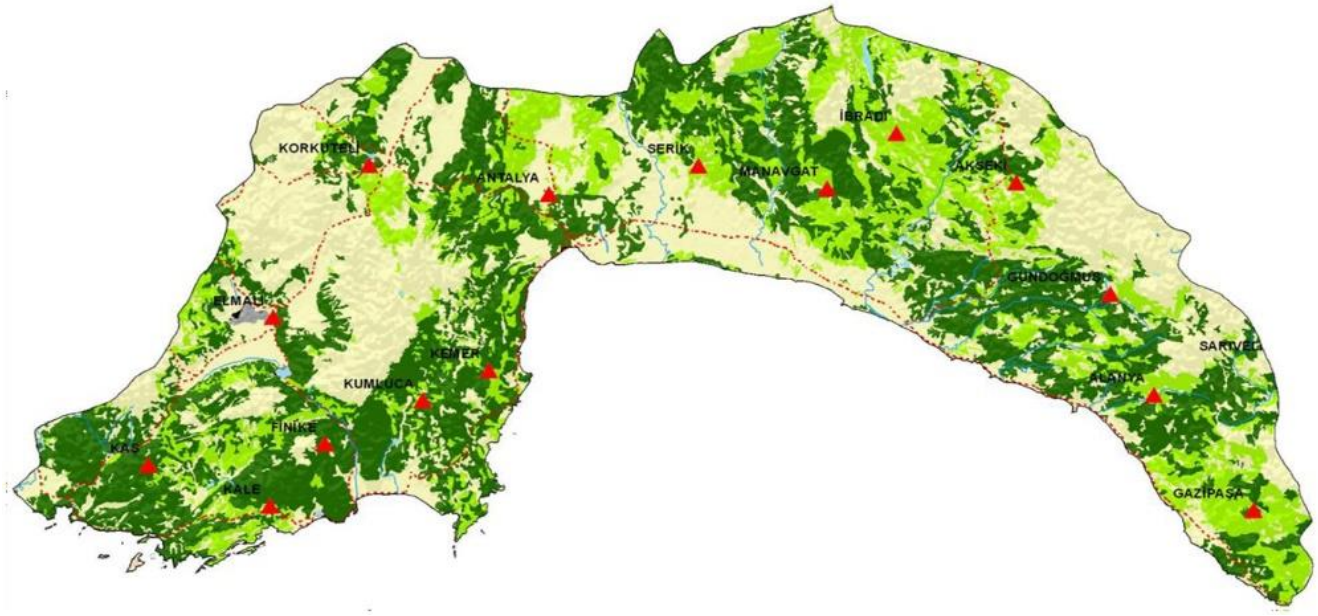


Figure52: Forest asset map of Antalya [54]

Table 21: State of forest assets in Antalya (ha)[55]

Small forest		Coppice Forest		Woodland	Clearing area	Total area
Fertile	Degraded	Fertile	Degraded			
651.259	489.296	3.611	1.896	1.146.062	915.702	2.061.764

In the Antalya State of the Environment Report prepared by the Antalya Provincial Directorate of Environment, Urbanization and Climate Change in 2019, land classification was made using Corine data. Table 22 shows that 72.3% of the city is covered with forests and semi-natural areas. It is noteworthy that this ratio has been decreasing since 1990.

Table 22: Land use classification in Antalya [56]

	SIZE OF AREA									
	1990		2000		2006		2012		2018	
Land Class	ha	%	ha	%	ha	%	ha	%	ha	%
1) Artificial Fields	15.444,63	0,77	27.351,00	1,36	30.681,52	1,52	35.232,09	1,75	37.600,15	1,86
2) Agricultural Fields	519.422,77	25,75	504.941,36	25,03	513.262,40	25,44	512.116,96	25,38	510.471,41	25,3
3) Forest and Semi-Natural Areas	1.475.691,84	73,14	1.476.722,17	73,19	1.464.774,08	72,6	1.460.316,48	72,38	1.458.646,42	72,3
4) Wetlands	1.985,34	0,1	1.868,66	0,09	1.488,35	0,07	1.541,26	0,08	1.541,26	0,08

[54] *AFAD, İRAP, 2021*
[55] *AFAD, İRAP, 2021.*
[56] *Antalya ÇEvre ve Şehircilik İl Müdürlüğü, Antalya ÇDP Raporu, 2019. (https://corinecbs.tarimorman.gov.tr, Corine, 2020)*

5) Water Structures	4.991,33	0,25	6.652,70	0,33	7.392,08	0,37	8.391,65	0,42	9.339,18	0,46
TOTAL	**2.017.535,91**	100	**2.017.535,89**	100	**2.017.598,43**	100	**2.017.598,44**	100	**2.017.598,42**	100

According to the IRAP report prepared by AFAD in 2021, the forests in Antalya are home to many trees such as fir, ash, wild pear, linden, sycamore, sycamore, olive, oak, sandalwood, gum tree, chaste, oleander, carob, white beech, heather, spruce. The forests cover approximately 1,146,062 ha, 65% of which are red pine, 16% cedar, 8% larch, 5% fir, 4% juniper and 2% other leafy species.

Antalya's mild climatic conditions and plant diversity have contributed to the richness of wildlife in the city. The national biodiversity inventory of Antalya, based on data from AFAD, IRAP report (2021) and Antalya Provincial Directorate of Environment, Urbanization and Climate Change, is shown in Table 23.

Table 23: Antalya's national biodiversity inventory

Group of biological assets	Number of Species	Endemic	Rate of Endemism %
Vascular Plants	2.732	825	30.2
Big Mammals	15	0	0
Small Mammal	59	4	6.6
Birds	329	0	0
Inland Water Fish	60	24	40
Reptiles	40	5	12.5
Double Lives	11	6	54.5
Seedless Plants	1045	0	0
Invertebrates	2875	226	7.9
TOTAL	**7166**	**1090**	**100**

Although Antalya is rich in forests and biodiversity, the lack of active green areas and green infrastructure in the city center and residential areas creates a serious risk. The lack of active green space, which both mitigates the effects of climate change and is necessary for climate adaptation, is one of the biggest problems of the city.

4.2.3 Water Resources and Management

Water is a prerequisite for life on Earth and a fundamental building block for sustainable development. Safe drinking water and sanitation care [57] are fundamental human rights. Clean water is critical for socioeconomic development, food security and healthy ecosystems. In addition, clean water is a vital requirement for reducing the global burden of disease, improving and protecting public health, well-being and productivity. Another issue that scientific studies have shown, and that we have begun to experience frequently in recent years, is that climate change is increasing the variability in the water cycle. This reduces estimates of the amount of available water resources and the predictability of water demand, affects water quality, leads to water scarcity, and threatens sustainable development. Poor and vulnerable communities are disproportionately more affected by these hazards.

In addition, the issue where the climate change crisis is felt most intensely by the whole society is water. Reduction or pollution of water used in many sectors such as energy, industry, agriculture, food, health, and transportation create an environment that directly affects the structure of society and public health. Population growth, urbanization, uncontrolled migration, land use changes, economic developments, declining soil health, population growth, accelerated and uncontrolled groundwater extraction, widespread ecological degradation and loss of biodiversity reduce water supply and increase water demand, posing a major risk to the sustainability of resources. In addition, these developments, especially land-use changes, will lead to environmental, natural and geomorphic changes, creating environments that will trigger the differentiation of climatic events and the transformation of these events into crises. [58]

Considering all these, investments in water systems and water management and efforts to adapt these systems to climate change will create a serious opportunity for the protection of water resources. In order to address the water management strategies of cities in the context of adaptation to climate change, assessments should be made both at the city scale and at the regional scale. The management and protection of water resources should be ensured primarily by

Water Systems

The importance of water is emphasized in many international conventions and framework programs prepared in the context of climate change. Moreover, it is stated that attempts to adapt water resources such as fresh water, coastal water, groundwater, and rivers to climate change should be put forward as the priority. Therefore, building water climate resilience in the national context and ensuring the management of water resources should be among the priorities of adaptation.

Importance of water management in climate change studies - 2015

[57] *Ensuring the continuity of hygiene conditions*
[58] *Climate Change and Water UN-Water Policy Brief, 2019*

laws at the national scale, and climate resilience at lower scales should also be ensured with a holistic approach. In this respect, basin protection plans, water management plans and studies related to the water management of the city should be handled together and meticulously and evaluated according to climate adaptation criteria.

Key Findings for Antalya

Turkey is classified as a water-constrained country with 1480 m3 of water per capita per year[59] . Therefore, it is very important to observe the balance of conservation and utilization for water resources. Strategies and practices to combat the climatic disasters of water scarcity and drought that may be experienced due to the effects of climate change should be implemented as a priority. In order for these water management strategies and practices to be effective and efficient, basin-scale studies should be carried out. In this context, Antalya's water resources should also be handled on a basin basis.

Figure 53: Basin borders of Antalya

Antalya has 7.6% of Turkey's water potential. There are a total of 29 rivers in the city. While 25 of them flow into the sea, 4 of them flow into lakes. In addition, the amount of surface water resources in the city according to basins is shown in Table 24. The basin boundaries of the city are shown on the map in Figure 55 [60]. In addition, 99% of Antalya's water needs are supplied from groundwater and 1% from spring water. The city's water network is controlled and monitored by the Centralized System for Controlling and Monitoring Areas (SCADA).

The water resources that make up the hydrological structure of Antalya are rivers, lakes, ponds, dams, surface waters and underground water resources. The underground water resources of the province are Kırkgöz Springs, Düdenbaşı Spring, Duraliler Spring, Kemerağzı Springs, Arapsuyu Springs, İskele Spring, Hurma Springs, Gürkavak Spring, Cave Spring, Boğaçay caisson wells, Meydan boreholes. It is stated that these water resources are important resources used for drinking and irrigation purposes [61].

Table 24: Surface water potential of Antalya 2019

Basin Name	Water Potential (hm^3)	Ratio (%)

[59] *Basin Flood Management Plan, 2016.*
[60] *AFAD, İRAP, 2021.*
[61] *Özmen, T., Flood-Overflow Türkiye and Antalya, 2015.*

Antalya Basin	13.129,35	86,9
West Mediterranean Basin	1.457,50	9,6
East Mediterranean Basin	351,4	3,5
Total	**15.118,25**	**100**

The main rivers of the Antalya Basin, where most of Antalya is located, are Boğaçay, Düden Stream, Aksu Stream, Köprüçay, Manavgat Stream, Karpuz Stream, Alara Stream, Kargı Stream, Obaçay and Dim Stream. Antalya Basin has a karstic structure and there are important closed basin sections and sinkholes within the basin. With a total rainfall area of 13,161 km², the Antalya Basin has approximately 1/3 more water potential than the Seyhan Basin with a rainfall area of approximately 22,000 km² and the Yeşilırmak Basin with a rainfall area of approximately 38,000 km². It also accounts for 5.9% of Turkey's total potential with a total annual average flow of 11.06 billion m^3 [62]. The area covered by both basins is not limited to Antalya, but also includes the surrounding provinces. Information on the rivers in Antalya, their lengths and intended uses are shown in Table 25.

Table 25: Streams of Antalya [63]

Name of the Stream	Total length (km)	Length within the borders of the province (km)	Ratio to total length (%)	Flow rate (m^3/sn)	Start and end points within the provincial borders	Purpose of use
Düden Çayı	14	14	100	15.192	Aşağı Mahalle Akdeniz (Antalya)	Tourism
Aksu Çayı	112	55	49	16.163	Eğridir Gölü Akdeniz (Aksu)	---
Köprü Çay	119	57	48	88.017	Yeşilbaş Mah. Akdeniz (Serik)	Water sports, Tourism, Fishing
Manavgat Çayı	93	993	100	66.200	Simyon Yaylası Akdeniz (Manavgat)	Water sports, Tourism, Fishing
Alara Çayı	82	82	100	25.336	Dereyurt Yaylası Akdeniz (Alanya)	---
Karpuz Çayı	30	30	100	1.446	Değirmen Taş. Akdeniz (Alanya)	---
Kargı Çayı	45	45	100	1.883	Sıçanlı Yaylası Akdeniz (Alanya)	---
Obaçayı	12	12	100	0.823	Avcılar Mahallesi Akdeniz (Alanya)	---
Dim Çayı	28	28	100	0.627	Alacami Akdeniz (Alanya)	Tourism, Fishing
Sedre Çayı	21	21	100	0.862	Tekne Dağı Akdeniz (Alanya)	---
Bıçkıcı Deresi	27	27	100	3.073	Soğuk Oluk Akdeniz (Gazipaşa)	---

Apart from rivers, lakes are also important in Antalya. Karagöl, covering an area of 10 km^2 in the north of the Elmalı Plain, is the most important lake of the province and feeds Kocaçay and Çengel Spring. The other important lake of the city is Manay Lake with an area of 40 km². Within the borders of Antalya, there are 14

[62] *Antalya Basin Flood Management Plan, 2019.*
[63] *Antalya EDP Report 2019, (sf:40)*.

ponds commissioned by the General Directorate of State Hydraulic Works. There are 5 dams in the province, which were constructed by the General Directorate of State Hydraulic Works and are in operation. Among these dams, Dim and Oymapınar Dams are operated for energy purposes, Alakır and Çaybağazı Dams are operated for irrigation purposes, and Korkuteli Dam is operated for irrigation, drinking and utility water purposes (UAP, 2016).[64]

It is clear that one of the most important areas to be affected by climate change will be water resources and management. In this context, Antalya needs to create action plans for water management and against possible drought risks according to short, medium- and long-term climatic projections. In this plan, which should be integrated with the existing basin protection, drought action and flood management plans, it is essential to determine in detail the methods of coping with severe drought, water pollution and thirst caused by climate change.

Although Antalya is rich in water resources, it struggles with water pollution. According to BAKA's Antalya-Isparta-Burdur (TR61 Level 2 Region) 2014-2023 Regional Plan Report (2013), the main causes of water pollution in the region are untreated wastewater, chemicals used in agricultural activities, drainage water from irrigation, industrial wastes and municipal solid wastes that are not disposed of under appropriate conditions. In order to control the causes of water pollution, integrated solutions and the use of appropriate treatment technologies are essential. In addition, preventing water and soil pollution caused by wastewater is seen as an important step by actively operating existing wastewater treatment plants under the supervision of municipalities. Leakages in the drinking water network are much higher than the standards and are reported to be 60-65%.[65]

As a result, Antalya, which is both an agricultural and tourism city, needs to take extra precautions regarding water management and resources. In addition to possible climate change scenarios, the uncontrolled[66] construction of greenhouses, the loss and leakage rate due to insufficient infrastructure, and the pollution of water from mining and agricultural pollution should be prevented.

4.2.4 Agriculture Areas

Plants need suitable soil, water, sunlight and heat to grow. Warming temperatures have already affected the growing length of crops in much of Europe. For example, flowering and harvest dates for cereal crops are now several days earlier in the season. These changes are expected to continue in many regions. Thus, climate change, changes in rainfall patterns, increases in the extremes of climatic events, increased pest and vector hazards, and changes in seasonal and daily temperature patterns are negatively affecting agricultural production at both local and regional levels. These impacts will also lead to higher national and international food prices. In addition, the increase in production costs caused by the energy crisis will also cause a very negative picture in terms of agricultural production. How farmers and producers respond to the impacts of the climate crisis and how their production systems adapt to the climate will have a direct impact on protecting natural resources and ensuring food security.

In addition, global food demand is expected to increase by up to 70% in the coming decades, in line with projected population growth and changes in dietary habits. This significant increase in food demand will

[64] *Antalya UAP 2040, 2016.*
[65] *Özmen, T., Flodl-Overflow Türkiye and Antalya, 2015.*
[66] *It means that it must be done in the standards and areas determined by the experts.*

create additional pressures in the production chain. Any reduction in staple food supplies will jeopardize food security around the world and increase global food prices. This will make it harder for many groups around the world to access affordable and nutritious food[67].

Producing more crops on land currently used for agriculture often requires more intensive use of nitrogen-based fertilizers. This leads to the release of nitrous oxide emissions, increasing the severity of climate change. In addition, intensive agriculture and fertilizer use increase the release of nitrates into soil and water. Although not directly linked to climate change, this causes eutrophication in water bodies. Eutrophication encourages algae growth, leading to a decrease in oxygen in the water, which negatively affects water quality. Meeting the growing demand for food by using more land globally will therefore have negative impacts on the environment and climate. The conversion of forest areas into agricultural land will also increase greenhouse gas emissions in this process. However, in Turkey, the opening of agricultural land and forest areas for construction also causes extremely negative impacts on the climate and environment. Deforestation puts biodiversity at risk and reduces the ability of natural areas to cope with disasters.

It is clear that more food production will be needed globally and that basic resources are limited. Considering the negative impacts of agriculture on the environment and climate, it is clear that a coherent and integrated political approach to food security is needed. Reducing dependence on agricultural chemicals, increasing yields, reducing food waste, and shifting towards renewable and clean energy sources in production are essential issues.

Access to clean energy enables farmers and agribusinesses to increase food production. For example, farmers living in off-grid areas can use solar-powered systems instead of expensive diesel generators, leading to cleaner agricultural production. For farmers and their suppliers, transitioning to a solarpowered agricultural market is a difficult initial transition due to high technology costs, limited awareness of the benefits, lack of appropriate policy incentives, and limited financial resources. To both mitigate climate change impacts and ensure sustainability of production with clean energy, solar pumping, cooling, drying and other forms of agricultural production should be encouraged and expanded. The use of such technologies will save money for farmers and local agricultural enterprises and will lead to increased yields and value creation. It is therefore crucial that local and central governments encourage and support such adaptation and change processes, especially in agricultural production[68]. In addition, issues such as deterioration of the soil structure caused by the use of fertilizers and other negative impacts should be detected with digital tools such as remote sensing systems and sensors, and restoration works should be carried out in the relevant areas and soil purification should be ensured.

In conclusion, agricultural production in Antalya, one of the leading cities in terms of agricultural production in Turkey, needs to be addressed in the context of climate change. The effects of climatic impacts on agricultural production should be investigated in detail and the use of technological tools and renewable energy sources should be increased.

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[67] *https://www.eea.europa.eu/downloads/a898650f58a641589eb0ad2cd92b55be/1620729304/agriculture-and-climate-change.pdf, Date of access: July 2022.*

[68] *https://energy4impact.org/impact/energy-4-agriculture?gclid=Cj0KCQjwof6WBhD4ARIsAOi65agj7C38tjB3XXxC8PI-71Yu9jIKT7vYipO8EksVi6jXKCBsmw4jyDMaAtzCEALw_wcB?gclid=Cj0KCQjwof6WBhD4ARIsAOi65agj7C38tjB3XXxC8PI-71Yu9jIKT7vYipO8EksVi6jXKCBsmw4jyDMaAtzCEALw_wcB, , Date of access: July 2022.*

Key Findings for Antalya

Antalya is one of Turkey's leading cities in the agricultural sector. According to the IRAP report prepared by AFAD (2021), the city has an agricultural production value of 9.53 billion TL with 156,000 farmer families. With these values, Antalya ranks 2nd in Turkey and 1st in Turkey, accounting for 6.79% of the value of crop production. In the city, where intensive agricultural practices are used, employment is also created, contributing to the national economy. Animal and plant production structure, cut flower production, seed sector, biological control agent production, medicinal and aromatic plants, endemic plant richness, agricultural production export values show the importance of Antalya in agriculture.[69]

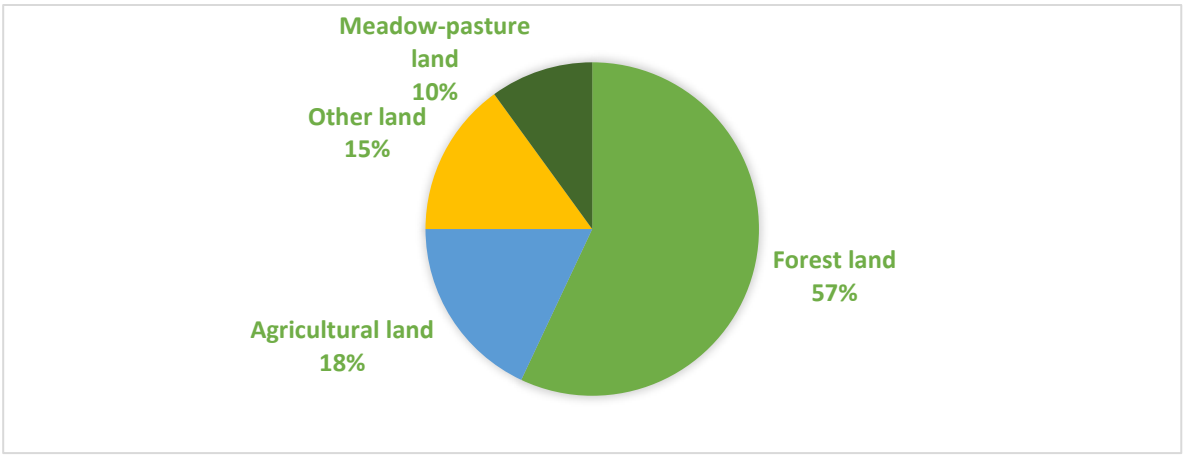


Figure 54: Land assets of Antalya

According to the diagram included in the IRAP report and prepared using data from the Provincial Directorate of Planning (2021), the city's land cover is shown in Figure 56. 57% of the city is covered by forests, 18% by agricultural areas, 10% by meadows and pastures, and 15% by other areas.

According to the Antalya EAP report (2019), Table 26 shows Antalya's land distribution and the share of these areas in Turkey. Forest areas and agricultural areas have a large share in Antalya city's land assets. With a surface area of 20,177 km^2, the city has 1,146,062 ha of forest and 360,245 ha of agricultural land. Of the 909 neighbourhoods in the province, 543 are rural neighbourhoods. The distribution of production areas by type is shown in Table 27. In this table prepared according to 2019 data, it is seen that field crops have the most production area. This is followed by fruit and vegetable production areas. The total production area is calculated as 360,254 ha.

Table 26: Land sizes of Antalya and its share in Turkey (2019)[70]

Land Distribution	Antalya (da)	Türkiye (da)	Share in Turkey (%)
Agricultural Land	3.617.072	230.949.238	1,6
Meadow-pastureland	2.044.630	146.170.000	1,4
Forest Land	11.417.020	226.220.000	5
Other Land	3.098.278	176.703.762	1,8
Area measurement	**20.117.000**	**780.043.000**	**2,6**

Table 27: Size of production areas in Antalya

[69] *AFAD, İRAP, 2021, (sf:48).*
[70] *Antalya EDP Report, 2019 (sf:114). (Antalya, Provincial Directorate of Environment and Urbanization, 2020).*

Production Areas	Production Area (Hectare)	Ratio (%)
Farm plants	180.587	50,13
Fruit	75.850	21,06
Vegetable	51.099	14,18
Ornamental Plants	550	0,15
Fallow and Unused Space	52.159	14,48
Total	**360.245**	**100**

Antalya accounts for 42% of the greenhouse agriculture in Turkey (Table 28). Figure 57 shows the production rates of the districts where greenhouse agriculture is practiced in the city. Kumluca district has the largest proportion in terms of both land availability and production under cover. Kumluca is followed by Serik, Aksu, Gazipaşa and Kaş districts. While greenhouse cultivation is more common in the coastal areas of the city, fruit cultivation is more intensive in the inland areas[71].

Table 28: Antalya greenhouse agricultural areas

Fields	Glass Greenhouse (da)	Plastic Greenhouse (da)	High Tunnel (da)	Low Tunnel (da)	Total (da)
Antalya	85.584	206.199	7.156	9.042	307.981
Türkiye	101.039	352.044	96.975	190.528	740.586
Ant./Tür. (%)	85	59	7	5	42

Table 29 shows the rates of change in production amounts between 2002 and 2018. The 89% increase in greenhouse production should be approached with caution. It is possible to say that the fact that greenhouse cultivation is so widespread in Antalya poses some climatic risks. In particular, the inability of rainwater to meet the soil and the excess of waste from greenhouse cultivation are among these risks. In the city where the risk of storms and tornadoes is high, whether greenhouse activities are carried out against these risks is a phenomenon that needs to be investigated. In addition, it is obvious that greenhouse agriculture production should be recorded, and existing and new greenhouse activities should be implemented according to climatic conditions. Another important issue is the need to restrict the establishment of greenhouses in some areas and to control these practices by preparing a guideline, taking into account situations such as the inability of rainwater to meet the soil, fire risk, storm and tornado risk.

[71] *AFAD, İRAP, 2021.*

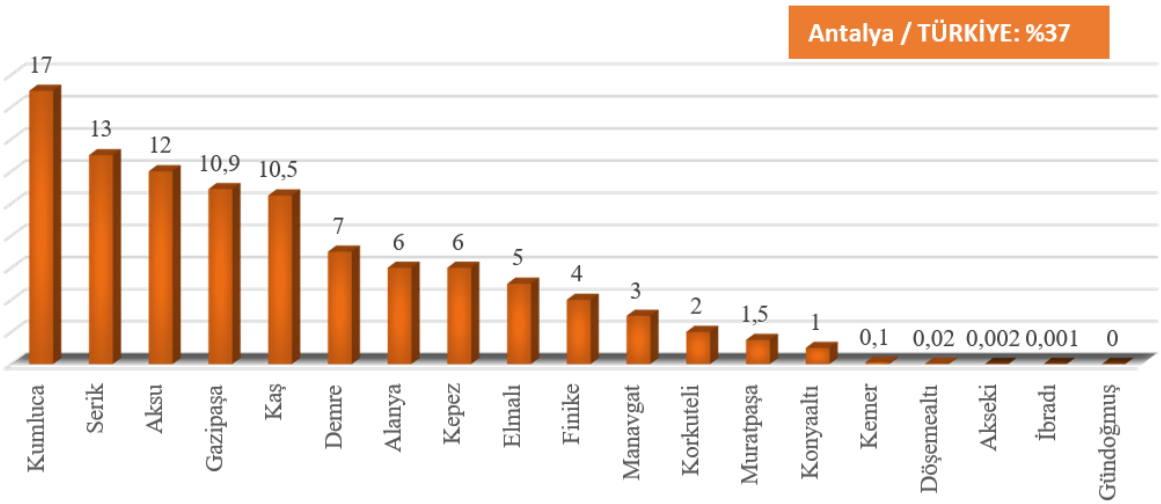


Figure 55: Greenhouse agricultural production rates in Antalya (%)[72]

Tablo 29: Rates of change in production in Antalya [73]

Product groups		Production Amount (Tone)			Rate of Change in 16 years (%)
		2002	2017	2018	
Vegetable	Greenhouse cultivation	1.944.629	3.609.006	3.667.040	**+89 %**
	Open field	915.835	988.773	939.030	**+3 %**
Fruit		732.763	1.484.728	1.477.200	**+102 %**
Field Crops		767.752	1.038.535	1.049.856	**+37 %**
Cut Flowers (Piece)		358.789.000	463.608.200	478.502.700	**+33 %**

If the impacts of climate change increase in Antalya and agricultural lands are affected, the national economy will also face the risk of damage. According to 2018 data, fruit, and vegetable exports from Antalya account for more than 10% of the country's exports (Table 30). In addition, if the production of many products produced in the city is disrupted, there will be difficulties in accessing these products throughout the country. The share of products produced in Antalya such as mushrooms, avocados, bananas, tomatoes, tomatoes, cucumbers, oranges, and carob in Turkey is more than 20% (Table 31). Apart from these, the entire production and export of Bumble Bee is carried out from Antalya. Silkworm farming and goat breeding in the city ranks second in Turkey. In 2018, 44% of Turkey's ornamental plants exports, which amounted to 99.2 million dollars, were made from Antalya. In Turkey's fresh fruit and vegetable exports, Antalya has 10.8% of the exported quantity and 16.8% of the economic value.

Table 30: Export of fresh vegetables and fruits [74]

Production	2017		2018		Share in Türkiye
	Türkiye	Antalya	Türkiye	Antalya	
Amount (ton)	3.961.634	449.155	4.513.348	489.431	% 10,8
Value (1.000$)	2.230.824	367.733	2.326.400	391.774	% 16,8

[72] *AFAD, İRAP, 2021.*
[73] *AFAD, İRAP, 2021.*
[74] *http://www.antalya.gov.tr/tarim, Data of access: July 2022.*

Table 31: Featured agricultural products (2019)[75]

Products	Türkiye	Antalya	Share in Türkiye
Tomatoes	12.150.000	2.508.622	% 21
Cucumber	1.848.273	439.255	% 24
Orange	1.950.000	525.821	% 27
Pepper	2.554.974	439.255	% 17
Eggplant	836.284	190.125	% 23
Pomegranate	502.606	123.880	% 25
Banana	369.009	163.422	% 44
Mushroom (culture)	46.144	25.337	% 55
New World	15.184	4.184	% 28
Carob	15.016	5.659	% 38
Avocado	3.164	2.567	% 81

As a result, in a city where the agricultural sector is so prominent, it is necessary to take precautions against possible climatic risks and hazards for both the national economy and the urban economy, and to create crop cultivation scenarios based on climatic projections.

4.2.5 Cultural and Natural Heritage

Climate change is fast becoming one of the most significant risks for World Heritage sites worldwide. Cultural and natural heritage assets are already affected by current climatic conditions. Moreover, it is an inevitable fact that they will suffer more damage from the effects of climate change projected in the future. Therefore, in order to protect these assets in perpetuity, their value in terms of Outstanding Universal Value needs to be understood. Natural heritage assets, such as forest areas, are also beneficial to the ecosystem by providing water and climate regulation features and enable adaptation to climate change. Cultural heritage assets transmit traditional knowledge to current generations to ensure a resilient and sustainable future. World heritage assets can also be used as climate change observatories to collect and share information on monitoring activities implemented and tested, and on climate change mitigation and adaptation practices. The global network of world heritage also helps raise awareness of the impacts of climate change on societies, cultural diversity, biodiversity, ecosystem services, cultural and natural heritage assets[76].

Most World Heritage sites are tourist destinations, and some have been described as the most iconic sites on the planet. The tourism sector is one of the largest and fastest growing economic sectors in the world. Tourism depends heavily on modes of transportation, including airplanes and automobiles. According to 2016 data, carbon emissions from tourism account for 5 percent of global carbon emissions. Over the next 20 years, this value is estimated to more than double.[77].

According to UNESCO's 2016 report, the tourism sector is vulnerable to climate change. Extreme weather events, rising insurance costs, security concerns, water scarcity, loss and damage to assets in tourism areas are some of the threats facing the tourism sector. Climate-induced damage and continued degradation of

[75] *http://www.antalya.gov.tr/tarim, Data of access: July 2022.*
[76] *https://whc.unesco.org/en/climatechange/, , Data of access: July 2022.*
[77] *UNESCO, World Heritage and Tourism in a Changing Climate, 2016.*

cultural and natural heritage in World Heritage sites will negatively impact the tourism sector, reduce the attractiveness of destinations, and reduce economic opportunities for local communities. Responsible tourism should therefore be used as a driver of sustainable development and conservation of natural and cultural heritage. However, an unplanned and poorly managed tourism sector can be socially, economically, and culturally destructive, causing degradation and damage to sensitive ecosystems, landscapes, monuments, and communities. It is therefore important that responsible tourism and sustainable tourism are well managed and embraced by local communities.

The adaptive capacity of the tourism sector will vary at different scales and in different areas. For areas with large infrastructure costs such as hotels, resorts, ports and airports, adaptation is likely to be difficult. However, as climate conditions worsen and disaster frequency increases due to climate change, it will become increasingly important and a priority to make all destinations disaster ready and revise management plans according to climate. However, in less developed countries, climate change impacts will have much more devastating consequences for tourism. For Turkey, for example, given that the tourism sector offers great potential for economic growth and sustainable development, it is clear that adaptation to climate change impacts should be a priority.

UNESCO's report on the impacts of climate change on World Heritage and tourism (2016) includes the following recommendations to protect World Heritage sites:

- The policies on responding to climate change agreed by the States Parties to the World Heritage Convention at the 16th session must be fully implemented.
- World Heritage sites that are most vulnerable to climate change should be identified and their impacts should be continuously assessed, monitored and early warning systems should be developed.
- Climate vulnerability should be a criterion in the World Heritage site nomination assessment and registration process.
- Increasing resilience to climate change requires increasing the inclusion of wilderness areas on the list of World Heritage sites, ensuring connectivity between them and increasing resources for protected area management.
- The climate sensitivity of cultural heritage should be assessed at all levels, from local to international, and policies should be formulated to address this sensitivity.
- Past human behaviour against climate change should be researched, archaeological data and cultural heritage should be analysed and used to increase climate resilience.
- Strategies and policies should be developed to reduce greenhouse gas emissions in the tourism sector in line with the objectives of the Paris Agreement.
- Develop detailed climate change action strategies for tourism management and development in vulnerable regions.
- Requirements for preparedness for climate change impacts should be integrated into tourism planning at national level and in the field of implementation.
- Management tools should be developed to collect data on tourism and climate impacts.
- Policies and actions that are sensitive to gender equality and take a participatory approach to the impacts of climate change on tourism should be implemented.

- Develop tourism investment guidelines that promote inclusive and equitable development.
- The latest scientific and innovative approaches in adaptation strategies should be fully integrated into World Heritage site management planning.
- Ensure that effective preparedness and strategies are in place for risk mitigation and disaster response, and that these strategies are kept up to date by utilizing current climate science theories.
- Indigenous peoples and local communities should be involved at every stage of climate adaptation and tourism development.
- All tourism stakeholders need to cooperate for site management planning and implementation.
- In a changing climate system, World Heritage values and conservation needs need to be communicated to tourists, guides, site managers and local communities, and targeted programs need to be created to raise awareness.

As a result, climate change poses a serious risk to World Heritage sites that have been preserved for centuries. Considering the effects of climate change on both heritage sites and the tourism sector, it is clear that urgent action plans need to be put into action, especially in cities like Antalya where the tourism sector is at the forefront.

Key Findings for Antalya

Antalya is one of the most important cities in Turkey in terms of cultural and natural heritage. Within the borders of the city, there are cultural heritage elements such as ruins, mosques, churches, fortifications, archaeological sites that bear the traces of thousands of years of civilizations. This makes Antalya a destination not only for sea tourism but also for cultural tourism. Among the most important cultural heritage items within the borders of Antalya are ancient cities, archaeological sites, city walls and castles. Kaleiçi, the historical clock tower, Aspendos Ancient City, Olympos Ancient City, Myra Ancient City, Patara Ancient City, Perge Ancient City, Phaselis Ancient City, Side Ancient City, Termessos Ancient City are some of them. In addition to the cultural heritage of the city, natural heritage elements are also extremely important. The most important of these are Beydağları Coastal National Park, Patara Beach, Kekova, Gömbe-Akdağ-Uçar Su, Karaöz, Alakır, Kızlar Sivrisi, Çandır Valley, Saklikent, Deer Bayırı, Gelidonya Lighthouse, Naldöken, Koca İn, Kurşunlu Waterfall Natural Park, Köprülü Canyon, Oymapınar Dam, Akseki, Dim Stream Basin, Akdağ.

The cultural and natural heritage elements that reveal the identity of the city have made Antalya a tourism city. Approximately 10 times more domestic and foreign tourists than Antalya's population visit the city annually, and accommodation facilities with a high bed capacity of nearly 600 thousand are located in many areas of the city. The number of foreign tourists visiting Antalya between 2015 and 2020 is shown in Table 32. The fact that there will be a significant decrease in the number of tourists in 2020 due to the corona virus reveals that the city should focus on income sources other than tourism[78]. According to the data mentioned in the UAP (2016) and obtained from the Provincial Directorate of Culture and Tourism, Antalya Governorship, there are 555 protected areas in the province (Table 33).

Table 32: Number of foreign tourists visiting Antalya by years

Year	Number of Foreign Tourists

[78] *AFAD, İRAP, 2021.*

2021	9.094.051
2020	3.444.426
2019	15.280.763
2018	12.712.603
2017	9.738.962
2016	6.181.913
2015	10.875.464

Table 33: Distribution of the protected areas of Antalya province according to their types [79]

Types of protected areas	Number
Archaeological protected sites	531
Urban protected sites	11
Historical protected sites	1
Archaeological – natural protected areas	6
Urban – archaeological protected sites	10
Urban – archaeological – natural historical protected sites	1
Interaction transition area	5
Total	565

Although tourism activities in Antalya are mainly focused on sea tourism, other tourism activities in the city should also be promoted and kept on the agenda. Sea tourism in Antalya leads to mass tourism movement. This leads to the destruction of coastlines and seas. In addition, with the increasing demand, the pressure to build secondary housing and tourism facilities in coastal areas and in some agricultural areas, resulted in the destruction of city's natural areas. This situation indirectly leads to an increase in the effects of climate change. For this reason, certain tourism activities are more in demand than their capacity, so the need for new tourism activity areas increases. The tourism activities that are currently carried out in Antalya and whose capacities need to be increased are highland tourism, mountain tourism, yacht tourism, cave tourism, adventure-sports tourism, agricultural tourism, mountain and trekking tourism, bird watching tourism, botanical tourism, cycling tourism, underwater tourism, paragliding tourism, and cave tourism.

As a result, Antalya's cultural and natural heritage assets need to be meticulously examined in the context of climate change. Extreme weather events such as increasing heat waves, storms and tornadoes can lead to the destruction of historical sites. The lack of a comprehensive climate change-related tourism master plan in the city to prevent such weather events points to a major deficiency.

4.2.6 Public Health and Disaster Management

Climate change has both indirect and direct impacts on public health. Extreme weather events, infectious diseases, natural disasters, scarcity of water and food resources as a result of climate change have serious and negative impacts on human health. Extreme weather events such as heat and cold waves have a direct impact on human health and can even lead to sudden deaths. Air pollution and allergens also have a direct

[79] *Antalya UAP 2040, 2016.*

impact. Air pollution causes an increase in asthma, COPD and cardiovascular diseases and increases mortality. Allergens in the environment are extremely risky for human health if inhaled or ingested when contaminated with food.

It is possible to show infectious diseases and natural disasters as indirect effects of climate change. Changes in the ecosystem affect human health by causing the proliferation of vectors, leading to both the emergence of new diseases and the re-spread of infectious diseases that have declined. Another impact is the spread of infectious diseases, which can be caused by the reduction in water resources and the degradation of aquatic ecosystems. Climate disasters such as floods, storms and excessive rainfall, which occur as a result of climate change, cause injuries and deaths of people and increase property losses [80]. In this context, it is essential to take more precautions in cities regarding the increasing natural disasters and changing disaster characteristics due to global climate change.

According to the IPCC report on disaster management (2020)[81] disasters are defined as serious changes in the normal functioning of communities or society due to hazardous physical events interacting with each other. These changes lead to economic, social and environmental impacts, increasing vulnerability and creating the need for emergency response to meet critical human needs and support for recovery.

The most critical risk from increasing natural disasters and changing weather patterns is loss of life. This will be triggered by missing infrastructure, unplanned development and poor construction quality, while the risk will be higher for groups dependent on social support networks or with limited mobility (e.g., the elderly, children and people with disabilities). More severe heat waves and an increased need for cooling in summer will also trigger health problems for at-risk groups. Events such as floods and overflows will facilitate the spread of food and water-borne diseases, while rising temperatures will facilitate the spread of vector-borne diseases. New infectious diseases specific to tropical climates may also be seen.

As seen in Figure 58, the occurrence of climatic events, their impacts and exposure situations constitute disaster risk. In order to eliminate these risks or minimize the impacts of risks, it is necessary to reduce greenhouse gas emission rates that increase the impacts of climate change. In addition, it is very important to prepare and put into practice disaster risk management plans, and finally to implement climate change adaptation efforts.

[80] *Atik H., Global Warming, Climate Change and Its Socioeconomic Effects, Nobel Academic Publishing, 2017, sf:17.*

[81] *Dokken, D. (N.D.). Special Report of the Intergovernmental Panel on Climate Change Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.*

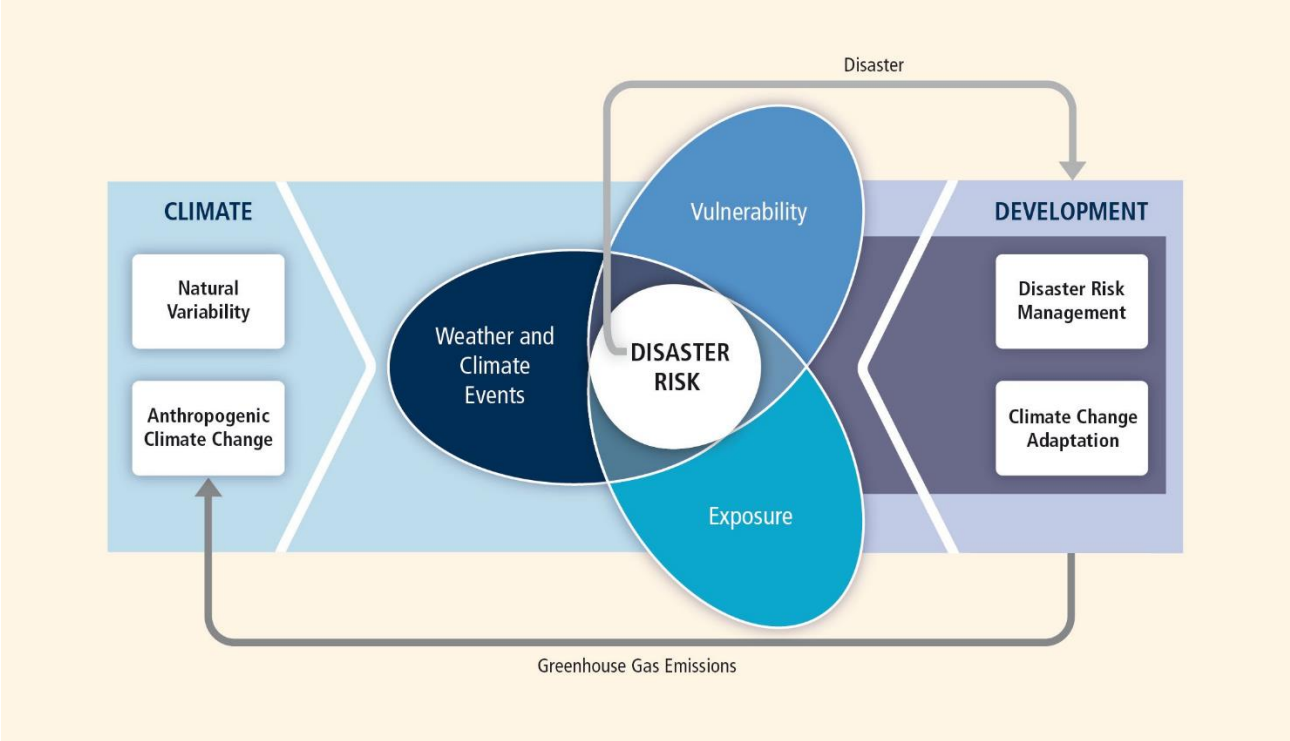


Figure 56: Demonstration of the relationship between disaster risk management and adaptation to climate change with basic concepts[82]

Key Findings for Antalya

Antalya is one of the provinces with the highest number of storms and tornadoes in Turkey, but it is also affected by high temperatures, especially in summer. Therefore, it is essential to take precautions knowing that the effects of climate change will create more risks in certain areas and population groups. It is clear that there is no detailed study on the direct effects of climate change on public health in the city, but there is a need for such a detailed study on extreme weather events. In the IRAP report prepared by AFAD in 2021, the number of vulnerable population groups was determined based on data from the Provincial Directorate of Family and Social Services. According to these values shown in Table 34, the ratio of the number of severely disabled and in need of care in Antalya is calculated as 0.92. Although this rate is low compared to the population, the number of vulnerable populations in Kepez, Muratpaşa, Alanya and Manavgat districts varies between 1000 and 4000.

Table 34: Vulnerable population distribution of Antalya by districts

District	Number of people with severe disabilities	Number of patients in need of care	Population	Ratio of the number of people severely disabled and in need of care to the population (%)
Akseki	73	71	10.957	1,31
Aksu	416	281	74.570	0,93
Alanya	1.593	1281	333.104	0,86
Demre	154	97	26.896	0,93
Döşemealtı	369	778	69.300	1,66
Elmalı	269	516	39.365	1,99
Finike	341	260	49.307	1,22

[82] *Special Report of the Intergovernmental Panel on Climate Change Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*

District	Number of people with severe disabilities	Number of patients in need of care	Population	Ratio of the number of people severely disabled and in need of care to the population (%)
Gazipaşa	460	156	51.555	1,19
Gündoğmuş	90	83	7.492	2,31
İbradı	35	20	2.947	1,87
Kaş	468	196	60.839	1,09
Kemer	157	113	45.082	0,60
Kepez	3.805	843	574.183	0,81
Konyaaltı	518	651	189.078	0,62
Korkuteli	345	400	55.588	1,34
Kumluca	346	346	71.931	0,96
Manavgat	1.243	906	242.490	0,89
Muratpaşa	2.202	2077	513.035	0,83
Serik	690	707	130.589	1,07
Antalya Geneli	**13.574**	**9782**	**2.548.308**	**0,92**

In addition to the vulnerable population of people with disabilities and people in need of care, societies with low socioeconomic development will also be more affected by climate change. In this context, according to the data in section 1.3.3 of the study, the districts of Antalya with the lowest development index are Gündoğmuş, İbradı, Elmalı, Demre, Akseki, Kaş, Gazipaşa, Finike, Korkuteli. These districts are followed from low to high by Kumluca, Serik, Kemer, Döşemealtı, Aksu, Alanya, Manavgat, Konyaaltı, Kepez and Muratpaşa. Therefore, it is possible to identify the regions that will be most affected in the event of a possible disaster. For this reason, the development of climate change adaptation strategies should first start from such areas and then be generalized throughout the city.

Antalya is a city that encounters climatic disasters quite frequently. Both its geographical structure and climate structure cause the weather news in the city are too many and varied. In addition to these, the fact that the climatic situation is changing day by day and the earth's temperature is increasing leads to the frequency and intensity of climatic disasters. In Antalya, floods, landslides, rockfalls, avalanches and heavy snowfall, earthquakes, fires, storms and tornadoes, heat waves and frosts are observed. Details on the risk and vulnerability posed by these events will be given in more detail in the risk and vulnerability assessment section of the study.

With Antalya being the 5th largest province of the country and the risks, it faces, Antalya Provincial Disaster and Emergency Directorate (Antalya AFAD) was established with the law in 2009. In addition, Antalya Provincial Disaster Plan (Antalya TAMP) was put into effect in 2014.

4.3 RISK AND VULNERABILITY ASSESSMENT FOR ANTALYA

In order to present the current situation of Antalya in the context of climate change, information on the basic situation of the district in terms of infrastructure systems, built environment, transportation and waste management, green infrastructure and forest areas, water resources and management, public health and disaster management is given in the previous section. In order to identify the risks and impacts of climate change in the future, a detailed risk and vulnerability assessment is required in line with the basic findings. The purpose of the risk and vulnerability assessment is to develop an understanding of the current and future climate risks faced by cities. In addition, this analysis will be the first step for the development of adaptation targets and actions within the scope of climate action plans.

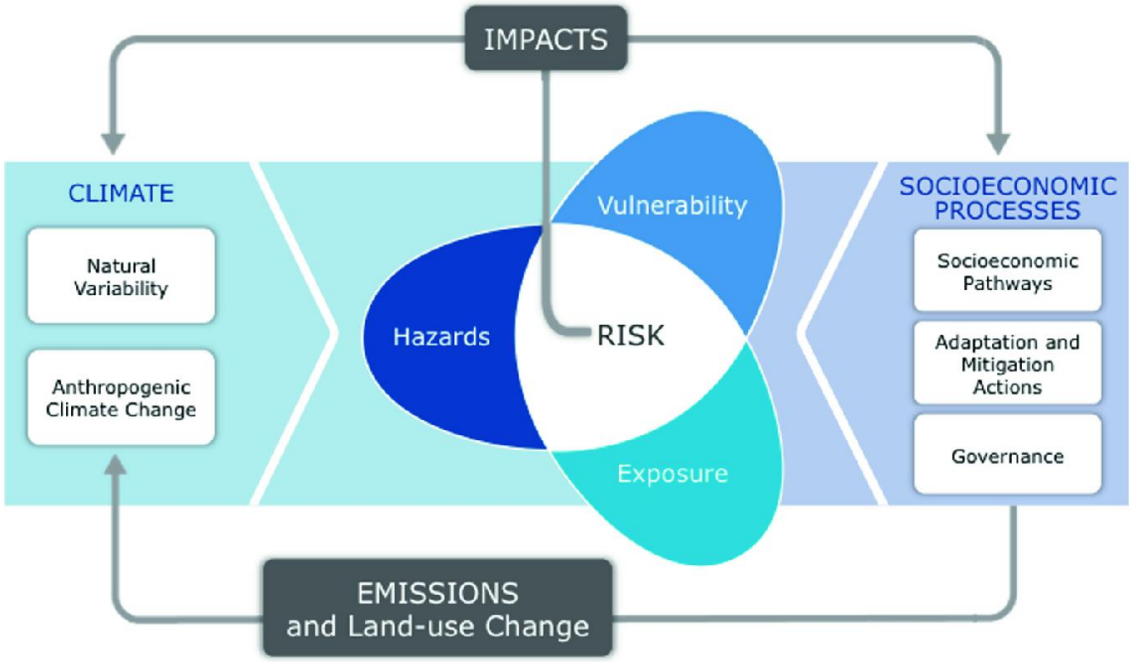


Figure 57: The socioeconomic process of climate risk[83]

The components of climate risk are hazard, exposure and vulnerability. In other words, climatic hazards become climate risks when vulnerable societies or communities are exposed to a particular hazard. Therefore, the need for climate adaptation plans arises. By implementing climate adaptation actions, regions and cities will build resilience and increase their adaptive capacity to climate-related shocks and stresses that will develop against these areas. However, before developing such adaptation actions, the risks of the region or city should be analyzed and an understanding specific to that area should be developed. In this context, it is shown in the diagram in Figure 59 prepared by IPCC.

Therefore, a risk and vulnerability assessment has been made for Antalya by taking into account the following topics: heat and cold waves, extreme precipitation, overflow and floods, sea level rise, storms and tornadoes, water scarcity and drought, forest fires and infectious diseases. As a result of this analysis, issues requiring urgent measures will be identified and recommendations will be put forward for Antalya's adaptation to climate change.

4.3.1 Risk and Vulnerability Assessment Methodology

According to the IPCC, the components of climate risk are hazard, exposure and vulnerability. In other words, climatic hazards become climate risks when vulnerable societies or communities are exposed to a particular hazard. Therefore, the need for climate adaptation plans arises. By implementing climate adaptation actions, regions and cities will build resilience and increase their adaptive capacity to climate-related shocks and stresses that will unfold against these areas. Therefore, before developing such adaptation actions, the risks of the region or city should be analysed and their resilience should be increased by developing an understanding specific to that area.

Resilience refers to the ability of a system (such as a community, business, natural environment) to adapt to an adverse situation or change. In other words, resilience is the capacity of a community, business or natural

[83] *Climate Risk and Vulnerability Assessment Methodology Climate Risk and Vulnerability Assessment (CRVA) Methodology, https://toolkit.climate.gov/tools, Data of access: March 2022.*

environment to respond to and recover from degradation. Climate resilience, on the other hand, refers to situations where adverse conditions or disruptions are related to climatic or extreme weather conditions. Therefore, in order to build climate resilience, it is necessary to prepare societies for climatic conditions, identify climatic risks and their impacts, and try to reduce the impacts of these risks.

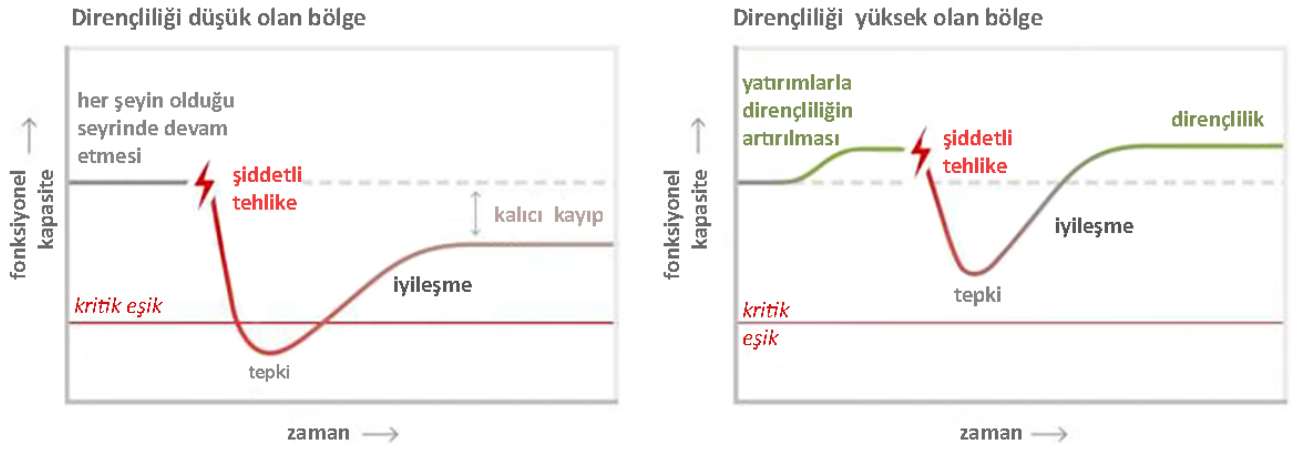


Figure 58: Resilience levels[84]

The graphs shown in Figure 60 illustrate two different levels of resilience. In the system on the left, life is maintained in a stable manner until a sudden danger occurs. As a result, when a sudden risk occurs, even if the system tries to maintain the service in line with its normal capacity, it cannot overcome the risky situation and a permanent loss cannot be prevented. In the system in the graphic on the right, the functionality of the system against risks has been increased by taking necessary precautions against possible risks before a sudden risk occurs. In this system, in the event of a sudden risk, the impact of the risk on the system will not be permanent and the damage can be overcome in a short time. From this point of view, by creating the resilience of cities, it will provide a more adaptable structure against future disruptions and risks and improve the conditions.

Within the scope of the study, these concepts are explained by utilizing the U.S. Climate Resilience Toolkit prepared for the states of the United States of America. The Climate Resilience Toolkit is a toolkit of digital tools, information, expert insights and sample action plans for building climate resilience[85]. In particular, the toolkit facilitates the use of information from all regions of the US and provides guidance on climate resilience and risk and vulnerability assessment. In this context, the steps to climate resilience according to the Climate Resilience Toolkit are shown in Figure 61.

The steps required to achieve resilience, shown in the climate resilience framework, represent a proven process to reduce climate-related risks. Following these steps, the climatic risks and hazards of the region are investigated. It is then assessed which groups, sectors and areas are more vulnerable according to the identified risks and hazards. Climate scientists and experts then contribute to integrating ecosystem and economic considerations for resilience into plans based on the baseline studies. Considering limited resources and competing options, a list of priority projects for building resilience needs to be developed prior to implementation. The final process involves the implementation of the identified actions and periodic monitoring of their impact.

[84] https://toolkit.climate.gov/, *Data of access: May 2022. * Taken from the source and translated into Turkish.*
[85] https://toolkit.climate.gov/, *Data of access: May 2022.*

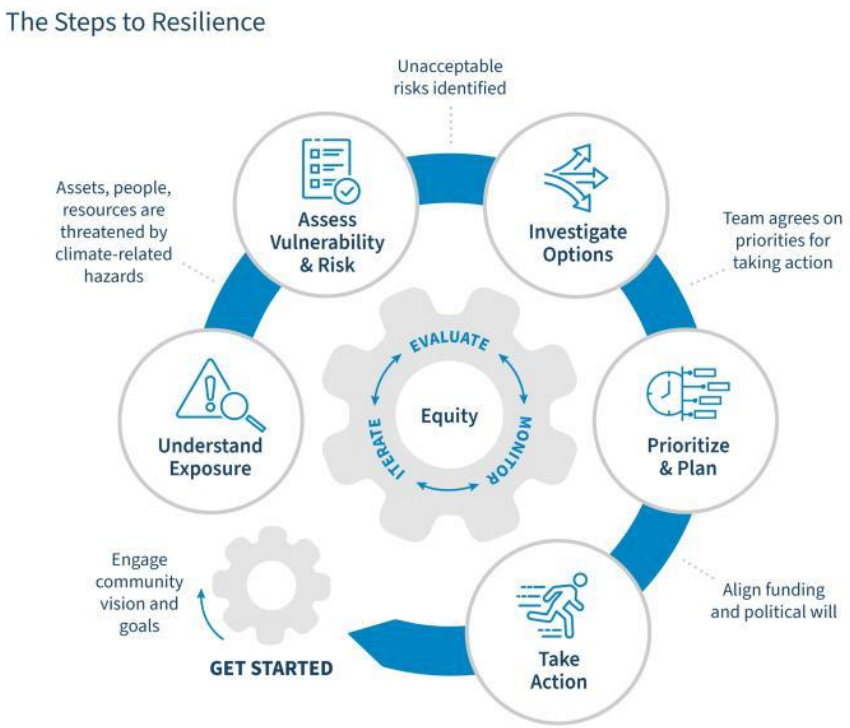


Figure 59: Climate resilience framework[86]

In this context, the climatic risks faced by Antalya, its current situation in the face of these risks, vulnerability assessment and possible future scenarios will be examined according to the methodology included in the Convention of Mayors. The first step for climate change risk and vulnerability assessment is to put forward a projection according to different climatic disasters. The climatic disasters considered for Antalya have been selected by taking into account the risks that the city has faced from past to present. Accordingly, climatic hazard topics are hot and cold air waves, extreme precipitation, floods and overflows, sea level rise, storms and tornadoes, drought and water scarcity, forest fires and infectious diseases.

The areas and sectors that will be affected by these climatic disasters are discussed in detail in the previous section where the current situation of Antalya is presented. The result of the risk and vulnerability assessment will guide the development of actions for emergency response areas by identifying priority issues for Antalya. In this respect, according to the risk and vulnerability assessment methodology of the Convention of Mayors, it is aimed to assess the probability of occurrence of the hazard and the impact of the hazard with low, medium and high degrees for the current risk situation of Antalya (Figure 62).

In order to reveal the future risk status of Antalya, the expected change in the intensity of the hazard as well as the expected change in the frequency of the hazard will be evaluated with low, medium and high degrees. In addition to this, determining the time interval (short, medium and long term) in which the climatic hazard will occur is also important in terms of presenting future scenarios. Another issue is that if the impact and timeframe of the hazard is unknown, the assessment status should be treated as unknown.

Unknown	Low	Medium	High

Figure 60: Climate change risk and vulnerability assessment levels

[86] https://toolkit.climate.gov/, *Accessed on May 2022. *Taken from the source and translated into Turkish.*

In addition, it is also important to identify the level of impacts of climate hazard on sectors and areas, and on which population groups it is most impactful. According to the CoM methodology, population groups are women and young girls, children, youth, the elderly, marginalized groups, people with disabilities, people with chronic diseases, low-income groups, unemployed people, people living in substandard housing, migrants, homeless people and others. Determining which groups and sectors are affected by climatic hazards in Antalya is very important in terms of the measures to be taken. In this context, Table 35 shows the information that needs to be obtained.

As a result, determining the climatic hazards and impact levels that Antalya, one of Turkey's leading cities in terms of agriculture and tourism, faces in the context of climate change should be handled as a separate study in a much more systematic and detailed manner, using risk analysis methods appropriate to the literature. The risk and vulnerability assessment within the scope of this study was conducted online with a consortium of internal and external stakeholders of Antalya Metropolitan Municipality, using specific survey methods and qualitative values.

Table 35: Table of information that needs to be transferred to the Covenant of Mayors system

Climatic hazard	Current risk situation		Future risk status				Sectors		Vulnerable population	
	Possibility of hazard	Impact of hazard	Expected change in hazard intensity	Expected change in hazard frequency	Time intervals		Vulnerable sectors	Level	Population groups	Selection
					Short term	☐	Buildings		Women and young girls	☐
									Children	☐
							Transportation		Youth	☐
									Seniors	☐
					Middle term	☐	Energy and infrastructu		Marginal groups	☐
									Disabled people	☐
							Health and disaster management		Group with chronic disease	☐
									Low income group	☐
					Long term	☐	Agriculture and livestoc		Jobless	☐
									Group living in low standard housing	☐
							Tourism		Agricultural and tourism workers	☐
									Immigrants	☐
					Unknown	☐	Ecosystem services and biodiversity		Others	☐
									All	☐

4.3.2 Risk and Vulnerability Assessment Online Workshop

The risk and vulnerability assessment of Antalya in the context of climate change was completed in an online workshop with the participation of Antalya Metropolitan Municipality and stakeholders. On April 27, 2022, during the workshop, general information about climate change was provided and the impact levels of the risks identified for Antalya, their impacts on sectors and vulnerable groups, as well as information on which districts are more intense were discussed.

A total of 91 people, both internal and external stakeholders of Antalya Metropolitan Municipality, participated in the workshop. The list of institutions invited to the workshop is available at the end of the study as an Appendix. The workshop was completed in approximately three hours using the online tools Mural and Mentimeter. The workshop schedule is shown in Table 36. The aim of the workshop was to complete the risk and vulnerability assessment in line with expert opinions, taking into account the current situation of Antalya in the context of climate change.

Table 36: Workshop plan

Hour	Workshop plan (27.04.2022)	Means

09:30 – 09:45	Antalya Metropolitan Municipality opening speeches	
09:45 – 10:00	Information presentation on the Adaptation action plan	
10:00 – 10:40	Risk and vulnerability assessment survey	Mentimeter
10:40 – 11:20	Determining the effects of climate change risks on sectors for Antalya	Mural
10 minuıtes break		
11:30 – 12:15	Determination of risky areas in Antalya province	Mural
12:15 – 12:30	Closing	

In the first part of the workshop, an informative presentation on climate change adaptation was made. In the following process, online tools were used to enable participants to contribute to the process interactively. For this purpose, the first stage of risk and vulnerability assessment, determining the impact levels of risks and prioritizing vulnerable groups, was discussed. In order to use the time efficiently, the types of risks were determined as 8 by considering the current situation and future scenarios of Antalya (Figure 63):

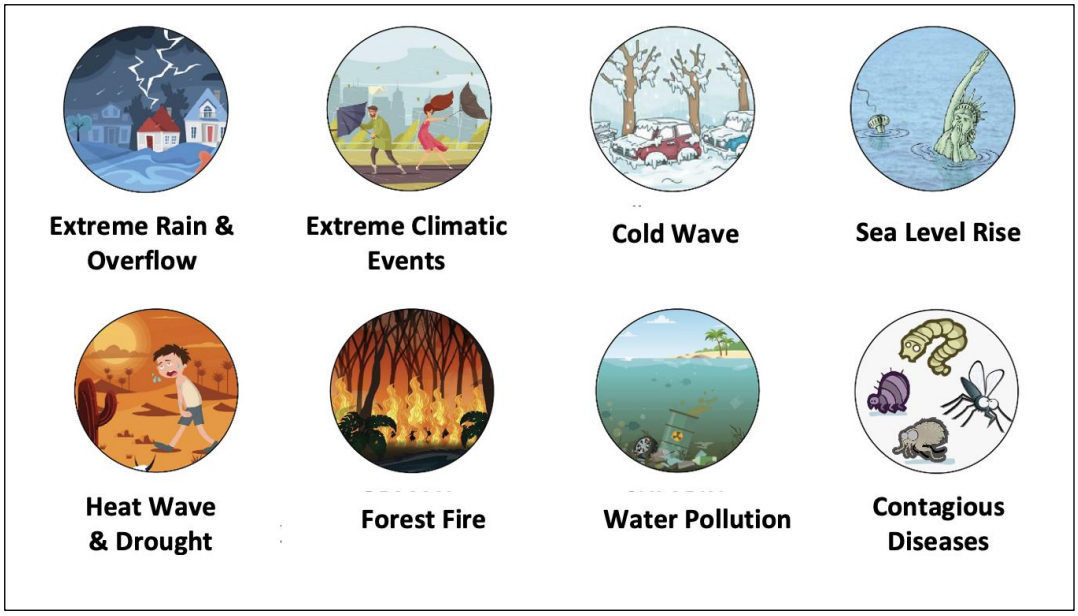


Figure 61: Climatic hazards identified for Antalya

In order to determine the impact of each risk on Antalya, the impact levels of the risks were divided into 4 groups according to the CoM methodology:

Unknown Low Medium High

Figure 62: Impact levels of risks

In the first stage, detailed information about these 8 climatic hazards identified for Antalya was prepared in presentation format and transferred to the Mentimeter online tool. In addition, a two-question questionnaire was prepared for each risk to determine the impact level of the risks in the current situation

and future projections. During the workshop, after discussing the status of each climatic hazard with the participants, they answered the survey questions related to the climatic hazard. Although not all of the participants answered each question, the participation rate in the survey was high.

Table 37 shows how many people voted for the risk levels of each climate hazard in the current and future scenarios.

Table 37: The results of the survey carried out to determine the level of impact of the risks

Risk level of extreme precipitation and flood events for Antalya			
Impact level		**Current situation**	**Future forecasts**
	Unknown	-	-
	Low	2	-
	Medium	4	6
	High	55	50
Risk level of extreme weather events for Antalya			
Impact level		**Current situation**	**Future forecasts**
	Unknown	-	-
	Low	-	-
	Medium	13	6
	High	44	44
Risk level of cold air wave for Antalya			
Impact level		**Current situation**	**Future forecasts**
	Unknown	-	1
	Low	10	8
	Medium	27	26
	High	12	9
The risk level of sea level rise for Antalya			
Impact level		**Current situation**	**Future forecasts**
	Unknown	-	-
	Low	10	2
	Medium	27	19
	High	16	17
Risk level of heat wave and drought for Antalya			
Impact level		**Current situation**	**Future forecasts**
	Unknown	-	-
	Low	2	1

	Medium	5	3
	High	46	53

The risk level of forest fires for Antalya			
Impact level		Current situation	Future forecasts
	Unknown	-	-
	Low	-	-
	Medium	4	-
	High	54	48

Risk level of water pollution for Antalya			
Impact level		Current situation	Future forecasts
	Unknown	-	1
	Low	5	1
	Medium	19	17
	High	29	28

Infectious diseases risk level for Antalya			
Impact level		Current situation	Future forecasts
	Unknown	3	3
	Low	10	2
	Medium	24	21
	High	18	18

According to the results of the survey, it is seen that the risks of climatic hazards in both the current situation and future projections of the city are at high and medium levels. The risk levels of climatic hazards revealed by the survey results are shown in Table 38.

Table 38: Risk impact levels in the current situation and future forecasts for Antalya

RISKS AND RISK LEVELS	 Excessive rainfall and flood	 Extreme weather events	 Cold wave	 Sea level rise	 Heat wave and drought	 Forest fires	 Pollution of waters	 Infectious diseases
Current situation								
Future forecasts								

In the last part of this phase, the prioritization of vulnerable groups that will be affected by climatic hazards was also ensured. A total of 64 people participated in the survey prepared for this purpose. Figure 65 shows

the vulnerability status of the groups in the CoM system, which constitute the majority in Antalya, according to the survey results.

In the second phase of the workshop, it was aimed to evaluate the impact of the climatic events on the sectors and for the participants to express their opinions on this issue. The impact level of climatic events on the sectors was determined as unknown, low, medium, and high as in the previous phase. In addition, the sectors for Antalya are grouped as shown in Figure 66:

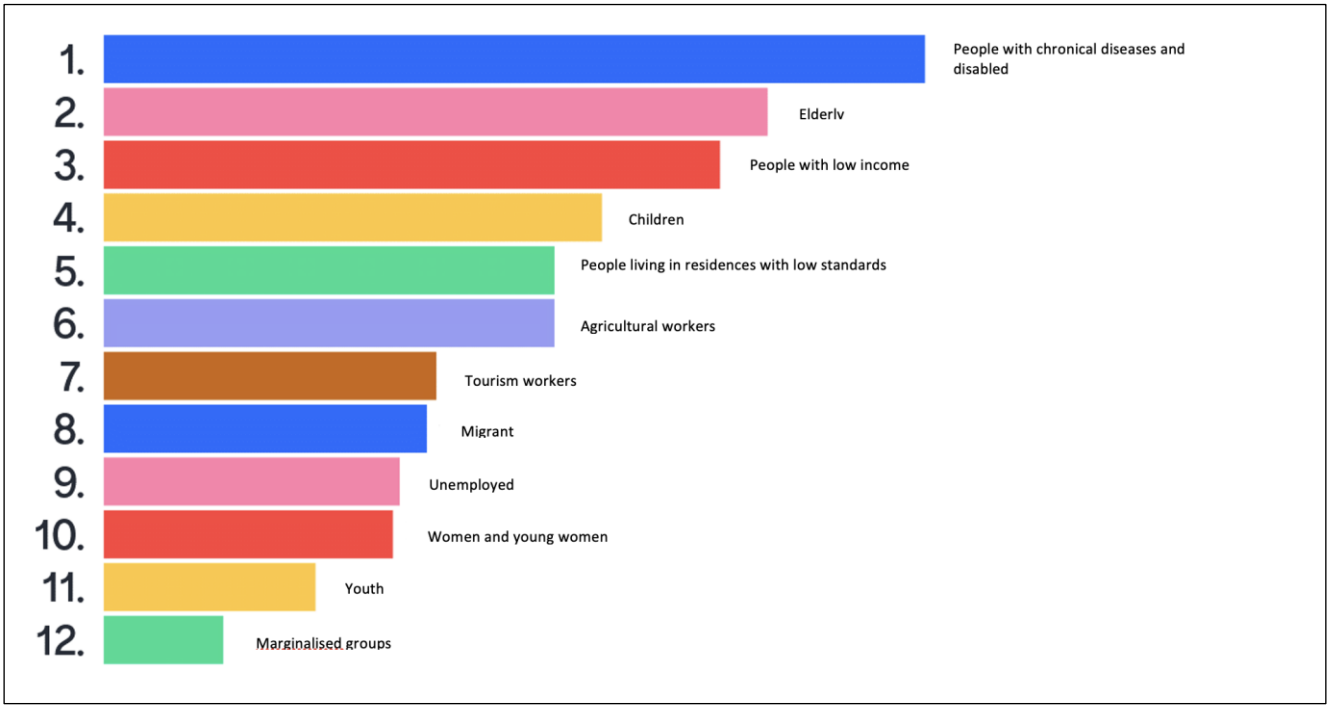


Figure 63: Survey result of prioritization of vulnerable groups that will be affected by climate hazards

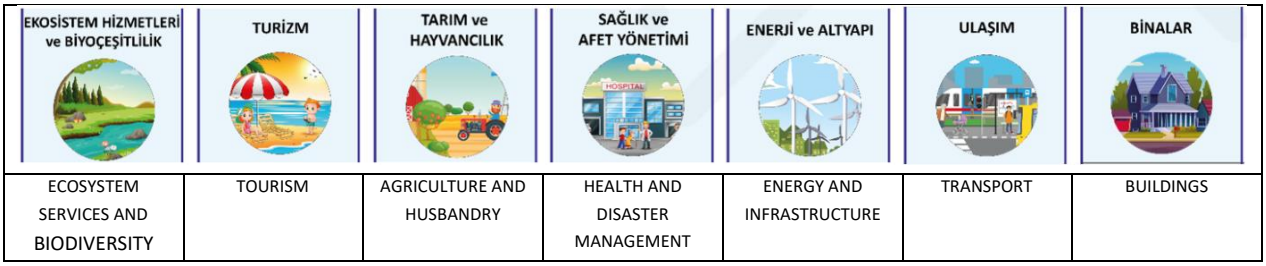


Figure 64: Sectors identified in risk and vulnerability assessment

In this part of the workshop, the participants were asked to use the Mural tool to move the impact level markers they deemed appropriate to the intersection of sectors and climatic events.

The exclamation points coloured according to the risk impact levels shown in Figure 67 were moved to the appropriate areas by the participants. The result obtained at the end of this process is shown in Figure 68. According to this result, it is seen that the risk of extreme precipitation and flood is high for all sectors. Extreme weather events are determined to have a high-risk impact on all sectors except buildings and energy and infrastructure sectors. The impact of a cold wave on the transportation sector is determined to be low, while the risk to other sectors is determined to be medium. Heat waves and droughts are identified as high

risk in all sectors except transportation and health and disaster management. Forest fires are identified as high risk for all sectors except transportation, energy and infrastructure, and health and disaster management. Water pollution is identified as low risk for buildings, transportation and energy and infrastructure sectors, but high risk for all other sectors. Finally, infectious diseases are identified as low risk in buildings, transportation, energy and infrastructure, health and disaster management, medium risk in agriculture and livestock, and high risk in tourism and ecosystem services and biodiversity.

Figure 65: The result obtained by determining the effects of risks on sectors using Mural

Figure 66: Impact of climatic events on sectors in Antalya

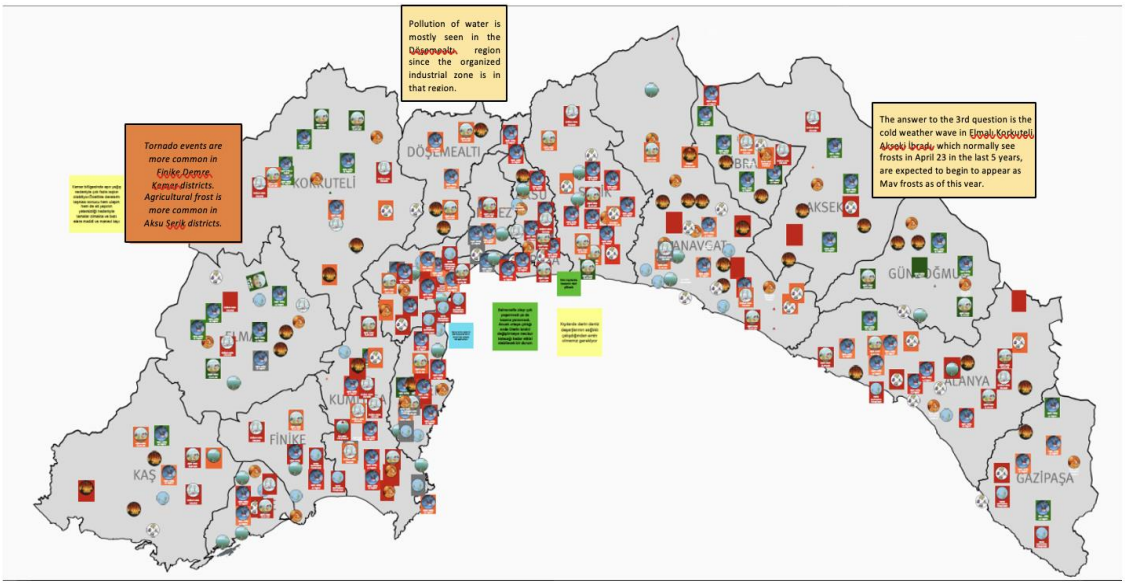


Figure 67: Antalya districts where climatic hazards are effective according to risk levels

In the last stage of the workshop, it was aimed to determine the distribution of climatic events in Antalya districts. In this direction, again using the Mural tool, it was aimed to place the climatic events coloured according to 4 different impact levels on a map with clear district boundaries. As in the previous stage, the participants moved the climatic event icons according to the climatic events and impact levels to the area they found appropriate on the map. As seen in Figure 69, it was revealed that climatic events were more intense in the coastal areas of the city.

Especially extreme weather events are identified as high risk throughout Antalya, especially in coastal districts. Following this, the risk of excessive rainfall and flooding is also highly marked, especially in coastal districts. Infectious diseases and water pollution are also seen as high and medium risk for coastal areas. Following this, forest fires are also seen as high risk.

As a result, the risks posed by climatic hazards for Antalya were discussed during the workshop and expert opinions were utilized. In the next section of the study, these climatic hazards identified according to the CoM strategy are detailed and the risks posed by each hazard for Antalya are presented based on the workshop data.

4.3.3 Climatic Risks for Antalya

Detailing the climatic hazards faced by Antalya due to its geographical structure, location and climatic characteristics is extremely important for determining adaptation actions. In this regard, the outputs of the online workshop conducted within the scope of risk and vulnerability assessment, the contributions made by the participants during the workshop, scientific data and academic studies on Antalya were used to detail the climatic hazards. In addition, within the scope of IRAP prepared by AFAD in 2021, the disasters and scientific data addressed for Antalya were also discussed. Table 39 and Table 40 show the disaster data between 2013-2020 included in the AFAD report. These disasters are listed as flood, flood, rockfall, landslide, fire, earthquake, heavy snowfall, storm, and tornado.

Table 39 shows the number of disasters that occurred in Antalya between 2003-2021. Table 40 shows the number of houses and workplaces that were damaged as a result of these disasters and can be registered. Accordingly, the most common disasters are meteorological disasters and floods. The disasters that caused the most damage to dwellings and workplaces were rockfall and landslide.

Table 39: Disasters in Antalya, 2003-2020 [87]

Risks	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Flood-overflow	3	15	3	14		1	10	10	5	4	9	12	14	10	10	10	2	2
Landslide	3	2	1	2			4	6	7	30		1	3	1	2	2	3	1
Rockfall		1	1	2			1											
Avalanche/heavy snowfall			1							1				1	1			
Earthquake										2	2	1	1			1	8	7
Fire			1			1		1		4	2	3	2	2	7	9	2	2
Storm- tornado	3	4	2	1				2		3	3	2	1	5	3	1		

[87] *AFAD, İRAP, 2021.*

Table 40: Number of residences/businesses affected/probable to be affected by the disaster, 2003-2020 [88]

RiskS	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Flood-overflow	40	297	11	4		12	50	7	59	1	10	595	28	7		64		
Landslide	7	11	2	7			8	60	10	53		1	14		25	21	18	3
Rockfall		1	15	17						1								
Avalanche/heavy snowfall										11								
Earthquake			1			55		2		52	4	1	355			4		4
Fire		2	22					3		3	2	14	4	31	20		7	
Storm- tornado	3									1	27	9		10	353			

In this direction, the climatic hazards and disasters of the city will be examined in more detail within the scope of this section, and the risk and vulnerability assessment will be completed for the development of climate adaptation actions.

4.3.3.1 Risk of Heat and Cold Waves

A heat wave is a period of surface temperatures above the expected normal temperature, occurring over a period of days or weeks. Heat waves can last for days or weeks. In addition, this climatic hazard affects both developed and developing countries and can cause deaths. Observed since the 1950s, heat waves have increased in intensity in recent years, causing drought, dehydration and public health problems such as heat stroke. Other effects of heat waves are forest fires and water scarcity. These climatic hazards are evaluated separately within the scope of the study.

Antalya's average temperature values have been increasing since the 1980s. This situation causes an increase in the frequency and increase in heat waves, especially in the summer months. In the Subscribe to DeepL Pro to edit this document. Visit www.DeepL.com/profor more information. summer months, the air temperature is above 40°C, posing a risk to public health. In addition to the negative impact of heat waves on human health in general, the impact on vulnerable groups is particularly severe. It is possible to say that this event may have a greater impact on people with chronic heart and lung diseases, the elderly and children. Extreme hot weather not only increases the number of hospital admissions of vulnerable groups, but also leads to an increase in mortality rates among these groups. In a study conducted by Oktay et al. for Antalya in 2009, it was revealed that people with heart failure were more likely to apply to emergency services in summer and in high temperatures. Research on this issue needs to be elaborated both nationwide and in Antalya and a public health database needs to be established.

Heat and cold waves also have negative impacts on agricultural areas. Increasing maximum average temperature, number of hot days and heat waves across the region cause burning or loss of crops and increase in diseases and pests. The decrease in the number of frosty days in inland areas such as Elmalı, Korkuteli, Tefenni, Burdur, Isparta, Beyşehir and Seydişehir due to the increase in the average temperature, and the extension of the growing season with the narrowing of the cold cycle periods; produce positive results in the short term in terms of agricultural aspects such as multiple harvests and more product diversity

[88] *AFAD, İRAP, 2021.*

during the year. However, the increase in maximum temperature values and the duration of the warm period also leads to an intensification of evaporation and drought conditions. This will lead to a decrease in crop productivity and water resources. With the unconscious agricultural irrigation in Antalya, the lakes in the Lake District will face the danger of decreasing water level and even drying up. The increase in heat waves will increase the possibility of forest fires in these regions, especially in Fethiye, Elmalı, Korkuteli, Burdur, Manavgat, Alanya in the summer period.

Changing thermal comfort conditions with increasing temperatures will also affect coastal tourism, which is an important sector for the region. It is very important to carry out the necessary adaptation studies for the tourism sector as increasing temperatures in summer periods may cause more energy needs, insufficient water supply, infectious diseases, stress and poor-quality air conditions.

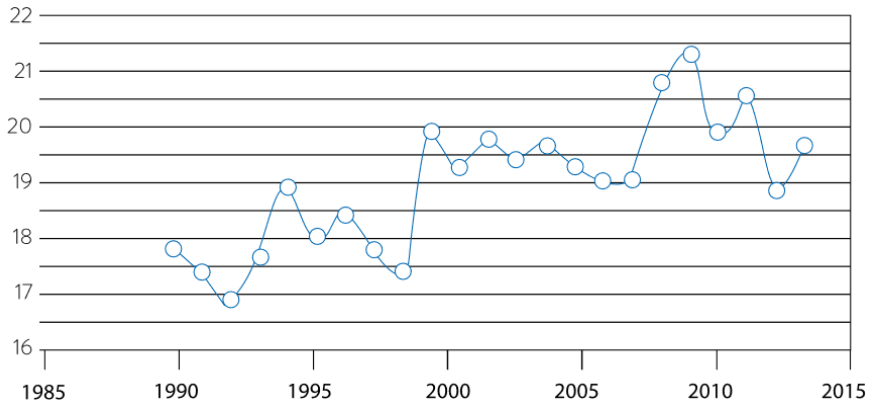


Figure 68: Antalya annual average temperatures (1990-2015)[89]

The most important issue that increases the impact of heat waves is the urban heat island effect and the lack of green areas. The rapid increase in population density with the urbanization process of Antalya has created pressure on rural areas and caused a decrease in agricultural areas and green areas. The decrease in forest areas along with green areas has also increased the level of sensation of air temperatures, leading to an intense urban heat island effect in the city. In this context, Antalya's temperature changes between 1985 and 2015 are shown in the graph in the 7th National Communication of Turkey (Figure 70).

As can be seen in the graph in the figure, the average temperatures of the city have been increasing after the 1990s. In addition to this, according to another study conducted for Antalya, the average temperature changes between 1980 and 2019 were tabulated in 10-year periods according to months (Table 41) [90]. In the last 10-year period, an increase in temperature is observed in all months except May.

Table 41: Average temperature changes between 1980 and 2019

STATION NAME/NO: ANTALYA / 17300, Monthly Average Temperature (°C)												
Years/ Months	1	2	3	4	5	6	7	8	9	10	11	12
1980-1989	9,44	9,39	11,55	15,8	19,95	24,74	28,02	27,52	24,17	18,77	13,55	10,57
1990-1999	9,19	9,72	11,82	15,33	20,18	25,3	28,16	27,97	24,21	19,99	14,24	10,88

[89] *Ministry of Environment and Urbanization, 7. National Statement, 2014.*

[90] *Ünal A., Özaslan B., Ünal O, İklim Değişikliğinin Antalya İlindeki Culex pipiens Linnaeus, 1758 (Diptera: Culicidae, Ev Sivrisineği)'e Etkisi, Sinop Uni J Nat Sci 5 (2): 147-162(2020), ISSN: 2536-4383.*

2000-2009	9,84	10,67	13,46	16,53	21,24	26,47	29,38	29,04	25,22	20,79	15,17	11,39
2010-2019	10,3	11,89	13,9	17,3	21,17	25,54	28,96	29,59	26,37	21,04	16,05	11,81

The current situation and projections in international studies reveal that Antalya will experience an increase in temperature and drought in the coming years. Extreme heat waves not only threaten human health but also pose a serious danger in the increase of forest fires. The results of the survey and the participants' contributions during the workshop are shown in Table 42.

Table 42: Risk and vulnerability table for heat wave

Climatic hazard	Current risk situation		Future risk status				Sectors		Vulnerable population	
	Possibility of hazard	Impact of hazard	Expected change in hazard intensity	Expected change in hazard frequency	Time intervals		Vulnerable sectors	Level	Population groups	Selection
 HEATWAVE	High	High	High	High	Short term	☑	Buildings	High	Women and young girls	☐
									Children	☑
							Transportation	Low	Youth	☐
									Seniors	☑
					Middle term	☐	Energy and infrastructu	High	Marginal groups	☐
									Disabled people	☑
							Health and disaster management	High	Group with chronic disease	☑
									Low İncome group	☑
					Long term	☐	Agriculture and livestoc	High	Jobless	☑
									Group living in low standard housing	☑
							Tourism	High	Agricultural and tourism workers	☑
									Immigrants	☑
					Unknown	☐	Ecosystem services and biodiversity	High	Others	☐
									All	☐

Another climatic hazard related to air temperatures is the cold wave. A cold wave is a weather phenomenon that occurs when the air suddenly cools or very cold air spreads over a large area. A cold wave is characterized by a temperature drop well below the average temperature in a region. A cold wave can be seen in the form of snow or ice storms, or it can be exacerbated by strong winds. Cold waves directly affect public order and public health by adversely affecting people, machinery, property, products, agricultural areas and services. [91]

The cold wave poses a great risk to agricultural areas and greenhouses, especially in winter. This climatic hazard, which causes agricultural frost, poses a great danger to agricultural production. However, the impact of cold waves on vulnerable groups is also serious. In particular, homeless people and people with cardiovascular disease are affected by cold waves. Frost hazards in Antalya are most common in January, February, December and March (Figure 71 [92]).

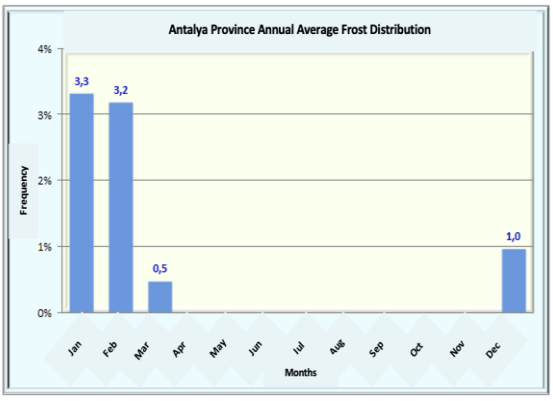


Figure69: Annual average frost distribution of Antalya

he early warning system of the General Directorate of Meteorology is used to mitigate the impact of risks posed

[91] https://www.ifrc.org/cold-waves, *Erişim tarihi: Nisan 2022.*

[92] *https://mgm.gov.tr/tarim/zirai-don-uyari-sistemi-harita.aspx?s=takvim, Erişim tarihi: Nisan 2022.*

by extreme cold waves on the agricultural sector. This warning system provides seasonal forecasts and information on whether crops are at risk. [93]

During the workshop, it was emphasized that the cold wave had a negative impact on greenhouse activities. It was stated that the risk of agricultural frost is more frequent especially in Aksu and Serik districts. In addition, it was determined that frost events, which have been seen towards the end of April in Elmalı, Korkuteli, Akseki and Ibradı districts for the last five years, will start to be seen in May as of 2022. The information obtained as a result of the workshop and the survey results are shown in Table 43.

Table 43: Risk and vulnerability table in terms of cold air wave

Climatic hazard	Current risk situation		Future risk status				Sectors		Vulnerable population	
	Possibility of hazard	Impact of hazard	Expected change in hazard intensity	Expected change in hazard frequency	Time intervals		Vulnerable sectors	Level	Population groups	Selection
 COLD WAVE	Medium	Medium	Medium	Medium	Short term	☐	Buildings	Medium	Women and young girls	☐
									Children	☑
							Transportation	Low	Youth	☐
									Seniors	☑
					Middle term	☐	Energy and infrastructu	Medium	Marginal groups	☑
									Disabled people	☑
							Health and disaster management	Medium	Group with chronic disease	☑
									Low İncome group	☑
					Long term	☐	Agriculture and livestoc	Medium	Jobless	☑
									Group living in low standard housing	☑
							Tourism	Medium	Agricultural and tourism workers	☑
									Immigrants	☑
					Unknown	☑	Ecosystem services and biodiversity	Medium	Others	☐
									All	☐

4.3.3.2 Extreme Rainfall, Overflow and Floods

Heavy and sudden precipitation describes situations where the amount of rain, hail or snow in a region significantly exceeds the normal amount of precipitation. The period of intense precipitation varies according to regions and seasons. However, climate change has affected the intensity and frequency of precipitation, especially in recent years. As sea and ocean temperatures rise, evaporation of water increases. This causes more water vapor to accumulate in the atmosphere, affecting more moisture-laden air-land systems. These systems sometimes turn into a storm system or precipitation system, causing sudden and excessive rainfall. Sudden and excessive rainfall not only affects agricultural areas but also causes soil erosion.[94]

When cities face inadequate infrastructure systems as a result of heavy and sudden rainfall, the risk of flooding and inundation arises, leading to loss of life and property. Flooding is a climatic hazard usually caused by heavy rainfall with thunderstorms and storms. Flood risk can also be caused by the breakage and damage to dam gates or levees in the area. Factors such as rainfall intensity, location and distribution of rainfall, land use and topography, plant species and soil type determine how effective flash floods can be. Urban areas whose infrastructure is not suitable for sudden and heavy rainfall are in a very risky position in terms of flooding and flooding. If urban areas have a lot of impermeable surfaces, water does not infiltrate into the ground and water can flow very quickly to low points. Sudden floods can occur so fast that people can be

[93] https://zdus.mgm.gov.tr/, *Date of access: April, 2022.*
[94] https://www.epa.gov/climate-indicators/climate-change-indicators-heavy-precipitation#tab-3, *Date of access :April, 2022.*

caught unprepared for this situation and may face loss of life and property. [95] Factors that increase the risk of overflows and floods are listed below:

- Flooding from coastal, river and rainfall sources brings additional stress and risk to the built environment. This additional risk causes damage to businesses, residences, critical infrastructure, etc. in the built environment.
- Impervious surfaces in green areas increase the risk of flooding. In addition, an increase in extreme flood events can lead to loss of habitats and damage to ecosystems.
- Increases in flooding events put more pressure on water systems, which are often located at lower altitudes and therefore at higher risk of flooding.
- Floodwater affecting landfills increases the risk of surface and groundwater pollution.
- Increased pollution of surface and groundwater due to flooding poses risks to human health, such as the spread of water-borne infectious diseases. In addition, flood waters pose a vital risk to society.

Due to its geographical structure and location, Antalya has been receiving sudden and excessive rainfall especially in recent years. Incorrect construction and inadequate infrastructure sometimes cannot meet these rainfall systems, causing floods and overflows. According to a 2015 study conducted for Antalya, floods and overflows occurred in 1993, 1995, 1999, 2001, 2002, 2003, 2009, 2010 and 2013 after sudden and heavy rainfall, resulting in loss of life and property. After 2013, floods and overflows continued to occur frequently in Antalya. One of the most important of this news was the flood and overflows event that occurred in the Elmalı district of Antalya in 2018. An academic study was conducted on this event in 2019 and photographs of the event were shared (Figure 72). [96] In the following years, floods frequently occurred in Antalya.

95 https://www.weather.gov/phi/FlashFloodingDefinition, Date of access: May 2022.
96 Fural, Ş., Cürebal, İ., İnan, F. (2019) Elmalı'da (Antalya) Geomorphological Analysis of Torrent, Flood and Mud Flow Disasters Triggered by Rainfall in Elmalı (Antalya - TURKEY), Journal of Geomorphological Researches, 2019 (3): 49-61.

Figure 70: The flood and overflow event that occurred in Antalya- Elmalı (Salur countryside) in 2018

According to the 2021 IRAP report of AFAD, flood disasters that occurred in the city between 1975 and 2020 were analyzed. Table 44 and Figure 73 show the number of flood disasters by districts. According to these data, the highest number of flood disasters in Antalya occurred in the central districts of Döşemealtı, Kepez, Muratpaşa, Aksu and Konyaaltı. In addition, the districts with the highest number of flood disasters were Kumluca, Finike, Manavgat, Kemer, Demre, Alanya, respectively.

Table 44: Number of flood disasters between 1975-2020 by districts[97]

District	Merkez	Kumluca	Finike	Kemer	Manavgat	Demre	Alanya	Kaş	Elmalı	Korkuteli	Serik	Akseki	İbradı	Gazipaşa	Gündoğmuş
Number of flood disasters	14	6	6	5	5	5	4	2	1	1	1	0	0	0	0

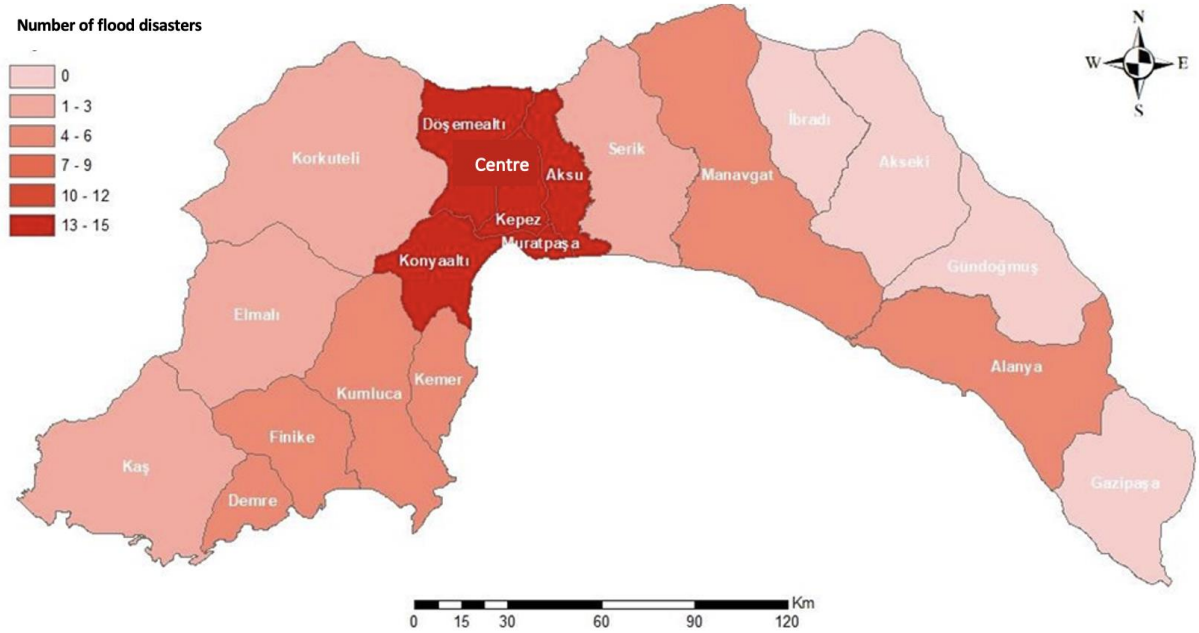


Figure 71: Distribution of flood disasters in Antalya between 1974-2020 by districts[98]

[97] *AFAD, İRAP, 2021 (DSİ data).*
[98] *AFAD, İRAP, 2021 (DSİ data).*

In addition to the flood risk, flood disasters occur frequently in Antalya. According to the latest report prepared by AFAD, the total rainfall in the city is 1085 mm. In Manavgat and Alanya districts, this rate is measured as 1100 mm. However, 80% of the total annual precipitation occurs in the winter months. For this reason, the flood risk caused by the high flow rate of precipitation during these months is quite high.

According to AFAD's IRAP report (2021), the number of flood disasters between 1975 and 2020 was mentioned in the study created with data obtained from the 4th Regional Directorate of Meteorology. According to these numbers in Table 45 and Figure 74, the districts with the highest number of flood disasters were the central districts of Döşemealtı, Kepez, Muratpaşa, Aksu and Konyaaltı. This is followed by Alanya, Kaş, Manavgat, Demre, Finike, Elmalı, Korkuteli and Serik districts.

Table 45: Distribution of flood disasters between 1975 and 2020 by district [99]

District	Merkez	Alanya	Kaş	Manavgat	Demre	Finike	Elmalı	Korkuteli	Serik	Akseki	Gazipaşa	Kumluca	Gündoğmuş	İbradı	Kemer
Number of flood disasters	57	47	19	14	12	12	6	4	4	2	1	1	0	0	0

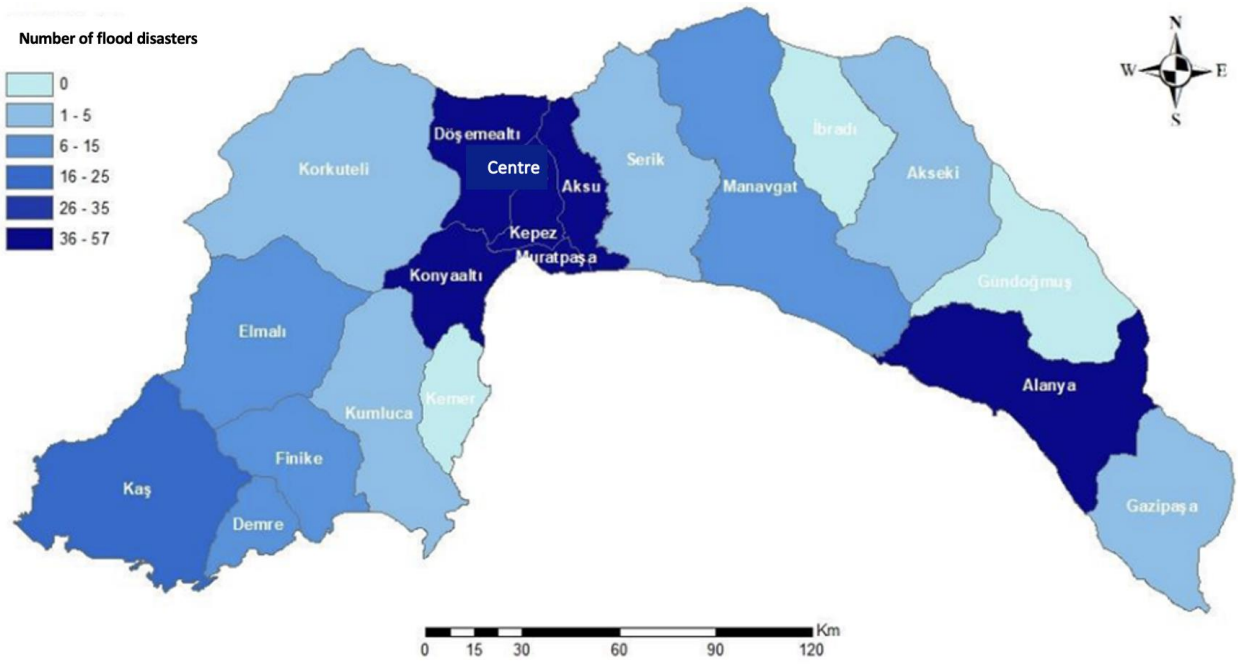
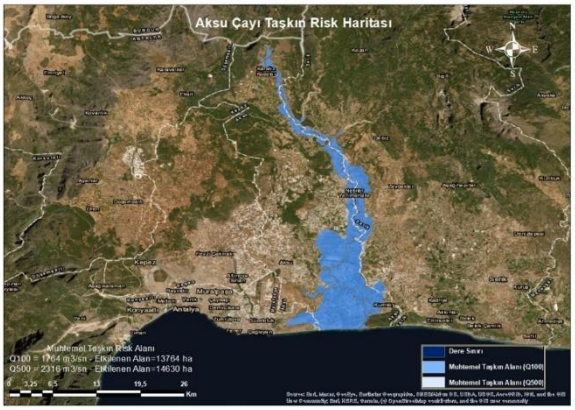


Figure 72: Distribution of flood disasters between 1975-2020 by districts [100]

The fact that the central districts of Antalya border the Mediterranean Sea, have a high population density and urbanization increases the risk of flood disasters. In the online workshop on risk and vulnerability assessment of Antalya in the context of climate change, the situation of the city in terms of flooding and flooding in both current and future scenarios is determined as high risk. In the IRAP report prepared by AFAD in 2021, the flood zone limits of the streams and rivers in the city were calculated. As can be seen in Figure 75, although the boundaries of the streams and rivers are quite narrow, the possible flood area boundaries

[99] *AFAD, İRAP, 2021 (MGM data).*
[100] *AFAD, İRAP, 2021 (MGM data).*

are seen to include the urban area in many regions. This situation shows that Antalya is under a very serious risk in terms of flood risk.



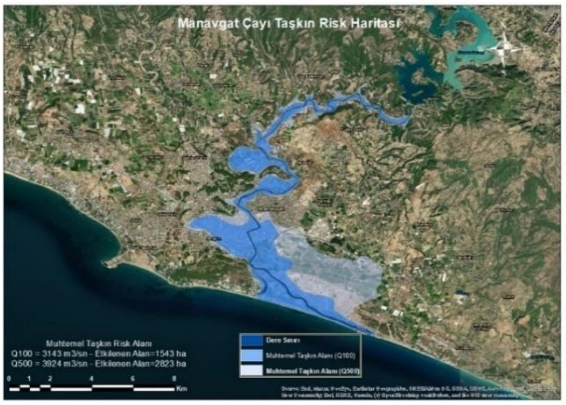


Figure 73: Flood risk maps for Antalya [101]

As a result, the risk and vulnerability status of Antalya in terms of extreme precipitation, flood and flood risk is presented in Table 46 prepared according to the CoM methodology, both in the light of available data and according to the results of the workshop. In the workshop, it was also stated that there are many floods in Kemer due to excessive rainfall, especially due to the inadequacy of both transportation and infrastructure as a result of overflowing streams.

Table 46: Antalya's risk and vulnerability table in terms of excessive precipitation, flood and overflow events

Climatic hazard	Current risk situation		Future risk status				Sectors		Vulnerable population	
	Possibility of hazard	Impact of hazard	Expected change in hazard intensity	Expected change in hazard frequency	Time intervals		Vulnerable sectors	Level	Population groups	Selection
 EXCESSIVE RAINFALL and FLOOD	High	High	High	High	Short term	☑	Buildings	High	Women and young girls	☐
									Children	☐
							Transportation	High	Youth	☐
									Seniors	☐
					Middle term	☐	Energy and infrastructu	High	Marginal groups	☐
									Disabled people	☐
							Health and disaster management	High	Group with chronic disease	☐
									Low income group	☐
					Long term	☐	Agriculture and livestoc	High	Jobless	☐
									Group living in low standard housing	☐
							Tourism	High	Agricultural and tourism workers	☐
									Immigrants	☐
					Unknown	☐	Ecosystem services and biodiversity	High	Others	☐
									All	☑

4.3.3.3 Risk of Sea Level Rise

Increasing ocean temperatures and melting of glaciers with the effect of global warming cause sea level rise in the world. Since 1880, the average global sea level rise has been 21-24 cm. However, 1 third of this rise has occurred in recent years. Rising water levels are mostly due to melting ice sheets and thermal expansion as seawater warms. In 2020, the global average sea level height was 91.3 mm higher than the average level measured in 1993. The average water level in the ocean increased by 3.6 mm per year between 2006 and 2015. This rate was 2.5 times higher than the average increase of the 20th century (1.4 mm). By the end of the 21st century, even if greenhouse gas emission rates are kept lower, global sea level is likely to be 0.3 meters higher than in 2000 (Figure 76). [102]

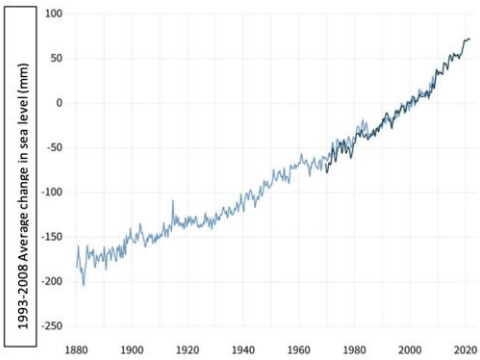


Figure 74: Global sea level rise graph

[101] *Ministry of Forestry and Water Affairs, Antalya Basin Flood Management Plan, Ankara, 2016.*

[102] *https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level, Date of access: April 2022.*

According to an online tool developed by Climate Central, if the sea level rises by 1 meter in Antalya, the areas that will be flooded are shown in Figure 77.

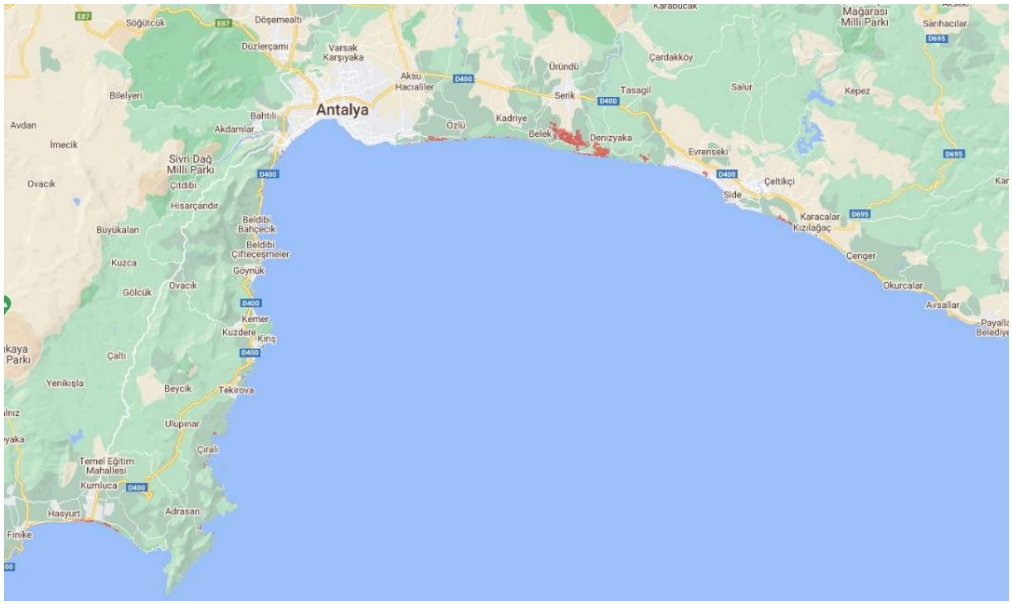


Figure75: Areas that will be flooded if the sea level rises by 1 m

According to WWF's 2021 report, average temperatures in the Mediterranean are rising 20% more than at the global level, with impacts spreading across the basin. This temperature rise, which is projected to increase in the coming period, could lead to a sea level rise of 1 meter by 2100 [103].

Rising sea level and warming sea temperature pose a great risk to both freshwater and marine ecosystems. The risk of seawater mixing with freshwater will increase Antalya's risk of water scarcity and drought, negatively affecting both agricultural production and the ecosystem in the region. In addition, rising sea temperatures will have a number of negative consequences by changing the environment of the creatures living under the sea. Currently, according to a WWF report, tropicalization in the Eastern Mediterranean has already started to affect the marine ecosystem. These ecosystem disruptions are destroying local ecosystems and causing uncontrolled proliferation of invasive species in the seas and the extinction of some species.

Another negative effect of sea level rise is the negative impact on seagrass meadows, the most important species in the Mediterranean ecosystem. This species[104], which is the oxygen source of the sea and the breeding ground for many species, is also instrumental in reducing wave intensity in Antalya, where storms and cyclones are very common. The disappearance of seagrass meadows will affect the deterioration of marine biodiversity and indirectly increase the risk of other climatic events.

As a result, sea level rise poses a serious risk in Antalya, a large part of which is adjacent to the sea. More comprehensive studies are required to provide more precise numerical data. During the workshop, the common opinion on this issue was that the risk of sea level rise is moderate both in the current situation and in the future. The outcome of the workshop is shown in Table 47.

Table 47: Risk and vulnerability table for sea level rise

[103] *Effects of Climate Change in the Mediterranean. Six Stories from an Overheating Sea" MMI (WWF Mediterranean Initiative, 2021)*
[104] *Posidonia*

Climatic hazard	Current risk situation		Future risk status				Sectors		Vulnerable population	
	Possibility of hazard	Impact of hazard	Expected change in hazard intensity	Expected change in hazard frequency	Time intervals		Vulnerable sectors	Level	Population groups	Selection
 SEA LEVEL ISE	Medium	Medium	High	Medium	Short term	☐	Buildings	Medium	Women and young girls	☐
									Children	☐
							Transportation	Low	Youth	☐
									Seniors	☐
					Middle term	☐	Energy and infrastructu	Medium	Marginal groups	☐
									Disabled people	☐
							Health and disaster management	Low	Group with chronic disease	☐
									Low income group	☐
					Long term	☑	Agriculture and livestoc	High	Jobless	☐
									Group living in low standard housing	☐
							Tourism	High	Agricultural and tourism workers	☐
									Immigrants	☐
					Unknown	☐	Ecosystem services and biodiversity	High	Others	☐
									All	☑

4.3.3.4 Storm and Tornado Risk

Storms can be defined as severe and abnormal atmospheric phenomena characterized by cloud cover, precipitation, strong winds, lightning, or thunder. [105] Due to climate change, an increase in weather phenomena such as lightning, hail, thunderstorms, and strong winds is expected. According to data from the European Severe Storms Laboratory, 22,216 weather events such as winds, storms and tornadoes were recorded in 2019.

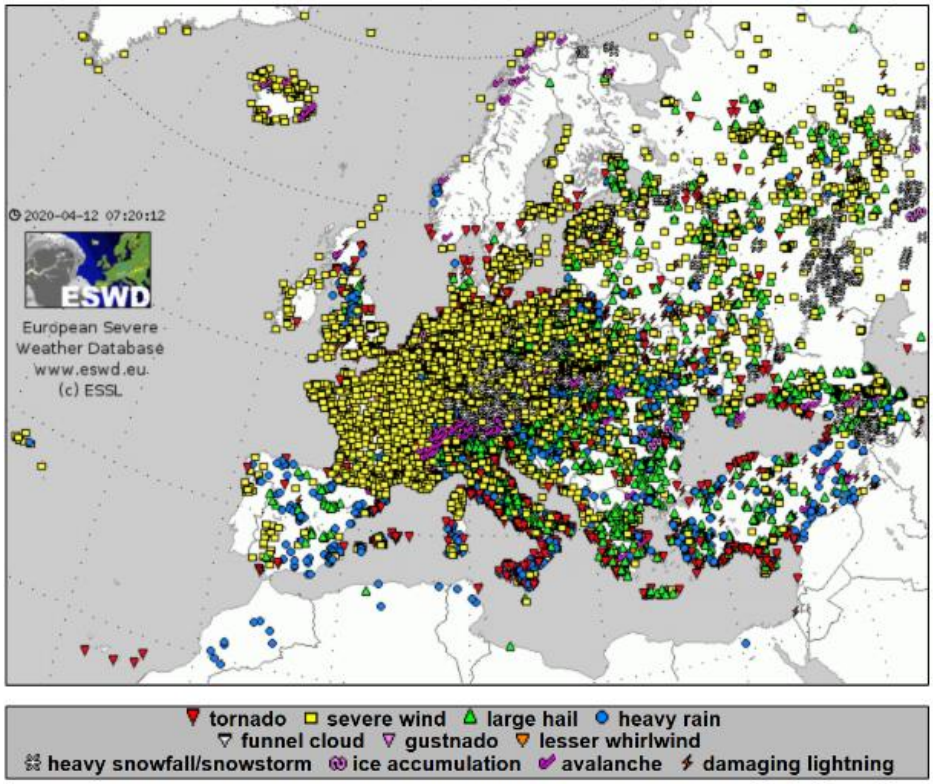


Figure 76: European Severe Storms Laboratory 2019 data

As seen in Figure 78, tornado and storm events marked in red are generally experienced in Antalya. Figure 79 shows the distribution of storms occurring in Turkey between 2010-2021 by provinces. Accordingly, Antalya is the city with the highest number of storm events. Figure 80 shows the tornado and storm events

[105] https://www.britannica.com/science/storm, *Date of accsess: May 2022.*

that took place in the last 10 years until April 2022. Although it is noteworthy that the severity of these events is higher on the northern and southern coasts of the country, it is seen that such events are severe in Antalya.

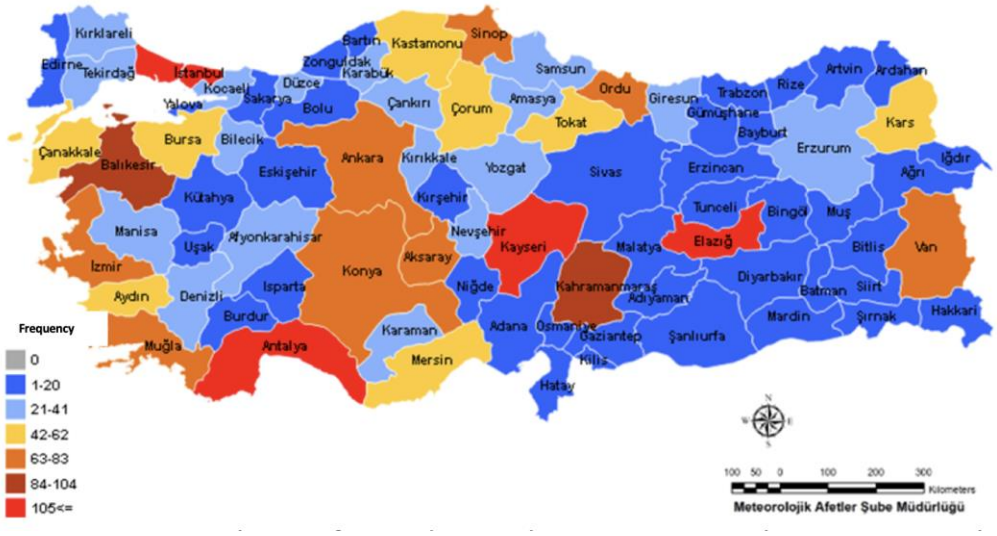


Figure 77: Distribution of storm disasters between 2010-2021 by provinces in Turkey[106]

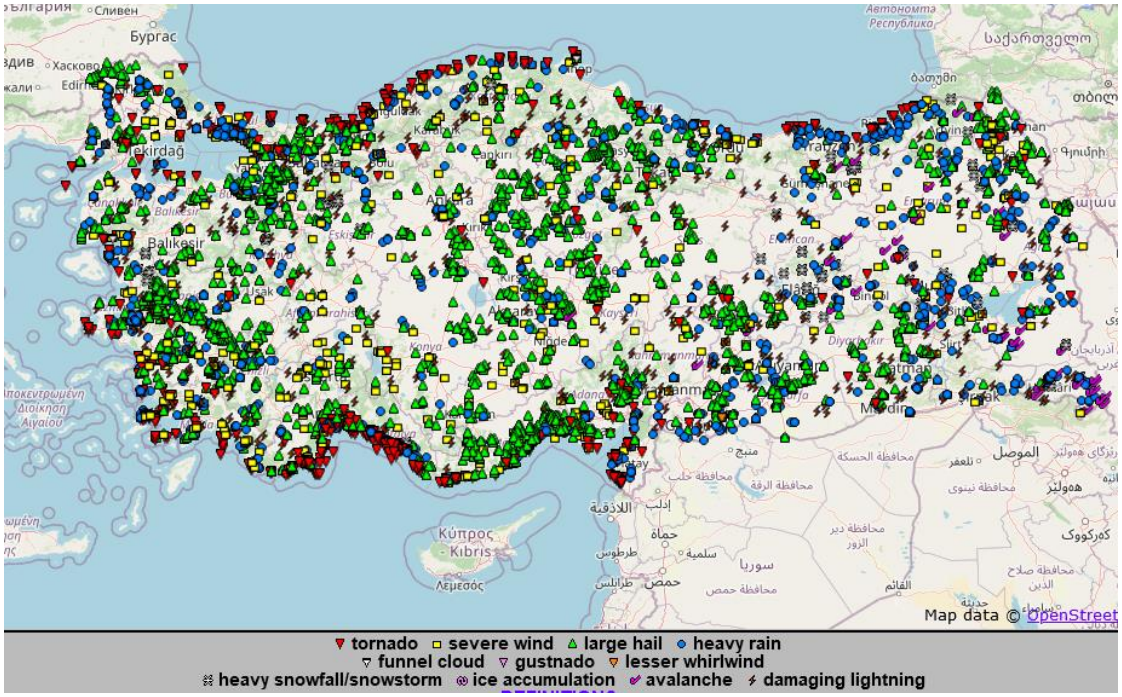


Figure 78: Storms and tornadoes in Turkey between April 2012 and April 2022

Due to the city's geographical structure, location, topography, land-sea interaction and climatic characteristics, it is clear that tornado events are very frequent. According to the IRAP report prepared by AFAD for Antalya in 2021, such weather events are very difficult to predict. Storm and tornado events that occur in atmospheric conditions in a short period of time can only be revealed by remote sensing methods and short-term forecasts. Therefore, it is very difficult to say the exact location where the tornado will occur. Therefore, it is extremely important to adapt the infrastructure of the city accordingly.

[106] *MGM, Turkey Meteorological Disasters Assessment (2010-2021)*

Greenhouse activities, which are quite common in Antalya, and other agricultural activities are highly affected by tornado events. In addition to the damage to agricultural products and equipment in storm events, there is also the possibility of loss of life. According to the study conducted by AFAD, the number of tornado events that occurred in the city between 2000 and 2020 by districts is shown in Table 48 and Figure 81. According to this table, the most frequent tornado events occurred in Alanya, central districts, Finike and Kaş districts.

Table 48: The number of tornado disasters that occurred between 2000-2020 by districts [107]

District	Alanya	Merkez	Finike	Kumluca	Kaş	Demre	Manavgat	Gazipaşa	Korkuteli	Akseki	Elmalı	Gündoğmuş	İbradı	Kemer	Serik
Number of tornado disasters	51	36	27	27	17	6	6	3	1	0	0	0	0	0	0

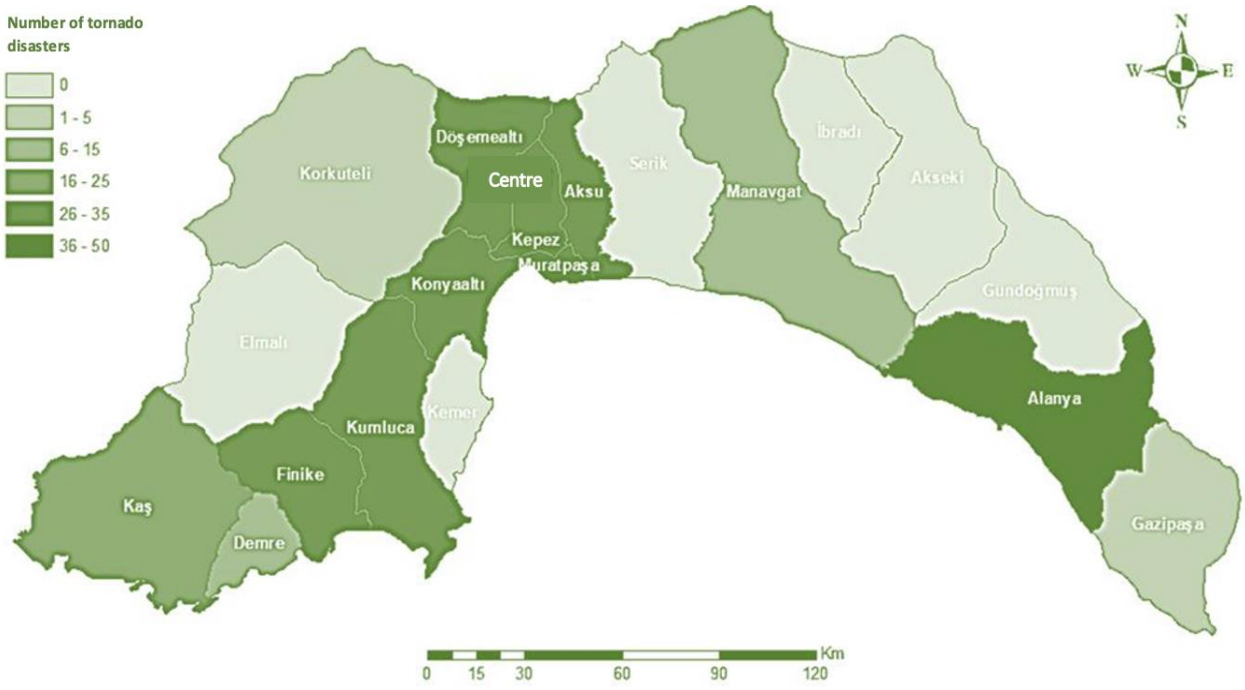


Figure 79: Distribution of tornado disasters between 2000-2020 by districts [108]

In addition to tornadoes, Antalya has also experienced severe storm weather, especially in recent years. With the last severe storm at the end of 2021, many vehicles were damaged and material damage occurred in the city (Figure 82). According to IRAP report (2021)", storm events that occurred in Antalya between 1975-2020 are shown in Table 49 and Figure 83. The data used in this study were compiled according to the records of the 4th Regional Directorate of Meteorology. In addition, the wind speed of 60 km/h, which can be considered as a meteorological storm, was recorded as 155 km/h in the city center of Antalya, which is the maximum value.

[107] *AFAD, İRAP, 2021.*
[108] *AFAD, İRAP, 2021.*

Figure 80: Images caused by the storm in 2021 [109]

Table 49: The number of occurrences of storm events in Antalya between 1975 and 2020 by districts [110]

District	Alanya	Merkez	Manavgat	Kaş	Finike	Kumluca	Gazipaşa	Serik	Demre	Korkuteli	Elmalı	Akseki	Gündoğmuş	İbradı	Kemer
Number of tornado disasters	51	28	13	9	8	8	5	4	3	3	2	1	0	0	0

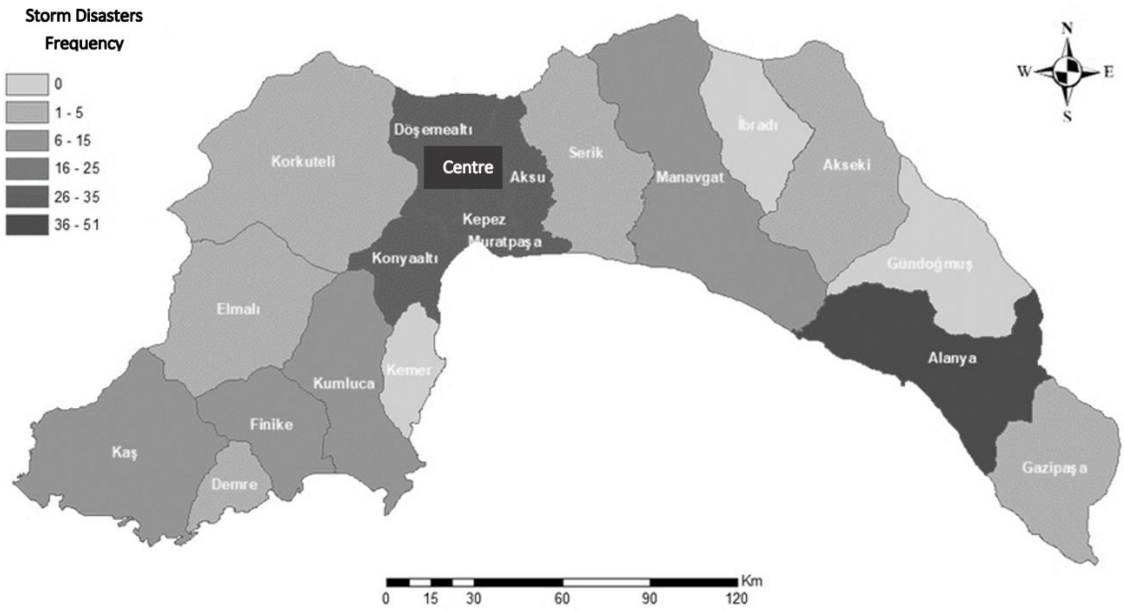


Figure 81: Distribution of storm events in Antalya between 1975-2020 by districts [111]

In addition to this information, severe tornadoes, storms, and downpours occurred at night in Aksu, Serik, Gazipaşa and Alanya districts of Antalya in March 2022. As a result, many greenhouses were destroyed, and crops were damaged. The tornado was most effective in Serik and Alanya districts. In Serik, approximately

[109] *https://www.sozcu.com.tr/2022/gundem/antalyada-firtina-ve-siddetli-dolu-yagisi-etkili-oldu-6929822, Date of access: April, 2022.*
[110] *AFAD, İRAP, 2021 (MGM data).*
[111] *AFAD, İRAP, 2021 (MGM data).*

256 decares of greenhouse area belonging to 65 farmers suffered 80% damage. In Alanya, 230 decares of covered agricultural area belonging to 55 farmers were damaged. In Gazipaşa, 10 decares of greenhouses of 3 farmers were damaged. In Aksu, approximately 134 decares of greenhouse area of 26 farmers were damaged and 18 decares of olive orchards of 4 farmers were damaged. In Aksu, Serik, Gazipaşa and Alanya districts, a total of 630 decares of greenhouse area suffered crop and plant damage. 153 farmers' agricultural areas including tomatoes, peppers, zucchini, watermelon, banana, eggplant, lettuce, cucumber and olive crops, most of which are greenhouses, were damaged.

As a result, the damage caused by such weather events is quite high in Antalya, where greenhouse and agricultural activities are very common. Since the sudden changes in the atmospheric pattern increasing with climate change will increase the frequency and severity of tornadoes and storms, it is possible to say that Antalya's risk situation both in the current situation and in the future is high. The workshop outputs on this issue also give the same result. It was also explained that tornado events are more frequent in Finike, Demre and Kemer districts. The results of the workshop are shown in Table 50.

Table 50: Risk and vulnerability table for extreme weather events

Climatic hazard	Current risk situation		Future risk status				Sectors		Vulnerable population	
	Possibility of hazard	Impact of hazard	Expected change in hazard intensity	Expected change in hazard frequency	Time intervals		Vulnerable sectors	Level	Population groups	Selection
 EXTREME WEATHER EVENTS	High	High	High	High	Short term	☑	Buildings	Medium	Women and young girls	☐
									Children	☐
							Transportation	High	Youth	☐
									Seniors	☐
					Middle term	☐	Energy and infrastructu	Medium	Marginal groups	☐
									Disabled people	☐
							Health and disaster management	High	Group with chronic disease	☐
									Low İncome group	☐
					Long term	☐	Agriculture and livestoc	High	Jobless	☐
									Group living in low standard housing	☐
							Tourism	High	Agricultural and tourism workers	☐
									Immigrants	☐
					Unknown	☐	Ecosystem services and biodiversity	High	Others	☐
									All	☑

4.3.3.5 Water Scarcity and Drought Risk

Water scarcity occurs when water resources are insufficient to meet average requirements over the long term. Low water resource availability combined with a water demand that exceeds the supply capacity of the natural system are the most important causes of water scarcity. Water scarcity problems are frequently observed in regions with low rainfall, high population density, intensive irrigation or industrial activity. Across the European continent, including Turkey, there are large spatial and temporal differences in the amount of water available. In addition to declining water quantity, decreasing availability of fresh and clean water and pollution of clean water also contribute to water scarcity. The main way to assess water scarcity is through the water use index (WEI) applied at different scales (national, river basin). The water use index is the average demand for freshwater resources over the long term. It also indicates the extent to which total water demand is putting pressure on the available water supply in a given region, as well as indicating areas of high-water demand. In this context, the map in Figure 84 shows water stress index data for European river basins in 2000 and a forecast scenario in 2030.[112]

[112] *https://ec.europa.eu/environment/water/quantity/about.htm, Date of access: August 2022.* The expressions in the image used have been translated into Turkish.*

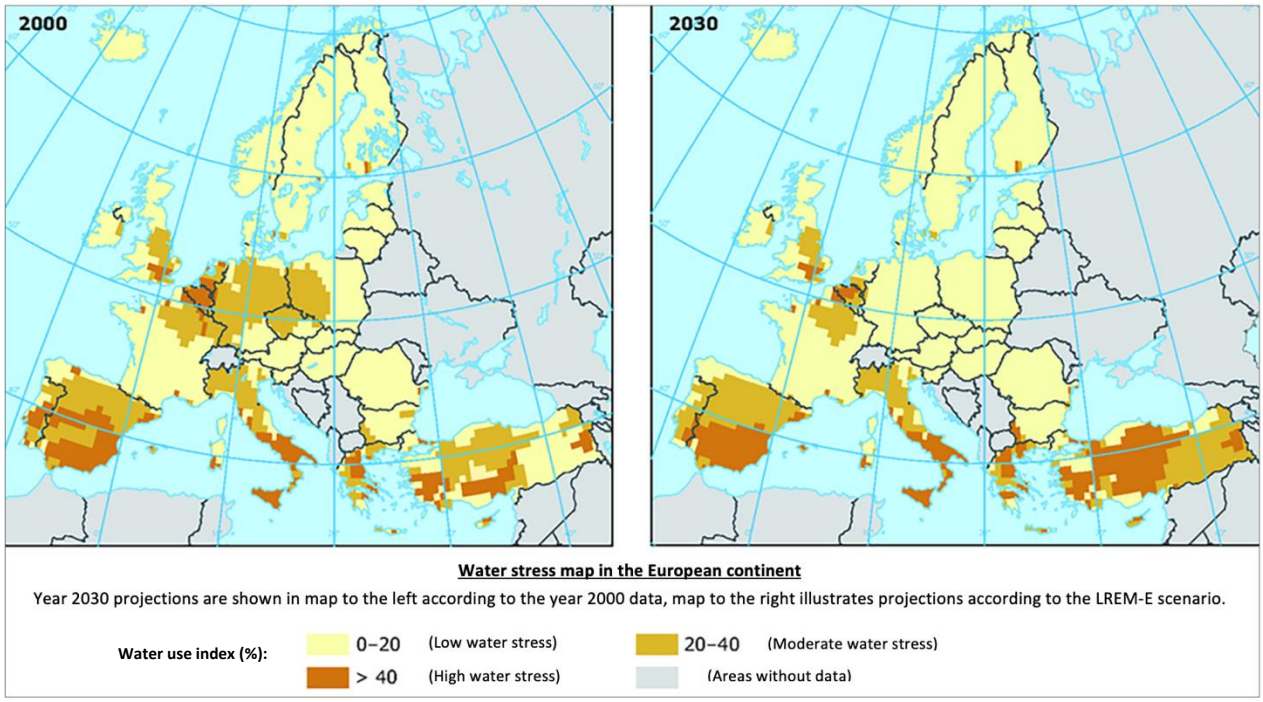


Figure 82: European river basins in 2000 and a forecast scenario for 2030

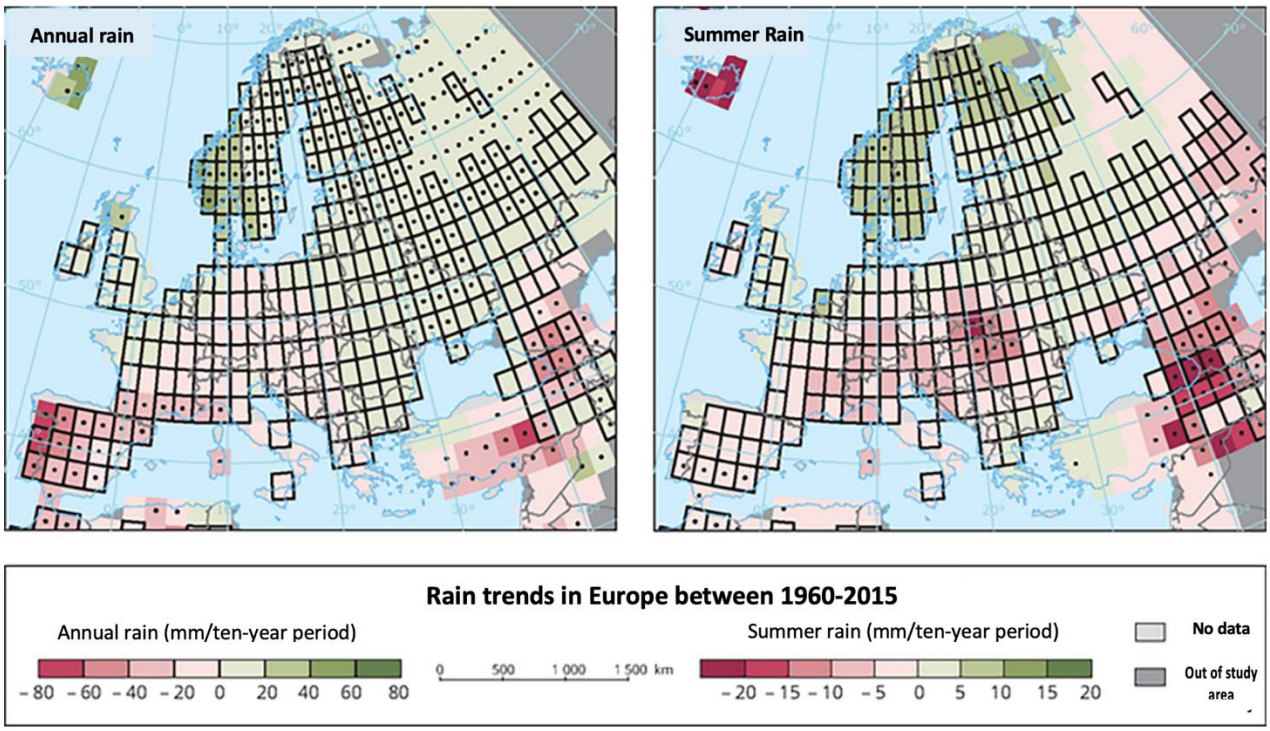


Figure 83: Precipitation trends in continental Europe between 1960 and 2015 [113]

Drought is characterized by a lack of rainfall, low water resources, inappropriate management of water resources, and an imbalance between water demands and the supply capacity of the natural system. Drought has increased dramatically in Turkey and the European Union, especially in the last 30 years. The number of

[113] https://www.eea.europa.eu/data-and-maps/indicators/european-precipitation-2/assessment, *Date of access: August 2022.* The expressions in the image used have been translated into Turkish.*

people and regions affected by drought increased by almost 20% between 1976 and 2006. [114]. Various indicators have been utilized to reveal the severity of a drought and the most important of these indicators is the precipitation level indicator. Figure 85 shows the rainfall trend between 1960 and 2015. According to this map, it can be seen that the annual precipitation of the region in which Antalya is located has decreased considerably.

In 2018, detailed drought management plans based on scientific methods and climatic projections were prepared for the Antalya Basin and Western Mediterranean Basin areas. In the management plans prepared by the General Directorate of Water Management of the Ministry of Agriculture and Forestry, the droughts that occurred in the recent past in the basin areas were evaluated in terms of both agricultural, hydrological, and meteorological aspects. The driest periods for the Antalya Basin occurred between 1973-1974 and 1989-1991. Following these years in which both meteorological, hydrological and agricultural droughts were experienced consecutively, droughts continued to be experienced for various reasons in certain periods every year [115].

In the drought management plan prepared for the Western Mediterranean Basin, the noteworthy aspect is the decrease in water supply with the increase in water demand in relation to the population growth rate of the region. Considering the basin population growth rate and projections (Table 51), current drought indices and the amount of evaporation, the risk of water scarcity is highlighted (Table 52)[116].

Table 51: Population change by Sub-Basins

Sub-Basin	2015	2050-2100	Population growth (%)
Milas-Bodrum	293.112	1.057.495	261
Namnam Stream	266.746	656.527	146
Dalaman Stream	167.498	283.641	69
Eşen Stream	267.651	531.015	98
Demre-Akçay-Alakır	254.590	426.214	67
Total	1.249.597	2.954.892	136

Table 52: Groundwater potential of the basin (future status)

Underground water recharge	hm^3/year	Underground water discharge	hm^3/year
Feeding from precipitation and spring	396,07	Artificial withdrawal	351,60
Percolation from runoff	223,51	Evaporation + perspiration	108,14
		Discharge into the sea	474.37
Total	619,58		934,11

[114] https://www.eea.europa.eu/data-and-maps/figures/observed-changes-in-annual-precipitation-1961-2006, *Daye of access: August 2022.*

[115] *Antalya Basin Drought Management Plan, Ministry of Agriculture and Forestry, General Directorate of Water Management, Department of Flood and Drought Management, 2018.*

[116] *Western Mediterranean Basin Drought Management Plan, Ministry of Agriculture and Forestry, General Directorate of Water Management, Department of Flood and Drought Management, 2018.*

Apart from these, drought maps prepared periodically by the General Directorate of Meteorology are shown in Figure 86 and Figure 87. Although it is seen that Antalya experienced a severe drought in 2022, it is pointed out that a large part of the city was found to be normal or above in terms of drought in a 1-year period.

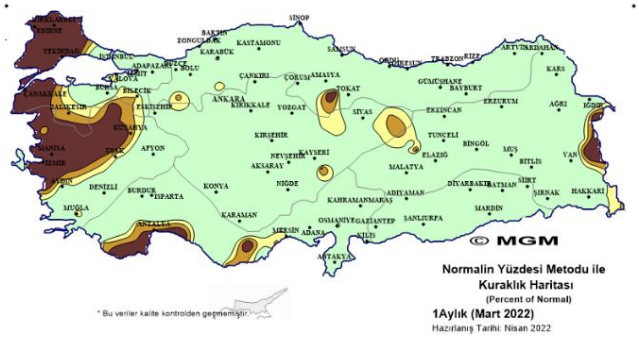


Figure 84: Turkey drought map for March 2022

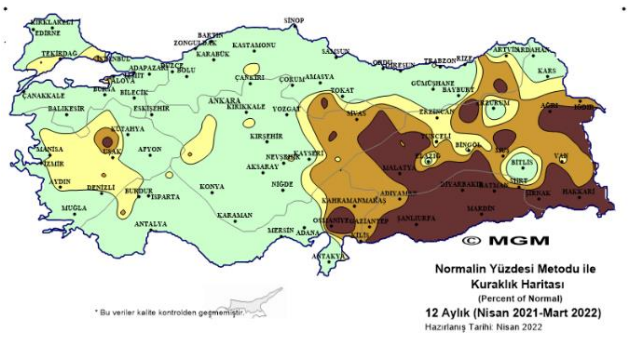


Figure 85: April 2021-March 2022 drought map for Turkey

part from these, Figure 88 shows satellite images showing the drought risk in January 2013 and 2022. In the 9-year period, it is stated that the drought risk has increased in Antalya in general and there is a severe drought risk in some regions.

Drought risk, January 2013 (week 1)

Drought risk, January 2022 (week 1)

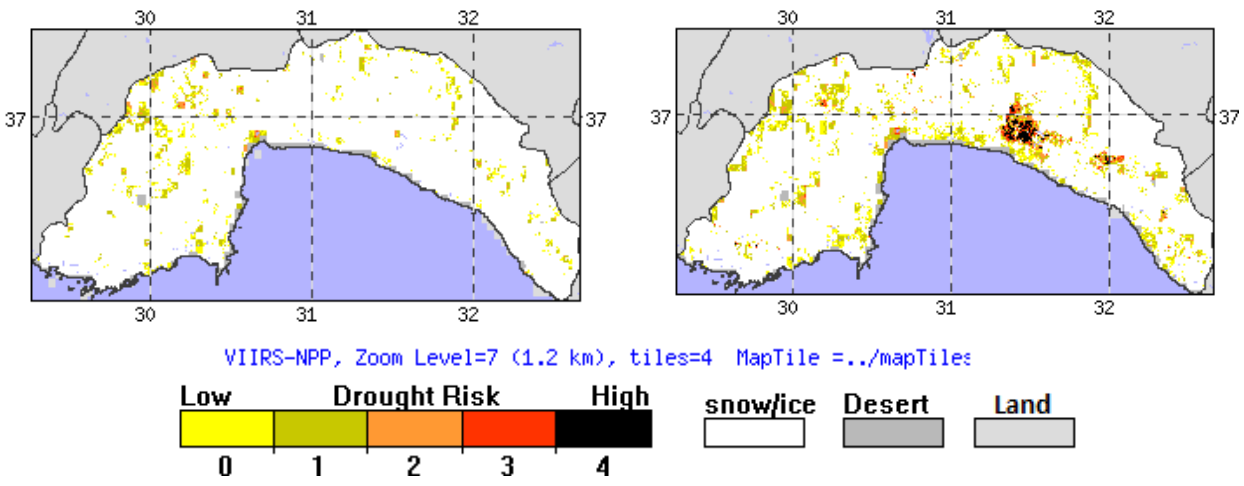


Figure 86 : Antalya 2013 – 2022 drought risk comparison [117]

As a result, the risk of drought and wataer scarcity has been identified as high for Antalya, which has the largest forest cover and is rich in rivers. In addition, scientific sources and the issues discussed during the workshop reveal that this risk will increase even more in the future. In the city where agricultural production and greenhouse cultivation are quite common, the amount of water used in this sense will also create a

[117] https://data.giss.nasa.gov/gistemp/faq/, *Date of access: April 2022.*

negative impact on future production scenarios. The risk and vulnerability table that emerged as a result of the workshop is shown in Table 53.

Table 53: Risk and vulnerability table in terms of drought

Climatic hazard	Current risk situation		Future risk status				Sectors		Vulnerable population	
	Possibility of hazard	Impact of hazard	Expected change in hazard intensity	Expected change in hazard frequency	Time intervals		Vulnerable sectors	Level	Population groups	Selection
 DROUGHT	High	High	High	High	Short term	☑	Buildings	High	Women and young girls	☐
									Children	☑
							Transportation	Low	Youth	☐
									Seniors	☑
					Middle term	☐	Energy and infrastructu	High	Marginal groups	☐
									Disabled people	☑
							Health and disaster management	High	Group with chronic disease	☑
									Low İncome group	☑
					Long term	☐	Agriculture and livestoc	High	Jobless	☑
									Group living in low standard housing	☑
							Tourism	High	Agricultural and tourism workers	☑
									Immigrants	☑
					Unknown	☐	Ecosystem services and biodiversity	High	Others	☐
									All	☐

4.3.3.6 Forest Fire Risk

Frequent and large-scale fires have negative impacts on air and water quality, biodiversity, soil and landscape aesthetics. Moreover, wildfires emit large amounts of greenhouse gases, threatening climate change mitigation targets, causing economic losses and adversely affecting human health. Fire risk depends on many factors, including climatic conditions. Climate change is expected to have a significant impact on wildfire risk in Europe and Turkey. Figure 89 shows wildfires in Europe and Turkey and future scenarios. [118]

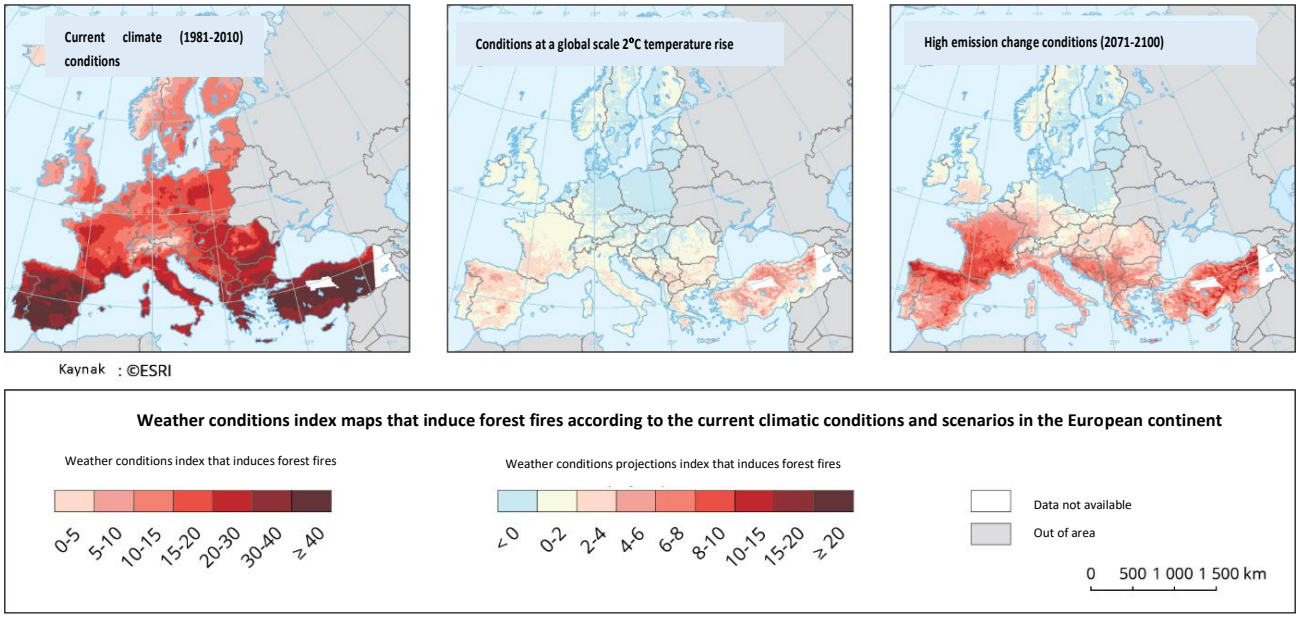


Figure 87: Climatically induced wildfire hazard in the current situation and under climate change scenarios

Record-breaking temperatures and drought in recent years have increased the risk of forest fires across Turkey and Europe. Moreover, wildfires emit large amounts of greenhouse gases, threatening climate change

[118] *https://www.eea.europa.eu/ims/forest-fires-in-europe, Date of access: May 2022.* The expressions in the image used have been translated into Turkish.*

mitigation targets, causing economic losses, and adversely affecting human health. Fire risk depends on many factors, including climatic conditions. Climate change is expected to have a significant impact on wildfire risk in Europe and Turkey. Figure 89 shows wildfires in Europe and Turkey and future scenarios. [119]

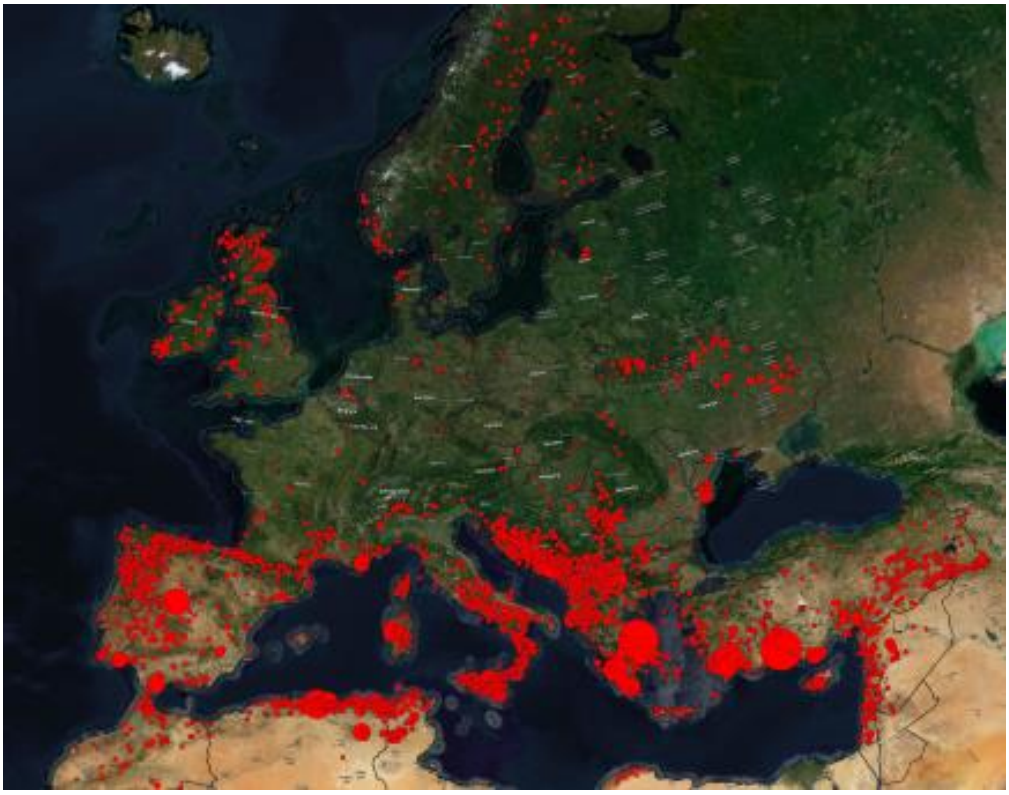


Figure 88: Forest fires in 2021

The forest fires, which started in Manavgat in 2021 and turned into the largest forest fire in the country, also draw attention on the map (Figure 89). The Manavgat fire, which went down in history as one of the largest forest fires in the history of the Republic, started simultaneously at 4 different points on Wednesday, July 28, 2021, when the air temperature in Antalya reached 45oC. The fires, which spread over a large area in the outer part of the district, could be extinguished on the 10th day.

The fire, which started in July 2021, when the air temperature reached 45oC in Antalya, spread in a short time and continued in Manavgat, Akseki, Gündoğmuş and Gazipaşa districts. On the first day, 33 thousand hectares were burned, and the dry wind speed reached 70-80 km from time to time. At the end of the fire, a total area of 88 thousand hectares was burned. While 28 villages were completely burned, thousands of trees and living creatures living in the forests perished in the fire.[120] The fire map in the Manavgat Forest Fire Assessment Notes report prepared by Çekül Foundation is shown in Figure 91 and the damaged Kavaklı, Sarılar, Kalemler and Yeniköy pictures are shown in Figure 92.

[119] *https://joint-research-centre.ec.europa.eu/jrc-news/eu-2021-wildfire-season-was-second-worst-record-finds-new-commission-report-2022-03-21_en, Access date: May 2022.*
[120] *Çekul Foundation, Manavgat forest fire evaluation notes, 2021 Antalya.*

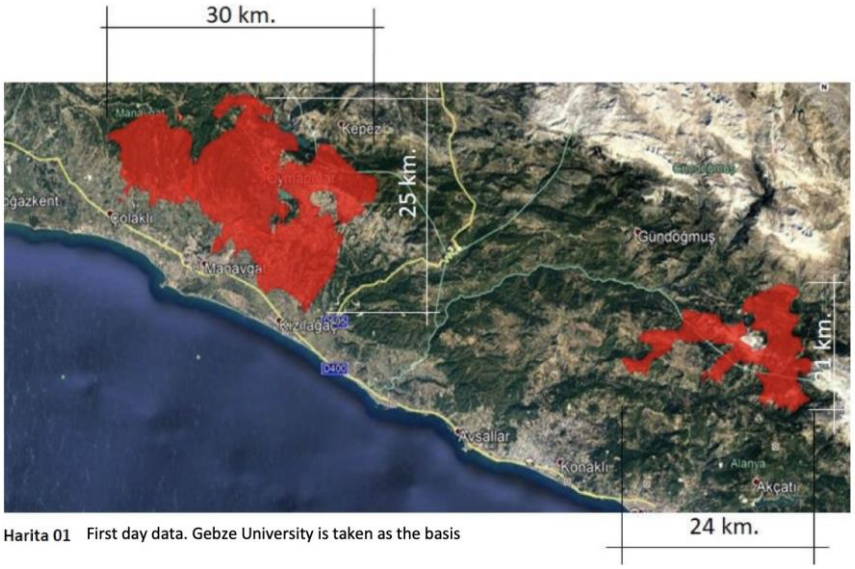


Figure 89: Display of burned areas on the map

Figure 90: Images from the villages burned in the Antalya Manavgat fire [121]

With this fire, projections show that the risk has increased even more. In the IRAP report prepared by AFAD for Antalya in 2021, the number of forest fires that occurred in the districts between 1997- 2020 is shown in Table 54. However, the same report also includes the studies conducted by Karabacak K. et al. in 2019 on forest fires in the city. Both the seasonal distribution of the number of fires and the examination of the causes of fire outbreaks are some of them. Figure 93 shows the seasonal distribution of forest fires in Antalya [122]. In Antalya, where summers are hot and dry, most fires are seen in this season.

[121] *Extracted from the fire report prepared by the Çekül Foundation.*

[122] *Karabacak, K. et al. (2019). Spatial Statistics Analysis of Forest Fires in Antalya, 1st Istanbul International Geography Congress Proceedings, 615-630. Istanbul University Press. * Figures 94 and 95 are taken directly from the study, along with data in Tables 54 and 55, Figure 93.*

Table 54: Forest fire statistics of Antalya districts (1997-2020)

Years	Akseki		Alanya		Antalya		Elmalı		Finike		Gazipaşa		Gündoğmuş		Kaş		Korkuteli		Kumluca		Manavgat		Serik		Taşağıl		TOTAL	
	Adet	Ha	Adet	Ha	Adet	Ha	Adet	Ha	Adet	Ha	Adet	Ha	Adet	Ha	Adet	Ha	Adet	Ha	Adet	Ha	Adet	Ha	Adet	Ha	Adet	Ha	Adet	Ha
1997	4	2	6	149	25	1788	3	51			5	2	1	12	4	80	1	1	3	9	15	26	21	14	12	25	**100**	**2159**
1998	5	3	8	7	30	64	1	30	3	1	8	7	9	8	9	42			8	8	22	780	43	307	21	149	**167**	**1406**
1999	11	12	13	12	50	33			3	1	12	19	18	8	14	11	3	2	13	17	18	11	58	16	23	10	**236**	**152**
2000	21	117	20	27	50	60			7	6	14	13	11	69	13	48	4	3	17	653	32	64	36	176	41	2620	**266**	**3856**
2001	17	14	16	10	28	32	1		6	2	13	3	5	4	21	16	2		6	65	11	2	21	7	18	28	**165**	**183**
2002	10	3	21	218	41	70			7	8	6	3	5	2	12	13	2		9	4	10	13	19	85	19	29	**161**	**448**
2003	14	9	31	48	32	87					7	8	10	125	17	13	2		9	267	16	27	36	232	21	10	**195**	**826**
2004	14	4	37	22	38	7			6	1	9	12	11	17	12	338	3	1	13	4	32	17	43	61	19	23	**237**	**507**
2005	11	4	36	8	87	24			10	1	11	18	4	1	23	17			8	5	29	10	33	291	27	26	**279**	**405**
2006	19	3	34	23	42	67			9	2	10	8	11	3	21	403	3	2	8	1	28	28	35	12	21	16	**241**	**568**
2007	21	40	38	282	55	70			5		18	81	5	2	22	486	2	2	19	233	32	353	25	12	19	520	**261**	**2081**
2008	14	6	22	125	45	139	4	3	12	51	14	20	3	1	19	243	3	10	10	515	24	55	19	5509	20	10348	**209**	**17025**
2009	11	5	14	5	33	46	2	6	8	9	10	14			18	66	3	2	7	260	12	23	12	52	13	3	**143**	**491**
2010	12	4	12	6	30	5	1	3	10	16	4	3	3		9	5	3		13	4	13	4	9	448	5	3	**124**	**501**
2011	9	3	13	12	42	25	3	4	3	1	10	10	2		16	6	4	1	4	2	14	3	12	3	20	21	**152**	**91**
2012	11	15	28	309	52	80	6	5	16	2	16	23	9	14	16	3	4	3	9	26	19	6	10	154	18	11	**214**	**651**
2013	26	37	54	47	75	103	1	2	12	2	19	218	8	1	30	29	5	7	19	458	32	156	16	238	24	15	**321**	**1313**
2014	9	10	19	4	29	9			9	4	9	2	2		24	12	2		7	141	24	36	12	6	23	10	**169**	**234**
2015	9	34	37	37	42	15	2	3	6	3	7	2	2	9	15	13	2		11	10	26	31	3		19	31	**181**	**188**
2016	12	6	39	39	62	92	2		7	6	10	22	3	1	33	33			17	1854	37	33	26	29	33	44	**281**	**2159**
2017	9	5	25	2080	66	385			7	3	5	1	4	8	32	156	2	1	12	46	46	16	38	23	27	26	**273**	**2750**
2018	5	1	15	11	66	153			6	9	8	2	6	5	17	48	3	1	15	285	56	26	24	48	23	5	**244**	**594**
2019	5	1	28	4	40	25			6	11	8	3	3	3	17	66			15	7	37	5	22	55	18	55	**199**	**235**
2020	9	3	21	8	69	35	1	1	3	1	11	28	9	27	22	44	3		17	78	53	54	15	95	27	26	**260**	**400**
TOPLAM	**288**	**341**	**587**	**3493**	**1100**	**3403**	**27**	**108**	**161**	**140**	**244**	**522**	**144**	**320**	**436**	**2191**	**56**	**36**	**269**	**4952**	**638**	**1779**	**588**	**7873**	**511**	**14054**	**5078**	**39223**

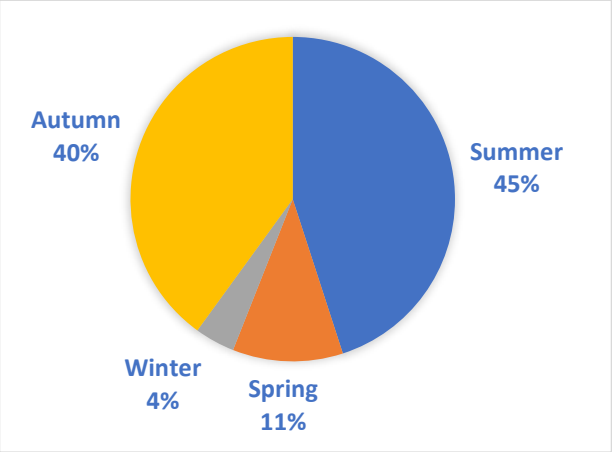


Figure 91: Seasonal distribution of forest fires in Antalya

Determining the causes of forest fires and the areas at risk of forest fires is extremely important in terms of combating forest fires. However, the causes of forest fires are not generally known in country-wide studies. However, there is a comparison data on the causes of forest fires between 2013 and 2018 in Table 55. In the study conducted by Karabacak K. et al. (2019), it was concluded that the causes of forest fires in Antalya are generally unknown.

One of the scientific studies is included in the IRAP report prepared by AFAD in 2021. In the study conducted by Karabacak et al. (2019), the fire risk areas of the city were obtained by Quadrat Analysis method. Figure 94 and Figure 95 show the results of the study conducted in 2019. It is noteworthy that the fire areas that took place in 2021 in both areas are highly risky.

Table 55: Distribution of fires in 2013 and 2018 according to their causes

Cause of Fire	2013 Year		2018 Year		Total	
	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)
Lightning	11	3,43	32	13,22	43	7,64
Negligence - Carelessness	55	17,13	34	14,05	89	15,81
Intent	28	8,72	38	15,70	66	11,72

Accident	18	5,61	15	6,20	33	5,86
Cause Unknown	209	65,11	123	50,83	332	58,97
Total	321	100,00	242	100,00	563	100,00

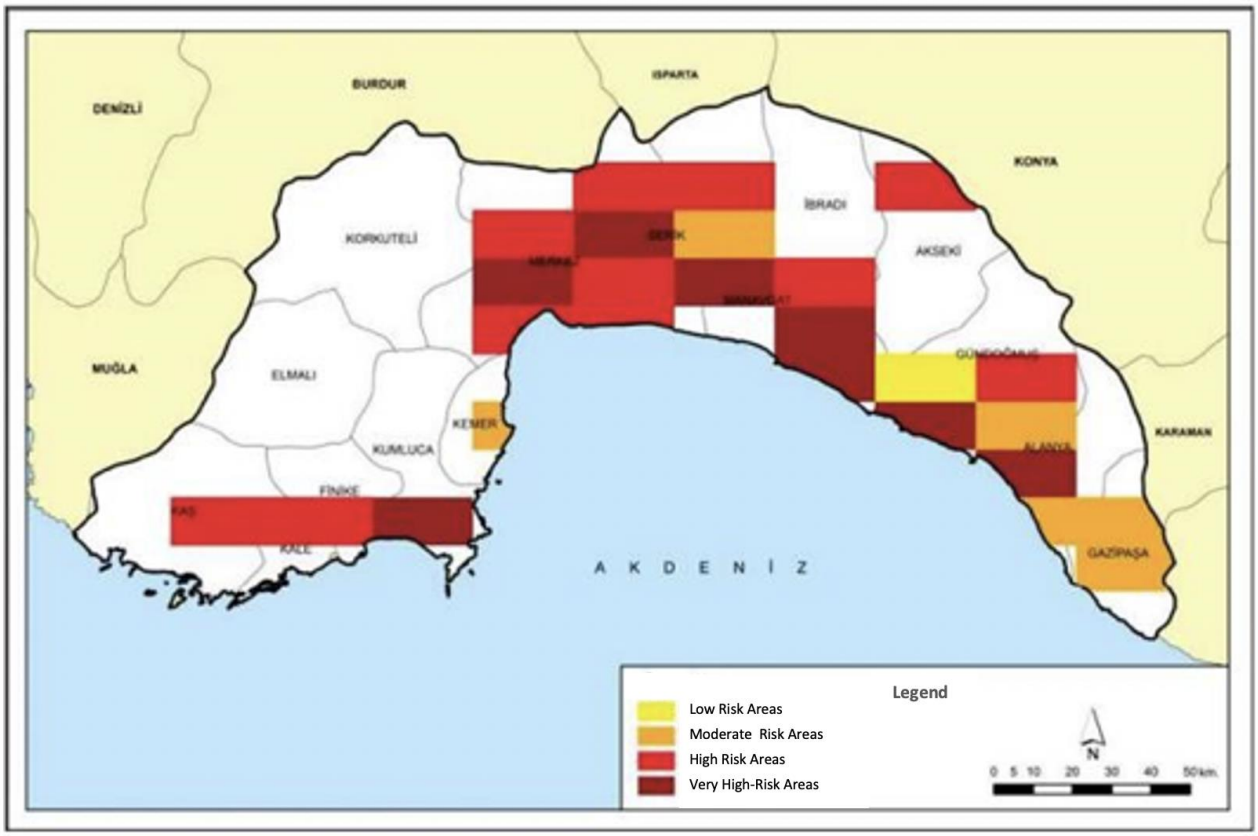


Figure 92: Fire risk areas of Antalya province determined by quadrat analysis

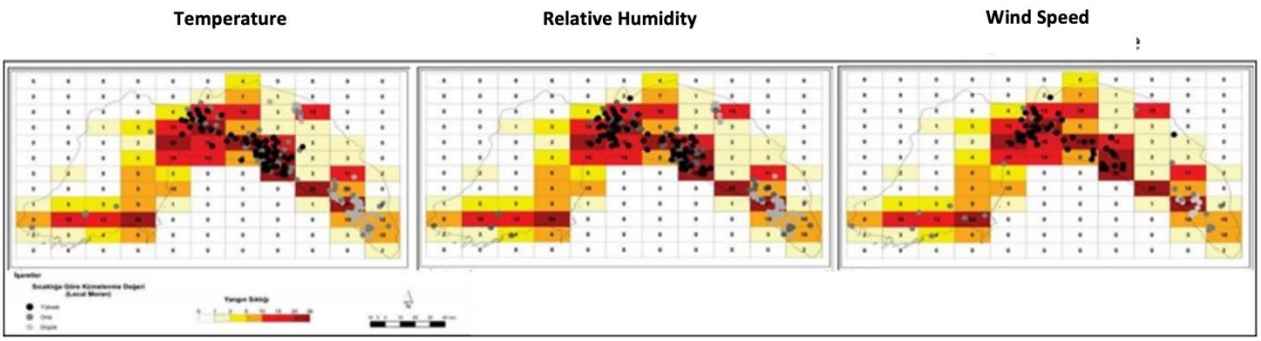


Figure 93: Evaluation of forest fires in Antalya province according to temperature, humidity and wind speed

As a result, Antalya, which has the largest forest wealth in the country, is in a very risky position in terms of forest fires. This situation is revealed both as a result of the workshop, the events experienced in the past and various scientific research. Table 56 shows the values obtained as a result of the workshop.

Table 56: Risk and vulnerability table in terms of forest fires

Climatic hazard	Current risk situation		Future risk status				Sectors		Vulnerable population	
	Possibility of hazard	Impact of hazard	Expected change in hazard intensity	Expected change in hazard frequency	Time intervals		Vulnerable sectors	Level	Population groups	Selection
 FOREST FIRES	High	High	High	High	Short term	☑	Buildings	High	Women and young girls	☐
									Children	☐
							Transportation	Low	Youth	☐
									Seniors	☐
					Middle term	☐	Energy and infrastructu	Medium	Marginal groups	☐
									Disabled people	☐
							Health and disaster management	Medium	Group with chronic disease	☐
									Low income group	☐
					Long term	☐	Agriculture and livestoc	High	Jobless	☐
									Group living in low standard housing	☐
							Tourism	High	Agricultural and tourism workers	☐
									Immigrants	☐
					Unknown	☐	Ecosystem services and biodiversity	High	Others	☐
									All	☑

4.3.3.7 Infectious Disease Risk

The most important determinants of transmission of infectious diseases are the survival and reproduction of the vector or virus, the bite rate if it is a vector, and the incubation period of the pathogen. Infectious diseases can also be transmitted through drinking water and food. The rate of transmission and reproduction of vector-borne and bacterial diseases directly depends on climatic conditions, air temperature and humidity. Sea level height, wind and daylight hours are also important. For example, wet weather can sometimes increase the prevalence of infection. Air temperature can also affect the spread and reproduction of infection.

The coronavirus pandemic, which started in early 2020 and is still ongoing in the summer of 2022, has shown variability with factors such as the survival time of the virus, sun rays and air temperature, even if it is not directly related to climate change. In addition, humanity's effort to dominate nature causes changes in other living things and natural areas and can increase the spread of such viruses. As in the coronavirus pandemic, climatic conditions affect the spread of viruses, parasites or bacteria that are not directly caused by climate change. Especially diseases transmitted by vectors put public health at risk. Malaria transmitted by mosquitoes is one of these diseases. Malaria, which can be seen almost everywhere where agriculture is practiced and in a large part of Anatolia, is fought in our country with various methods. In 2019, according to the report prepared by the Ministry of Health, the malaria transmission rate in the country was zero. However, it has been reported that people who travel abroad and are in risky areas still apply to hospitals with malaria.

A study conducted in Antalya in 2012 provides information on malaria cases in the city. With advances in the health sector and measures taken, malaria cases are also declining in Antalya. However, factors such as the high number of people coming from abroad and the large number of people coming to Antalya from the Southeastern Anatolia Region, where malaria is endemic, to work in the tourism, construction and agriculture sectors leave Antalya in a risky position in terms of malaria. Figure 96 shows the distribution of malaria spread in Antalya by months between 2001 and 2011. [123] From this point of view, although cases have decreased throughout the country, the density of people coming from countries such as Pakistan, Afghanistan and Africa

[123] *Ser, Ö., Cetin, H. (2012). [Evaluation of malaria cases in Antalya between 2001 and 2011]. Turkish Journal of Parasitology / Turkish Parasitology Association = Acta Parasitologica Turcica / Turkish Society for Parasitology 4–8, 36(1).*

where malaria is endemic, climatic conditions, the presence of stagnant and swampy water areas create a risk for malaria and similar diseases. The geographically risky areas of the city in terms of malaria are shown in the maps in Figure 97, which were prepared using satellite images.

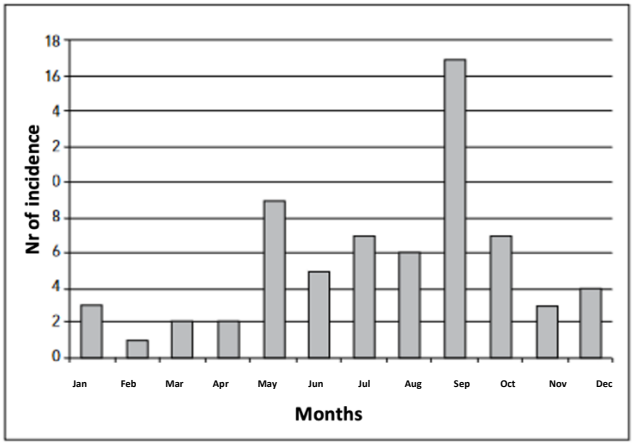


Figure 94: Distribution of malaria cases detected between 2001 and 2011 by months

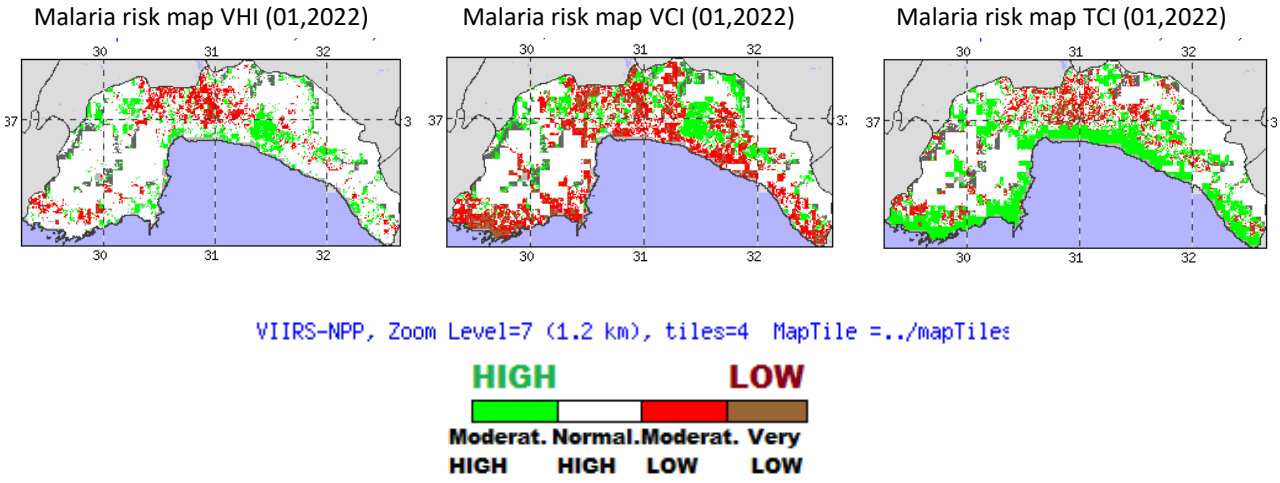


Figure 95: Malaria risk map for Antalya [124]

In Antalya, a city with a very high share of the tourism sector, the high number of tourists from a wide range of countries increases the risk of other infectious diseases. The workshop drew attention to a Salmonella outbreak in the past. This outbreak led to the closure of a hotel and posed a serious risk. In addition, water contamination also poses a serious risk to public health. Another issue mentioned at the workshop was that the risk of water pollution is more prevalent in Döşemealtı, where the Organized Industrial Zone is located. The fact that the risk of infectious diseases is higher in coastal areas was also mentioned.

As a result, infectious disease poses a serious risk for Antalya, which is rich in rivers and streams and hosts tourists from all over the world. During the workshop, participants identified the risk as very high for both current and future scenarios. In this context, the results of the workshop are shown in Table 57 and Table 58.

Table 57: Table of risk and vulnerability in terms of communicable diseases

[124] https://data.giss.nasa.gov/gistemp/faq/, *Date of access: April 2022.*

Climatic hazard	Current risk situation		Future risk status				Sectors		Vulnerable population	
	Possibility of hazard	Impact of hazard	Expected change in hazard intensity	Expected change in hazard frequency	Time intervals		Vulnerable sectors	Level	Population groups	Selection
 INFECTIOUS DISEASES	Medium	Medium	Unknown	Unknown	Short term	☐	Buildings	Low	Women and young girls	☐
									Children	☐
							Transportation	Low	Youth	☐
									Seniors	☐
					Middle term	☐	Energy and infrastructu	Low	Marginal groups	☐
									Disabled people	☐
							Health and disaster management	Low	Group with chronic disease	☐
									Low İncome group	☐
					Long term	☐	Agriculture and livestoc	Medium	Jobless	☐
									Group living in low standard housing	☐
							Tourism	High	Agricultural and tourism workers	☐
									Immigrants	☐
					Unknown	☑	Ecosystem services and biodiversity	High	Others	☐
									All	☑

Table 58: Risk and vulnerability table in terms of water pollution

Climatic hazard	Current risk situation		Future risk status				Sectors		Vulnerable population	
	Possibility of hazard	Impact of hazard	Expected change in hazard intensity	Expected change in hazard frequency	Time intervals		Vulnerable sectors	Level	Population groups	Selection
 WATER POLLUTION	High	High	Unknown	Unknown	Short term	☐	Buildings	Low	Women and young girls	☐
									Children	☐
							Transportation	Low	Youth	☐
									Seniors	☐
					Middle term	☐	Energy and infrastructu	Low	Marginal groups	☐
									Disabled people	☐
							Health and disaster management	High	Group with chronic disease	☐
									Low İncome group	☐
					Long term	☐	Agriculture and livestoc	High	Jobless	☐
									Group living in low standard housing	☐
							Tourism	High	Agricultural and tourism workers	☐
									Immigrants	☐
					Unknown	☑	Ecosystem services and biodiversity	High	Others	☐
									All	☑

4.4 IDENTIFYING ADAPTATION STRATEGIES

Climate change adaptation action plan studies are extremely important in order to make cities resilient to climate change. In order to mitigate the impacts of climate change, Antalya's current greenhouse gas inventory calculations are one of the most important steps in putting forward mitigation scenarios and commitments. In addition, the issue of developing adaptation actions by reconsidering the cities and increasing the social, economic and environmental resilience of the city through these actions should be kept on the agenda against the inevitable situations and impacts that will arise due to climate change.

In this context, Antalya's climate change adaptation actions are evaluated together with other strategic plans of the city and put forward as a solution proposal. These actions are grouped in parallel with the methodology of the Covenant of Mayors and considering the current situation of Antalya. The action groups are ecosystem services, biodiversity and green areas, water management, urban, infrastructure and waste management, public health and disaster management, agriculture and tourism.

In order to eliminate the needs of the city in the climatic context and the risks faced or to minimize their impacts, actions should be determined by considering the results of the risk and vulnerability assessment. In this section, adaptation actions are put forward by considering the current situation of Antalya and the risk and vulnerability assessment. These actions have been identified and included in this study within the scope

of the workshop where Antalya's internal and external stakeholders came together in the context of ensuring public awareness.

4.4.1 Workshop on Climate Adaptation Actions

A face-to-face workshop was organized on 15 June 2022 with the participation of internal and external stakeholders of Antalya Metropolitan Municipality to identify and prioritize actions for Antalya's adaptation to climate change. During the workshop, the results of the previous risk and vulnerability assessment workshop were discussed, and informative presentations were made on how to increase resilience against risks. Participants were shown examples of nature-based solutions and climate change actions implemented around the world and were asked to determine the importance and applicability of the actions for Antalya. A total of 68 people participated in the workshop as internal and external stakeholders of Antalya Metropolitan Municipality. The workshop was completed in approximately three and a half hours (Table 59).

Table 59: Workshop plan

Hour	Workshop plan 15.06.2022
09:30 - 09:40	Keynote speeches
09:40 – 10:00	Presentation of risk and vulnerability assessment results
10:00 – 12:15	Determination of climate adaptation actions for Antalya together with the participants
12:15 – 12:30	Closing

During the workshop, attention was drawn to the issues necessary for Antalya to adapt to climate change, and examples of climate adaptation practices in the world were shown. In addition, strategies for Antalya's adaptation actions by sectors and areas were put forward. The areas identified are health and disaster management, agriculture, tourism, ecosystem services and biodiversity, green areas, urban, infrastructure and waste management, and water management (Figure 98).

Figure 96: Climate adaptation action areas

A total of 41 climate adaptation actions have been proposed for Antalya related to the identified action areas. The workshop aimed for participants to prioritize these actions according to their importance and feasibility. In this direction, using the Mentimeter tool, participants were shown the actions and asked to score each action. This scoring was designed according to a matrix system as shown in Figure 99. In this matrix system, the level of importance and applicability of the action were ranged from 1 to 5. The level of importance of the action describes the level of importance of implementing the action, while the level of feasibility of the action refers to the feasibility capacity of the action in the context of issues such as local government capacity, budget, and cooperation. In this context, participants gave high scores to actions that they considered important and had a high capacity for implementation, and lower scores to actions that were less important and more difficult to implement.

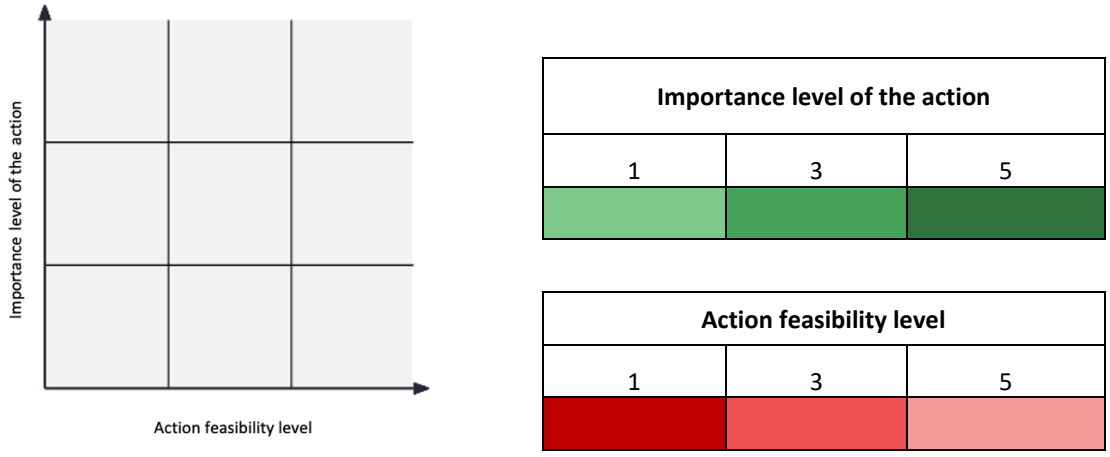


Figure 97: Action prioritization scheme

Table 60 shows the actions rated by the participants. The level of importance of most of the actions was determined at the highest level, and the level of feasibility was determined at medium and high levels. It should be noted that the survey results, which are generally based on qualitative information, were obtained within the scope of the workshop without a specific sampling system. For this reason, the actions do not point to specific areas, but to general strategies that need to be implemented throughout the city. Therefore, it is clear that this study should be considered as a preliminary study and that much more detailed analysis is needed by forming expert teams on the actions.

Table 60: Antalya climate adaptation actions and prioritization scores

Action areas	Actions	Number of participants	Action's applicability level score1-5	Action severity score 1-5
Ecosystem services, biodiversity and green spaces	E1: Preparation of vulnerability maps in the context of urban heat island.	46	3,67	4,37
	E2: Afforestation of stream banks and floodplain boundaries.		4,02	4,43
	E3: Establishment of orchards in the city.		3,37	3,83
	E4: Giving the transportation axes a green corridor function.		3,76	4,30
	E5: Conducting long-term monitoring activities for ecosystem restoration.		3,72	4,20

Action areas	Actions	Number of participants	Action's applicability level score1-5	Action severity score 1-5
	E6: Ensuring the integration of blue infrastructure into green areas.		3,49	3,96
	E7: Enforcement of green roof requirement in commercial buildings		3,60	4,18
	E8: Combating forest fires, communication between institutions		4,33	4,78
Water management	WT1: Establishing guidelines for water saving in commercial buildings.	42	3,98	4,52
	WT2: Dissemination of rain gardens and water pools.		3,67	4,43
	WT3: Using water transfer schemes		3,57	4,02
	WT4: Expanding the use of water-saving mechanisms.		3,88	4,50
	WT5: Use of sustainable urban drainage system.		3,54	4,51
	WT6: Replacement of water treatment lines according to drought and increasing temperature factors.		3,48	4,33
City, infrastructure and waste management	C1: Minimizing food waste.	39	3,97	4,64
	C2: Conducting awareness raising activities on waste.		4,33	4,56
	C3: Placing recycling bins in public areas.		4,41	4,64
	C4: Separate collection of hotel, restaurant, cafe waste.		4,18	4,44
	C5: Using light-colored materials in floor coverings.		3,67	3,59
	C6: Increasing water permeable surfaces (sidewalks, roads, traffic-free areas, parks)		3,77	4,74
	C7: Increasing bike lanes and ensuring their integration with green corridors.		3,69	4,72
Public health and disaster management	PD1: Giving information about diseases and prevention methods.	42	4,07	4,12
	PD2: Making applications to prevent vector reproduction.		3,81	4,43
	PD3: Monitoring air and water quality values and developing a warning system.		4,10	4,48
	PD4: Identify areas that will be most affected by extreme weather events.		3,95	4,52
	PD5: Ensuring food and nutrition security against the risk of drought.		3,50	4,62
	PD6: Explaining the risks of climatic disasters to the society.		3,98	4,63

Action areas	Actions	Number of participants	Action's applicability level score1-5	Action severity score 1-5
	PD7: Developing disaster early warning systems.		3,90	4,43
	PD8: Development of GIS-based risk maps.		3,93	4,57
Agriculture	AG1: Creation of vegetated buffer strips along agricultural irrigation channels.	46	3,52	4,17
	AG2: Informing farmers about climatic risks.		4,07	4,43
	AG3: Implementation of nature-based solutions in appropriate areas.		3,85	4,48
	AG4: Making greenhouses resistant to climatic risks.		3,52	4,43
	AG5: Providing support to farmers to increase production variety and quantity.		3,83	4,50
	AG6: Establishment of rainwater tanks for agricultural irrigation.		4,15	4,78
Tourism	TO1: Dissemination of the concept of responsible tourism.	37	3,62	4,19
	TO2: Limitation and control of certain tourism activities.		3,30	4,05
	TO3: Not destroying natural areas for tourism purposes.		3,68	4,70
	TO4: Promoting the use of renewable energy by businesses.		3,46	4,73
	TO5: Limiting the use of natural resources in tourism establishments.		3,59	4,54
	TO6: Establishing cooperation between tourism enterprises in order to protect the environment.		3,84	4,43

Identifying and prioritizing Antalya's climate adaptation actions has been an important study for determining the starting points in different problem areas in Antalya's fight against climate change. The methodology and scope of this study should be considered as a preliminary study and it is very important that internal and external stakeholders come together in certain periods to discuss Antalya in the context of climate change adaptation and update both the priority and content of the actions.

4.4.2 Adaptation Actions Identified for Antalya

Determining the applicability and importance level of the action groups determined according to the sector and field titles determined the prioritization of the actions. This study was finalized in a workshop where internal and external stakeholders of Antalya Metropolitan Municipality came together. Within the scope of this study, the result of the risk and vulnerability assessment has guided the identification of adaptation actions. In order to adapt Antalya to climate change and increase its resilience, it is clear that regional research should be carried out in detail by forming expert teams, cost and time plans of the actions should be determined and diversified according to the application areas.

4.4.2.1 Ecosystem Services, Biodiversity and Green Spaces

In Antalya's challenge against climate change, 8 actions have been identified for ecosystem services, biodiversity and green areas.

Action E1: Preparation of vulnerability maps in the context of urban heat island
As risky as tornadoes, storms and excessive rainfall are for Antalya, the destruction caused by heat waves and the urban heat island effect is just as risky. Heat waves, which will directly affect the health of people living in urban areas, are even more effective due to buildings, roads and other gray infrastructure systems. For this reason, it is very important for Antalya to identify areas with urban heat island effect and to transform these areas into ecosystem services with natural-based solutions. Considering the urbanization rate and population density, it is possible to talk about the large number of areas where the urban heat island effect is intense throughout the city of Antalya. Therefore, it is clear that risk and vulnerability maps should be made by expert teams in order to reduce and prevent the impact.
Implementation details:
-Advance warning of city administrations and citizens of a possible heat wave situation. - Cooperation with institutions engaged in weather data collection, measurement and forecasting to ensure reliable weather forecasts. - Identifying the population (respiratory, heart diseases, pregnancy, etc.) that may be affected in the 1st degree in a possible heat wave event and being prepared in awareness raising and intervention types. - Covering urban buildings and their surroundings with trees and various plants that are natural coolers.
Stakeholders to collaborate with:
Antalya district municipalities, Antalya Provincial Directorate of Environment, Urbanization and Climate Change, Antalya 4th Regional Directorate of Meteorology-Antalya, Antalya Provincial Directorate of Agriculture and Forestry, Antalya Provincial Directorate of Health, Antalya Provincial Directorate of Disaster and Emergency (AFAD)
Time plan:
2022- 2030

Action E2: Afforestation of stream banks and floodplain boundaries.
As revealed in the risk and vulnerability assessment of Antalya and scientific studies, the city is under high risk in terms of excessive rainfall, floods and overflows. In addition, the presence of rivers and streams throughout the city is quite high. Therefore, according to the worst possible scenario, construction should not be allowed on the banks of streams and rivers. In order to protect the safety of life and property, the living areas of existing constructions should be moved outside the flood boundary. Especially the materials used on the banks of streams and rivers passing through urban areas should be water permeable and intensive afforestation works should be carried out in these areas. This is one of the most important effects that will significantly reduce the risk of flooding and flooding
Implementation details:
- Increasing the cool air corridor effect by afforesting around stream beds. - Ensuring the protection of existing old and large trees while afforestation is carried out throughout the province.

- -Ensuring that tree planting and planting (arid landscaping practices) with less water needs are carried out in Antalya.
Stakeholders to collaborate with:
Antalya district municipalities, Antalya Provincial Directorate of Environment, Urbanization and Climate Change, Antalya 4th Regional Directorate of Meteorology-Antalya, Antalya Provincial Directorate of Agriculture and Forestry, Antalya Provincial Directorate of Health, Antalya Provincial Directorate of Disaster and Emergency (AFAD)
Time plan:
2022- 2030

Action E3: Establishing orchards in the city
Increasing green areas in urban areas of Antalya and establishing urban orchards in existing green areas will provide many ecological benefits. Urban orchards are a highly functional nature-based solution both in terms of improving biodiversity and reducing the urban heat island effect. In addition to these, the low maintenance cost of urban orchards is another issue. Therefore, it is important to establish and popularize urban orchards in the city where many agricultural products can be grown thanks to its climatic characteristics and soil structure
Implementation details:
- -Conducting a determination study on the establishment of fruit orchards in 19 district centres, taking into account the relevant climatic conditions. - Establishment of orchards in various urban areas to increase biodiversity.
Stakeholders to collaborate with:
Antalya district municipalities, Antalya Provincial Directorate of Agriculture and Forestry
Time plan
2022 - 2030

Action E4: Providing green corridor function to transportation axes.
Giving green corridor function to suitable transportation axes and expanding this function within the city is one of the most important strategies for Antalya to reach sustainable solutions and adapt to climate change. Considering the existing transportation axes and tram routes in Antalya, afforestation of suitable areas or implementation of other nature-based solutions will both reduce the urban heat island effect, increase urban biodiversity and contribute to ecosystem services.
Implementation details:
- Planning of urban greenways, bicycle parking areas and sightseeing routes. - Ensuring the integration of green areas with rail systems in order to ensure their accessibility. - Increasing bicycle lanes and encouraging the public to use bicycles. - Ensuring the greening of horizontal and vertical transportation axes. - Increase green areas to encourage walking and public transportation.
Stakeholders to collaborate with:
Antalya district municipalities, Antalya Provincial Directorate of Environment, Urbanization and Climate Change, Republic of Turkey Ministry of Transport and Infrastructure, Antalya Police Department

Time plan:
2022 - 2030

Action E5: Conduct long-term monitoring for ecosystem restoration.
Climate change and urbanization pressure lead to the deterioration of ecosystems, causing damage to both natural areas and people. Especially in Antalya, which is one of the leading cities in terms of ecosystem richness, the demand for new settlement areas created by the rapidly increasing population after the 1980s has led to the shrinkage of natural areas and the growth of artificial areas. Consequently, the artificial boundaries of the city have expanded, resulting in the destruction of ecosystems. In addition, climate change, which has been increasing in recent years, causes extremely negative impacts on ecosystems. Ecosystem degradation is both caused by climate change and increases the effects of climate change. Therefore, restoration of ecosystems in Antalya is extremely important. In order to carry out ecosystem restoration, the city's ecosystems should be monitored periodically with various digital tools (such as using databases obtained from satellite images and creating new GIS-based data sets), degradation should be detected and methods to prevent degradation should be applied by expert teams.
Implementation details:
- Increase the number and area of protected areas to protect biodiversity and rare ecosystems and declare them urgently. - Conducting illegal hunting inspections. - Conducting information and training activities. - Rehabilitation of forests, implementation of the action plan and national afforestation campaign. - Preparation of environmental baselines for natural ecosystems using GIS and satellite imagery.
Stakeholders to collaborate with:
Antalya district municipalities, Antalya Provincial Directorate of Agriculture and Forestry, Antalya Regional Directorate of Forestry
Time Plan:
2022 - 2030

Action E6: Integration of blue infrastructure in green areas
For Antalya, which is at risk in terms of extreme precipitation, flooding and flooding, it is very important to develop sustainable urban development systems together with improvement. The use of nature-based landscape components, especially in green areas, should also be considered in terms of the integration of blue and green infrastructure
Implementation details:
- Expansion of arid landscaping and water-free turf application areas. - Ensuring that dry stream beds are transformed into green corridors. - Raising awareness by establishing green rings in the districts. - The green corridor to be created for adaptation to climate change should be planned to connect green areas in coastal areas with green areas within the city. - Ensuring that trees with less water demand are planted and planted in green areas as a precaution against the risk of a decrease in expected rainfall in Antalya.

Stakeholders to collaborate with:
Antalya district municipalities, Antalya Provincial Directorate of Agriculture and Forestry, Antalya Regional Directorate of Forestry, 13th Regional Directorate of State Hydraulic Works Antalya
Time plan
2022 - 2030

Action E7: Introduce a green roof obligation for commercial buildings
In Antalya, where urbanization pressure and population growth is intense, increasing green areas are solutions that can be realized in long processes due to property problems. For this reason, it is important to popularize the green roof application in Antalya, which reduces the urban heat island effect, increases biodiversity and can be utilized as an ecosystem service. In order to increase applicability and set an example, it should be planned to start with commercial buildings and public buildings. It is clear that if incentive systems such as tax reductions are put in place for green roof applications, especially in public buildings, these applications will increase and become widespread in the city.
Implementation details:
- Green roof sample applications. - Supporting rainwater retention through green roof applications. -Encouraging the application of green roofs on large buildings such as municipal buildings, industrial facilities and shopping malls. - Inclusion of green roof applications in new regulations. - Prioritizing green roof applications in new architectural works and conducting feasibility studies including load calculations. - Applying green roofs to all possible areas gradually, starting from the largest areas.
Stakeholders to collaborate with:
Antalya district municipalities, professional chambers, Antalya public institutions and organizations, Antalya Chamber of Commerce and Industry (ATSO)
Time plan:
2022 - 2030

Action E8: Combating Forest fires, inter-institutional communication.
Antalya is one of the richest cities in Turkey in terms of forest cover. Both the heat waves and wind conditions that frequently occur in the summer season and the abundance of forests make the city very risky in terms of forest fires. For this reason, different groups and specialties should work together and be ready to respond to fire with adequate equipment preparation and fire prevention measures should be increased. All institutions and organizations that may be related to fire should be periodically informed and teams should be kept on alert against the temperature increases experienced in recent years and the prolonged duration of heat waves. The continuous deployment of certain teams, especially in risky parts of the city, and the scanning of forest areas with thermal camera requests 24 hours a day under risky conditions are extremely important in terms of preventing fires.
Implementation details:
- Protecting and expanding forested areas, protecting vegetation along coastlines, creating sheltered areas for plant survival, protecting and increasing urban green spaces.

- Identifying areas with high fire risk and taking measures in line with these risks - Proper planning with the creation of response systems and risk maps. - Ensuring that work is carried out in cooperation with public institutions and organizations.
Stakeholders to collaborate with
Stakeholders to collaborate with
Time plan:
2022- 2030

4.4.2.2 Water Management

6 actions were determined on water management in Antalya's challenge against climate change.

Action WT 1: Establish guidelines for water conservation in commercial buildings
Against the risk of drought and water scarcity, water saving practices should be applied throughout the city. If water savings are started especially in public and commercial buildings, an example can be set for residential areas and the water saving mechanism can be generalized throughout the city. Guidelines can be created for water saving practices of commercial buildings and some incentive mechanisms such as tax reductions can be created for those who can save water within the set targets.
Implementation details:
- Collecting rainwater and using it in the facility to save water. -Providing incentives for the reuse of wastewater in the industrial sector. -Organizing meetings to share experiences between sectors. -Increasing investments in new water-saving technologies.
Stakeholders to collaborate with:
Antalya district municipalities, Antalya General Directorate of Water and Wastewater Administration (ASAT), Antalya Chamber of Commerce and Industry (ATSO
Time plan:
2022 - 2030

Action WT 2: Expand rain gardens and water ponds.
In densely urbanized areas where it is difficult for rainwater to meet the soil, the use of nature-based solution strategies can make a big difference. Rain gardens and water ponds are effective ways to collect rainwater and then use it for irrigation. Both in urban and agricultural areas, collecting rainwater and using it for irrigation activities will be very beneficial in terms of saving water and reducing resource use.
Implementation details:
-Use of underground storages for effective management of rainwater. -Creation of rainwater retention ponds, use of the accumulated water in areas such as street washing and plant irrigation. -Ensuring that the use of permeable materials is made compulsory for intermediate arteries, except for main arteries, in street renovation and arrangement projects. -Studies for the use of rainwater for own needs in sites and buildings (such as garden irrigation, use as gray water). -Creation of urban water retention reservoirs to increase rainwater harvesting.

-Application of natural urban pavements (stone, soil), avoiding pavements that prevent groundwater recharge
Stakeholders to collaborate with:
Antalya district municipalities, Antalya General Directorate of Water and Wastewater Administration (ASAT), Antalya Chamber of Commerce and Industry (ATSO), professional chambers
Time plan:
2022 - 2030

Action WT3: Use of water transfer schemes..
Drought and shortage of water resources can sometimes affect the whole city, and sometimes affect certain regions more. The location of groundwater resources or the frequency of use in that region is also a factor affecting the capacity of water resources. In such cases, water transfer schemes can be used from distribution centres where the main water sources are located to supply water to areas experiencing water scarcity and drought. In addition, reducing the loss and leakage rates that occur during the circulation of network water is very important in terms of water saving and protection of water resources.
Implementation details:
-Preventing water losses by renovating drinking water tanks. -Ensuring water control through the SCADA system. -Coordinated work during the planning process. -Designing integrated management of groundwater and surface waters. -Ensuring stakeholder participation in feasibility studies.
Stakeholders to collaborate with:
Antalya district municipalities, Antalya General Directorate of Water and Wastewater Administration (ASAT), 13th Regional Directorate of State Hydraulic Works Antalya
Time plan:
2022 - 2030

Action WT4: Scaling up the use of water-saving mechanisms.
Water-saving mechanisms need to be expanded throughout the city against the risks of drought and water scarcity. Water-saving practices that can be achieved through nature-based solutions in public spaces should be widespread throughout the city. In addition to this, it is important to work on making existing systems in households, public and commercial buildings compatible with water saving.
Implementation details:
- Encouraging the use of water-saving aerators installed on faucet heads in households, public and commercial buildings[125]. - Expanding the use of photocell faucets in public and commercial buildings to save water. - Promote the use of communal dispensers instead of disposable products (bottles, cups, etc.) in public and commercial buildings. - Carrying out information and awareness raising activities on water conservation.

[125] *Saving tap head.*

-Drawing attention to the issue of climate change by organizing activities throughout the city on World Water Day.
Stakeholders to collaborate with:
Antalya district municipalities, Antalya General Directorate of Water and Wastewater Administration (ASAT))
Time plan:
2022 - 2030

Action WT5: Utilization of sustainable urban drainage system
Changing weather and temperature conditions with the effects of climate change cause changes in infrastructure systems. It is very important to adapt drainage systems to the effects of climate change in terms of protecting water resources and supplying recyclable water. It is possible to say that the cost of adapting the drainage system to climate change can be much higher than the cost of the negative effects that will occur in possible risks. As a long-term investment, it is clear that infrastructure systems throughout the city should be climate compatible.
Implementation details:
-Ensuring the realization of urban drainage solutions. -Creating a sustainable urban drainage system and ensuring storm water management. -Conducting R&D studies on sustainable drainage system and water sensitive urban design. -Within the scope of the development of green infrastructure strategies, sustainable urban drainage and water sensitive urban design principles will be implemented in all planned green areas and buildings. -Separate collection of rainwater to reduce the burden on the drainage network and wastewater treatment plants.
Stakeholders to collaborate with:
Antalya district municipalities, Antalya General Directorate of Water and Wastewater Administration (ASAT)
Time plan:
2022 - 2030

Action WT6: Modification of water treatment lines according to drought and increasing temperature factors
Increasing temperatures due to climate change cause an increase in the amount of evaporation in dams and open water pools, resulting in water losses. Therefore, these systems need to be revised according to the new climate conditions. In addition, it is essential to establish water treatment lines and adapt them to the climate in order to protect natural water resources.
Implementation details:
- Installation of GES (solar energy systems) on water canals. - Covering the water surface with a white, light, water-insoluble and non-toxic substance.
Stakeholders to collaborate with:
Antalya district municipalities, Antalya General Directorate of Water and Wastewater Administration (ASAT)

Time plan:
2022 - 2030

4.4.2.3 Urban, Infrastructure and Waste Management

In Antalya's challenge against climate change, 7 actions have been identified in urban planning, infrastructure and waste management.

Action C1: Minimization of food waste
In Antalya, where the tourism and agriculture sectors are leading the way, the collection and recycling of food waste is very important in combating climate change. Incentivizing the separation of food waste in hotels and restaurants as well as in the municipality's own enterprises will lead to the expansion of this system. The collection and recycling of the separated waste will both create a circular economy and minimize waste.
Implementation details:
- Separation of waste through recycling. -Conducting feasibility studies for the development of a penalty and reward system for solid waste disposal for enterprises. -Taking the waste disposal tax on the agenda and conducting research for spreading it throughout the province.
Stakeholders to collaborate with:
Ministry of Environment, Urbanization and Climate Change, Antalya Provincial Directorate of Environment, Urbanization and Climate Change, district municipalities, commercial enterprises
Time plan:
2022 - 2030

Action C2: Raising awareness on waste
The society needs to be informed in order to reduce the use of plastics, which has been increasing in recent years, and to ensure that household waste is collected separately or that waste is separated in households. Waste awareness should be raised in schools, especially from a young age. Local governments should organize reward-based campaigns to encourage citizens to separate waste at home.
Implementation details:
- Identification of businesses that use single-use plastics intensively in Antalya. - Create an incentive mechanism to reduce single - use plastics in local businesses. Reducing the use of single-use plastics in public institutions and organizations. - Creating incentive mechanisms to increase recycling and recovery and organizing events on this issue. - Carrying out information and awareness raising activities for students and citizens
Stakeholders to collaborate with:
Ministry of Environment, Urbanization and Climate Change, Antalya Provincial Directorate of Environment, Urbanization and Climate Change, district municipalities, Antalya Provincial Directorate of National Education
Time plan:
2022 - 2030

Action C3: Placing recycling bins in public spaces.
In addition to waste segregation and minimizing waste generation, recycling bins should be placed in publicly used indoor and outdoor areas and buildings according to waste type. Local governments should collect these recycling bins separately according to frequency of use and waste type and deliver them to recycling centers. In this way, over time, society's waste habits will change for the better.
Implementation details:
- Develop pilot projects with universities for sustainable and innovative waste management. - Smart route planning for waste collection and transfer vehicles. - Determination of the recycling infrastructure needed in Antalya province. - Cooperation with relevant institutions for investments in recycling. - Development of R&D projects with universities for investment planning in waste sorting and recovery facilities
Stakeholders to collaborate with:
Ministry of Environment, Urbanization and Climate Change, Antalya Provincial Directorate of Environment, Urbanization and Climate Change, district municipalities, commercial enterprises, universities, Antalya public institutions and organizations
Time plan:
2022 - 2030

Action C4: Separate collection of hotel, restaurant and café waste
Collecting food waste from restaurants, cafes, hotels, catering establishments and ensuring that the waste is converted into fertilizer to be used in agricultural production. Creating guidelines for food waste generators to segregate and minimize their waste to save on waste disposal and transformation processes.
Implementation details:
- Making separate collection of materials with high recycling rates compulsory. - Incentivizing the citizens about the wastes that can be turned into compost and organizing events for composting by the municipality. - Investigating the potential of waste collection services for the food secto.
Stakeholders to collaborate with:
Ministry of Environment, Urbanization and Climate Change, Antalya Provincial Directorate of Environment, Urbanization and Climate Change, district municipalities, Antalya Provincial Directorate of National Education
Time plan:
2022 - 2030

Action K5: Use light-coloured materials for floor coverings.
Increasing air temperatures, especially in the summer months, and the sensitivity of the urban heat island effect are also highly related to the type of material in the environment. By ensuring that the floor coverings are light coloured in areas with dense buildings, more absorption of sunlight can be prevented. For the dissemination of this action, it will be possible to observe the positive effect of the material on the

heat island after determining pilot areas and monitoring the temperature in certain periods. In the following process, pilot applications can be increased and the use of light-coloured materials in floor coverings throughout the city can be made widespread.
Implementation details:
- Ensuring that the spatial development of the city is realized by considering the creation of green areas and green corridors. - Establishment and implementation of a green infrastructure system in harmony with nature. - Preparation of feasibility reports by identifying locations where pilot studies can be carried out for sustainability purposes
Stakeholders to collaborate with:
Ministry of Environment, Urbanization and Climate Change, Antalya Provincial Directorate of Environment, Urbanization and Climate Change, district municipalities, Antalya public institutions and organizations
Time plan:
2022 - 2030

Action C6: Increase water permeable surfaces (sidewalks, roads, traffic-free areas, parks).
The urban growth in Antalya in recent years with the increasing population has led to the expansion of artificial areas in the city. The risk of flooding and flooding increases as rainwater cannot reach the ground. In this respect, first of all, the ground of certain places in risky areas in the city should be covered with a water-permeable surface. Then, the use of water-permeable surfaces should be expanded throughout the city. Especially covering the hard floors in areas closed to traffic, sidewalks, bicycle paths and parks with this material is one of the solutions that will minimize the risk of flooding and flooding in these areas in a possible rainfall.
Implementation details:
- Covering the floors of areas such as commercial areas, building gardens, parking lots, public areas with permeable surfaces. - Implementation of good practice examples on the design of permeable surfaces in infrastructure works
Stakeholders to collaborate with:
Ministry of Environment, Urbanization and Climate Change, Antalya Provincial Directorate of Environment, Urbanization and Climate Change, district municipalities, Antalya public institutions and organizations
Time plan:
2022 - 2030

Action C7: Increase the number of bicycle lanes and ensure their integration with green corridors
Emission rates from intensive vehicle use are among the most important issues that increase climate change. Therefore, in addition to encouraging the use of low-emission, hybrid and electric vehicles in mitigation targets, it is also very important to encourage bicycle use and walkability. In this regard, it is very important to increase the number of bicycle routes in Antalya and to integrate existing roads with nature-based solutions and transform them into ecosystem services. Giving the bicycle network a green corridor function will both reduce the heat island effect and increase biodiversity.
Implementation details:

- Establishing green rings in neighbourhoods to increase accessibility (bicycle paths, fusion of passive and active green spaces). - Using web-based systems for structuring the bicycle transportation network - Making arrangements to transform bicycle paths into ecosystem services by integrating them with nature-based solutions. - Ensuring that the use of electric vehicles is preferred in public institutions and organizations.
Stakeholders to collaborate with:
Antalya district municipalities, Ministry of Transportation and Infrastructure 6th Regional Directorate, Ministry of Energy and Natural Resources, Iller Bank, vehicle manufacturers
Time Plan:
2022 - 2030

4.4.2.4 Public Health and Disaster Management

8 actions have been identified on public health and disaster management in Antalya's challenge against climate change.

Action PD1: Providing information on diseases and prevention methods.
Antalya is a city that welcomes tourists from all over the world, with a big difference between its general population and its population during tourism months. For this reason, it is extremely important to prevent infectious diseases and to explain them to the public. Every citizen should be periodically informed about infectious diseases and methods of protection against them.
Implementation details:
- Performing awareness-raising activities to protect against the negative impacts of climate change on health. - Raising awareness of primary health care workers (community health and family health centers) on health risks related to climate change. - Embedding climate change in the curriculum -Training of managers and staff working in public living areas (dormitories, kindergartens, care homes, nursing homes, retirement homes, etc.) to improve their behavioral capacities during extreme weather events. - Organization of climate education in adult education centers. - Integrating climate change adaptation into in-house training programs.
Stakeholders to collaborate with:
Ministry of Health, Provincial Health Directorate, Antalya Provincial Directorate of National Education - Antalya Provincial Disaster and Emergency Directorate (AFAD) - Antalya General Directorate of Water and Wastewater Administration (ASAT) - Antalya public institutions and organizations
Time Plan:
2022 - 2030

Action PD2: Implementing practices to prevent vector breeding.
Separate efforts should be carried out against vector-borne diseases, especially in areas where pollution and population density are high. At the same time, along with vector-borne diseases that are contagious,

the reproduction of vectors that are harmful to plants and forests due to climate change should be prevented.
Implementation details:
- Take appropriate steps in urban planning to prevent vector breeding and to consider air currents. - Investigating the increase in vector-borne diseases due to climate change and environmental problems. - Establishment of working groups across the city
Stakeholders to collaborate with:
Ministry of Health, Provincial Directorate of Health, Antalya public institutions and organizations
Time Plan:
2022 - 2030
Action PD3: Monitoring air and water quality values and developing a warning system.
It is very important to monitor Antalya's water and air quality values. Developing warning systems against possible risks will both ensure that precautions are taken and minimize the vulnerability.
Implementation details:
- Strengthening existing early warning systems. - Ensure appropriate shelter conditions for those adversely affected by extreme weather events. - Adding climate change-related diseases to the early warning system and ensuring case-based followup. -Developing an early warning system by eliminating the lack of interfaces in areas where measurement and monitoring are carried out, especially air quality and water quality - Development of early warning systems for changes in air quality and heatwave risk within action plans
Stakeholders to collaborate with:
Ministry of Health, Provincial Directorate of Health, Antalya public institutions and organizations, Ministry of Environment, Urbanization and Climate Change, Antalya Provincial Directorate of Environment, Urbanization and Climate Change
Time Plan:
2022 - 2030

Action PD4: Identify areas that will be most affected by extreme weather events.
The effects of climate change are not seen equally in all areas of the city, and its impact on some groups is different. Especially in areas where urbanization is dense and green areas are scarce, the impact of climatic risks is generally higher. In addition, vulnerable groups such as the elderly population, those with chronic diseases, and low-income groups are much more affected by the impacts of climate change. For this reason, the implementation of climate adaptation actions should be expanded throughout the city, starting from the vulnerable and more at-risk areas. Therefore, it is extremely important to identify the areas and groups in Antalya that will be more affected by extreme weather events.
Implementation details:
- Work to prevent extreme weather events from adversely affecting the health of the chronically ill, disabled, new-borns, the elderly and other vulnerable groups. - Ensure appropriate shelter conditions for those adversely affected by extreme weather events. - Planning allergy sensitive areas. - Realization of awareness-raising activities to protect against the negative effects of climate change on health at the social and individual level.

Stakeholders to collaborate with:
Ministry of Health, Provincial Health Directorate, Antalya public institutions and organizations, Antalya Provincial Disaster and Emergency Directorate (AFAD)
Time Plan.
2022 - 2030

Action PD5: Ensuring food and nutrition security against drought risk
Even if drought and water scarcity negatively affect all sectors, it affects agricultural production much more seriously. For this reason, agricultural production models that can be developed by making use of new and technological developments should be expanded in Antalya.
Implementation details:
- Enrichment of temperature-resistant food and beverage facilities. - Determination by the Ministry of Agriculture and Forestry of the appropriate product pattern to be selected, taking into account the climatic conditions, soil structure and food needs of Antalya, and the expansion of its production. - Guidance to crop growers for the development of appropriate crop varieties. - Analyzing the impact of climate change on important agricultural products in the province. - Measuring the level of awareness of the public and agricultural sector stakeholders on the impact of climate change on agricultural production and food security. - Determining the effects of drought on plant development, new diseases due to excessive rainfall and drought, the effects of increased hail and frost events on plant pattern and taking necessary measures. - Conducting information and awareness raising activities on hygiene, especially during drought periods.
Stakeholders to collaborate with:
Antalya district municipalities, Antalya Governorship, Ministry of Health, Provincial Directorate of Health, Antalya public institutions and organizations, Provincial Directorate of Agriculture and Forestry
Time plan:
2022 - 2030

Action PD6: Communicating climate disaster risks to the public.
Explaining climatic disasters and the effects of climate change to all segments of the society and ensuring that the seriousness of the event is understood is very important in terms of reducing possible risks. The measures to be taken against climatic risks should be periodically explained to all age groups in schools. In addition, informative meetings should be organized for all those engaged in agricultural production and in the tourism sector, and all segments from rural to urban areas should be reached.
Implementation details:
- Developing a communication strategy for target audiences based on the findings. - Operationalization and implementation of educational and training activities. - Increasing the effectiveness of activities (in terms of resource management) by developing cooperation with civil society organizations.

- Demonstrating the risks of climate change on the health and quality of life of living beings and raising awareness by communicating these impacts to the public - Establish plans to inform the public. - Awareness raising activities by experts on global warming and climate change, especially starting from primary education level. - Organizing informative meetings for all those involved in agricultural production and the tourism sector. - Informing sector stakeholders and local communities about the purpose and functioning of early warning systems and how their findings can be used.
Stakeholders to collaborate with
Antalya district municipalities, Antalya Governorship, Ministry of Health, Provincial Directorate of Health Antalya public institutions and organizations, Antalya Provincial Directorate of National Education
Time plan:
2022 - 2030

Action PD7: Development of disaster early warning systems.
In Antalya, which faces many disaster risks, it is very important to develop and use early warning systems to prevent possible loss of life and property. With the preparation of risk maps of the city, warning systems that will alert the society by using technological tools according to the existing risks should be disseminated throughout the city. Although warnings against possible weather events are currently being communicated to citizens via the internet and television channels, more advanced systems are needed to cover rural areas as well. Another important point is to ensure that citizens pay attention during such warnings.
Implementation details:
- Work with AFAD at national level on strategies and capacities for monitoring indicators that need to be tracked, as well as with DG Meteorology. - Conducting studies based on the SECAP risk and vulnerability assessment in order to better identify the physical, social and economic vulnerabilities associated with flooding across the province of Antalya. - Increasing the possibilities of access to climate information - Strengthening early warning systems.
Stakeholders to collaborate with:
Antalya Governorship, Ministry of Health, Provincial Directorate of Health, Antalya public institutions and organizations, Meteorology 4th Regional Directorate-Antalya, Antalya Provincial Disaster and Emergency Directorate (AFAD)
Time Plan:
2022 - 2030

Action PD8: Development of GIS-based risk maps.
As one of the most important steps of disaster management, it is very important to develop risk maps based on geographic information system starting from the riskiest areas throughout the city. It will be possible to clearly reveal the vulnerability and risk status of Antalya from climate change through GIS risk maps that technical teams can create with scientific methods.
Implementation details:

- Increasing technical capacity by providing theoretical and technical trainings on measurement and monitoring methods for the early warning system to relevant units and field staff. - Complete processing of the works to be carried out throughout Antalya into the geographical information system environment - Development of a decision support mechanism built on the geographic information system for more effective management of disasters, which can effectively manage all resources in the event of a disaster. - By ensuring the coordination of institutions, processing of risky areas and risk maps throughout Antalya into the GIS information program.
Stakeholders to collaborate with:
Antalya district municipalities, Antalya Governorship, Antalya public institutions and organizations
Time plan::
2022 - 2030

4.4.2.5 Agriculture

In Antalya's challenge against climate change, 6 actions have been identified for agriculture.

Action AG1: Creation of vegetated buffer strips along agricultural irrigation canals.
In order to collect rainwater and reduce the risk of erosion, rain collection and irrigation borders should be opened in agricultural areas and supported with vegetated buffer strips.
Implementation details:
- Carrying out studies for the return of rainwater to the soil and underground. - Development and dissemination of water harvesting techniques and technologies. -Informing the producer.
Stakeholders to collaborate with:
State Hydraulic Works 13th Regional Directorate Antalya, Antalya Provincial Directorate of Agriculture and Forestry, irrigation cooperatives, farmers
Time plan:
2022 - 2030

Action AG2: Informing farmers according to climatic risks.
Climate change impacts have a very serious impact on agricultural production and food security. Changing climate and temperature conditions cause changes in many issues such as the production periods and regions of agricultural products. It is essential to share such changes and solutions with producers. Farmers need to be periodically informed about the impacts of climate change according to the product type and production needs. In addition, it is important to explain to farmers the types of production that will be adapted to climate change.
Implementation details:
- Engage with farming communities and cooperatives to identify the most effective training formats and the support needed to transition to more sustainable practices. - Working with farming communities and cooperatives to increase farm biodiversity. -Organization of appropriate training workshops in agricultural basins.

- Measuring the level of awareness of the public and agricultural sector stakeholders on the impact of climate change on agricultural production and food security. - Developing a communication strategy for target audiences based on the findings.
Stakeholders to collaborate with:
Antalya Provincial Directorate of Agriculture and Forestry, irrigation cooperatives, farmers
Time plan:
2022 - 2030

Action AG3: Implementing nature-based solutions in appropriate areas.
Nature-based solutions can be implemented not only in urban areas but also in agricultural areas. Especially in regions facing the risk of water scarcity and drought, practices such as the construction of rainwater harvesting areas for agricultural irrigation, the application of vegetated buffer strips on the edges of agricultural areas, leaving soils uncultivated according to the type of soil and crops, and erosion control systems are nature-based solutions. Such practices need to be implemented and expanded according to the needs of agricultural areas.
Implementation details:
- Expansion of basin erosion control works and construction of dry stone embankments on slope lands and streams in order to transfer basin rainwater to the soil and underground - Conducting a study on the quality and interconnectedness of natural habitats -Changing irrigation methods and agricultural pattern - Taking institutional and technical measures to reduce water consumption - Increasing public investments for improving soil quality (increasing organic matter, etc.). - Increase support mechanisms for sustainable land management and climate-friendly agricultural practices.
Stakeholders to collaborate with
Antalya Provincial Directorate of Agriculture and Forestry, irrigation cooperatives, farmers, 13th Regional Directorate of State Hydraulic Works Antalya
Time plan:
2022 - 2030

Action AG4: Making greenhouses resilient to climate risks.
Floods and overflows, fires, storms and tornadoes, excessive rainfall, frost events affect greenhouse areas very seriously. Especially in Antalya, where storms and tornadoes are frequent, greenhouse activities should be carried out subject to a guide. Implementation of greenhouse structures resistant to possible risks and making existing greenhouses resistant to risks should be started with pilot applications and spread to the entire production mechanism. In addition, a separate guideline should be created on the intense demand for greenhouse production due to the production process and cost burden. It is also very important to create a guide on which regions and at what density greenhouses can be built according to climatic risks.
Implementation details:
- Preparation of a detailed guide on the conduct of greenhouse activities in Antalya.

- Creating a guideline on which regions and at what density greenhouses can be built according to climatic risks.
- Implementation of resilient greenhouse structures throughout Antalya, creation of a support system for farmers on making existing greenhouses resilient according to risks.
- Increasing greenhouse production that is resilient to climate change, supported by new technologies.
- Piloting the construction of new greenhouses and making existing greenhouses resilient.
- Increasing grant support to farmers for the construction of resilient greenhouses.

Stakeholders to collaborate with:

Antalya Provincial Directorate of Agriculture and Forestry, irrigation cooperatives, farmers, Antalya Chamber of Commerce and Industry (ATSO), Antalya public institutions and organizations, agricultural council, Antalya Chamber of Commerce, Antalya NGOs, Ministry of Agriculture and Forestry

Time plan:

2022 - 2030

Action AG5: Providing support to farmers to increase the diversity and quantity of production

One of the most important impacts of climate change is the risk to food security. Issues such as changing climatic conditions, increasing population, chemicals used, production costs affect production processes and quantities. For this reason, it is very important to support producers by developing business models to increase production capacities and varieties in Antalya, one of the leading cities in agricultural production. It is also very important to identify regions where production yields decrease due to climate and to disseminate new production models according to new climatic conditions. It is also clear that new business models should be developed in order to reduce production costs and to ensure that the products are delivered directly to the consumer and that producers are encouraged to produce.

Implementation details:

- Providing support to producers by developing business models to increase production capacities and varieties in Antalya.
- Identification of regions where production yields are reduced due to climate.
- Dissemination of new production models according to new climatic conditions.
- Providing training and support to farmers on cultivation of different crops.
- Determining the decisions to be taken by the agricultural sector together with stakeholders engaged in agricultural activities.

Stakeholders to collaborate with:

Antalya Provincial Directorate of Agriculture and Forestry, farmers, Antalya Chamber of Commerce and Industry (ATSO), Antalya institutions and organizations, agriculture council, Antalya Chamber of Commerce

Time plan:

2022 - 2030

Action AG6: Establishment of rainwater reservoirs for agricultural irrigation.

In Antalya, which has a large share in the agricultural sector, it is important that irrigation activities continue uninterruptedly in terms of food security and agricultural production. Especially in areas with dense greenhouses, the inability of rainwater to meet the soil both increases the risk of flooding and overflows and prevents its collection. Therefore, rainwater collection ponds should be increased,

especially in these areas. In addition, rainwater harvesting systems should be established in areas where there is no covered agriculture and rainwater should be used for agricultural irrigation. It is predicted that Antalya's risk of drought and water scarcity will be reduced by extending these practices to all agricultural areas.
Implementation details:
- Establishment of Antalya agricultural drought management coordination board. - Ensuring effective storm water management. - Establishing rainwater collection systems and ensuring their use in agricultural irrigation. - Making it compulsory to install rainwater collection systems in agricultural areas over a certain m². - Establishment of rainwater collection systems in areas where there is no subsurface agriculture.
Stakeholders to collaborate with:
Antalya Provincial Directorate of Agriculture and Forestry, farmers, agricultural council
Time plan:
2022 - 2030

4.4.2.6 Tourism

In Antalya's challenge against climate change, 6 actions have been identified for tourism.

Action TO1: Promote the concept of responsible tourism.
In order to make tourism activities and businesses sensitive to climate change, various incentive mechanisms should be established, and the concept of responsible tourism should be promoted throughout Antalya.
Implementation details:
- Conducting studies to investigate the direct and indirect positive and negative impacts of climate change on tourism and making recommendations to increase the resilience of the sector. - Funding for a study to investigate the direct and indirect positive and negative impacts on tourism according to the latest projections. - Creating and implementing sustainable tourism policies that adapt to climate change. - Implementation of a tax system in line with sustainable tourism opportunities and climate change sensitivity.
Stakeholders to collaborate with:
Ministry of Culture and Tourism, Antalya Provincial Directorate of Culture and Tourism, NGOs carrying out tourism activities, tourism operators
Time plan:
2022 – 2030

Action TO2 Restrict and control certain tourism activities.
It is very important to limit and control tourism activities that involve intensive water use and destruction of natural areas. Instead of these activities, tourism activities that are compatible with the climate and nature should be promoted and defined.
Implementation details:
- Promoting tourism activities that are compatible with the climate and nature. - Inspection of facilities with high water consumption (pools, water slides, etc.).

Stakeholders to collaborate with:
Republic of Turkey Ministry of Culture and Tourism Antalya Provincial Directorate of Culture and Tourism, NGOs carrying out tourism activities, tourism operators
Time Plan:
2022 - 2030

Action TO3: Natural areas should not be destroyed for tourism purposes.
The units that supervise the destruction and pollution of natural areas under tourism activities should be periodically trained and the destruction of these areas should be prevented.
Implementation details:
- Informing city councils. -Informing employees working in the tourism sector about climate change. - Periodic training of the units conducting inspections. - Imposing penalties for the destruction of natural areas.
Stakeholders to collaborate with
Ministry of Culture and Tourism, Antalya Provincial Directorate of Culture and Tourism, NGOs carrying out tourism activities, tourism operators
Time Plan:
2022 - 2030

Action TU4: Promote the use of renewable energy by enterprises.
Incentive systems such as tax reductions, promotion and branding support can be used to encourage tourism businesses to use renewable energy sources. For example, businesses that use recycled materials and pay attention to minimum waste generation can be placed in a category to be determined by local governments and ministries, and businesses that provide a certain portion of their energy needs with renewable energy sources can be placed in another category and incentives can be provided to the business.
Implementation details:
- Implement incentive systems such as tax reduction, promotion and branding support to encourage tourism enterprises to use renewable energy. - Involve and empower local authorities in planning, management and tourism development
Stakeholders to collaborate with:
Republic of Turkey Ministry of Culture and Tourism Antalya Provincial Directorate of Culture and Tourism, NGOs carrying out tourism activities, tourism operators, Antalya district municipalities
Time Plan:
2022 - 2030

Action TO5: Limiting the use of natural resources in tourism enterprises.
Mitigating and adapting to the impacts of climate change will be possible by limiting the consumption of natural resources. Therefore, it is important to limit such uses and establish incentive mechanisms for renewable resources in the city where tourism enterprises are concentrated. Another important step

should be to prevent activities that damage natural resources and to bring other tourism activity areas to the city.
Implementation details:
-Identifying development areas for ensuring energy efficiency and increasing the use of renewable energy. - Controlling the consumption of natural resources in tourism. - Establish incentive mechanisms for renewable resources in tourism. - Ensuring that nature-friendly tourism activities are prioritized.
Stakeholders to collaborate with:
Ministry of Culture and Tourism, Antalya Provincial Directorate of Culture and Tourism, NGOs carrying out tourism activities, tourism operators
Time Plan:
2022 - 2030

Action TO6: Ensuring cooperation among tourism enterprises for environmental protection.
In Antalya, where the tourism sector is a pioneer, tourism enterprises, ministries, NGOs and local governments should work in cooperation in the context of protection of the natural environment and climate change impacts. In this context, sustainable tourism guides can be created to promote the sustainable tourism model in the city. Issues such as promoting the use of renewable energy resources, minimum waste production, ensuring the use of green procurement products, developing and promoting alternative tourism activities can be included in this guide and can be disseminated through cooperation.
Implementation details:
- Preparation of a situation analysis, sustainable production and consumption strategy, green procurement and supply chain management strategy for tourism enterprises in the region regarding the use of renewable energy resources. - Raising awareness of tourism enterprises on energy efficiency and renewable energy use. - Creation of a sustainable tourism guide. -Ensuring the dissemination of the sustainable tourism model by cooperating with stakeholders throughout the city. - Ensuring that tourism enterprises, ministries, NGOs and local governments work in cooperation in the context of protection of the natural environment and climate change impacts.
Stakeholders to collaborate with:
Ministry of Culture and Tourism, Antalya Provincial Directorate of Culture and Tourism, NGOs carrying out tourism activities, tourism operators
Time plan:
2022 - 2030

4.5 ADAPTATION MONITORING PLAN

To ensure that Antalya's adaptation process is both effective and sustainable over time, it is necessary to regularly assess the progress of planned and implemented actions. In addition, it is important to check the current situation in certain periods by comparing it with the objectives set out in the context of adaptation. With the evaluation of the monitoring results, a more effective way can be followed in terms of adaptation

to climate change by making changes such as making necessary adjustments in some actions and adding new actions.

It should not be forgotten that adaptation indicators are an important part of the monitoring and evaluation process. Selecting appropriate indicators for the city is a necessity for collecting and evaluating information that will guide actions. For this reason, it is important to negotiate and cooperate with stakeholder institutions and organizations to select appropriate indicators and collect the necessary data.

In this context, there are a number of indicators defined for the SECAP process under the Covenant of Mayors. However, it is possible for local governments to create their own indicators and continue monitoring activities according to these indicators. Within the scope of the CoM process, it is emphasized that it is very important to identify and monitor at least one adaptation indicator for each important action in climate action plans.

In the table shown in Table 61, the adaptation indicators defined within the scope of CoM are shared in order to create a roadmap for monitoring activities in Antalya's climate adaptation process. These indicators can be used as well as other indicators that are suitable in terms of data access.

Table 61: Adaptation indicators

Field/Sector	**Indicators of impact**
Buildings	Number or % of buildings damaged due to extreme weather conditions/events (public/residential/non-residential)
Transportation Energy, Water, Waste, Civil Defense and Emergency	Number or % of transportation/energy/water/waste/ICT infrastructure damaged due to extreme weather conditions/events
Land Use	% of gray/blue/green areas affected by extreme weather conditions/events (e.g., Heat Island Effect, Flood, Rockfall and/or Landslide, Forest/Land Fire)
Transportation Energy, Water, Waste, Civil Defense and Emergency	Number of days with public service interruptions (e.g., energy/water supply, health/civil protection/emergency services, waste)
Transportation Energy, Water, Waste, Civil Defense and Emergency	verage length (in hours) of public service interruptions (e.g., energy/water supply, public transport traffic, health/civil protection/emergency services)
Public Health	Number of people injured/rescued/resettled due to extreme weather event(s) (e.g. heat or cold waves)
Public Health	Number of deaths associated with extreme weather event(s) (e.g., heat or cold waves)
Civil Defense & Emergency	Average response time (in minutes) of police/fire/emergency services in case of extreme weather events
Public Health	Number of water quality alerts issued
Public Health	Number of air quality alerts issued
Environment and Biodiversity	% of area affected by soil erosion / soil quality degradation
Environment and Biodiversity	% habitat loss due to extreme weather event(s)
Environment and Biodiversity	% change in the number of native species

Field/Sector	Indicators of impact
Environment and Biodiversity	% of indigenous (animal/plant) species affected by diseases associated with extreme weather conditions/events
Agriculture and Forestry	% of agriculture loss due to extreme weather conditions/events (e.g. drought/lack of water, soil erosion)
Agriculture and Forestry	% of livestock stock loss due to extreme weather conditions
Agriculture and Forestry	% change in crop yield/evolution of annual grassland productivity
Agriculture and Forestry	% loss of animal stock due to pests/pathogens
Agriculture and Forestry	% of timber loss due to pests/pathogens
Agriculture and Forestry	% change in forest composition
Agriculture and Forestry	% change in water extraction
Finance	Annual direct economic loss in Euros from extreme weather event(s) (e.g., in the commercial, agricultural, industrial/touristic sectors)
Finance	The annual amount of compensation received in euros (e.g., insurance)
Climate	Number of days/nights with extreme temperatures (day/night time relative to reference annual/seasonal temperatures)
Climate	Frequency of heat/cold waves
Climate	Number of days/nights with extreme precipitation (day/night time relative to reference annual/seasonal precipitation)
Climate	Number of consecutive days/nights without rain
Socioeconomic	Comparison of current population and projections 2020/2030/2050
Socioeconomic	Population density (relative to national/regional average in country/region X in year X)
Socioeconomic	% share of vulnerable population groups (e.g. older (65+)/younger (25-) people, lone pensioner households, low-income/unemployed households) - in country X relative to the national average in year X
Socioeconomic	% of population living in areas at risk (e.g., flood/drought/heat wave/forest or land fire)
Socioeconomic	% of areas without access to emergency/fire services
Physical and Environmental	% change in average annual/monthly temperatures
Physical and Environmental	% change in average annual/monthly rainfall
Physical and Environmental	Length of transportation network (e.g., road/rail) in areas at risk (e.g., flood/drought/heat wave/forest or land fire)
Physical and Environmental	Length of coasts/streams affected by extreme weather conditions/soil erosion (no adaptation)
Physical and Environmental	% of areas at low altitude or elevation
Physical and Environmental	% of area on coasts or in rivers
Physical and Environmental	% of protected areas (ecologically and/or culturally sensitive) / % of forest cover
Physical and Environmental	% of areas (e.g. residential/commercial/agricultural/industrial/touristic) at risk (e.g. flood/drought/heat wave/forest or land fire)
Physical and Environmental	Comparison of current energy consumption per capita and projections 2020/2030/2050

Field/Sector	Indicators of impact
Physical and Environmental	Comparison of current per capita water consumption and projections 2020/2030/2050
Socioeconomic	% of land area hosting industry/agriculture located in areas at risk of climate hazards (floods, droughts, heat waves, wildfires or fires difficult to extinguish)
Socioeconomic	Percentage of available public funds that address a climate hazard and its impacts (e.g. fire, flood, heat wave, etc.)
Socioeconomic	c % share of vulnerable population groups (e.g. older (65+)/younger (25-) people, lone pensioner households, low-income/unemployed households) - in country X relative to the national average in year X
Socioeconomic	Number of households trained on energy/water/waste management
Socioeconomic	Population density (relative to national/regional average in country/region X in year X)
Socioeconomic	Percentage of population living in areas at risk (e.g. flood/drought/heat wave/forest or land fire)
Governance and Corporate	Change in the city's green/blue infrastructure/areas (%)
Physical and Environmental	Length of transportation network (e.g., road/rail) in areas at risk (e.g., flood/drought/heat wave/forest or land fire)
Physical and Environmental	Average time to reach a health facility (min/hr)
Physical and Environmental	% of areas (e.g. residential/commercial/agricultural/industrial/touristic) at risk (e.g. flood/drought/heat wave/forest or land fire)
Physical and Environmental	Percentage of inaccessible areas for emergency response (e.g. fire intervention services)
nformation and Technology	Time required to inform the population about a risk through an early warning system (min/hr)

5. GENERAL EVALUATION

As a result of this study to reduce the effects of climate change in Antalya, both greenhouse gas reduction and climate change adaptation approaches are focused. The mitigation approach aims to reduce the current and future greenhouse gas impacts in order to mitigate the impacts of climate change. It is stated that it is possible to achieve this goal through actions such as reducing energy use, ensuring transition to renewable energy sources, and creating carbon sink areas. Adaptation, which is the other approach in combating climate change, has adopted targets that will reduce the impacts of weather events that have occurred and are foreseen to occur in the future due to changing climate conditions. It was pointed out that these goals can be achieved through the implementation of actions such as the protection of flood zones, the adoption of green infrastructure strategies, and the adaptation of infrastructures.

Antalya's urban greenhouse gas emissions calculated for the base year 2019, including industry, total 10,683,551 tCO_2e. When the emissions of Antalya including industry in 2019 are analyzed, total energy consumption in the province is 28,623,531 MWh and greenhouse gas emissions are 10,683,551 tCO_2e. Within the total inventory, emissions from fuel and electricity consumption of buildings (including industry) account for 47.7% (40.9% buildings and 6.1% industry), emissions from transportation account for 30.24%, emissions from agriculture and animal husbandry account for approximately 6%, emissions from energy generation account for 8.5% and emissions from solid waste and wastewater processes account for 8.2%.

For 2019, Antalya's greenhouse gas emissions excluding industry [126] were calculated as 8,232,919 tCO_2. Since the next emission reduction targets of the district do not cover the industrial sector, it has been excluded. With the mitigation measures put forward in the sectors, Antalya's per capita emissions are planned to decrease from 3.28 tCO_2e /person in 2019 to approximately 1.96 tCO_2e /person in 2030.

With the mitigation measures put forward in the sectors, it is concluded that a 40% reduction in Antalya's per capita emissions by 2030 can be achieved in 2030 compared to 2019. Antalya's BAU (Continuation of the Status Quo Unchanged) scenario is presented by evaluating the projections made by different institutions regarding population and sectoral growth, and 2030 emissions are calculated as 7,886,537 tCO_2e according to this scenario. By 2030, it is targeted to reduce 4,576,943 tCO_2e in the buildings sector, 2,009,046 tCO_2e in the transportation sector, 923,349 tCO_2e in other sectors including waste and wastewater actions, and 377,208 tCO_2e with renewable energy. Antalya Sustainable Energy Action Plan creates a roadmap for reducing emissions from energy consumption in different sectors determined with the participation of urban stakeholders.

For Antalya, eliminating climate change risks or mitigating its impacts will only be possible through a comprehensive implementation process. As seen in Figure 100, the most important topics covering mitigation activities are public transportation, energy use, circular economy and human behavior.

Climate change adaptation strategies within the scope of this plan, based on the available historical data and studies carried out, make a vulnerability analysis for the city in the light of the climate change scenarios created for Antalya province, and bring together proposals for new planning practices with a perception that

[126] *Emissions specified as excluding industry are greenhouse gas emission values excluding industry, civil airports, fugitive emissions, agriculture and energy production.*

recognizes the city as an ecosystem that includes the interaction of cultural and natural structures and systems, as well as an area where anthropogenic activities are concentrated. Antalya is one of the most special cities both in Turkey and in the world in terms of its forest cover, intensive agricultural and tourism activities, and rich natural and cultural heritage.

The Antalya adaptation strategy aims to mitigate the impacts of climate change and improve the quality of urban life. It focuses on issues such as managing high and sudden changes in temperatures, water resources management, reducing flooding and soil erosion, and reducing the impact of frequent extreme weather events. In the fight against climate change in Antalya, it is important to create a sustainable and resilient urban structure against long-term and sudden impacts.

In urban design practices, it is important to integrate design approaches and tools such as "water sensitive urban design", "green infrastructure strategies", "nature-based solutions" that take into account the natural and cultural life form for urban dwellers with spatial planning. Antalya Climate Adaptation Strategy will be a key document in establishing design principles and guiding practices in this context. However, it should not be forgotten that this document should be considered as a starting point and should pave the way for detailed studies on other issues that are included in its content or that may develop later and should be updated periodically in line with changing conditions. The most critical activities in adaptation activities are the implementation of disaster resilient urban plans and design practices, emergency response plans, adapted infrastructure systems, green infrastructure systems, sustainable agriculture, and tourism to make the region climate resilient.

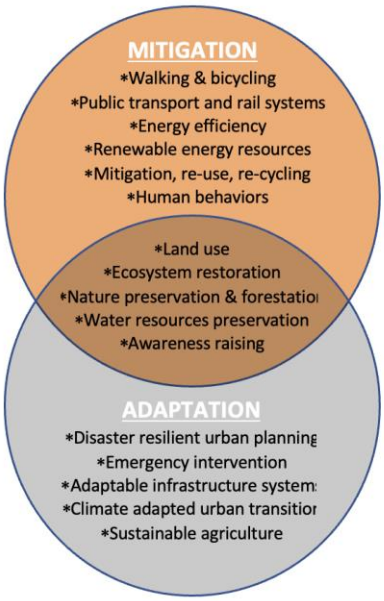


Figure 98: Antalya climate change mitigation and adaptation scheme

6. REFERENCES[127]

- Antalya Büyükşehir Belediyesi 2020-2024 Stratejik Planı, 2019, ss.1-118.
- Antalya Büyükşehir Belediyesi 2021 Faaliyet Raporu.
- Cambridge Centre for Risk Studies, Cambridge Risk Atlas, Part II: Methodology Documentation, "World Cities Risk 2015-2025", 2015.
- KENTGES Bütünleşik Kentsel Gelişme Stratejisi ve Eylem Planı 2010-2023, Eylem 5.5.3, s.51, http://www.sp.gov.tr/upload/xSPTemelBelge/files/bk0sC+KENTGES.pdf
- Londra Büyükelçiliği Kültür ve Tanıtma Müşavirliği 'İngiltere Pazar Raporu', 2012.
- Türkiye Cumhuriyeti Cumhurbaşkanlığı, Strateji ve Bütçe Başkanlığı, "On Birinci Kalkınma Planı (2019-2023)", Temmuz 2019, https://www.sbb.gov.tr/wp-content/uploads/2019/11/ON_BIRINCI_KALKINMA-PLANI_2019-2023.pdf
- T.C. Batı Akdeniz Kalkınma Ajansı (BAKA), Bölge Planı 2014-2023, TR61 Düzey 2 Bölgesi Antalya-Isparta-Burdur, 2013, https://www.baka.gov.tr/assets/upload/dosyalar/tr61-duzey-2-bolgesi-2014-2023-bolge-plani.pdf
- T.C. Batı Akdeniz Kalkınma Ajansı, Güneş Enerjisi Sektör Raporu, Şubat 2011, http://baka.gov.tr/uploads/1303486512GUNES-TURKCE-KATALOG.pdf
- T.C. Çevre ve Şehircilik Bakanlığı, "İklim Değişikliği 6. Ulusal Bildirimi", Ankara, 2016.
- T.C. Çevre ve Şehircilik Bakanlığı, "Türkiye İklim Değişikliği Stratejisi 2010-2023", ss.42, https://www.gmka.gov.tr/dokumanlar/yayinlar/Turkiye-Iklim-Degisikligi-Stratejisi.pdf
- T.C. Enerji ve Tabii Kaynaklar Bakanlığı, 2019-2023 Stratejik Planı, ss.167, https://sp.enerji.gov.tr/ETKB_2019_2023_Stratejik_Plani.pdf
- T.C. Sanayi ve Teknoloji Bakanlığı, Kalkınma Ajansları Genel Müdürlüğü, İlçelerin Sosyoekonomik Gelişmişlik Sıralaması Araştırması, 2022
- Kadıoğlu M, Kent Selleri Yönetim ve Kontrol Rehberi, Marmara Belediyeler Birliği, İstanbul, 2019.
- T.C Antalya Valiliği, Çevre ve Şehircilik İl Müdürlüğü, Antalya Çevre Durum Raporu, 2019, ss. 1-126.
- T.C. Tarım ve Orman Bakanlığı, Meteoroloji Genel Müdürlüğü, "İllere ait Mevsim Normalleri", https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?m=ANTALYA
- T.C. Tarım ve Orman Bakanlığı, Meteoroloji Genel Müdürlüğü, "Küresel İklim Modellemesi", https://mgm.gov.tr/iklim/iklim-degisikligi.aspx?s=kuresel
- T.C. Tarım ve Orman Bakanlığı, 2019-2023 Stratejik Plan, s.4-5.
- T.C. Tarım ve Orman Bakanlığı, Meteoroloji Genel Müdürlüğü, 2019 Yılı Meteorolojik Afet Değerlendirmesi Raporu, 2020.
- The European Climate Adaptation Platform Climate-ADAPT, https://climate-adapt.eea.europa.eu/knowledge/tools/urban-ast/step-0-0
- TÜİK, https://biruni.tuik.gov.tr/
- UNISDR & CRED, Economic Losses, Poverty & Disasters 1998-2017, 2018.
- World Disaster Report, "The International Federation of Red Cross and Red Crescent Societies", 2018.

[127] These sources include only those that are not given as footnotes. All remaining source information is given as a footnote in the relevant section.

ANNEX

Climate Change Adaptation 1st Workshop Participant List (27.04.2022)

External stakeholders:

Mediterranean Touristic Hoteliers and Operators Association (AKTOB)
Akdeniz University Energy Management Unit
Akdeniz University Engineering Faculty Environmental Engineering Department
Akseki Municipality
Aksu Municipality
Alanya Municipality
Antalya Chamber of Environmental Engineers
Antalya Provincial Directorate of Environment, Urbanization and Climate Change
Antalya DSI
Antalya Chamber of Electrical Engineers
Union of Chambers of Tradesmen and Craftsmen of Antalya
Antalya Provincial Directorate of Disaster and Emergency
Antalya Provincial Directorate of Culture and Tourism
Antalya Provincial Health Directorate
Antalya Provincial Directorate of Agriculture and Forestry
Antalya Chamber of Civil Engineers
Antalya Chamber of Geological Engineers
Antalya City Council
Antalya Chamber of Mechanical Engineers
Antalya Chamber of Architects
Antalya Organized Industrial Zone Directorate
Antalya Regional Directorate of Forestry
Antalya Chamber of Forestry Engineers
Antalya OSB Technopark
Antalya Free Zone Founder and Operator Inc. (ASBAŞ)
Antalya Chamber of City Planners
Antalya Agriculture Council
Antalya Technopolis
Antalya Chamber of Commerce and Industry
Baka (Western Mediterranean Development Agency)
ÇEVKO
Demre Municipality
Antalya Provincial Directorate of Nature Conservation and National Parks (Ministry of Agriculture and Forestry)
Dosemealti Municipality
Elmali Municipality
Municipality of Finike
Gazipasa Municipality
Ibradi Municipality
Iller Bank 5th Regional Directorate
Kas Municipality
Kemer Municipality
Kepez Municipality
Konyaalti Municipality

Korkuteli Municipality
Kumluca Municipality
Manavgat Municipality
4th Regional Directorate of Meteorology Antalya
Muratpasa Municipality
Ministry of Industry and Technology Antalya Provincial Directorate of Industry and Technology
Serik Municipality
TURKSTAT Antalya Regional Directorate
TURÇEV

Internal stakeholders:

ASAT
Information Processing Department
Environmental Protection and Control Department
Department of Foreign Relations
Department of Science Affairs
Department of Housing and Urban Development
Fire Department
Department of Urban Aesthetics
Department of City History and Promotion
Financial Services Department
Department of Parks and Gardens
Department of Health Affairs
Social Services Department
Department of Agricultural Services
Department of Transportation Planning and Rail System

Climate Change Adaptation 2nd Workshop Participant List (June 15, 2022)

External stakeholders:

Mediterranean University
Aksu Municipality
ANSIAD
Antalya Provincial Directorate of Environment and Urbanization
Union of Chambers of Tradesmen and Craftsmen of Antalya
Antalya Provincial Directorate of Agriculture and Forestry
Antalya Chamber of Geological Engineers
Antalya City Council
Antalya Chamber of Mechanical Engineers
Antalya Chamber of Architects
Antalya Organized Industrial Zone Directorate
Antalya Regional Directorate of Forestry
Antalya Free Zone Founder and Operator Inc. (ASBAŞ)
BAKA (Western Mediterranean Development Agency)
Antalya Provincial Directorate of Nature Conservation and National Parks (Ministry of Agriculture and Forestry)
Dosemealti Municipality
Municipality of Finike
Iller Bank 5th Regional Directorate

Kepez Municipality
Konyaalti Municipality
Korkuteli Municipality
Kumluca Municipality
Manavgat Municipality
4th Regional Directorate of Meteorology Antalya
Muratpasa Municipality
Technocity
TURKSTAT Antalya Regional Directorate

Internal stakeholders:

Information Processing Department
Environmental Protection and Control Department
Department of Foreign Relations
Department of Housing and Urban Development
Fire Department
Department of Urban Aesthetics
Financial Services Department
Department of Parks and Gardens
Department of Health Affairs
Social Services Department
Department of Agricultural Services
Department of Transportation Planning and Rail System