REPUBLIC OF TÜRKİYE
MINISTRY OF ENVIRONMENT,
URBANIZATION AND CLIMATE CHANGE

REPUBLIC OF TÜRKİYE MINISTRY OF ENVIRONMENT, URBANIZATION AND CLIMATE CHANGE
DIRECTORATE of CLIMATE CHANGE

CLIMATE CHANGE ADAPTATION STRATEGY AND ACTION PLAN (2024-2030)

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ABBREVIATIONS

AFAD	Disaster and Emergency Management Presidency
AG	Agriculture
AHS	Assembly of Health Services
AR5	IPCC Fifth Assessment Report
AR6	IPCC Sixth Assessment Report
ARDSI	Agriculture and Rural Development Support Institution
ARI	Agricultural Research Institute
AYDES	Disaster Management and Decision Support System
BAU	Business as Usual
BES	Biodiversity and Ecosystem Services
BET	Board of Education and Training
BIO	Biodiversity
BOTAS	Petroleum Pipeline Corporation
BRSA	Banking Regulation and Supervision Agency
BTMP	Bike Transport Master Plans
CBAM	Carbon Border Adjustment Mechanism
CCA	Climate Change Adaptation
CCACB	Climate Change and Adaptation Coordination Board
CCAP	Climate Change Action Plan
CCASAP	Climate Change Adaptation Strategy and Action Plan
CCBM	Central Committee of Basin Management
CHE	Council of Higher Education
COP	Conference of the Parties
CORINE	Coordination of Information on the Environment
CWMS	Continuous Wastewater Monitoring Systems
DA	Development Agency
DCC	Directorate of Climate Change
DCCZW	Department of Climate Change and Zero Waste
DEEE	Department of Energy Efficiency and Environment
DEUFP	Division of European Union Framework Programmes
DGI	Directorate for Guidance and Inspection
DGSHW	Directorate General of State Hydraulic Works
DHR	Department of Human Rights
DIA	Department of Internal Audit
DIC	Department of International Cooperation
DIP	Department of Information Processing
DMPF	Department of Management of Ports and Ferries
DNR	Department of Natural Resources
DRGCCNA	Directorate of Regional Board for Conservation of Cultural Assets
DRR	Disaster Risk Reduction
DRRS	Disaster Risk Reduction System
DSS	Department of Support Services
DTP	Department of Training and Publication
EBA	Ecosystem-Based Adaptation
EC	European Commission

ECIA Executive Committee of Insurance Assessors
EEC European Economic Community
EIA Environmental Impact Assessment
EM-DAT Emergency Events Database
EMRA Energy Market Regulatory Authority
EU European Union
EUAS Electricity Generation Corp.
FAO Food and Agriculture Organization of the United Nations
FRI Forestry Research Institute
GDAE General Directorate of Agricultural Enterprises
GDAR General Directorate of Agricultural Reform
GDC General Directorate of Customs
GDC General Directorate of Communications
GDCA General Directorate of Civil Aviation
GDCAM General Directorate of Cultural Assets and Museums
GDCDE General Directorate of Combating Desertification and Erosion
GDCS General Directorate of Child Services
GDDA General Directorate of Development Agencies
GDDMCC General Directorate of Disaster Management and Climate Change
GDDT General Directorate of Domestic Trade
GDEA General Directorate of Energy Affairs
GDEE General Directorate of Energy and Environment
GDEHS General Directorate of Emergency Health Services
GDEIAPI General Directorate of Environmental Impact Assessment, Permit and Inspection
GDEM General Directorate of Environmental Management
GDEUFR General Directorate of European Union and Foreign Relations
GDF General Directorate of Forestry

GDF General Directorate of Foundations
GDFA General Directorate of Fisheries and Aquaculture
GDFC General Directorate of Food and Control
GDFER General Directorate of Foreign Economic Relations
GDGIS General Directorate of Geographic Information System
GDHI General Directorate of Health Investments
GDHIS General Directorate of Health Information Systems
GDHP General Directorate of Health Promotion
GDHS General Directorate of Health Services
GDI General Directorate of Industry
GDIE General Directorate of Investments and Enterprises
GDIET General Directorate of Innovation and Educational Technologies
GDIFC General Directorate of Incentives and Foreign Capital
GDII General Directorate of Infrastructure Investments
GDILF General Directorate for International Labour Force
GDIPME General Directorate of Investment Programming, Monitoring and Evaluation
GDIT General Directorate of Information Technologies
GDIUTS General Directorate of Infrastructure and Urban Transformation Services
GDIZ General Directorate of Industrial Zones
GDL General Directorate of Labour
GDL General Directorate of Livestock
GDLA General Directorate of Local Authorities
GDLL General Directorate of Lifelong Learning
GDMA General Directorate of Maritime Affairs
GDMPA General Directorate of Mining and Petroleum Affairs
GDMRE General Directorate of Mineral Research and Exploration
GDNCNP General Directorate for Nature Conservation and National Parks

GDNP	General Directorate of National Property
GDOSHS	General Directorate of Occupational Safety and Health and Safety
GDP	Gross Domestic Product
GDP	General Directorate of Promotion
GDPA	General Directorate for Provincial Administrations
GDPCNA	General Directorate for Protection of Natural Assets
GDPCP	General Directorate of Plant Production
GDPE	General Directorate of Primary Education
GDPEI	General Directorate of Private Education Institutions
GDPH	General Directorate of Public Health
GDPH	General Directorate of Public Hospitals
GDRCS	General Directorate of Relations with Civil Society
GDRE	General Directorate of Research and Education
GDRI	General Directorate of Religious Instruction
GDSA	General Directorate of Social Assistance
GDSCS	General Directorate of Shipyards and Coastal Structures
GDSE	General Directorate of Secondary Education
GDSECS	General Directorate of Special Education and Counselling Services
GDSP	General Directorate of Spatial Planning
GDSPDE	General Directorate of Services for Persons with Disabilities and Elderly
GDSPI	General Directorate of Sectors and Public Investments
GDSRP	General Directorate for Strategic Research and Productivity
GDSS	General Directorate of Support Services
GDST	General Directorate of State Theatres
GDSW	General Directorate onf the Status of Women
GDSWM	General Directorate of Water Management
GDTSR	General Directorate of Transport Services Regulation

GDVS	General Directorate of Vocational Services
GDVTE	General Directorate of Vocational and Technical Education
GDYS	General Directorate of Youth Services
GHG	Greenhouse Gas
GIS	Geographic Information System
GNAT	Grand National Assembly of Türkiye
GW	Groundwater
HIA	Health Impact Assessment
HPP	Hydropower Plant
IAT	Insurance Association of Türkiye
ICD	International Statistical Classification of Diseases and Related Health Problems
ICOM	International Council of Museums
ICOMOS	International Council on Monuments and Sites
ICTA	Information and Communication Technologies Authority
IFAD	International Fund for Agricultural Development
IHR	International Health Regulations
IIMC	Insurance Information and Monitoring Centre
ILBANK	Bank of Provinces Inc.
INDC	Intended Nationally Determined Contribution
IOM Türkiye	International Organization for Migration Türkiye Office
IPCC	Intergovernmental Panel on Climate Change
IPRSA	Insurance and Private Pension Regulation and Supervision Agency
ISKUR	General Directorate of Turkish Employment Agency
IUCN	International Union for Conservation of Nature
IZCI	Infectious Diseases Surveillance and Early Warning System
JGKGGC	Gendarmerie General Command
KENTGES	Integrated Urban Development Strategy and Action Plan 2010-2023

KGM General Directorate of Highways
KOSGEB Small and Medium Enterprises Development Organization
LCCAP Local Climate Change Action Plan
LQ Location Quotient
MM Metropolitan Municipality
MoAF Ministry of Agriculture and Forestry
MoCT Ministry of Culture and Tourism
MoD Ministry of Development
MoENR Ministry of Energy and Natural Resources
MoEUCC Ministry of Environment, Urbanization and Climate Change
MoFA Ministry of Foreign Affairs
MoFAL Ministry of Food, Agriculture and Livestock
MoFSS Ministry of Family and Social Services
MoFWA Ministry of Forestry and Water Affair
MoH Ministry of Health
MoI Ministry of Interior
MoIT Ministry of Industry and Technology
MoJ Ministry of Justice
MoLSS Ministry of Labour and Social Security
MoND Ministry of National Defence
MoNE Ministry of National Education
MoT Ministry of Trade
MoTF Ministry of Treasury and Finance
MoTI Ministry of Transport and Infrastructure
MoYS Ministry of Youth and Sports
MUSIAD Independent Industrialists' and Businessmen's Association
NACE Statistical Classification of Economic Activities in the European Community

NDC Nationally Determined Contribution
NESAP National Earthquake Strategy and Action Plan
NFC Naval Forces Command
NGO Non-Governmental Organization
NSDCB National Sustainable Development Coordination Board
NWIS National Water Information System
OECD Organization for Economic Co-operation and Development
OIZ Organized Industrial Zone
OSBUK Organized Industrial Zones Senior Organization
PA Privatization Administration
PCA Principal Component Analysis
PD Provincial Directorate
PDRP Provincial Disaster Response Plan
PDRRP Provincial Disaster Risk Reduction Plan
PMM Presidency of Migration Management
POA Public Oversight Authority (Public Oversight, Accounting and Auditing Standards Authority)
PPA Public Procurement Authority
PPDRP Provincial Post-Disaster Recovery Plan
PSB Presidency of Strategy and Budget
PTT Post and Telegraph Organization
R&D Research and Development
RCAM Research Centre for Asylum and Migration
RCP Representative Concentration Pathway
RCTMC Research Centre for Transport, Maritime and Communications
RDA Regional Development Administration
RDF Regional Directorate of Forestry
RICECCS Research Institute for Clean Energy, Climate Change and Sustainability

RTUK Radio and Television Supreme Council
SARS Spatial Address Registry System
SASF Social Assistance and Solidarity Foundation
SDD Strategy Development Department
SDGs Sustainable Development Goals
SEA Strategic Environmental Assessment
SEDI Socio-Economic Development Index
SGC Coast Guard Command
SGK Social Security Institution
SPA Special Provincial Administration
SPP Solar Power Plant
SRMC Special Risks Management Centre
SSF Social Service Federation
TAGEM General Directorate of Agricultural Research and Policies
TANAP Trans-Anatolian Natural Gas Pipeline Project
TARSIM Agricultural Insurance Pool Corp.
TCFD Task Force on Climate-related Financial Disclosures
TCMB Central Bank of the Republic of Türkiye
TDI Turkish Maritime Enterprises Corp.
TDMS Türkiye Disaster Management Strategy
TDRP Türkiye Disaster Response Plan
TDRRP Türkiye Disaster Risk Reduction Plan
TEDAS Turkish Electricity Distribution Corp.
TEIAS Turkish Electricity Transmission Corp.
TGA Türkiye Tourism Promotion and Development Agency
TIHEK Human Rights and Equality Institution of Türkiye
TKI Turkish Coal Enterprises

TMMOB Turkish Union of Chambers of Engineers and Architects
TSMS Turkish State Meteorological Service
TNA Turkish National Agency
TNC Turkish National Commission
TNGIS Turkish National Geographic Information System
TOBB Union of Chambers and Commodity Exchanges of Türkiye
TOKI Housing Development Administration
TPAO Turkish Petroleum Corporation
TPDRP Türkiye Post-Disaster Recovery Plan
TRC Turkish Red Crescent
TRT Turkish Radio and Television Corporation
TSE Turkish Standards Institute
TSIC Transport Safety Investigation Centre
TSMS Turkish State Meteorological Service
TUBITAK Scientific and Technological Research Council of Türkiye
TURKSTAT Turkish Statistical Institute
TURSAB Association of Turkish Travel Agencies
TUSIAD Turkish Industry and Business Association
TUSKA Turkish Health Services Quality and Accreditation Institute
TWI Turkish Water Institute
UMT Union of Municipalities of Türkiye
UN United Nations
UNDP United Nations Development Programme
UNDRR United Nations Office for Disaster Risk Reduction
UNESCO United Nations Educational, Scientific and Cultural Organization
UNESCAP United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC United Nations Framework Convention on Climate Change

UVS Union of Village Services

VQA Vocational Qualifications Authority

WHO World Health Organization

WFD Water Framework Directive

WMO World Meteorological Organization

WPP Wind Power Plant

WRM Water Resources Management

WSA Water and Sewer Administration

FOREWORD

Climate change has become one of the most pressing global concerns of our time, as a consequence of centuries-long human activities affecting our planet. Intensive fossil fuel use since the Industrial Revolution, rising demands, overexploitation of natural resources, ecosystem degradation, and biodiversity loss have all been key drivers of climate change.

The Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) underscores the importance of limiting global warming to 1.5°C to achieve a just, equitable, and sustainable world.

In addition, the IPCC highlights that surface temperatures in the Mediterranean Basin are now 1.5°C above pre-industrial levels. Rising temperatures have significantly increased the frequency and intensity of extreme weather events in our country and across the region. Türkiye, located within the Mediterranean Basin, is experiencing an escalation in adverse events such as storms, heavy rainfall, forest fires, floods, hailstorms, and droughts. In the light of these developments, we are resolutely continuing our efforts to protect our country from the adverse impacts of climate change and to enhance its resilience.

The State of the Global Climate 2023 report by the World Meteorological Organization (WMO) reveals that 2023 broke records in all climate indicators. According to the report, the global average near-surface temperature increased by 1.45°C compared to the pre-industrial levels, making 2023 the warmest year in the recorded 174-year history. Additionally, the decade from 2014 to 2023 was the warmest on record, with the average temperature in this period standing 1.2°C above the 1850-1900 average.

The adverse impacts of climate change necessitate the timely and effective implementation of adaptation measures, as well as cooperation and coordination across various sectors and levels of government.

Accordingly, Türkiye has developed the "Climate Change Adaptation Strategy and Action Plan (2024-2030)" with a vision of becoming more resilient, sustainable and greener from an economic, social, and ecological perspectives. The plan aims to enhance the preparedness and adaptability of both public and private sector institutions to the effects of climate change.

Our Strategy and Action Plan, based on vulnerability and risk assessments, encompasses eleven sectors along with cross-cutting themes. These sectors include Urban, Water Resources Management, Agriculture and Food Security, Biodiversity and Ecosystem Services, Public Health, Energy, Industry, Tourism and Cultural Heritage, Transport and Communication, Social Development and Disaster Risk Reduction.

As part of the Action Plan, 40 strategic goals and 129 actions have been identified in cooperation with responsible and relevant institutions and organizations.

Through these meticulous and comprehensive efforts, Türkiye remains committed to fulfilling its responsibilities in protecting both our planet and future generations.

I sincerely believe that this nationally led initiative will further advance Türkiye's efforts of to combat global climate change through strengthened collaboration with all our stakeholders.

I truly hope that our Climate Change Adaptation Strategy and Action Plan will bring positive outcomes for our country, our nation and the planet Earth, as our shared home.

Murat KURUM
Minister of Environment, Urbanization
and Climate Change

EXECUTIVE SUMMARY

Climate change, caused by human activities such as excessive use of fossil fuels, changes in land use, and deforestation since the Industrial Revolution, is one of the most significant global issues confronting humanity today.

According to the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC), global temperatures have risen by approximately 1.1°C since the pre-industrial period. If current trends persist, it is projected that global warming will reach 3°C by 2100.

Climate change has already led to various impacts of different magnitudes on ecosystems, economic sectors, and human health worldwide. The IPCC Report emphasizes that even if Greenhouse Gas (GHG) emissions were minimized today, the unavoidable effects of climate change would continue to be experienced for a long time.

Although climate change is universally acknowledged, complementary policies and actions are essential for adapting to its impacts. This highlights that adaptation to climate change is as essential as mitigation efforts aimed at reducing emissions. Indeed, adaptation actions to address climate change have increased steadily across the world, with adaptation policies gaining prominence alongside mitigation strategies in international agreements, such as the Paris Agreement (Article 7).

At this point, with the intensifying impacts of climate change, it is clear that a balance must be struck between adaptation and mitigation within the framework of the policies formulated at both global and national levels. Local dynamics play a crucial role, as vulnerability to climate change and the resulting adaptation needs vary according to national and regional contexts.

Adaptation can be defined as the process of strengthening and implementing strategies to address and manage the impacts of climate change. It involves adjusting to changing climate conditions, mitigating adverse effects and turning challenges into opportunities wherever possible. Adaptation to climate change is a dynamic and integrated process, involving decision-making across numerous areas such as agriculture, food, water, public health, tourism, disaster management, insurance, infrastructure, biodiversity and ecosystems, energy, finance, urbanization, transport, industry, migration, and social development.

Climate and disaster risks are increasing worldwide, with a significant rise in both severity and frequency climate-related disasters over the past 50 years.

Türkiye is located in the Mediterranean Basin, which, according to IPCC reports, is one of the regions most vulnerable to climate change. Due to its geographical position, Türkiye is already impacted by climate-related disasters such as droughts, floods, and extreme weather events, and projections indicate that the country's vulnerability to such disasters will increase in the future.

Between 2010 and 2021, a total of 8,274 meteorological disasters recorded in Türkiye. The three most frequent meteoritical events were storms (32%), heavy precipitation/floods (30%) and hailstorms (17%). Additionally, extreme heat events have also become more frequent in recent years.

According to Disaster and Emergency Management Presidency (AFAD) Natural Phenomena Statistics, 450 floods, 18 avalanches, and 859 landslides occurred, and 13 sinkholes formed in 2022. These disasters have expanded across vast areas, both in terms of impact and frequency.

In 2021, Türkiye experienced 2,793 forest fires, significantly above the annual average, damaging 139,503 hectares of forest area.

The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) reports that floods in Türkiye between 1970 and 2021 caused damages amounting to 2.8 billion USD and resulted in the loss of 758 lives. Additionally, economical losses due to drought have been estimated at 1.2% of Gross Domestic Product (GDP).

According to UNESCAP data, the annual average loss from climate-related disasters accounts for 2.2% of Türkiye's GDP. Under the moderate scenario (RCP4.5), these losses are projected to reach 2.8% of the GDP, while under pessimistic scenario (RCP8.5), they could rise to and 3.2%. Therefore, it is critical for Türkiye to enhance its resilience against the impacts of climate-related disasters and to unwaveringly pursue adaptation efforts at all levels.

Türkiye acknowledges that climate change is a multifaceted and complex challenge with significant environmental and socio-economic consequences. The impacts of climate change may become one of the most serious threats to the lives of future generations. With this understanding, Türkiye recognizes the importance of reducing GHG emissions and adapting to climate change, as well as the need for international cooperation in combating climate change. In line with this, Türkiye submitted its Updated First Nationally Determined Contribution (NDC) to support global efforts to mitigate the impacts of climate change in accordance with its specific circumstances and capacities. Through this updated NDC, Türkiye has committed to reducing GHG emissions by 41% by 2023, compared to the baseline scenario outlined in 2015. Given the importance Türkiye places on

climate change adaptation, a separate section on adaptation was included in its Updated First NDC.

Subsequent to the announcement of Türkiye's Net Zero Emissions target for 2053, the first Climate Council was held by the Ministry of Environment, Urbanization and Climate Change (MoEUCC) in Konya between 21-25 February 2022. The objective of the Council was to determine the building blocks of the country's long-term roadmap on climate change together with all stakeholders. The event was attended by approximately 5,000 participants from various stakeholder groups, including representatives from the public and private sectors, academia, Non-Governmental Organizations (NGOs) and students. Following the Council meeting, a roadmap guiding Türkiye's long-term climate change policies was outlined, incorporating a total of 217 recommendations, with 76 designated as priorities. In this context, critical decisions were made to directly or indirectly support climate change adaptation, with particular emphasis on the Climate Change Adaptation Decisions. These decisions adopted at the Council serve as a foundation for Türkiye's climate change policies, strategy papers, and legislative efforts.

As part of the Council decision to "Identify, implement, and monitor national, regional, and local sectoral adaptation actions by conducting climate change impact, vulnerability, and risk assessments", Türkiye launched its efforts to prepare the Climate Change Adaptation Strategy and Action Plan (CCASAP) for 2030.

Furthermore, measure no. 865.3 under the "Environmental Protection" heading in the Twelfth Development Plan (2024-2028) focuses on the formulation and implementation of strategies and action plans to establish the actions for GHG emissions reduction, climate change adaptation, and climate change response to achieve the objectives of the Paris Agreement.

In addition, the Medium-Term Programme for 2024-2026 defines "the development of planning and implementation tools for activities related to GHG emissions reduction, climate change adaptation, and climate response, in order to achieve and sustain green transformation and the net zero emissions target by 2053" as a priority reform area.

With Presidential Decree No. 85, issued on 29/10/2021 (Official Gazette of 29/10/2021, issue no. 31643), the responsibility for "determining national and international policies, strategies, and actions within the scope of Türkiye's climate response and adaptation efforts, conducting negotiation processes, and ensuring coordination with institutions and organizations" was assigned to the Directorate of Climate Change (DCC). In this context, preparatory works for the CCASAP for the period 2024-2030 were initiated within the framework of the "Enhancing Adaptation Action in Turkey Project". This project is implemented by the MoEUCC and the United Nations Development Programme (UNDP), and jointly financed by the European Union (EU) and the Republic of Türkiye.

In this direction, the CCASAP for 2024-2030 was drafted, defining the strategies and actions to be implemented by 2030 with a vision for "Türkiye that is more resilient, more sustainable and greener in economic, social and ecological terms to ensure the preparedness and adaptation of the people in Türkiye, and of public and private institutions to the impacts of climate change".

The strategies and actions outlined in the Plan are described under a total of 12 chapters, covering 11 sectors, namely: Urban , Water Resources Management, Agriculture and Food Security, Biodiversity and Ecosystem Services, Public Health, Energy, Industry, Tourism and Cultural Heritage, Transport and Communication, Social Development, and Disaster Risk Reduction, as well as cross-cutting issues.

As part of the preparatory work for the Strategy and Action Plan, a general framework outlining the current situation was developed. In this process, the climate change adaptation efforts currently undertaken by the public and private sectors, academia and NGOs were reviewed. Additionally, national and international legislation, ongoing plans, programmes, and relevant documents were evaluated, alongside national-level practices.

In the second phase, current and future climate hazards were analyzed based on the results of the regional climate projection studies carried out by different institutions. Vulnerability and risk assessments were conducted at the national level for each sector, aligned with the results of these analyses. The action options derived from the sectoral vulnerability and risk assessments were discussed in stakeholder consultation meetings, which included participants from 180 different public and private sector institutions, academia and NGOs. In addition to the meetings, stakeholder opinions were incorporated into the Action Plan through official letters, e-mails and bilateral discussions.

The CCASAP comprises 40 strategic goals and 129 actions designated for 11 main sectors and cross-cutting issues, and the key strategic goals include:

- Identifying and transforming urban and buildings at risk of flooding,
- Increasing the quantity of treated wastewater and raising the reuse rate of treated wastewater to 15% by 2030,
- Updating agricultural policies to ensure climate resilience, efficient use of technology, and alignment with basin product patterns and water budgets,
- Contributing to the global efforts to raise the share of marine and land protected areas to 30%,
- Establish a system to develop indicators and health impact chains based on Türkiye Climate and Health Profile,
- Identifying climate-related risks in the energy sector and strengthening production, transmission, distribution, and storage infrastructure to enhance climate change adaptation,
- Drafting guides to identify and manage climate risks to movable and immovable cultural heritage elements and areas,
- Identifying facilities at risk of major industrial accidents and developing priority adaptation actions,
- Ensuring the resilience of urban vehicle, bicycle, and pedestrian roads and all public transport infrastructure to climate-related risks,
- Incorporating social development elements into the 2053 long-term climate change strategy,
- Prioritizing investments to build resilience against climate-related disasters in critical sectors,

- Drafting Local Climate Change Action Plans (LCCAP) for all 81 provinces.

Given the broad scope of the subject and the need to implement numerous sub-actions under each action, detailed "Sectoral Implementation Plans" have also been drafted. These plans will be published by the DCC to guide responsible institutions in implementing the actions outlined in the Action Plan.

Since climate change adaptation is a cross-cutting issue that deeply affects many sectors, the measures to be implemented are crucial for ensuring the resilience of the economy, cities, and infrastructure. Moreover, the Action Plan will provide a significant contribution to the global adaptation objective currently under negotiation as part of the Paris Agreement.

The adverse impacts of climate change require timely and effective adaptation measures, as well as coordination and cooperation among various sectors and levels of government. In this regard, it is essential that the strategies and actions identified are implemented by the relevant institutions and organizations with sensitivity, taking into account the importance of adaptation for Türkiye.

INTRODUCTION

INTRODUCTION

Climate change has introduced a variety of impacts across ecosystems, economic sectors, and human health worldwide. The Sixth Assessment Report (AR6) published by the Intergovernmental Panel on Climate Change (IPCC) in 2022 emphasizes that even if Greenhouse Gas (GHG) emissions were minimized today, the inevitable effects of climate change would continue for a long time.

Although climate change is now widely recognized, complementary policies and actions are required to adapt to its consequences. This clearly demonstrates that adaptation to climate change impacts is as crucial as mitigation through emissions reductions. Indeed, adaptation efforts are growing globally, with adaptation policies becoming preeminent alongside mitigation strategies in international agreements, such as the Paris Agreement (Article 7).

As the impacts of climate change become more severe, it is evident that a balance between adaptation and mitigation must be maintained in the framework of global and national policies. At this point, local dynamics take precedence, as vulnerability to climate change and the corresponding adaptation needs vary according to national, regional, and local conditions.

Adaptation can be described as the process of strengthening and implementing strategies and policies to combat and manage the impacts of climate change. It involves adjusting to the changing climate and mitigating its adverse impacts, while also turning challenges into opportunities wherever possible. Adaptation is a dynamic process that integrates decision-making across numerous sectors (including agriculture, food, water, public health, tourism, disaster, insurance, infrastructure, biodiversity and ecosystem, energy, finance, urbanization, transport, industry, migration, and social development and etc).

As adaptation required the integration of needs and measures across local, national, and regional levels, continuous cooperation and coordination among all relevant stakeholders is essential. In this context, the success of adaptation policies is closely linked to development models adopted by countries. Development models that consider the sectors most exposed to climate change impacts,

such as urbanization, disaster, agriculture, tourism, ecosystems, water resources management, play a critical role in achieving effective climate change adaptation.

With the awareness that climate change is a multi-faceted and complex issue that can lead to serious environmental and socio-economic consequences and create significant challenges threatening the lives of future generations, Türkiye recognizes the importance of GHG emissions reduction, climate change adaptation, and international cooperation as integral components of its climate change response. In this context, Türkiye has submitted its NDC and announced its 2030 climate objectives, aiming to contribute to the global efforts to mitigate the impacts of climate change within its specific conditions and capabilities. Given the importance it places on climate change adaptation, Türkiye included a separate heading for adaptation in its NDC.

The first Climate Council of Türkiye, coordinated by the MoEUCC, was held in Konya between 21-25 February 2022. The Council was attended by nearly 5,000 participants from various stakeholder groups, including representatives from the public and private sectors, academia, NGOs, and students. Following the Council, a roadmap guiding Türkiye's long-term climate change policies was prepared, comprising a total of 217 recommendations, of which 76 were prioritized. In this context, critical decisions were made to directly or indirectly support climate change adaptation, with special emphasis on the decisions taken by the Climate Change Adaptation Commission. The decisions made at the Council formed the basis for Türkiye's policies, strategy papers, and legislative efforts on climate change.

1.1. INTERNATIONAL PROCESS AND PARIS AGREEMENT

In recent years, the topic of adaptation has gained momentum in international climate negotiations. The significance of climate change adaptation has grown since the establishment of the Nairobi Work Programme in 2005. With the adaptation the Cancun Adaptation Framework and the formation of the Adaptation Committee in 2010, adaptation efforts were reinforced by a strong structure promoting international cooperation.

Adaptation became a key topic in negotiations with Article 7 of the Paris Agreement, adopted in 2015 at the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC). Article 7.1, in particular, guides countries toward a global adaptation goal: "Parties hereby establish the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature referred to in Article 2" (UNFCCC, 2015).

Article 2 of the Paris Agreement links climate change adaptation to sustainable development and efforts to eradicate poverty in socio-economic terms. It aims to strengthen the capacity to respond to the threat of climate change and emphasizes adapting to its adverse impacts in a way that does not endanger food production. The article also highlights the importance of fostering climate resilience and ensuring consistent financial flows to support adaptation efforts.

The United Nations (2030 Agenda for Sustainable Development has reinforced the adoption of international objectives on adaptation. Sustainable Development Goal (SDG) 13 on "Climate Action: Take urgent action to combat climate change and its impacts" encourages countries to implement both mitigation and adaptation actions and sets various objectives within this context.

The United Nations Sendai Framework for Disaster Risk Reduction (2015-2030) provides a comprehensive approach to managing disaster risks, including those caused by climate change. The framework introduces a disaster risk management approach that emphasizes policies and practices aligned with sustainable development, ensuring that disaster risk reduction does not come at the expense of sustainable progress (UNDRR, n.d.). It is also supported by indicators designed to function in conjunction with the Paris Agreement and the 2030 Agenda for Sustainable Development.

1.2. TÜRKIYE'S NATIONALLY DETERMINED CONTRIBUTION

In September 2015, in accordance with decisions 1/CP.19 and 1/CP.20, the Republic of Türkiye submitted its Intended Nationally Determined Contribution (INDC) to the UNFCCC Secretariat towards achieving the ultimate objective outlined in Article 2 of the Convention. Under the framework of the Paris Agreement, Türkiye set a target to reduce its GHG emissions by up to 21% by 2030, compared to the Business as Usual (BAU) scenario. Subsequently, Türkiye signed the Paris Agreement on 22 April 2016 and ratified it after parliamentary approval on 7 October 2021 (Official Gazette of 07.11.2021, issue no. 31621). Like all parties to the UNFCCC, Türkiye is required to submit its NDC to the UNFCCC Secretariat every five years, with increasingly ambitious mitigation targets and, optionally, climate change adaptation targets.

On 13 April 2023, the Republic of Türkiye submitted its updated first NDC to the UNFCCC, committing to a 41% reduction in GHG emissions by 2030, compared to the reference scenario. Türkiye aims to advance on the path of sustainable development by considering both domestic development policies and international developments, while addressing economic, social, and environmental issues in a balanced manner. As a country that acknowledges the importance of adaptation policies, Türkiye continues to act with determination in pursuing its goals to through a range of initiatives, including vulnerability and risk assessments, information systems, and legal and policy instruments.

The legislation and policy papers in this regard are listed below:

- Environmental Law
- Eleventh Development Plan (2019-2023)
- Regulation on Strategic Environmental Assessment
- National Climate Change Strategy (2010-2023) and Action Plan (2011-2023)
- National Climate Change Adaptation Strategy and Action Plan (2011-2023)
- Energy Efficiency Strategy and National Energy Efficiency Action Plan (2017-2023)
- 2053 National Transport and Logistics Master Plan
- Türkiye's Green Deal Action Plan
- Final Recommendations of the Climate Council
- Türkiye's National Energy Plan
- Medium-Term Programme (2024-2026)
- Twelfth Development Plan (2024-2028)

The primary legislation and policy papers being drafted, with completion planned as soon as possible to enhance Türkiye's climate action, are as follows:

- Climate Law
- Regulation on Local Climate Change Action Plan
- Türkiye's Spatial Strategy Plan for 2053
- Water Law
- Flood Law
- Long-Term Climate Change Strategy for 2053
- Strategy and Action Plan on Circular Economy
- Sustainable Consumption and Production Strategy
- Sustainable Smart Transport Strategy and Action Plan
- Green Growth Technology Roadmap
- Climate Finance Strategy

1.3. CLIMATE CHANGE ADAPTATION STRATEGY AND ACTION PLAN PREPARATION PROCESS

Türkiye's CCASAP for 2011-2023 was formulated to develop strategies and actions related to climate change adaptation. The Action Plan covers water resources management, the agriculture sector and food security, ecosystem services, biodiversity and forestry, disaster risk management, and public health.

Since the period covered by the previous plan concludes in 2023, preparatory work for a CCASAP (2024-2030) has been carried out under the "Enhancing Adaptation Action in Turkey Project". This project is implemented by the MoEUCC in collaboration with the UNDP and jointly financed by the EU and the Republic of Türkiye.

The sectoral scope was expanded in the CCASAP (2024-2030) to include Urban , Energy, Tourism and Cultural Heritage, Industry, Transport and Communication, and Social Development sectors, in addition to those included in the previous plan.

Thus, adaptation strategy and action plan efforts for 2024-2030 were undertaken in 12 sectors, namely: agriculture and food security, ecosystem services and biodiversity, water resources management, tourism and cultural heritage, industry, Urban , social development, public health, transport and communication, energy, disaster risk reduction, and cross-cutting issues.

As part of the preparatory work, the climate change adaptation efforts already executed by the public and private sectors, academia and NGOs in Türkiye were reviewed and compiled.

The most significant topics that must be addressed before formulating an Adaptation Action Plan are vulnerability and risk assessments. The correct identification of problems is essential to determine appropriate adaptation actions. As discussed in detail in the "Vulnerability and Risk Assessments" section, regional climate projections produced by various institutions were used to analyze and assess the outcomes of the projected future climate hazards.

Using the results of the analyses and assessments, vulnerability and risk assessments were conducted for the sectors designated under the Plan, employing the internationally accepted risk assessment methodology. Initial findings from the vulnerability and risk assessments were shared during the consultation meetings involving representatives from the public and private sectors, academia, and NGOs, where participants provided their feedback. After these consultations, the national vulnerability and risk assessments were finalized. Following these assessments, the preliminary studies for gap analyses were carried out, and recommended actions from international literature were reviewed and reported. The options for action developed based on sectoral vulnerability and risk assessments were discussed

during consultation meetings with the relevant stakeholders, and draft action lists were formulated. In the subsequent phase, meetings and workshops were held with stakeholders to conduct detailed studies on the action options. During these meetings, actions were prioritized based on various criteria, including urgency, importance, co-/multi-benefits, economic benefit, viability and flexibility, as well as environmental and social outcomes.

In the consultation meetings held in the final stage before the completion of the Action Plan, discussions covered the strategic goals for climate change adaptation, cross-sectoral interactions, overlapping areas of action, institutional structures and cooperation opportunities, data and information infrastructure, monitoring systems and finance. The meeting also exposed actions that related to communication, awareness, and training. Based on these discussions, it was decided to add "Cross-Cutting Issues" as the twelfth heading in the Action Plan.

During the preparatory process for the CCASAP, more than 25 stakeholder meetings were held. The meetings were attended by over 2,000 participants representing 180 different public, private, academic, and NGO institutions, with gender balance ensured among participants. As part of the Action Plan, 129 actions were identified in cooperation with responsible and relevant institutions and organizations. Sectoral Implementation Plans were drafted to guide the implementation of these actions by responsible institutions.

Lastly, the Adaptation Working Group under the Climate Change and Adaptation Coordination Board (CCACB) convened and the Action Plan was finalized after being presented to the Working Group.

Following these efforts, the CCASAP was submitted to the CCACB, approved and published.

Table 1. Number of strategic goals, actions, and responsible and relevant institutions designated in Action Plan

Sector	Strategic Goal	Adaptation Action	Responsible and Relevant Institutions
Urban	3	12	13
Water resources management	2	14	18
Agriculture and food security	3	12	18
Biodiversity and ecosystem services	4	12	29
Public health	2	12	31
Energy	2	11	12
Tourism and cultural heritage	3	11	19
Industry	6	8	14
Transport and communications	4	12	15
Social development	4	6	26
Disaster risk reduction	4	8	27
Cross-cutting issues	3	11	29
Total	**40**	**129**	

Table 2. Sectoral strategic goals

URBAN	• Enhancing the adaptation capacity and resilience of cities and urban communities. • Revising legislation and spatial plans to strengthen climate change adaptation capacity. • Ensuring environmentally balanced, climate-resilient, and sustainable urbanization.
WATER RESOURCES MANAGEMENT	• Developing policy and legal frameworks for water resources management; enhancing the generation and sharing of data and information. • Ensuring the protection, improvement and efficient use of water resources.
AGRICULTURE AND FOOD SECURITY	• Developing policy and legal frameworks to support the agriculture sector's adaptation to climate change; enhancing institutional capacity, cooperation, and awareness. • Protecting, enhancing, and promoting the sustainable use of ecosystems and natural resources in agricultural production. • Expanding R&D activities on climate change impacts and adaptation in agriculture; developing databases, information technologies, and innovation solutions to guide agricultural activities.
BIODIVERSITY AND ECOSYSTEM SERVICES	• Enhancing awareness and capacity on biodiversity, ecosystem services, nature-based solutions, and ecosystem-based adaptation; ensuring data and information exchange, preventing overlapping responsibilities, and strengthening cooperation among stakeholders. • Reducing the pressures threatening biodiversity and ecosystem services, such as habitat fragmentation, pollution, and over-exploitation. • Exploring, monitoring, and assessing the impacts of climate change on biodiversity and ecosystem services. • Increasing the number of protected areas for effective nature conservation, restoring degraded ecosystems, and integrating climate change adaptation into management plans.
PUBLIC HEALTH	• Strengthening the evidence-based analysis, assessment and reporting infrastructure regarding climate change, and increasing R&D studies in the field of health. • Enhancing capacity, cooperation and awareness across national and local institutions for integrating climate change and health perspectives.
ENERGY	• Developing policy and legal frameworks for the energy sector's adaptation to climate change; enhancing institutional capacity and cooperation; increasing the generation and sharing of data and information • Strengthening production, transmission, distribution, and storage infrastructure in energy systems, ensuring necessary designs are considered, and enhancing power system flexibility to support climate change adaptation.
TOURISM AND CULTURAL HERITAGE	• Enhancing the adaptation capacity of tourism investments and enterprises to climate change by improving physical infrastructure. • Improving social infrastructure to develop climate change adaptation capacity in the tourism and cultural heritage sectors. • Considering climate change adaptation in strategic and spatial decisions related to tourism and cultural heritage, and ensuring coordination among relevant authorities.
INDUSTRY	• Identifying facilities exposed to the technological risks and major industrial accident risks and developing priority adaptation actions for them. • Evaluating and monitoring the impacts of climate change on investments and the impact of investments on the climate before launching investment projects. • Making the necessary updates to insurance legislation after reviewing it to increase insurability against the impacts of climate change. • Ensuring quick and practical access to national projections and databases for the industry sector. • Encouraging cooperation within the sector through a mentorship system and training of trainers • Promoting the inclusion of climate change adaptation components in green procurement criteria.

TRANSPORT AND COMMUNICATIONS

- Ensuring the resilience of critical transport and communication infrastructure.
- Securing transport activities and passenger health by reducing vulnerability levels.
- Enhancing emergency management and response capacity by improving accessibility, communication, and evacuation capabilities during climate-related disasters.
- Strengthening planning capacity in transport and communication in alignment with the climate change adaptation objective.

SOCIAL DEVELOPMENT

- Integrating the impacts of and measures against climate change into socio-economic development and ecosystem protection strategies at all levels (national, regional, local) and embedding the social development component into climate change adaptation policies, planning, and implementation processes across all sectors.
- Developing social protection policies that enhance public resilience and adaptation to existing or potential climate hazards.
- Transitioning from a crisis management mindset to a risk management model to support public adaptation to climate change and strengthening the legal, institutional, administrative, scientific, social, and financial capacity required in this shift.
- Implementing national climate change adaptation policies by focusing on a rights- and benefits-based approach and promoting equal opportunities to ensure the well-being of all segments of society.

DISASTER RISK REDUCTION (DRR)

- Strengthening the understanding of and information infrastructure regarding climate change and disaster risks to promote sustainable and resilient development.
- Ensuring transformative risk governance to enhance climate and disaster resilience.
- Building institutional capacity and raising awareness to achieve inclusive and responsive climate and disaster resilience.
- Making consistent and sustainable investments in the context of climate and disaster resilience.

CROSS-CUTTING ISSUES

- Integrating climate change adaptation in all policies and strategies.
- Enhancing the knowledge supporting decision-making processes and developing institutional capacity for increasing expertise, training, database creation, monitoring, and Research and Development (R&D) studies related to climate change.
- Raising awareness, knowledge, and consciousness on climate change adaptation to ensure citizens become part of the solution and engage in decision-making processes.

1.4. MONITORING AND EVALUATION

Monitoring and evaluation are a critical step in ensuring the long-term success of climate change adaptation action plans. The monitoring process serves two key purposes:

- Monitoring the performance of the actions in the plan
- Determining whether the planned outputs and adaptation action outcomes have been achieved

A successful monitoring and evaluation process plays a crucial role in enhancing the effectiveness of actions and ensuring accountability. A proper monitoring system also helps secure continuous support and the additional financing, if required.

In this context, an online monitoring and evaluation system will be established to track the Climate Change Adaptation Strategy and Action Plan.

Institutions responsible for each action under the CCASAP will input the previous year's developments into the system, which will be open for data entry from 1 January to 31 March annually. Based on the information entered annual monitoring and evaluation reports will be prepared by the DCC of MoEUCC by 30 June each year, with input from the key responsible institutions. The recommendations and actions outlined in the reports will be discussed in the CCACB Working Groups. The annual evaluation report, drafted in coordination with the DCC will be submitted to the CCACB by 31 December of the monitoring year. Where necessary, the action plan may be revised on a case-by-case basis.

1.5. CLIMATE CHANGE ADAPTATION VISION

The works undertaken as part of the CCASAP and during its preparation take an integrated approach to adapting nature, human development, and healthy living conditions to the changing climate, along with the key sectors of the Turkish economy. The strategy, which acts as a reference document summarizing the strategic framework and priorities related to climate change adaptation through 2030, is supported by vulnerability and risk assessments and highlights the key priority areas and regions for the actions. The strategy is accompanied by an action plan that sets objectives and priorities to enhance adaptation capacity, formulates climate change adaptation measures for each sector, provides a timeline for their implementation, and identifies the required resources and responsible institutions.

Türkiye set the following vision for climate change adaptation:

A more resilient, sustainable and greener country in economic, social and ecological terms to ensure the preparedness and adaptation of its people, along with public and private sector institutions, to the impacts of climate change.

The ultimate goal is to ensure that key economic sectors, along with nature, superstructures, infrastructure, and healthcare and emergency services, are not only resilient to risks but also able to maximise opportunities.

In order to achieve this goal, CCACB will spearhead actions at the national level to reduce the vulnerability of the natural, social, and economic systems in Türkiye and to maintain and enhance their capacity to adapt to the inevitable impacts of global climate change.

Adaptation actions aim to increase the resilience of the society and institutions capable of making timely and well-informed decisions to address the challenges and opportunities introduced by the changing climate. The inclusion of a vision and a set of strategic goals to trigger mental transformation for such a society, along with awareness raising, institutional capacity building, and the integration of climate change adaptation into sectoral policies, was influential in selecting the relevant adaptation actions.

Based on this vision, climate change adaptation actions will be scaled up in the current and future policy cycles and incorporated into the plans developed under the responsibility of the relevant ministries and local authorities.

1.6. CLIMATE CHANGE ADAPTATION STRATEGY AND PRINCIPLES

The following key principles, which are to be taken into consideration in developing a national adaptation strategy for Türkiye, were established during the preparatory consultation meetings for the Strategy and Action Plan together with all stakeholders.

Evidence-based decision-making

This approach aims to ensure that decisions affecting the public are taken rationally and transparently. When the extent of the impacts, as well as the systems and regions affected, are determined based on scientific data through increased research, development, and fieldwork on climate change impacts across different sectors, the work of decision-makers is facilitated. They are then able to conduct prioritization studies to use of resources efficiently in line with the findings obtained. Evidence-based decisions can also enhance consistency and coordination in public sector practices.

Sustainability

The principle of sustainability focuses on improving societal welfare without harming the environment, with a special emphasis on ensuring equal access to resources and amenities for all. The concept of sustainability is essential to allow nature to self-restore and to enhance the quality of economy, health, life, and education. Decelerating fast consumption, particularly by enabling the natural regeneration of resources, is one of the key principles to minimize the environmental threats posed by globalisation.

Risk-driven approach

A risk-driven approach, also known as risk-based thinking, refers to taking into account potential risks during decision-making and making necessary preparations accordingly. The potential risks posed by climate change hazards must be carefully analyzed when identifying and prioritizing adaptation actions. This approach is closely linked with evidence-based decision-making.

Awareness raising and training

This principle involves developing training programmes, capacity-building initiatives, and awareness-raising campaigns to enhance the understanding of public servants, the private sector, and citizens,—particularly decision-makers—on climate change hazards and the potential cross-sectoral impacts of the decisions taken.

Integrated approach

Many sectors and systems, particularly the eleven priority sectors identified under the Action Plan, are interdependent not only in terms of climate change but across many areas. For instance, the water resources in a watershed are vital for several sectors, notably agriculture, as well as for drinking-utility, energy, and tourism needs. A decision made in energy policy may influence the ability of other sectors to meet their demands. Therefore, decisions at the policy level should be evaluated in a broad and detailed manner to account for these interdependencies.

Prioritization

Prioritization is the process of implementing specific adaptation actions more urgently than others based on identified criteria. Prioritizing adaptation actions typically accounts for the geographic distribution of climate change impacts and varying degrees of vulnerability across the country's population.

Inclusion

All actors impacted by climate change (e.g., public institutions, NGOs, businesses, local communities, and individuals) must be identified and engaged, with accurate and regularly information provided to ensure their participation in adaptation efforts. It is particularly important to engage disadvantaged communities from the design stage of adaptation actions to promote their ownership of these efforts and empower them to take part in their implementation.

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URBAN

climate adaptation

URBAN
climate adaptation

2.1. GENERAL FRAMEWORK

Carbon-intensive urbanisation that degrades natural areas and disregards climate parameters increase risks, leaving our cities and inhabitants vulnerable to the changing climate.

Cities, which host more than half of the world's population and account for approximately 70% of global Greenhouse Gas GHG emissions, are at the heart of the climate crisis. Moreover, urban sprawl in modern cities destroys natural ecosystems.

While cities contribute to climate change, they are also highly vulnerable to its effects. Climate hazards such as floods, extreme temperatures, heatwaves, cold waves, and droughts are already being felt in Urban.

Cities located at points of intense climate risks can also become part of the solution by offering opportunities for climate action. Sustainable and resilient urban planning, smart city applications, nature-based solutions, efficient water management, urban agriculture, zero-waste practices, and green transportation can foster a more inclusive and equitable life (UNEP, 2022b).

With the potential to cut emissions by 90% by 2050 using technically feasible measures, cities also serve as critical hubs for infrastructure, playing a key role in climate adaptation.

In Türkiye, prominent climate impacts in Urban include heatwaves during increasingly hot summers, cold waves, and floods caused by heavy rainfall. Rapid urbanisation exacerbates the impacts of climate change, increasing flood risks and intensifying their effects. Although precipitation patterns have shifted, changes in land use and construction on floodplains have amplified the destructive power of floods. Drought is another major climate hazard. During the severe drought of 2007–2008, several large Turkish cities experienced significant water shortages. Therefore, it is essential to protect catchment basins in Urban (Krellenberg & Turhan, 2017).

The relationship between urbanization and observed climate impacts—such as rising temperatures and

urban heat islands—must be clearly established. This understanding will support better design and planning decisions while guiding appropriate actions to address the two-way relationship between cities and climate. Land use changes, such as reduced forests and agricultural areas due to urban sprawl, influence the climate at both macro and micro levels.

Urbanization not only impacts the climate but is also shaped by it. The physical characteristics of settlements are crucial in this reciprocal relationship. The built environment influences the urban climate, energy flows, and the water cycle, shaping quality of life and climate-related risks.

The lack of natural surfaces and green spaces, combined with more paved surfaces, exacerbates the effects of extreme heat in cities. Since light-colored materials absorb less heat, their use can mitigate the impact of extreme temperatures. Prominent strategies for creating climate-resilient Urban include expanding blue and green infrastructure, developing green corridors, and building outdoor and green space systems. These strategies help reduce the impact of heatwaves and facilitate drainage during heavy rainfall (Sass; Gartland, 2008; Givoni, 1998; Emmanuel, 2005). While these design parameters contribute to urban resilience, they may have limitations. Additionally, street orientation and the form and geometry of Urban (Givoni, 1998; Emmanuel, 2005; Herrmann & Matzarakis, 2010) influence ambient temperatures. Wind corridors also play an important role in urban climate management. On a building scale, green façades and roofs provide similar benefits.

Research on urban climate and design asserts that no single solution can fully address the relationship between cities and climate or ensure resilience. Therefore, detailed local analyses are essential to guide tailored actions. Identifying specific physical characteristics and problem areas is critical in these efforts. Social factors must also be integrated into this process. For example, identifying the most vulnerable populations—such as people with disabilities, the elderly, and children—and mapping their living spaces is essential. Continuous monitoring of urban developments, along with adjustments based on inclusive design principles, will be crucial in meeting the needs of these groups.

2.2. SECTORAL LEGISLATIVE FRAMEWORK AND RESPONSIBLE INSTITUTIONS

International climate agreements and national legislation define key policy and legal frameworks, while central bodies, municipalities, and provincial organizations of ministries serve as the responsible institutions for climate change adaptation actions in Urban.

Key laws related to increasing vulnerability and risks or enhancing adaptation in Urban include the Law on Land Development Planning and Control, Law on Soil Conservation and Land Use, Law on Cadastre, Law on National Parks, Law on Conservation of Cultural and Natural Property, Laws on Wetlands and Water Resources, Coastal Law, Law on Protection Against Floods, Environmental Law, Law on Construction Inspection, and Law on the Transformation of Areas under Disaster Risk (Urban Regeneration).

The Law on Land Development Planning and Control ensures that settlements and buildings are established according to plans and meet scientific, health, and environmental standards. The Law on Soil Conservation and Land Use promotes soil conservation and improvement, ensuring planned, balanced, and efficient land management in line with environmentally prioritised sustainable development.

The Law on Cadastre establishes the legal status of real property by designating boundaries and managing soil, water resources, and land use planning. The Law on National Parks provides for the identification and protection of national parks, nature parks, natural monuments, and conservation areas. The Law on Conservation of Cultural and Natural Property safeguards the protection and use of movable and immovable cultural and natural assets. Wetlands and Water Resources Legislation ensures the protection, registration, and management of wetlands, while the Coastal Law preserves and regulates the sustainable use of seas, lakes, rivers, and coastlines, safeguarding their natural and cultural characteristics. The Law on Protection Against Floods mandates the identification and declaration of flood-prone areas. The Law on Construction Inspection ensures the safety of life and property by enforcing the inspection of building projects to comply with land development plans, technical standards, and health and safety regulations. It also mandates the use of materials that meet thermal insulation and low energy standards. The Law on Transformation of Areas under Disaster Risk (Urban Regeneration) aims to create healthy and safe living environments by transforming disaster-prone Urban . Finally, the Environmental Law promotes environmental protection in line with sustainable development principles. It regulates land and resource use, encourages efficient energy consumption, and

enforces the use of mandatory standards, economic instruments, and incentives to prevent and address environmental pollution (Talu and Kocaman, 2022; Talu, 2019).

Many institutions are involved in ensuring urban resilience through the implementation of these laws. Both the organizational structures and legal mandates of these institutions evolve continuously. The two key institutions dealing with urban issues are the MoEUCC and municipalities. The Ministry holds a comprehensive mandate regarding climate change, including executing climate-related works and procedures, developing plans and projects, and implementing necessary measures. It coordinates actions on global climate change and ozone depletion, promotes renewable energy and clean energy use, and ensures that fuel consumption does not lead to air pollution. The Ministry establishes principles, procedures, and standards for controlling exhaust emissions from motor vehicles and defines national climate change policies. It also engages in climate negotiations and oversees the monitoring of GHG emissions. Additionally, the Ministry ensures the development of local climate change policies, supports R&D initiatives and applications, and supervises emissions, discharges, waste management, and disposal systems of polluting activities and facilities. Its responsibilities further extend to spatial strategy planning, environmental planning, spatial development plans, sectoral planning, and the management of integrated coastal areas.

Municipalities are divided into two groups: metropolitan and other municipalities. Law on Metropolitan Municipalities and Municipal Law describe the duties to be performed at the two levels, as well as other tasks, each of which may point to action in the face of changing climate conditions. These tasks involve:

- Land development, transport, urban traffic, and public transport.
- Water and sewer systems, riverbed rehabilitation, and disaster management.
- Planning, regulation, approval, and supervision of regional parks and natural assets.
- Protection of agricultural lands, watersheds, and natural assets.
- Forestation, solid waste management, and establishing central heating systems.
- Workplace licensing and inspection, environmental health, and wastewater management.
- Rainwater removal, emergency response, and rescue operations.
- Development of parks, green spaces, economic activities, and housing production.

Given the powers of municipalities and the central government, it is essential to establish a governance model where both levels work together to set shared objectives and implement effective climate adaptation strategies. Creating a legal framework that promotes collaboration among all relevant stakeholders will ensure planning efforts are aligned with climate change adaptation and disaster resilience, accelerating the adaptation process.

Development Agencies, in collaboration with regional institutions and organizations, produce regional plans that guide local governments' planning and implementation activities. These agencies also offer financial and technical support for activities and projects that facilitate the implementation of regional plans and programmes.

The policy support, responsible institutions, and other endorsement for the climate response of local governments can be summarized as follows:

Regional plans developed by Development Agencies, in collaboration with regional institutions and organizations, provide a framework for planning and implementation activities carried out by local governments. These agencies also offer financial and technical support to projects and activities that enable the effective implementation of regional plans and programmes.

Local governments collaborate with regional development administrations, including the Southeastern Anatolia Project Regional Development Administration, Eastern Black Sea Project Regional Development Administration, and Konya Plains Project Regional Development Administration, to address climate change prevention and adaptation at regional and local levels.

Bank of Provinces Inc. (ILBANK) also supports the preparation process for the local climate action plans of local governments. The Directorate General of ILBANK Trade Incorporation provides both technical and financial support for sustainable urban development projects, such as those focused on renewable energy, urban planning, architecture, engineering, consultancy, infrastructure, superstructure, and urban regeneration. ILBANK also assists local governments in preparing local climate action plans.

In addition to the MoEUCC and municipalities, the Ministry of Transport and Infrastructure (MoTI) plays a role in climate-related efforts. The Ministry's General Directorate of European Union and Foreign Relations (GDEUFR) oversees environmental, energy, GHG, and climate change studies, while the General Directorate of Aeronautics and Space Technologies focuses on protecting public health and the environment. This includes early detection of climate-induced disasters, mitigating damages, and promoting the sustainable use of natural resources.

The AFAD, under the Ministry of Interior (MoI), is responsible for actions related to climate impacts in Urban . AFAD's efforts include:

- Early detection of hazards and risks to prevent disaster-related damages.
- Implementing measures to prevent or minimise potential losses before disasters occur.
- Ensuring effective emergency response and coordination.
- Managing integrated post-disaster recovery efforts.

2.3. CLIMATE CHANGE IMPACTS

Cities in the Black Sea, Mediterranean, and Southeastern Anatolia regions are at the highest risk of exposure to heavy precipitation. Meanwhile, cities in the Mediterranean and Southeastern Anatolia regions face the greatest risk of heatwaves in Türkiye.

To implement effective climate adaptation actions in cities, local-level vulnerability and risk assessments are essential. At the national level, the most prominent climate hazards for Turkish cities are heavy precipitation and heatwaves. As part of this study, risk assessments were conducted for both hazards in urban environments, focusing on exposure, sensitivity, adaptive capacity, and vulnerability. The assessments also included risk analysis for each area, with detailed maps produced for every city to illustrate the risk components.

Urban risk assessments: heavy precipitation

An impact chain was developed to assess the heavy precipitation hazard in Urban (Figure 1). Settlements were evaluated using risk assessments based on selected indicators. While conducting a national-level spatial analysis of climate-related urban issues is currently limited by data availability and human resources, collaboration with central units and local actors can address these challenges. The analyses aimed to assess the general condition of cities in response to identified risks and highlight particularly vulnerable cities and regions. However, the lack of reliable urban infrastructure data can weaken the outcomes. To address this, data infrastructure studies must be prioritised to ensure accurate and reliable information that can guide policy. Hazard analyses should also consider water depth and range as part of flood maps for Urban .

The dataset used to assess the exposure of Urban to heavy precipitation included factors such as population size, building surfaces, and continuous Urban . In efforts to combat climate change, establishing a comprehensive database must remain a priority, with institutions producing and sharing data specific to urban and rural areas. For this study, the CORINE Project database from the Ministry of Agriculture and Forestry (MoAF) was analysed, with calculations conducted on variables like settlement sizes and building permits.

The sensitivity indicators included discontinuous urban fabric , population in sensitive age groups, total number of floods, settlement type, and the concentration of high-risk economic sectors. Settlement types in the central areas of all 81 provinces were identified through satellite images and other sources, resulting in the classification of 12 settlement types: Riverside (e.g., Eskişehir), Coastal (e.g., Mersin) Slope (e.g., Artvin) Plain (e.g., Iğdır) Plateau (e.g., Gaziantep) Slope and plain (e.g., Denizli) Slope and plateau (e.g., Erzurum) Coastal and slope (e.g., Trabzon) River and slope (e.g., Amasya) Coastal and plain (e.g., Burdur) River and plateau (e.g., Kars) River and plain (e.g., Aksaray).

Different settlement types exhibit varying degrees of sensitivity to heavy precipitation. Settlements such as river and slope, coastal and slope, slope, and riverside areas were identified as more sensitive, while plain and plateau settlements were found to be relatively less sensitive. Another sensitivity factor involved economic sectors with significant weight in the urban economy that are vulnerable to heavy precipitation. A Location Quotient (LQ) analysis was conducted, evaluating the number of firms and employees in 18 different categories, including: Building and non-building construction, landscaping and private construction activities, sewer systems, housing, and water and airline transport, food and beverage services, fisheries, and aquaculture, manufacture of food products, insurance, finance, and healthcare. Cities were grouped based on the number of activities with an LQ value of 1 or higher, helping to identify those at greater risk.

Data on the number of active associations, gross national product per capita, GINI coefficient, education levels (high school and higher education graduates), number of R&D centers, physicians per capita, beds per 10,000 persons, and urban green areas were assessed to evaluate adaptation capacity.

The study first analyzed cities using exposure indicators. The Marmara, Aegean, Mediterranean, and Black Sea Regions contain cities facing very high heavy precipitation hazards. Cities like Ankara, Konya, and Kayseri in Central Anatolia, with large populations and expansive Urban , show high exposure. In contrast, cities in Northeastern and Eastern Anatolia display lower exposure levels, though they remain at risk for heavy precipitation compared to other cities. This variation reflects urbanization patterns in Türkiye, including sprawling development, dense Urban , limited green spaces, car-dependent transportation, high energy consumption, inappropriate material choices, non-localized architecture, and poorly accessible public areas. These factors exacerbate the risks associated with heavy precipitation, necessitating city-specific analyses to guide climate adaptation strategies. Cities like Antalya, Mersin, İstanbul, and İzmir are particularly vulnerable due to their geographic structure, urban sprawl, impermeable surfaces, altered streams, and limited green spaces. It is essential to conduct zoning studies and develop tailored actions based on varying risk levels within each city. Urban differences can be better identified using high-resolution satellite images and grid-based data to capture elements such as urban geometry, form, street orientations, sky visibility, and permeable surfaces for more accurate analysis.

The sensitivity analysis shows that coastal cities in the Mediterranean, Aegean, and Black Sea Regions exhibit very high sensitivity. Factors contributing to high sensitivity include large populations, economic

[1] This refers to areas where a large portion of the land is covered by transport networks and buildings, with more than 80% of the total surface occupied by built structures, roads, and other impervious surfaces.
[2] This refers to areas where the land is covered by scattered built structures along with patches of soil and vegetation, with 30% to 80% of the surface being impermeable..

Figure 1. Impact chain: relationship between urban areas and heavy precipitation

HAZARD		EXPOSURE
Climate Signal	**Climate Impact**	
Increase in precipitation amount and frequency	Increase in the number of heavy rainfall days	**Urban infrastructure**
	Flooding	Water and sewer infrastructure*
		Transport infrastructure*
		Transmission infrastructure*
		Energy infrastructure*
		Urban superstructure
		Population density
		Building surface area
		Total areas of roads, railways, airports, and ports
		Proportion of continuous Urban
		City macroform size*
		Archaeological and urban conservation sites*
		Registered structures*
		Presence of sensitive ecosystems within or near Urban *

VULNERABILITY		RISK
Sensitivity	**Adaptation Capacity**	
Proportion of discontinuous Urban	Per capita GDP	Damage to transport and transmission infrastructure
Types of urban settlements	GINI coefficient	Material damage to businesses
Dependent population ratio	Ratio of high school and above education	Damage to residential areas
Number of registered unemployed people	Number of R&D centres	Damage to human health
Sectoral concentration with high risk from heavy rainfall	Number of active associations	
Infrastructure age and capacity*	Number of physicians per thousand inhabitants	
Damaged roadways and transport connections*	Number of hospital beds per hundred thousand inhabitants	
Total number of floodings	Proportion of green Urban	
Urban sprawl trend*	Insurance system*	
Number of buildings in risk-prone areas*	Protected green spaces*	
City form*	Presence of disaster management plans*	
Presence of highways*	Presence of plans targeting controlled urban sprawl*	
Proportion of water surfaces*	Number of climate- and environment-sensitive associations*	
Poor neighbourhoods*	Number of social services experts*	
Number of social aid recipients*	Urban growth projections*	
Proportion of low-income population*	Rate of urban sprawl*	
Migrant population*	Continuity of the green system*	
Population and economic damage affected by flood risk*	Per capita green space*	
	Highway projects*	
	Implementation status of measures proposed in flood management plans*	

The (*) symbol denotes indicators excluded from the risk assessments.

development, vulnerable settlement types, urban sprawl, and high numbers of people in sensitive age groups. These cities are characterized by dense urban cores, economic growth in services and industry, high surface coverage, and uncontrolled expansion.

In terms of adaptation capacity, metropolitan areas such as Ankara, İstanbul, and İzmir demonstrate very high adaptation capacity due to their strong human resources and developed economies. Conversely, cities in Eastern Anatolia show low to very low adaptation capacity. In general, cities with higher income levels, a well-educated population, a greater number of associations, advanced healthcare infrastructure, and extensive green spaces exhibit high adaptation capacity, while cities lacking these characteristics show lower capacity.

According to the vulnerability analysis—which assessed sensitivity and adaptation capacity—Central Black Sea and Southeastern Anatolia cities exhibit very high and high vulnerability, while cities in Central Anatolia and the Aegean are classified as highly and moderately vulnerable. Cities with high vulnerability are marked by very high sensitivity and very low adaptation capacity. Factors driving high sensitivity include rapid urban sprawl, risk-increasing settlement types, a high dependent population, frequent floods, and concentrations of high-risk economic activities. Vulnerable provinces also struggle with low-income levels, low educational attainment, limited social capital, inadequate healthcare infrastructure, and development that conflicts with natural ecosystems.

Risk assessments for heavy precipitation hazards revealed that the risk is very high in the Urban of Mersin, Adana, Hatay, Osmaniye, Samsun, Ordu, Kayseri, Kahramanmaraş, Şırnak, Batman, and Diyarbakır. The risk is classified as high to moderate in other cities across the Black Sea, Aegean, and Southeastern Anatolia Regions (Figure 2).

The cities identified as high-risk have low adaptation capacity and relatively high exposure and vulnerability. Although urbanization trends in these cities are not aligned with climate-resilient development, the elevated hazard levels contribute to their heightened risk. Revising and implementing spatial plans with a climate-resilient urban planning approach that enhances adaptation capacity will be crucial. Risk-increasing factors include narrowed and blocked riverbeds in coastal cities, roads and buildings acting as dykes where water meets the sea, sloped geography, and rapid urban sprawl in hilly areas. In landlocked cities like Diyarbakır and Kayseri, urbanization has increased demand for transportation, promoted high-density development, and converted agricultural lands, further aggravating the risk of heavy precipitation under changing climate conditions. In total, 32 cities—11 with very high risk and 21 with high risk—must be prioritized for adaptation actions.

Urban risk assessments: heatwaves

Heatwaves were identified as the second most significant climate hazard in Urban . An impact chain was developed based on the indicators of exposure, sensitivity, and adaptation capacity (Figure 3). While much of the data required for city-level assessments is unavailable, producing and maintaining such data is essential for accurate results.

Most information specified in the impact chain is unavailable on a city basis. However, producing and ensuring the continuity of such information is important to obtain more accurate results. The urban infrastructure and superstructure characteristics as heatwave exposure components were determined as population size, building areas, continuous urban structure, road lengths, and number of workplaces. The exposure components for heatwaves included population size, building areas, continuous urban fabric, road lengths, and number of workplaces. Sensitivity components included discontinuous urban fabric, settlement types, electricity consumption, water extraction from resources, population growth rate, dependent population, and concentration of high-risk sectors. Twelve settlement types were identified from analyses of the 81 provinces, including riverside (e.g., Eskişehir), coastal (e.g., Mersin), slope (e.g., Artvin), plain (e.g., Iğdır), and plateau (e.g., Gaziantep). Others included slope and plain (e.g., Denizli), slope and plateau (e.g., Erzurum), coastal and slope (e.g., Trabzon), river and slope (e.g., Amasya), coastal and plain (e.g., Burdur), river and plateau (e.g., Kars), and river and plain (e.g., Aksaray). Settlement types like plain, slope and plain, and slope and plateau were found to increase sensitivity, while coastal and slope settlements were less sensitive to heatwaves. As another variable, sectors with significant weight in the urban economy and vulnerable to heatwaves were analyzed using

Figure 2. Risk map for current period: relationship between urban areas and heavy precipitation

a LQ across 19 categories, including building and non-building construction, tree and wood production, plant and animal production, forestry, housing, fisheries and aquaculture, manufacture of food products, residential care activities, mining, insurance and finance, healthcare, and travel agencies. The analysis, based on the number of active firms and employees, grouped cities by the number of activities with an LQ value of 1 or higher, identifying those with higher risk. For adaptation capacity, the analysis considered indicators such as number of active associations, GDP per capita, education level (high school and above), number of R&D centers, physicians per capita, hospital beds per 10,000 persons, and green area data.

Exposure data revealed that cities in the western part of Türkiye had very high to high exposure to heatwaves, while cities in Southeastern Anatolia showed high to moderate exposure. Factors contributing to high exposure include population size, limited green areas, continuous urban fabric, extensive road and building surfaces, and a high number of workplaces. The lower-exposure provinces were those with smaller populations and less extensive urban development (macroform). Although these cities have lower exposure than others, their urban characteristics still present risks during heatwaves. Therefore, each city must be evaluated individually to draw more accurate conclusions.

Cities such as Antalya, Mersin, İstanbul, Bursa, and İzmir are at higher risk due to factors such as geographical structure, urban sprawl, impermeable surfaces, densely concentrated areas, blocked or channelled streams, and insufficient green spaces. However, drawing conclusions about an entire city based solely on urban area studies can be misleading. Therefore, zoning studies must be conducted, and risk assessments should be made based on specific risk levels within each city.

An analysis of sensitivity status revealed that Southeastern Anatolia cities between Osmaniye and Batman, Aegean coastal cities (excluding İzmir), and Kayseri and Konya in Central Anatolia exhibit very high sensitivity. Other inland cities were also classified as highly sensitive. Key factors contributing to this sensitivity include settlement types with poor ventilation, vulnerable economic activities, rapid population growth, high dependent populations, and elevated water and electricity consumption.

In terms of adaptation capacity, Malatya and Trabzon stand out in the eastern part of the country, while major cities like Antalya, İzmir, and İstanbul lead in the Marmara, Aegean, and Mediterranean Regions with very high adaptation capacities. In contrast, cities in Southeastern Türkiye exhibit very low adaptation capacities. The analysis shows that cities with high income and education levels, strong social capital, advanced healthcare infrastructure, and R&D centers tend to have higher adaptation capacities.
Kahramanmaraş, Adıyaman, Şanlıurfa, Diyarbakır, Mardin, Batman, Osmaniye, Karaman, Çorum, Nevşehir and Afyonkarahisar stand out with very high levels in the vulnerability analysis. Aegean and Southeastern Anatolian cities, on the other hand, are highly vulnerable. The cities with very high and high vulnerability levels also have high sensitivity and low adaptation capacity.

In the evaluation of urban, all risk components were analyzed with reference to the heatwave hazard map, and a heatwave risk assessment was conducted. The analysis revealed very high risk along a west-to-east corridor between the provinces of Manisa and Şırnak (Figure 4).

The cities that stand out in this regard exhibit low adaptation capacities along with high exposure and vulnerability, driven by the climate-incompatible spatial development trends and high hazard levels. Revising and implementing spatial plans with a climate-resilient urban planning approach that enhances adaptation capacity will be a crucial adaptation action. Cities with high to moderate heatwave risk are primarily concentrated in the southern half of the country.

When reviewing Turkish cities based on the findings of both analyses, it becomes clear that, in addition to physical and geographical characteristics, development patterns and processes play a crucial role in determining cities' risk levels from climate-related hazards. Many coastal cities are particularly vulnerable due to their low altitude, with high and very high-risk regions concentrated along the Black Sea and Mediterranean coastlines. In central urban, stream beds contribute significantly to the formation of risky zones. The covering of streams and unauthorized interventions exacerbate flooding, damaging blue infrastructure and reducing permeability through urbanization. This leads to high water flows and an increased flood risk. Additionally, insufficient attention to flood impacts in upper basins further contributes to the problem. urban on plains also face high risk. Urban activities, including central business districts, housing, and industrial areas, are often concentrated in high-risk regions. In housing zones, unplanned urban (slums) pose the greatest risks. Even in planned urban regions, areas with high population density and limited green spaces are at elevated risk (Aydın, Erdin & Kahraman, 2017).

Low-risk areas, in terms of geography, can still become vulnerable due to inappropriate spatial development strategies and poor land use planning.

Figure 3. Impact chain: relationship between urban areas and heatwaves

HAZARD		EXPOSURE
Climate Signal	**Climate Impact**	
Increase in average temperature	Heatwave	**Urban infrastructure**
Increase in the number of extremely hot days	Increase in the number of consecutive hot days	Water infrastructure *
		Energy infrastructure*
		Urban superstructure
		Population density
		Building surface area
		Proportions of state roads, provincial roads, and divided roads
		Number of workplaces
		Proportion of continuous Urban
		Road, railway, airport, and port areas*
		Sensitive ecosystems around the city*
		City macroform size*
		Archaeological and urban conservation sites*
		Registered cultural assets*

VULNERABILITY		RISK
Sensitivity	**Adaptation Capacity**	
Proportion of discontinuous Urban	Per capita GDP	Stress on energy and water infrastructure
Proportion of municipalities served by drinking and utility water treatment facilities	Proportion of population with high school education and above	Deterioration of health conditions, decline in quality of life
Amount of water withdrawn for drinking and utility water networks	GINI coefficient	High urban heat island effect
Per capita electricity consumption	Number of R&D centres	Decrease in labour productivity
Sectoral concentration with high risk from heatwaves	Number of active associations	Diseases and epidemics
Urban settlement elevation	Number of active associations	Disruptions in construction activities
Type of urban settlement	Number of physicians per thousand people	
Dependent population ratio	Number of beds per hundred thousand people	
Population growth rate	Proportion of green Urban	
Wastewater and stormwater infrastructures*	Heatwave management plan*	
Slum or illegal building areas*	Proportion of natural areas within built-up areas*	
City form/geometry*	Continuity of the green system*	
Proportion of water surfaces*	Proportion of green spaces in plans*	
Capacities and accessibility of healthcare facilities*	Presence of temperature-sensitive urban plans*	
Proportion of low-income groups, proportion of social aid recipients*	Early warning systems*	
Migrant population*	Highway projects*	
Urban sprawl*	Urban growth projections*	
Amount of impervious surfaces in Urban *	Number of social services experts*	
Presence of an existing highway*	Presence of nature parks and natural conservation sites*	
Amount of green space*	Protected areas*	
Street orientations*	Length of bicycle paths*	
Sky visibility ratios*	Length of rural bicycle paths*	
	Proportion of forested areas*	

The (*) symbol denotes indicators excluded from the risk assessments.

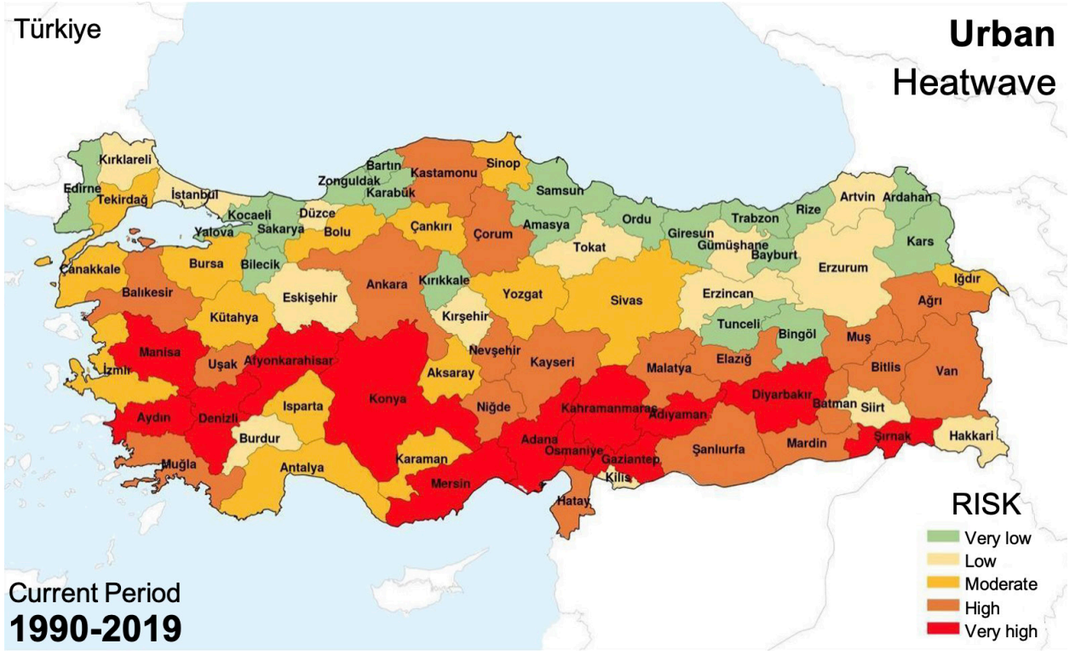

Figure 4. Risk map for current period: relationship between urban areas and heatwaves

2.4. CLIMATE CHANGE ADAPTATION MEASURES

Urban risk assessments based on new research and data will make planning processes more climate-sensitive, while transforming the carbon-intensive urbanization model—characterized by rapid growth, sprawl, and land misuse—will promote sustainable and resilient urbanization.

The first step in determining climate change adaptation actions for urban is to identify cities and their characteristics that make them highly vulnerable to risks such as heavy precipitation and heatwaves. A prominent issue across Turkish cities is rapid growth and urban sprawl, which create structures vulnerable to the adverse effects of climate change. While the impacts vary based on the form of sprawl, common challenges include: Degradation of agricultural and forest lands, settlements on inappropriate lands and stream beds, urbanization that disrupts the natural balance, new infrastructure and resource needs (water, electricity, natural gas), increased transport demand and automobile dependency, extended transport networks and impermeable surfaces, decline in green spaces. These factors not only worsen climate impacts but also increase damage from climate-related hazards. There are several cities across Türkiye have transitioned from compact sprawled forms, with spatial plans promoting linear development, peripheralization, and satellite city expansion. Cities built on sloped topography or fragmented sprawl, especially those located in stream beds, flood-prone areas, or regions with high groundwater levels, are particularly threatened by heavy precipitation. Cities in the Black Sea Region are notable for their sloped terrain, sprawl trends, and expansion into risky areas. These cities have experienced significant loss of life and property from recent flood disasters. Similarly, coastal cities in the Mediterranean and Aegean Regions, which expanded without regard for natural balance, have suffered severe damage from heavy precipitation and storms.

Cities with limited natural spaces, no air corridors, covered water routes, and high building densities are highly vulnerable to heatwaves. Metropolitan areas are especially at risk due to their sprawled urban forms , high densities, and lack of sensitivity toward blue infrastructure. Such conditions increase the likelihood of health problems and fatalities during heatwaves. A key risk factor lies in the over-allocation of urban development areas in spatial plans. It is evident that urban sprawl models driven by planning decisions pose a significant threat in the

[3] Compact form refers to a uni- or multi-focal mass urbanization model which allows mixed uses, can harbour various uses in land-use pattern, has relatively higher density, aims to strike optimal use of urban land through building decisions. Compact cities afford sustainable use of space through reducing sprawling in the space.

[4] Sprawled form refers to an urban model where urban activities and functions are located at distance from one another and transport among them increases dependency on private and public transport vehicles. For such model, presence of developed highways and vehicles is critically important for urban mobility.

context of climate change and must be reconsidered. Implementing controlled urban development and adopting spatial planning that aligns with natural ecosystems will be critical adaptation actions moving forward.

In the context of adaptation in urban, storm damage, water security, flood risk, migration management, heatwave and cold wave threats, quality of life, air pollution, rapid growth, the built environment, and investment projects must be prioritized. In this regard, it is important to formulate risk maps for climate-related disasters and integrate them into spatial planning processes. These priorities were emphasized in the policies and measures outlined in the Twelfth Development Plan (829.1 and 829.2). As underlined in policy 831.2, conducting data analyses on disasters and integrating them into early warning systems is essential for enhancing cities' adaptation capacity to climate change. The following adaptation measures can be developed in this framework:

- Protect sensitive areas in urban settings, including water bodies, wetlands, and agricultural or forest lands. Urban development should be restricted within certain distances from these areas.
- Coastal areas are heavily impacted by storms. Settlements, transport infrastructure (e.g., ports), and tourism facilities should be climate resilient.
- Plan and manage areas exposed to storm surges, floods, and river overflows.
- Develop projects for drinking water supply to address increasing water demand and declining precipitation, while establishing advanced water governance systems.
- Enforce limits on the physical characteristics of built environments.
- Encourage green buildings aligned with nature and resilient to climate change.
- Relocate communities from high-risk areas through planned relocation strategies.
- Restore urban water banks, valleys, and woodlands to improve ecological resilience.
- Develop alternative transport modes to reduce commuting times.
- Build flexible and resilient urban infrastructure to withstand climate impacts.
- Mitigate urban pressure on agricultural lands and watersheds.
- Prohibit industrial development on agricultural lands.
- Protect and expand urban green spaces.
- Ensure site selection for industrial areas considers climate risks and environmental impacts.
- Integrate climate sensitivity requirements into investment projects.
- Establish early warning systems and strengthen emergency services.
- Foster coordination and cooperation among key actors.
- Increase knowledge levels, improve legislation, and expand financial opportunities to support adaptation.
- Ensure strict enforcement of risk-prevention measures in urban development through legislation and government agencies.
- Create continuous data production systems and establish a centralized database.
- Expand municipal budgets for climate action.
- Protect cultural heritage from climate-related risks.

In addition to the above framework and measures, adaptation actions must be designed within a structured framework, as urban are inherently dynamic and complex. This framework consists of climate hazards, the urban components affected by these hazards, the key problem areas for cities based on these components, and adaptation action categories that provide targeted solutions (Figure 5). The proposed actions address all relevant issues within this framework. Prominent climate hazards identified for Turkish cities include heatwaves, cold waves, heavy precipitation, drought, storms, and hail. These hazards impact various urban components, such as building stock, green spaces, technical infrastructure, industrial plants, and transport systems. Key challenges concerning building stock include: illegal construction, buildings located in flood-prone areas, use of inappropriate materials and high building densities, land misuse and poor site selection, lack of design guidelines to address climate risks. The problems related to green areas include insufficient green spaces with low accessibility, failing to meet per capita standards. In terms of technical infrastructure, the main issue is its insufficient capacity to cope with the changing climate. For industrial plants, key challenges include facilities located in flood-prone areas, poor site selection, and the concentration of polluting industries. The transport sector faces challenges such as automobile dependency and limited pedestrian and bike accessibility. To address these issues and ensure climate adaptation in urban, actions were categorized into three types: technological (hard-grey), social (soft), and nature-based (green) solutions.

Technological actions include the use of innovative building materials, the construction of infrastructure and building sets, and green roof and façade applications. Social actions focus on education, capacity building, legislative reforms, and the development of coordination, cooperation, and strategic plans. Nature-based actions involve expanding and protecting green areas, creating ecological corridors, implementing urban design solutions, and developing rainwater collection systems. Three key strategic goals were established based on the developed framework, addressing the issues outlined in each action category, with adaptation actions grouped under these objectives.

Climate hazards	Urban components	Issues	Types of action
Heatwave	Building stock	Illegal buildings Risky buildings Inappropriate materials Inappropriate concentrations Misused areas Wrong site selection Lack of design guidelines	Technological actions: Advanced building materials Barrier construction Infrastructure development Green roofs and façades Social actions: Education Capacity building Legislative reforms Coordination Cooperation Spatial planning Nature-based actions: Expansion of green areas Urban agriculture Ecological corridors Rainwater collection systems
Cold wave	Green areas	Insufficient green areas Low accessibility	
Heavy precipitation Drought	Technical infrastructure Industrial facilities	Low and non-resilient capacity Facilities prone to floods Incorrect site selection Polluting industries	
Storm/hail	Transport	Automobile-dependency Limited pedestrian and bike access	

Figure 5. Points to consider when determining adaptation actions for urban

STRATEGIC GOAL 1

To enhance the adaptation capacity and resilience of cities and urban dwellers.

URB1. Identify Urban and buildings at flood risk; improve and transform these areas by addressing the needs of vulnerable groups. Develop evacuation and escape corridors, reopen blocked stream beds, and establish protection zones around streams.
URB2. Increase the resilience of building roofs and façades against severe weather events; scale up location-specific green roof, façade, and smart building applications.
URB3. Improve urban infrastructure by enhancing capacity, restructuring drainage systems, separating consolidated (rainwater and wastewater) systems, and utilizing smart systems with sensory monitoring.
URB4. Consider installing urban climate monitoring stations.

STRATEGIC GOAL 2

To revise legislation and plans to enhance climate change adaptation capacity.

URB5. Conduct studies to review and revise urban development legislation with a climate change perspective.
URB6. Develop guidelines for climate change adaptation, covering topics such as site selection, spatial planning, urban design, wind direction, passive ventilation, insulation, construction, and implementation, using climate data.
URB7. Formulate risk maps for urban based on spatial data.
URB8. Review and update spatial plans and planning processes at all levels, aligning them with local climate action plans and analyses.

STRATEGIC GOAL 3

To ensure environmentally balanced, climate-resilient, sustainable urbanization.

URB9. Create new parks, forests, vegetated gardens, and ecological corridors. Convert unused (brown) areas or buildings into green spaces or emergency shelters. Build green corridors in urban peripheries and between industrial areas and settlements.

URB10. Protect existing water bodies. Create rainwater ditches and natural water surfaces in urban and peripheries. Design public spaces to accumulate and channel rainwater into storage systems during heavy precipitation.

URB11. Promote sustainable urban transport through a pedestrian-focused approach by developing sub-centers and pedestrian zones. Ensure pedestrianization projects account for climate impacts, such as extreme heat.

URB12. Implement urban agriculture initiatives and establish urban gardens on productive agricultural land within urban.

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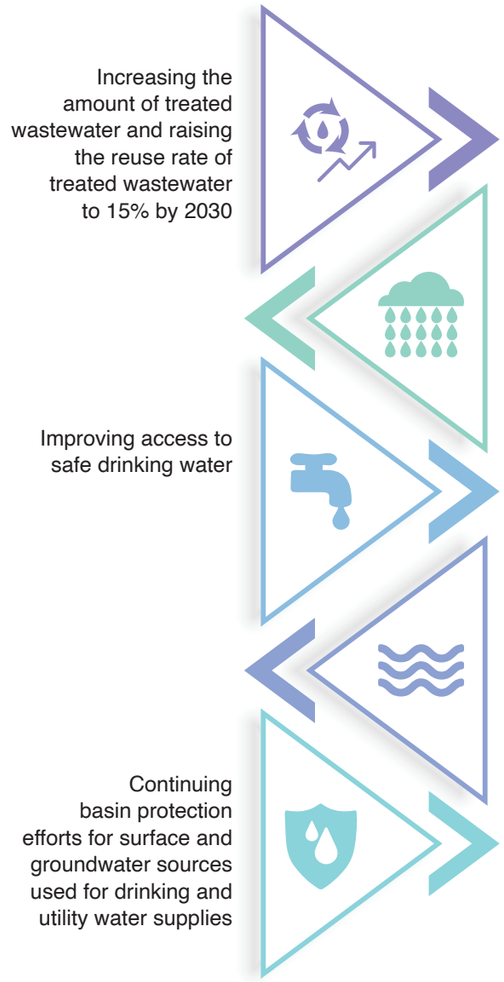
WATER RESOURCES MANAGEMENT



WATER RESOURCES MANAGEMENT

climate adaptation

GENERAL FRAMEWORK

In 2022, 44 billion m^3 (77%) of the 57 billion m^3 of water was supplied and used for irrigation, while 13 billion m^3 (23%) was allocated for drinking and utility water.

Climate change affects interactions between the atmosphere, hydrosphere, and biosphere, disrupting the hydrological cycle. Due to its geographical location, Türkiye lies between temperate and subtropical zones, resulting in varied climatic characteristics. Coastal regions experience milder climates due to the influence of the sea, while continental climates dominate inland areas, where high mountains block maritime effects. These geographical factors create regional differences in Türkiye's precipitation patterns.

The average annual precipitation between 1991 and 2020 was 573.4 mm, equivalent to 450 billion m^3 of water per year. The eastern Black Sea region receives the highest rainfall (1,200-2,500 mm/year), while Central Anatolia (around the Salt Lake) receives the least (250-300 mm/year). Snowfall occurs in most regions during winter, except for coastal areas of the Mediterranean and southern Aegean (Directorate General of State Hydraulic Works (DGSHW), 2021a).

In addition to precipitation variability, rising temperatures further disrupt the hydrological cycle, affecting timing, location, duration, and intensity of rainfall. Climate projections for Türkiye suggest that climate change will increase precipitation variability, directly influencing the availability and potential of water resources. More frequent and intense droughts and floods are expected, along with water scarcity and changes in precipitation intensity.

By 2100, rising temperatures are projected to cause more precipitation as rain during winter and accelerate snowmelt, increasing surface runoff. Changes in precipitation frequency and distribution could lead to water shortages at critical times, particularly in areas where agricultural and urban water demands depend on snowpack at higher altitudes (Repuclic of Türkiye, Ministry of Development (MoD), 2018).

Türkiye's current average annual water flow is 185.37 billion m³, corresponding to 41.2% of the average precipitation. According to hydrogeological studies, the groundwater recharge is estimated at 23.0 billion m³, with an exploitable groundwater reserve of 17.8 billion m³ (DGSHW, 2021).

Under prevailing conditions, the surface water potential available for various uses averages 94.0 billion m³ per year. Including the groundwater potential, estimated at 18.0 billion m³, Türkiye's total consumable surface and groundwater potential is approximately 112.0 billion m³ per year (DGSHW, 2021a). In 2021, 52.2% of this potential was utilized. By the end of 2022, 18.055 billion m³ of the groundwater reserve had been allocated. Of this: 12.168 billion m³ was allocated for irrigation (4.642 billion m³ for irrigation cooperatives, DGSHW irrigation systems, and public irrigation; 7.526 billion m³ for individual irrigation), 4.259 billion m³ for drinking water, and 1.628 billion m³ for industrial use.

Approximately 35% of Türkiye's 24 million hectares of agricultural land (8.5 million ha) is considered economically irrigable. By the end of 2021, around 80.6% of this area (6.85 million ha) was cultivated through irrigation. Of this, 3.54 million ha was developed by the State Hydraulic Works (DGSHW, 2022).

According to 2022 sectoral water consumption statistics, Türkiye's total annual water consumption amounted to 57 billion m³: 77% (44 billion m³) used for agricultural irrigation, 12% (6.84 billion m³) for drinking purposes, 11% (6.16 billion m³) for industrial use.

Table 3. Sectoral water consumption, 2018

Sector	Surface water + Groundwater bn m³/year	Usage Rate
Irrigation	43,95	80.00%
Drinking - Service/Utility	6,584	12.00%
Industry	4,418	8.00%
Total	**54,952**	**100.00%**

Source: Turkish Statistical Institute (TURKSTAT)

As of 2018, the total irrigated area within irrigation projects developed by the DGSHW amounted to 3,334,521 hectares. Provinces were grouped based on the size of their agricultural fields. Giresun, İstanbul, and Yalova had irrigated fields of less than 1,000 hectares, while 35.8% of the provinces (29 provinces) had irrigated areas between 10,000 and 50,000 hectares. The irrigated areas of provinces were further evaluated based on the total irrigated land developed by DGSHW as of 2018 (DGSHW, 2021). In this respect, the provinces with the highest share of irrigated cropland in the total irrigated zone are Şanlıurfa (9.56%), Konya (9.10%) and Adana (7.44%). The irrigated field in these provinces exceeds 250,000 ha. There were no irrigation projects in Ardahan, Artvin, Bursa, Hakkari, Ordu, Rize, Siirt, Trabzon and Zonguldak as of 2018.

77% of sectoral water use in Türkiye is allocated to agricultural activities. Ensuring the effective and economical use of water in agriculture is essential for both efficient water management and climate change adaptation. Among irrigation methods, surface irrigation results in the highest water loss (35%-60%), whereas sprinkler and drip irrigation systems (pipe-based) significantly reduce water loss to 5%-25%. A review of irrigation systems larger than 1,000 hectares, built by the DGSHW in 2018, shows that 73.4% of the irrigated areas rely on classical and canal systems, while 26.6% use pipe systems.

Starting from 2018, the ratio of land irrigated using closed (piped) systems developed by the DGSHW was evaluated at the provincial level (DGSHW, 2021). Provinces were grouped based on this ratio. In 23 provinces (31.9%), there are no closed irrigation systems. In Aksaray, Eskişehir, Karaman, and Niğde, the share of land irrigated with a closed system is less than 5%. In contrast, six provinces have more than 50% of their irrigated land under a closed system. These provinces are Balıkesir, Adıyaman, Gaziantep, Muğla, Tunceli, and Batman, with Batman having the highest rate at 96.4%.

Efficient water use involves minimizing water losses and supplying plants with only the amount of water they need. The ratio of a plant's total water requirement to the amount of water withdrawn from the source is known as 'irrigation efficiency.' Higher irrigation efficiency is achieved when the plant receives the exact amount of water it requires. According to the Regulation on Controlling Water Use and Reducing Water Loss in Irrigation Systems, the goal is to increase irrigation efficiency to 55%. As part of this effort, DGSHW evaluated the ratio of irrigated fields with efficiency levels above 55% across provinces as of 2018 (DGSHW, 2021). The analysis showed that 30 provinces (41.7%) had irrigation efficiency below 55%. In Adana, Afyonkarahisar, Edirne, Elazığ, Muğla, Nevşehir, Niğde, Sinop, and Tokat (12.5%), less than 10% of irrigated land achieved efficiency above 55%. In contrast, six provinces had more than 50% of their cultivated land irrigated with an efficiency rate exceeding 55%. These provinces are Aksaray, Burdur, Bursa, Tekirdağ, Aydın, and Mardin (8.4%). Aydın recorded the highest rate, with 88.7% of its irrigated land achieving high efficiency.

Climate change is expected to adversely impact drinking water resources, while urban population growth continues to increase water demand. As a

result, provinces with high annual water withdrawals and high per capita water consumption are predicted to face greater risks of drought and water scarcity. In 2018, a total of 6,193.16 hm³ of water for drinking and municipal use was withdrawn from surface and groundwater resources and lakes. Of this, 46.5% came from groundwater sources, while 53.5% came from surface water resources. Out of 81 provinces, 59 provinces (72.8%) utilize a combination of surface and groundwater resources for drinking water. However, 22 provinces (27.2%) rely solely on groundwater (TURKSTAT, 2021a).

Provinces are classified based on their annual drinking water withdrawals. The population size and loss rates are key factors in determining the amount of water withdrawn. In 2022, the average loss rate in drinking water systems across Türkiye was 32%, with a total of 6.08 billion cubic meters of water withdrawn for the drinking and utility network. Of this, approximately 2.2 billion cubic meters were lost before reaching the user. Provinces with the lowest withdrawals (less than 10 hm³ per year) include Ardahan, Artvin, Bartın, Bayburt, Gümüşhane, Hakkari, Iğdır, Kilis, and Tunceli (11.1% of all provinces). These provinces account for only 0.07% to 0.13% of the total water withdrawn. In 24 provinces (29.6%), water withdrawals range between 10.01 and 25 hm³ annually. The provinces with the highest water withdrawals are İstanbul (1,041 hm³; 16.8% of total withdrawal), Ankara (475.2 hm³; 7.8%), and İzmir (324.6 hm³; 5.2%) (TURKSTAT, 2021a).

In 2018, 2,878.5 hm³ of groundwater was used for drinking purposes at the municipal level, representing 46.48% of the total water withdrawn (TURKSTAT, 2021a). Provinces are grouped based on the ratio of drinking water withdrawn from groundwater wells to the total water withdrawn from all sources (groundwater, surface water, lake water). In 27.2% of the provinces (22 provinces), the drinking water demand is met entirely by wells. The least use of groundwater is recorded in Ankara, Diyarbakır, Eskişehir, İstanbul, Kırıkkale, Trabzon and Yalova, where the annual rate is less than 10% (8.6% of the provinces), the share of groundwater extracted by these provinces in the total water extracted is between 0.04%-9.4%. In these provinces, surface water resources are exploited mainly. The least use of groundwater for drinking purposes is recorded in Ankara, Diyarbakır, Eskişehir, İstanbul, Kırıkkale, Trabzon, and Yalova, where groundwater accounts for less than 10% of the total water withdrawn (8.6% of all provinces). In these provinces, surface water resources are predominantly used, with the share of groundwater ranging from 0.04% to 9.4%. The average daily water withdrawal per person in municipalities across Türkiye is 224 liters per person per day (TURKSTAT, 2021a). Provinces are classified based on their average daily per capita water withdrawal.

- Hakkari records the lowest water withdrawal at 117 l/person/day, followed by Iğdır (130 l/person/day) and Diyarbakır (147 l/person/day).
- On average, 30 municipalities (37%) withdraw between 200 and 250 l/person/day.
- The highest water withdrawal per capita is in Kars, with 461 l/person/day. Kars is followed by Muğla (403 l/person/day), Ardahan (382 l/person/day), Kahramanmaraş (357 l/person/day), and Trabzon (355 l/person/day).

Water losses in drinking and utility pipelines are categorized into physical water losses and administrative water losses, with their combined total referred to as total water losses. On average, 60% of the total losses are physical, while 40% are administrative (Muhammetoğlu & Muhammetoğlu, 2017).To provide insight into water losses across provinces, the difference between the amount of water withdrawn by municipalities and the amount distributed through the drinking water network in 2018 was calculated as a proportion of the total water withdrawn. According to TURKSTAT data, municipalities withdrew 6,193.2 hm³ of water, of which 4,045.5 hm³ was distributed to users (TURKSTAT, 2021a). This indicates a 34.7% loss across the drinking water network. Provinces were grouped based on their loss rates:

- In Afyonkarahisar, Aydın, Bingöl, Karabük, Kırıkkale, Manisa, Nevşehir, Osmaniye, Tunceli, and Uşak (12.3% of provinces), the loss rate ranged between 10-20%.
- In 23.5% of provinces (19 provinces), the loss rate was 35-40%.
- The highest loss rate was recorded in Mardin, with 79.4%. Batman, Trabzon, Erzurum, and Kahramanmaraş followed, with loss rates of 59.3%, 58%, 57%, and 55.6%, respectively.

Access to safe and clean water is a fundamental human right and essential for quality of life and public health. Ensuring a reliable water supply and maintaining water quality requires the proper operation of water and wastewater treatment plants, the establishment of adequate drinking water and wastewater networks, and the discharge of wastewater into receiving environments according to established criteria. According to TURKSTAT data, in 2018, 1,397 out of 1,399 municipalities were served by drinking and utility networks. The average proportion of the urban population served by these networks across Türkiye was 98.6% (TURKSTAT, 2021a). Provinces were divided into eight groups based on their service rates:

- Mardin had the lowest service rate at 86%.
- In 30.9% of the provinces (25 provinces), the service rate ranged between 88% and 98%.
- In 67.9% of the provinces (55 provinces), the service rate was higher than 98%.

According to TURKSTAT data, as of 2018, 443 out of 1,399 municipalities (31.7%) were served by drinking and utility water treatment facilities (TURKSTAT, 2021a). One reason for the low rate is that the drinking water used by municipalities is mostly sourced from groundwater sources and wells of good quality. The ratio of the urban population served by drinking and utility water treatment plants to the total urban population is 60.1%. According to this ratio, the provinces are divided into 10 groups. The proportion of provinces without drinking and utility treatment plants is 22.2% (18 provinces). In 16 of these provinces, only groundwater is used. The province with the highest rate is İstanbul. All the water used in this province is treated in the drinking water treatment plant and put into service. Including İstanbul, the municipalities where more than 80% of the urban population is served by drinking water treatment plants are Adana, Ankara, Diyarbakır,

Eskişehir, Karabük, Kırıkkale, Kilis, Kocaeli and Yalova (11.1% of the provinces).

According to TURKSTAT data, as of 2018, 443 out of 1,399 municipalities (31.7%) were served by drinking and utility water treatment facilities (TURKSTAT, 2021a). One reason for this low rate is that many municipalities source their drinking water primarily from high-quality groundwater and wells. The ratio of the urban population served by water treatment plants to the total urban population is 60.1%. Based on this ratio, the provinces are divided into 10 groups.

- 22.2% of provinces (18 provinces) have no water treatment plants. In 16 of these provinces, drinking water is supplied exclusively from groundwater.
- İstanbul has the highest service rate, with 100% of its water treated at drinking water plants.
- In addition to İstanbul, municipalities in Adana, Ankara, Diyarbakır, Eskişehir, Karabük, Kırıkkale, Kilis, Kocaeli, and Yalova serve more than 80% of their urban population through drinking water treatment plants, accounting for 11.1% of the provinces.

According to TURKSTAT data, 1,357 (97%) out of 1,399 municipalities were served by the sewer network as of 2018. The ratio of the municipal population served by the sewer network to the total municipal population is high across Türkiye, with an average of 90.7% (TURKSTAT, 2021b). According to TURKSTAT data, as of 2018, 644 out of 1,399 municipalities (46%) were provided with wastewater treatment facilities. The ratio of the municipality population served by a wastewater treatment facility to the total municipality population is 78.7% (TURKSTAT, 2021b).

In 2018, the volume of wastewater discharged into the receiving environment was 4,795.1 hm3. The volume of treated wastewater is 4,236.4 hm3. The ratio of treated wastewater to discharged wastewater is 88.4% (TURKSTAT, 2021b). Provinces are grouped according to this ratio. The share of provinces without treatment plants is 8.6%. In provinces where the ratio of treated wastewater to discharged wastewater is 99%, all discharged wastewater is considered treated. The rate for these provinces is 17.3%.

Dams are water storage structures built for drinking, irrigation, power generation, industrial use, and flood control purposes to provide water supply during dry and drought periods by regulating the flow of rivers to mitigate the impact of changes in the precipitation regime on water resources and to reduce the risk of flood during wet periods. The hydrological, topographical, and geological-geotechnical characteristics of the selected location are important in the construction of these structures. The dams and ponds built by DGSHW on a provincial basis from 2018 (DGSHW, 2021) are grouped according to their number. Between 10 and 20 reservoirs were built in 25.9% of the provinces. Provinces with two or fewer storage facilities: Ağrı, Ardahan, Bartın, Batman, Bitlis, Düzce, Muş, Siirt, Trabzon, Yalova and Zonguldak (13.6%). Provinces with more than 50 storage facilities: Afyonkarahisar, Balıkesir, Edirne, Konya, and Sivas (6.2%). In Rize province, there is no storage facility built by DGSHW.

The impact of climate change on water resources is also demonstrated by reservoir fill rates. Decreases in reservoir fill rates are observed during dry periods. Although the opening years of dams built by DGSHW with an active water volume of 3 million m3 and above are different, the average fill rates were evaluated according to data availability between 2010 and 2019 (DGSHW, 2021). Based on the decade change, it is evident that the annual average fill rate of reservoirs has changed by about 40%. In 2014, the fill rate of reservoirs decreased to approximately 29%.

The provinces that do not have reservoirs at the determined active water volume are Bartın, Bitlis, Giresun, Hakkari, Iğdır, Karabük, and Sakarya. In the evaluation, the provinces are grouped according to their occupancy rates. In 83.6% of the provinces (60 provinces), the average fill rate of reservoirs was less than 50%. The reservoirs in Adıyaman (7.7%) and Niğde (7.8%) had the lowest average fill rate within the selected period. The highest fill rate was recorded in Trabzon (94.2%).

The impacts of climate change can lead to changes in the magnitude and frequency of floods. However, changes in land use, unplanned urbanization, interventions in stream beds, inadequate infrastructure, etc. also increase the impact of these disasters. Floods are one of the most frequent disasters in our country.

According to Turkish State Meteorological Service (TSMS), provinces are grouped according to the total number of flood events occurring on a provincial basis in Türkiye in 2021 (TSMS, 2021). Between 11 and 20 flood events occurred in 19.8% of the provinces (16 provinces), and between 51 and 75 flood events occurred in 19.8% of the provinces (16 provinces). The lowest number of flood events (2 events) occurred in Bayburt (1.2%). Provinces with more than 100 flood events: Balıkesir, İstanbul, İzmir, Konya, Muğla, Rize, and Antalya (8.6%). The province with the highest number of flood events is Antalya (163 events).

Flood control activities within the frame of protection of socio-economic structure in Türkiye are carried out by relevant institutions and municipalities, specifically by DGSHW.

As of 2018, the number of flood control facilities in operation as part of structural measures has been evaluated by province (DGSHW, 2021). As of 2018, the provinces are grouped according to the number of flood control facilities in operation. In 30.9% of the provinces (25 provinces), between 100 and 150 flood control facilities have been constructed. The provinces with 25 or less facilities are Batman, Hakkari, Iğdır, İstanbul, Karaman, Kilis and Şanlıurfa (8.6%). The provinces with more than 200 flood control facilities are Afyonkarahisar, Ankara, Bursa, Edirne, İzmir, Konya, Sivas and Erzurum (9.8%). Erzurum is the province with the most facilities with 392 flood control facilities.

As part of the flood control works, flood-protected areas with flood control facilities built in 2018

(DGSHW, 2021) were assessed. The provinces were grouped by calculating the ratio of the size of the flood-protected areas to the area of the province. In 19.8% of the provinces, the flood-protected areas are between 10-25‰ of the provincial area (16 provinces). The provinces with flood-protected areas of less than 1‰ of the provincial area are Ardahan, Batman, Bitlis, Diyarbakır, Hakkari, Kars, Kilis, Malatya, Mardin, Ordu, Siirt and Van (14.8%). The provinces with more than 100‰ of the provincial area protected against floods are Adana, Iğdır, and Osmaniye (3.7%).

3.2. SECTORAL LEGISLATIVE FRAMEWORK AND RESPONSIBLE INSTITUTIONS

Given the involvement of multiple institutions in water resource management, it is crucial to improve coordination between them and establish regulations that ensure consistency in licensing, permitting, inspection, and sanctioning processes.

Water resources management in Türkiye follows a centralized structure. Strategic decisions and plans are formulated at the national level and implemented by provincial units of relevant ministries and local administrations. Various institutions and organizations, with different roles and responsibilities, are involved in water management at multiple levels. These entities can be categorized into three administrative levels: national, regional, and provincial.

At the national level, key institutions responsible for decision-making include:

- Presidency of Strategy and Budget (PSB)
- Ministry of Agriculture and Forestry (MoAF)
- Ministry of Environment, Urbanization and Climate Change (MoEUCC)
- Ministry of Energy and Natural Resources (MoENR)
- Ministry of Health (MoH),
- Ministry of Culture and Tourism (MoCT)
- Ministry of Industry and Technology (MoIT)
- Ministry of Transport and Infrastructure (MoTI)
- Ministry of Interior (MoI)
- Disaster and Emergency Management Presidency (AFAD)

At the regional/basin and national levels, key institutions include:

- Directorate General of State Hydraulic Works (DGSHW)
- General Directorate of Water Management (GDWM)
- General Directorate of Forestry (GDF)
- Turkish State Meteorological Service (TSMS)
- Bank of Provinces Inc. (ILBANK)
-

At the provincial level, actors include:

- Provincial directorates of relevant ministries
- Special provincial administrations
- Metropolitan municipalities
- Water and Sewer Administrations (WSAs)
- Provincial and district municipalities
- Irrigation unions and cooperatives
- Chambers of industry and commerce
- Private sector representatives
- Non-governmental organizations (NGOs)

As part of harmonization efforts with the European Union acquis Communautaire, various studies have been conducted to develop a river basin management model for transitioning to integrated and sustainable water management in Türkiye. The European Union's Water Framework Directive (WFD) is one of the most significant pieces of environmental legislation adopted, requiring the "river basin management" approach through the identification of "river basin regions" and the designation of "competent authorities" to manage them.

To implement watershed-based management, the "Regulation on Preparation, Implementation and Follow-up of Basin Management Plans" was published on 17 October 2012, with revisions in 2017 and 2019. Additionally, on 8 January 2019, the "Communiqué on the Establishment, Duties, Working Procedures, and Principles of the Central Committee of Basin Management, Basin Management Committees, and Provincial Water Management Coordination Committees" was issued, and efforts toward watershed-based management continue.

The Central Committee of Basin Management (CCBM) has been established as the highest administrative authority, with Basin Management Committees at the basin level and Provincial Water Management Coordination Committees at the provincial level.

In terms of management structure:

- Provincial Water Management Coordination Committees submit tracking reports on the implementation of watershed management plans to the Basin Management Committees.
- Basin Management Committees evaluate the progress reported by Provincial Committees and other relevant institutions, submitting meeting minutes and reports to the Central Committee of Basin Management.
- The CCBM addresses agenda items based on delegation reports from the basins and presents them to the Water Management Coordination Committee.

The institutions and bodies involved, both directly and indirectly, in water resource management in Türkiye are summarized below.
The organization, duties, and powers of the Ministry of Agriculture and Forestry (MoAF) are outlined in Articles 410-440 of Presidential Decree No. 1. The Ministry was formed in 2018 through the merger of the Ministry of Food, Agriculture and Livestock (MoFAL) and the Ministry of Forestry and Water Affairs (MoFWA).

The Ministry's responsibilities include plant and animal production, food safety, protection of soil, water resources, forests, and biodiversity, raising farmers' awareness, regulating agricultural markets, and training farmers, among other duties.

The Directorate General for Water Management is responsible for several key tasks:

- Developing policies for the protection, improvement, and sustainable use of water resources, including river basin management at the basin level.
- Protecting and improving the ecological and chemical quality of aquatic environments while balancing the protection and utilization of water resources, including coastal waters.
- Preparing or supervising the preparation of plans and conducting legislative studies on integrated river basin management.
- Following international conventions and legal processes related to the protection and management of water resources.
- Cooperating with relevant institutions on issues related to transboundary and boundary waters.
- Monitoring the impact of climate change on water resources and conducting related studies.
- Establishing protection plans and regulations for surface and groundwater used or intended to be used as drinking water sources.
- Setting objectives, principles, and environmental standards for the quality and quantity of surface and groundwater in collaboration with relevant institutions.
- Working with organizations to monitor water quality or arrange for monitoring activities.
- Providing secretarial services to the National Water Board.

Issues related to the reduction of water losses are discussed in the Regulation on Control of Water Losses in Drinking Water Supply and Distribution Systems (amended O.G.: 30874, dated 31.08.2019), published in the Official Gazette No. 28994 and dated 08.05.2014. Article 9 of this Decree states that "Metropolitan and provincial municipalities shall limit their water losses to a maximum of 30% by 2023 and a maximum of 25% by 2028, and other municipalities shall limit their water losses to a maximum of 35% by 2023 and to a maximum of 30% by 2028 and to a maximum of 25% by 2033". According to the regulation on controlling water use and reducing water losses in irrigation systems, issued in 2017, the aim is to increase irrigation efficiency to more than 55%.

In the Twelfth Development Plan, the issue of combating water losses is regulated through the following policy measures:

- 880.2: "The real value of water, water loss rate, and non-revenue water targets will be determined using economic leakage level indices."
- 880.3: "Municipal efforts to combat water losses will be supported."

The responsibilities of the DGSHW encompass the construction of irrigation systems, flood control structures, drinking water facilities, and sewer projects as part of the planning and development of water resources. They also include conducting studies on transboundary and boundary waters, managing water allocation, and determining the quality of surface and groundwater. Additional areas of focus involve monitoring, erosion and sediment control, land consolidation, on-farm development services, and hydroelectric power generation.

The Directorate General for Agricultural Reform is responsible for ensuring the efficiency of agricultural irrigation, protecting soil resources, establishing soil and irrigation water analysis laboratories, and conducting analyses and classification of land, soil, and water resources.

The Directorate General for Agricultural Research and Policies conducts research on the development and rational use of soil and water resources, along with scientific studies on marine and inland aquaculture.

The Directorate General for Fisheries and Aquaculture is tasked with protecting fisheries and aquaculture resources. It oversees or facilitates scientific research on aquaculture in marine and inland waters, designates production and aquaculture areas, and implements measures to safeguard these areas from environmental degradation.

The General Directorate of Nature Conservation and National Parks manages the identification and protection of national parks, nature parks, natural monuments, nature reserves, and wetlands. Its responsibilities also cover the development and management of sites registered by the MoEUCC, along with the protection of wildlife and forest water resources. This includes safeguarding springs, streams, lakes, ponds, and other wetlands.

The Turkish Water Institute is responsible for directing and supervising future water-related studies, developing short- and long-term water management strategies, and creating sustainable water policies and strategies to address global water challenges. It also focuses on building national and scientific research capabilities to formulate international water policies, tracking the activities of national and international organizations related to water, producing information and statistical data, monitoring external developments, and collaborating with foreign institutions on matters within its mandate.

The General Directorate of Environmental Management, under the Ministry of the Environment, Urbanization, and Climate Change, defines and implements procedures for eliminating and controlling pollutants to protect underground and surface waters, seas, and soil. It also ensures pollution prevention and control, including emergency response efforts.

The Directorate General for Environmental Impact Assessment, Permits, and Inspections is tasked with monitoring the receiving environment, creating the necessary infrastructure, and establishing criteria for measuring and analyzing environmental pollution.
The General Directorate of Local Authorities is responsible for executing, supervising, and developing the services mandated by law for local governments, including the provision of water and sewer infrastructure.

The Directorate General for Combating Desertification and Erosion implements integrated plans and projects aimed at reclaiming watersheds, combating desertification and erosion, and controlling avalanches, landslides, and floods. It ensures watershed integrity to protect soil, develop natural resources, and address climate change.

The duties of the General Directorate for the Protection of Natural Assets include determining the procedures and principles for the registration, approval, and notification of national parks, natural parks, natural monuments, nature reserves, wetlands, and other areas with similar protection statuses. It is also responsible for establishing, managing, and ensuring the identification, registration, approval, modification, and notification of environmental protection zones, including special environmental protection zones. In addition, the directorate oversees national parks, natural parks, natural monuments, nature reserves, and wetlands. Its responsibilities extend to making key decisions on the use and development of protected areas and ensuring the preparation, amendment, approval, and implementation of environmental planning, master plans, and implementation plans at all scales. TSMS is authorized to archive and publish information obtained through studies and investigations directly related to determining the climatic characteristics of Türkiye. The institution was established to open and operate meteorological stations, conduct and evaluate observations, make weather forecasts for various sectors, and provide meteorological information support.

One of the duties of ILBANK is to provide financing for drinking water supply, wastewater, and stormwater projects from national and international sources, covering the entire water management processes of municipalities, as well as offering technical support for project preparation, implementation, and management processes.

The AFAD, a sub-unit of the MoI, takes the necessary measures to ensure the effective delivery of services related to disasters and emergencies, including floods, at the national level. It is responsible for preparation and risk reduction before disasters occur, as well as implementing measures during disasters, coordinating interventions, and managing post-disaster recovery efforts. AFAD and DGSHW conduct joint surveys in hazard-prone areas to mitigate flood damage prior to disasters. Based on these surveys, DGSHW designs and constructs flood control works as part of river rehabilitation efforts. However, AFAD is responsible for relocating structures within flood boundaries that cannot be safeguarded by DGSHW's flood control facilities to non-disaster risk areas. In addition, special provincial administrations engage in disaster response and post-disaster recovery efforts, assisting AFAD with coordination.

The mission of the General Directorate of Public Health within the Ministry of Health (MoH) is to monitor and inspect the quality of drinking and utility water to protect and improve public health, reduce and prevent disease risks, inspect swimming pools and oversee water quality, authorize the sale of packaged water, conduct market surveillance and control activities, monitor and classify the quality of bathing water, and inform the public accordingly.
MoIT defines industrial policy, establishes industrial zones and sites, inspects these organizations, compiles an inventory of industrial enterprises, and collects and evaluates relevant statistical information.

MoTI develops plans and programs for railways, ports, shelters, and related equipment and facilities, as well as coastal protection structures and other coastal facilities, in coordination with relevant organizations.

MoFA monitors water-related developments on bilateral and multilateral platforms, in coordination and cooperation with executive institutions and organizations, conducts negotiations in line with Türkiye's transboundary water policy, and ensures compliance with and implementation of relevant EU legislation.

TURKSTAT is responsible for collecting data and information on water and sanitation, producing the necessary statistics, and publishing and disseminating them.

Water management policies and priorities are shaped within the framework of the Development Plan, the Medium-Term Programme, and the Annual Programme of the President, all prepared under the coordination of the Strategy and Budget Directorate. The Development Plan functions as the primary policy document guiding the preparation of sectoral plans and programs in the field of water management. The Strategy and Budget Directorate ensures that the strategic plans of public administrations align with the Development Plan, the President's policies, and the objectives and targets set in the Medium-Term Programme. It also monitors their implementation and evaluates the outcomes.

3.3. CLIMATE CHANGE IMPACTS

Climate change reduces the availability and accessibility of water resources, heightening vulnerability and posing significant challenges to water-dependent sectors.

While the demands for water allocation and use are constantly increasing, water resources are decreasing, and water quality is deteriorating (MoAF, 2018).
It is estimated that changes in the precipitation regime that may occur as a result of rising temperatures due to climate change will adversely affect the availability of water resources through changes in precipitation distribution, snow melt, soil moisture, and river and groundwater recharge. Climate change increases the vulnerability of water resources by reducing the availability and accessibility of water resources and has negative impacts on water-dependent sectors. It is predicted that droughts and water scarcity due to rising temperatures and decreasing precipitation, and flood hazards due to increasing precipitation will pose a risk to socio-ecological systems.

Risks that may arise as a result of the effects of drought due to reduced precipitation and rising temperatures, reduced soil moisture, increased evaporation, reduced river flows, groundwater levels and reservoir levels can be listed as follows:

- Inability to meet household water demand due to depletion of drinking water resources,
- Failure to satisfy the water needs of the ecosystem,
- Contamination of water resources,

- Failure to meet agricultural irrigation needs, resulting in reduced crop yields,
- Economic losses due to non-fulfilment of energy production and industrial needs,
- Economic losses due to the failure to meet the needs of sectors such as commerce, tourism, leisure, mining, livestock farming, transport, etc.

Floods resulting from heavy precipitation cause loss of life and damage to flood-impacted properties (residences), agricultural areas, socio-economic elements (power plants, infrastructure facilities, roads, hospitals, schools, factories, commercial areas, shopping centers), etc.

It is estimated that climate change will also affect water demands for drinking water, agriculture, energy, industry, etc. Pressure on water resources is increasing as urban populations grow. Agriculture is the world's leading sectoral water user, accounting for an average of 70%. It is projected that inter-sectoral competition for water resources will increase due to population growth, food security, urbanization, economic growth, land use preferences, and climate change.

In Türkiye, the overwhelming use of water is in the agricultural sector (about 77%). About 76% of the water used in agriculture is extracted from surface water and 24% from groundwater. This situation exerts pressure on both surface and groundwater. If we look at DGSHW irrigation, surface irrigation methods are used in about 60% of irrigation, and water losses are between 35% and 60%. However, irrigation efficiency remains at 51%. Climate change is predicted to affect agricultural land, crop yields, and livestock production, as well as food security, by reducing yields and increasing the incidence of droughts and other extreme weather events. For this reason, the agricultural sector is a priority for vulnerability and risk assessment studies on drought and water scarcity that will occur as a result of the negative impacts of climate change on water resources, as well as for adaptation studies on its water-saving potential.

Cities become more attractive depending on their socio-economic development. In addition to population growth and land use decisions, employment decisions are also important issues that affect the city's water demand. In times of drought and water scarcity, urban water demand is difficult to meet and water shortages occur. The use of packaged water has become widespread in cities. As a result of unplanned construction, increasing impermeable surfaces, and interventions in riverbeds, the consequences of floods are aggravating, resulting in loss of life and property. The urban poor are particularly affected. While the water loss rate in our country is higher than that of developed countries at 32%, the non-revenue water rate is around 40%. This brings to the fore vulnerability and risk assessment studies on drought, water scarcity, and floods in cities, as well as adaptation studies for water conservation and flood control.

Water released into the receiving environment without treatment causes pollution of water resources. Reduced stream flows and lower lake levels lead to water quality degradation due to the presence of nutrients and pollutants in a smaller volume of water. The increase in water temperatures reduces the amount of dissolved oxygen, which has a direct impact on water quality. Prolonged drought leads to the accumulation of pollutants on the soil surface, which poses a risk to the quality of water resources at the onset of precipitation.

Another important factor is that heavy precipitation intensively transports sediments, and concentrates, and diffuses sources of pollution to streambeds. During floods, the risk of water quality deterioration increases, particularly as a result of sewer overflows, agricultural runoff, and urban surface runoff.

Droughts and floods make water storage more challenging. It is very important to store water for dry periods and discharge it in a controlled manner before the flood period to protect downstream communities. Given that the design of water storage is based on lower flow variability and relatively short-term historical data, the designed storage volume may not be sufficient for flood control if the variability increases. However, flows due to early spring snowmelt also cause difficulties in reservoir operation.

Groundwater is predicted to be adversely affected by climate change due to changes in precipitation. In most regions, groundwater is used as the main source of water for irrigation, drinking, and utility water supply. Recoverable aquifers are affected by hydrologic processes, and therefore by climate change, as an immediate function of surface conditions. Most renewable groundwater aquifers are under overdraft pressure at a rate faster than recharge.

Ecosystems and biodiversity are the systems most vulnerable to climate change. Rainfed wetlands and streams provide habitats for many species and help reduce flood damage. Reduced precipitation and deteriorating water quality threaten wetlands.

Water resources risk assessment: drought

To analyze the risks of climate change in the water management sector at the provincial level in Türkiye, impact chains were prepared according to the drought hazard and shown in Figure 6. In the process of establishing the impact chain, the necessary indicators for analyzing the risk of the sector were identified. However, in the framework of the study, the analyses were carried out per the data available for all provinces.

Focusing on the drought exposure of the water resources sector at the provincial level, it is generally observed that the provinces with high population density, irrigated area ratio, and average daily water withdrawal per capita have very high exposure. Accordingly, high and very high levels of exposure were found in the provinces of the eastern part of the Marmara region, including İstanbul, in the coastal provinces of the Aegean and Mediterranean regions, and provinces of Ankara, Konya, Karabük in Central Anatolia, and Southeastern Anatolia provinces.

The sensitivity is at a high level in provinces where parameters such as water stress and drinking water rates of municipalities, sectoral total of GDP in the agricultural sector, the difference between the total drinking water withdrawn and the water distributed

Figure 6. Impact chain: relationship between water resources management and drought

HAZARD		EXPOSURE	VULNERABILITY		RISK
Climate Signal	**Climate Impact**		**Sensitivity**	**Adaptation Capacity**	
Disruptions in construction activities	Drought	Population density	Per capita water potential	Population served by sewer network	Reduction in water resources
Decrease in total precipitation amount	Decrease in precipitation amount and number of rainy days	Proportion of irrigated areas	Proportion of drinking and utility water withdrawn by municipalities	Ratio of treated wastewater to discharged wastewater	Inability to meet household water needs
	Increase in the number of consecutive dry days	Per capita water withdrawal for drinking and utility use	Difference ratio between withdrawn and distributed drinking and utility water by municipalities	Number of facilities with storage	Decline in agricultural yield
		Reservoir fill rates	Proportion of agriculture sector in GDP	Proportion of irrigation areas with efficiency above 55%	Inability to meet sectoral water demands
				Proportion of irrigation areas with piped irrigation systems	
				Proportion of land consolidation areas	
				Socio-Economic Development Index score	

by municipalities are at a high level. Accordingly, the sensitivity is above the high level in the Marmara region, except for the provinces of Çanakkale and Balıkesir. The provinces of Ankara, Eskişehir, Konya, Aksaray and Nevşehir in Central Anatolia; İzmir, Aydın and Denizli in the Aegean; Samsun, Amasya and Ordu in the Black Sea; Adana, Osmaniye, Hatay in the Eastern Mediterranean; and Gaziantep in Southeastern Anatolia have high and very high sensitivity.

In general, the adaptive capacity of the urban population served by the sewer network, the ratio of treated wastewater to discharged wastewater, the number of dams and ponds, the provinces with irrigated land with an irrigation efficiency above 55%, and the provinces with a high socio-economic development ranking are at a very high level. Similarly, adaptive capacity is generally found to be at moderate and higher levels in the western half of the country and declines towards the east.

In terms of the vulnerability analysis, which assesses both sensitivity and adaptive capacity, the provinces in the Southeastern half of the country in particular are assessed as having moderate and high vulnerability. However, vulnerability is high in the Black Sea provinces of Düzce, Zonguldak, Samsun, Ordu, Trabzon and Tokat, in the Marmara provinces of Sakarya, Kırklareli and Edirne, and in the Central Anatolian provinces of Aksaray, Nevşehir, Niğde, Çankırı and Kırıkkale.

The drought risk of water resources for the current period has been analyzed with all components and its distribution by province is shown in Figure 7. According to the results of the risk assessment, the risk of drought is high in the provinces located in the southern and Southeastern half of the country, where the overall vulnerability is high. Accordingly, Konya, Isparta, Aksaray, Niğde, and Nevşehir in the south of Central Anatolia, all provinces in the eastern Mediterranean, the whole of Southeastern Anatolia, the provinces of the Eastern Anatolian region (except Erzincan, Tunceli, and Bingöl) and in Edirne, Sakarya, Yalova, and Manisa the risk of drought is high.

Water resources sector risk assessment: heavy precipitation

In the water resources sector, a risk assessment was also carried out for the risk of heavy precipitation, and the prepared impact chain is shown in Figure 8. In defining the impact chain, the indicators necessary to analyze the risk of the sector were identified. However, in the framework of the study, the analyses were carried out in accordance with the data available for all provinces.

In terms of the exposure of the water resources sector to heavy precipitation at the provincial level, the provinces of İstanbul, Kocaeli, Sakarya, Yalova, Bursa, İzmir, Ankara, Gaziantep, and Hatay were found to have very high exposure in terms of population density. While the provinces on the Mediterranean and Aegean coasts are at moderate and higher levels of exposure to heavy precipitation, the eastern Black Sea region is at high levels.

In terms of the sensitivity of the provinces, the sensitivity was found to be high in the provinces with a high number of floods and a high ratio of artificial

Figure 7. Risk map for current period: relationship between water resources management and drought

Figure 8. Impact chain: relationship between water resources management and heavy precipitation

HAZARD		EXPOSURE
Climate Signal	**Climate Impact**	
Increase in precipitation amount and frequency	Increase in the number of heavy rainfall days	Population density
	Flooding	

VULNERABILITY		RISK
Sensitivity	**Adaptation Capacity**	
Total number of floods and inundations experienced	Number facilities with storage	Loss of life and property
Proportion of artificial areas	Proportion of flood protection areas	Economic losses
	Number of flood protection facilities	
	Proportion of land consolidation areas	
	Proportion of forest areas	
	Socio-Economic Development Index score	

areas. Likewise, sensitivity was generally reported to be high and very high in the western provinces of Marmara, Aegean, Mediterranean, and Central Anatolia. However, sensitivity is also high in the Black Sea provinces of Zonguldak, Samsun, Ordu, Giresun, and Rize, and in Şanlıurfa and Van.

Assessing the adaptive capacity of the provinces, as in the drought study, the adaptive capacity is higher in the western part of the country. In general, very low adaptive capacity is observed in all provinces in the Eastern Anatolia and Southeastern Anatolia regions, with the exception of Erzurum.

The vulnerability assessment identified high levels of vulnerability in the eastern Mediterranean provinces, Southeastern Anatolia, the eastern provinces of eastern Anatolia and the eastern Black Sea provinces. The provinces of Kırşehir, Nevşehir, Aksaray and Kayseri to the east of Ankara were also reported to be extremely vulnerable.

The heavy precipitation risk for water resources management in the current period has been assessed and its distribution by province is shown in Figure 9. Looking at the distribution of heavy precipitation risk for Türkiye's water resources sector, almost all provinces located on the coast and in the southeast are at moderate and higher risk. The provinces of İstanbul, Tekirdağ, Yalova, Kocaeli and Sakarya in the Northern Marmara region, Düzce, Zonguldak, Bartın, Karabük, Ordu, Giresun, Trabzon, Rize, Artvin, Amasya and Tokat in the Black Sea region and İzmir, Manisa, Muğla in the Aegean; Manisa, Muğla, Antalya, Mersin, Adana, Osmaniye and Hatay in the Mediterranean; Kayseri in Central Anatolia; Gaziantep, Adıyaman, Şanlıurfa, Batman in the Southeastern; and Elazığ, Muş and Van in Eastern Anatolia are at high and severe risk.

Figure 9. Risk map for current period: relationship between water resources management and heavy precipitation

3.4. CLIMATE CHANGE ADAPTATION MEASURES

Given Türkiye's location in a semi-arid climate zone, enhancing water quality, increasing the availability of usable water, and ensuring the sustainable balance between conservation and utilization are critical priorities.

Many studies on climate change, its impacts on water resources, and adaptation are being carried out in Türkiye. Some of these studies carried out in recent years are summarized below.

In the National Water Plan (2019-2023) prepared by MoAF, the problems of water resources management are summarized as follows: shortcomings in water legislation, confusion of power between institutions, lack of coordination and institutional capacity imbalance between water demand and supply in certain basins/regions; high water losses in agricultural irrigation; significant water losses in drinking water networks and distribution systems; droughts, water withdrawals and water pollution pressures threatening the ecosystems; inadequate protection of water resources; water pollution, especially in all reservoir and river basins since they act as drinking water supply, the need to increase water supply; inadequacies in ensuring efficient use of water and reuse of used water; decrease in hydroelectric energy production due to drought.

The First Water Council was convened by MoAF in 2021. Eleven different working groups have been formed within the Council, including water efficiency, basin-scale water management, water law and policy, water security and sanitation, protection and monitoring of water resources in terms of quality and quantity, impacts of and adaptation to climate change on water resources, decision support systems for water resources management, water resources development, agricultural irrigation, reservoirs (underground and surface dams, ponds) and water, forest and meteorology. The Conclusions of the First Water Council, consisting of 28 articles and outlining the decisions taken at the end of the Council, was published.

Also in 2021, the report of the Parliamentary Inquiry Commission was published to determine the measures to be taken to mitigate the effects of global climate change, combat drought, and use water resources efficiently.

In affiliation with MoAF, the General Directorate for Water Management is reviewing the current situation regarding water efficiency, national and international legislation, plans, programs, and documents in force, as well as the bottlenecks encountered in this process, and the institutions and organizations directly responsible and involved in the implementation of practices. The "Water Efficiency Strategy and Action Plan in the Framework of Adaptation to Changing Climate (2023-2033)" came into force with Presidential Circular No. 2023/9, to set forward-looking goals and strategies for productivity. In addition, the Twelfth Development Programme was adopted to ensure the implementation of the measures in the policy document. It is included in the policies and measures article numbered 880.1 of the Plan.

The Climate Council held by the MoEUCC in 2022 analyzed the impacts, vulnerability, and risks of climate change and emphasized the identification, implementation, and monitoring of adaptation measures by sectors at national, regional, and local levels. The Council also adopted decisions on actions related to water resources management.

The strategic goals that can be identified to overcome the bottlenecks identified as a result of the evaluation of the studies, documents, and legislation on the subject, and to implement the policy recommendations, can be summarized as follows.

- Reinforcement of Water Resources Management studies,
- Expanding the Water Resources Observation Network and Improving the Information
- Management System,
- Protection of Water Resources,
- Efficient Use of Water Resources,
- Development of Financing Policies,
- Development of Training, Awareness Raising, Capacity Building and R&D Studies.

Adaptation measures need to be developed in line with the strategic goals identified for the risks that may arise as a result of the adverse impacts of climate change. As Türkiye is located in a semi-arid climate zone, improving water quality, increasing the amount of usable water, and ensuring the sustainability of the balance between conservation and use are of great importance (MoAF, 2018).

Several institutions hold duties, powers, and responsibilities related to water in Türkiye. Such a state of affairs causes various problems in water management. As it is known, the preparatory work for the Water Law is in progress to introduce legislation that will address the above-mentioned shortcomings in the framework of compliance with the Acquis Communautaire of the EU and integrated river basin management.

Integrated water resources management is a key approach to mitigating the impact of climate change on water resources. Successful integrated water management ensures stakeholder participation, incorporates sustainability into planning processes, coordinates land and water resource management, addresses the relationship between water quality and quantity, leverages the link between surface and groundwater, protects and restore natural systems, and includes strategies that take into account climate change.

Basin management plans prepared under the integrated water resources management approach include all water-related plans prepared at the basin level, such as basin protection measures, basin water allocation, basin management, basin flood management, and basin drought management. These plans are prepared to protect the surface and underground water bodies in the basin in terms of quantity and quality, to allocate them according to the prioritization of requirements, and to ensure

sustainable water use by protecting them from disasters such as droughts and floods.

In this context, the procedures and principles for the establishment and maintenance of the Central Committee Basin Management, Basin Management Committees, and Provincial Water Management Coordination Committees have been regulated to establish integrated basin management, to prepare, implement, and monitor basin management plans and to ensure inter-institutional coordination throughout the process.

Basin Management Committees have been established for each basin to carry out studies to monitor and evaluate the implementation of basin management plans at the basin level. The Basin Management Committees contribute to the studies of the Basin Management Plans, monitor and evaluate the implementation of the plans, monitor studies on the protection of drinking water resources, ensure the implementation of the prepared drinking water basin protection plans, conduct studies to solve problems related to water management at the Basin level, It is the most powerful structure in the basin, responsible for evaluating the work carried out by the Provincial Water Management Coordination Committees and relevant institutions or organizations, and for ensuring public access to information, obtaining their opinions and active participation in the preparation, review, and updating of basin management plans. In this context, it is of utmost importance to increase the effectiveness of the Basin Management Committees.

The procedures and principles regarding the duties, powers, and responsibilities in the work to be carried out together with the relevant institutions in the framework of mitigating the effects of the agricultural drought that is likely to occur in Türkiye and determining the measures to be taken have been regulated (Presidential Decree No. 5140). Per the decision, an agricultural drought management structure has been established to mitigate the effects of agricultural drought and to combat agricultural drought. Agricultural drought management refers to the Agricultural Drought Management Coordination Committee and the Monitoring, Early Warning and Forecasting Committee, the Risk Assessment Committee, data flow units, working groups, and the Agricultural Drought Provincial Crisis Centre working under this committee. The provincial crisis centers are also tasked with preparing provincial agricultural drought action plans and preparing and updating data on provincial land availability, water resources, and climate.

Floods occur from time to time in Türkiye. There are many legal and institutional regulations concerning floods, especially DGSHW (Directirate General of State Hydraulic Works), GDWM (General Directorate of Water Resources Management), GDCDE (General Directorate of Combating Desertification and Erosion), GDF (General Directorate of Forestry), TSMS (Turkish State Meteorological Service), AFAD, (Disaster and Emergency Management Presidency), Governorates, Special Provincial Administrations, and Metropolitan and Provincial Municipalities have different responsibilities. In this regard, there is a need to improve the existing organizational structure and working systematics to effectively manage flood risks at the basin level (T.R. Court of Accounts, 2022). The publication of the Flood Law should primarily ensure the protection of riverbeds in land-use plans and the prevention of construction in riverbeds. However, the fact that structural measures for flood protection are designed to take into account nature-based solutions should be evaluated in the framework of the legislation.

Sustainable management of water resources is only possible if the balance between supply and demand is successfully established. To this end, the quantity and quality of water resources and sectoral water needs, and consumption must be accurately determined. In this context, the monitoring network should be strengthened, data collected by different institutions should be transferred to the National Water Information System (NWIS) according to common standards, and the functionality of the system should be improved and disseminated. This issue has been emphasized in the Twelfth Development Plan and the effectiveness of the NWIS will be improved and the regulatory infrastructure strengthened by providing up-to-date data from all relevant institutions and organizations. It is stipulated in the Policies and Measures Article no. 876.1.

In order to protect drinking and utility water basins from pollution, it is necessary to draw up protection plans in accordance with the relevant legislation as part of the process of designating protection areas and protection principles.

The adverse effects of climate change make effective and holistic water management activities across all sectors essential to ensure water security. To increase the adaptive capacity of water resources management to climate change, it is essential to identify all risks that may threaten the safety of water from its source to the end user in normal and exceptional situations, to determine the level of these risks and to take the necessary technical, legal and administrative measures to eliminate them. In addition, it is necessary to be prepared for the negative effects of climate change with “emergency action plans focused on sustainable water management” (before, during, and after the disaster) to be prepared for extraordinary situations such as floods and long dry periods caused by climate change. The implementation of “Drinking Water Safety Plans from Source to Tap” in the provinces, which will be prepared with this understanding, will reduce losses and increase the adaptive capacity to climate change in the drinking water sector throughout the country. “National Water Security Plans will be prepared by preparing similar plans for the agriculture and industry sectors throughout the country.

In Türkiye, surface and groundwater resources are used for drinking, agricultural, and industrial purposes. The sources of water supply for these uses are the lake, existing reservoirs, springs, and wells. In this context, sustainability is important in the management of water resources.

In this context, the prioritized areas for adaptation studies in water management are summarized below.

- Integration of climate change adaptation studies into water management policies must be ensured.

- As set out in the National Water Plan published in 2019, it is imperative to eliminate fragmented water legislation, confusion of power between institutions, and lack of coordination.
- There is a need to reduce losses in urban water use under the pressure of population growth and intensifying migration, to develop alternative water resources such as rainwater, grey water, and used water, and to develop adaptation measures for the efficient use of water resources.
- Owing to its geographical location, Türkiye has major aquatic ecosystems and special environmental protection zones. Meeting the water needs of these areas in terms of quantity and quality is essential for the continuity of the ecosystem.
- Water is withdrawn from some natural lakes for industrial and agricultural irrigation, as well as for drinking water, exerting pressure on the lakes. In this context, it is important to deliver the water required by the ecosystem and to ensure the adequate water quality.
- To improve adaptation to climate change, it is imperative to protect wetlands, restore areas whose ecological structure has been damaged, ensure their rational use and create artificial wetlands.
- In the context of adaptation to climate change, it is necessary to develop measures for irrigation management and efficient use of water in the agricultural sector, which makes extensive use of surface and groundwater; in this context, it is necessary to disseminate closed systems, increase irrigation efficiency, determine the product pattern appropriate to the water availability of the basin and resistant to drought, reuse of used water and water returned from agriculture through similar measures. It is necessary to develop harmonizing measures for the recording, monitoring, efficient use, recovery, and reuse of underground and surface water used in agriculture, industry, tourism, services, mining, livestock, and similar sectors.
- Efficient use of water in tourism facilities should be ensured through methods such as rainwater harvesting, reuse of grey water and used water, and xeric landscaping. Excessive use of groundwater places pressure on groundwater. Groundwater protection, groundwater monitoring and controlled groundwater use should be ensured. The construction of underground dams and artificial groundwater recharge structures is essential.
- It is important to reduce water contamination caused by agricultural, urban and industrial sources and to protect water quality.
- To reduce flood damage, it is essential to establish flood forecasting and early warning systems, to take the necessary structural and non-structural measures and, above all, to protect riverbeds from development pressure.
- Given the variations in the precipitation regime, it is crucial to create and disseminate recharge systems to replenish the underground waters of the rainwater that flows out of the upper basins during periods of excessive precipitation, causing floods or landslides, mixing with the sea, and where traditional rainwater collection systems are inadequate.
- It is therefore imperative to inform and educate water users about efficient water use, water conservation and disasters, and to develop and disseminate R&D and scientific activities.

In addition, reducing water losses in all sectors, especially in urban, agricultural and industrial areas, preventing water wastage in individual uses, disseminating efficient, modern and environmentally friendly techniques in agricultural irrigation, used urban water, especially rainwater, grey water, brackish water, etc., dissemination of alternative water resources, the implementation of sponge city models with nature-based solutions to extreme weather events such as droughts and excessive precipitation, the retention of water in the use cycle in industrial applications, the long-term use of clean production techniques and products and the increase of recycling potential, the technical support for all these studies and the establishment of economic incentive and support mechanisms are also of major importance for our national water policies.

Adaptation measures related to water resources management can be classified under the two strategic goals below:

STRATEGIC GOAL 1

To develop policy and legal frameworks on water resources management, to increase the production and sharing of data and information.

As part of this action, the aim is to prepare, implement and monitor basin scale management plans (River Basin Protection Action Plan, River Basin Water Allocation Plan, River Basin Management Plan, River Basin Flood Management Plan, River Basin Drought Management Plan) will be prepared per the Regulation on Preparation, Implementation, and Follow-up of River Basin Management Plans for effective river basin management, and to prepare and monitor the implementation of measures and actions in existing plans. While the pressure on water resources, which are essential for the continuity of life and development activities, is increasing day by day due to reasons such as adverse effects of climate change and increased consumption, continue to increase, the preparation of national water security plans is targeted to ensure sustainable, fair and reasonable access to national efforts are being made to ensure "water security". Additionally, to determine the total amount of water resources used for the production of goods or services and to achieve the consumption-based water use indicator at the basin level, basin-based water efficiency action plans for drinking and utility water need to be prepared, and water footprint determination studies are required. In addition, within the scope of this action, it is aimed to evaluate numerous legal and institutional regulations related to floods that cause significant loss of life and property in order to establish and effective flood risk management structure and to prepare provincial agricultural drought action plans and monitor the actions within the scope of combating drought.

WRM1. Formulate and implement river basin management plans by following up on the measures, precautions, and actions outlined in existing management plans.

With the action described below, the aim is to establish a water information management system that enhances the production of water resources data and information at the national level, ensuring compliance with standards for data collection, storage, analysis, and sharing; increase the number of wastewater-producing facilities entering the Wastewater Information System to monitor wastewater at the provincial level, strengthen monitoring activities of wastewater treatment plants effluents with Continuous Wastewater Monitoring Systems (CWMS) for plants with capacity of 5,000 m3/day and above prevent the dumping of excavation waste into riverbeds, and enhance the effectiveness of controls through the widespread adoption of an "Excavation Management Information System" to protect and prevent factors that could cause floods. Additionally, it is also aimed under this action to continue monitoring by developing the monitoring network in line with the needs in order to ensure the continuity in monitoring the quantity and quality of surface and groundwater; and to establish an inventory by determining the quantity and quality

STRATEGIC GOAL 1

To develop policy and legal frameworks on water resources management, to increase the production and sharing of data and information.

of surface and groundwater and sectoral water consumption with a view to creating a basis for water resources development projects by determining current and potential water at basin level.

WRM2. Develop monitoring and information systems to improve water and wastewater management, enabling the effective monitoring of the quantity and quality of surface and groundwater resources and sectoral water consumption.

The action also aims to establish an effective flood risk management structure by evaluating the multitude of legal and institutional regulations related to floods that cause loss of life and property alongside water management.

WRM3. Strengthen and update legislation on water resources management to align with emerging needs and challenges.

Due to rapid growth, urbanization and climate change, among other factors, water resources are both diminishing and rapidly becoming polluted. The first stage in preventing this trend is to assess the impact of climate change on different water resources.

WRM4. Assess the impacts of climate change on water resources, including lakes, wetlands, and coastal areas, to support informed policy development and management.
WRM5. Monitor the implementation of the Water Efficiency Strategy and Action Plan within the Climate Change Adaptation Framework (2023-2033).

As water is a shared resource across sectors, water efficiency strategies for each sector are of great importance for the sustainable management of water resources. To this end, the "Water Efficiency Strategy and Action Plan in the framework of Adaptation to Climate Change" has been prepared, which sets out far-sighted goals and strategies to enhance water efficiency in all sectors in our country.

STRATEGIC GOAL 2

To ensure the protection, improvement and efficient use of water resources.

In line with this strategy, the following action aims to promote the preparation and implementation of basin protection plans for water resources from which drinking and utility water is supplied or is to be supplied, in accordance with the "Communiqué on Procedures and Principles for the Preparation of a Drinking Water Basin Protection Plan".

WRM6. Continue efforts to protect surface and groundwater basins used, or planned to be used, for drinking and utility water supplies.

The aim of the following action is to reuse highly treated wastewater while meeting the mandatory quality criteria set out in the Water Pollution Control Regulation to prevent pollution of water resources by controlling wastewater and limiting discharge standards to protect water quality, accelerating the construction/renovation of wastewater treatment plants needed throughout the basin, increasing the amount of treated wastewater and evaluating treated wastewater.

WRM7. Update and enforce discharge standards and parameters to protect water quality across all basins, with the goal of increasing the amount of treated wastewater and achieving a 15% reuse rate for treated wastewater by 2030.

In the context of the protection of water resources and aquatic ecosystems, the following measures will monitor water quality and water levels of aquatic ecosystems at risk in the context of climate change, establish water balances to protect the ecosystem properties of lakes and natural lakes from which water is withdrawn for sectoral purposes, and the preparation of management plans pursuant to the "Regulation on Protection of Wetlands", aimed at implementing and monitoring existing management plan provisions, restoring degraded wetlands to nature and increasing the water retention capacity of basins through the creation of artificial lakes, ponds and wetlands.

WRM8. Monitor water quality and water levels in aquatic ecosystems to assess the effects of climate change. Develop water budgets for natural lakes, particularly those from which water is withdrawn for sectoral uses, and prepare or revise management plans for protected areas and wetlands. Identify, rehabilitate, and restore degraded wetlands while promoting the creation of artificial lakes, ponds, and wetlands using natural resources.

STRATEGIC GOAL 2

To ensure the protection, improvement and efficient use of water resources.

The objective of the action is to create a comprehensive legal framework for rainwater management in cities, including the protection of rainwater from pollution, collection, accumulation and reuse, and to establish an information management system on rainwater management.

WRM9. Establish a legal framework for stormwater management, and prepare or update inventories of rainwater infrastructure and contaminant sources.

As part of another measure, according to the "Regulation on Amendments to the Regulation on Control of Water Loss in Drinking Water Supply and Distribution Systems", in line with the goal of initiating/enforcing efforts to reduce the water loss rate to a maximum of 30% by 2023 and to a maximum of 25% by 2028 in the Metropolitan Municipality, and to a maximum of 35% by 2023, to a maximum of 30% by 2028 and to a maximum of 25% by 2033 in the District Municipalities. Installation of rainwater harvesting systems in buildings to be constructed on plots larger than 2000 m², in accordance with the "Regulation on Rainwater Harvesting, Storage and Discharge Systems" and the "Regulation on Amendments to the Planned Areas Zoning Regulation" will be evaluated so that rainwater can be harvested in this way and used for irrigation of parks and gardens and for fire-fighting purposes; expansion of the use of grey water, increasing the proportion of the population served by drinking and utility water networks (piped system) as part of access to healthy water at the provincial level, using wastewater treatment plant effluent as an alternative water source in cities in areas for the purpose of agricultural irrigation, environmental nutrition, landscape irrigation and secondary use.

WRM10. Work towards reducing water losses in municipalities in accordance with applicable legislation and Water Efficiency Strategy targets. Increase the use of alternative water sources, such as rainwater harvesting and greywater reuse in urban, and expand access to safe drinking water networks.

It is important to achieve efficient use of water in irrigation areas with the highest water consumption among the sectors, reduce water losses in irrigation systems and prevent illegal use, develop irrigation facilities, and use efficient and appropriate irrigation methods per the Regulation on Controlling Water Use in Irrigation Systems and Reducing Water Losses. It is necessary to plan the irrigation period, implement correct crop rotation, implement measures to increase irrigation efficiency, and carry out monitoring and evaluation studies. The Water Efficiency Strategy and Action

STRATEGIC GOAL 2

To ensure the protection, improvement and efficient use of water resources.

Plan for Adaptation to Climate Change aims to increase irrigation efficiency to 60% by 2030. Necessary measures must be taken to increase irrigation efficiency to 60% by 2030. In order to conserve water and reduce energy costs in pumped irrigation in the framework of efficient use of groundwater, switching to "Night Reservoir Operation" and automation of irrigation systems. The projects to be prepared under the "Land Consolidation and On-Field Development Services Implementation Regulation" aim to prevent the degradation and fragmentation of agricultural land due to natural and man-made impacts, and to increase the efficiency of irrigation through practices such as irrigation, drainage and stream improvement. Irrigation can be achieved by using water more efficiently by evaluating different recycling alternatives, such as improving the quality of water returned from agriculture by reusing it, reusing it cyclically in the same irrigation, and opening up new irrigation areas by transferring it to currently unirrigated agricultural areas.

WRM11. Promote efficiency-enhancing practices in agricultural irrigation in line with the Water Efficiency Strategy objectives within the climate change adaptation framework.

To preserve groundwater, which is one of the most important water resources, and to ensure its efficient and sustainable use in the framework of the following measures, groundwater withdrawal shall be regulated by the Groundwater Act, the Regulation on Protection of Groundwater against Pollution and Deterioration and the Communiqué on the Protection of Aquifers and Springs Supplying Drinking Water which aims to ensure the sustainable use of groundwater through measures such as the protection of water resources, the prevention of unauthorized withdrawal, the installation of meters in wells and the development of groundwater storage facilities, and to conduct studies to protect and improve the quantity and quality of groundwater bodies.

WRM12. Identify groundwater protection areas designated for drinking purposes and conduct groundwater body assessments. Prepare annual reports on groundwater withdrawal monitoring and control, install water meters on operational groundwater wells, and expand the use of underground dams and artificial groundwater recharge structures

STRATEGIC GOAL 2

To ensure the protection, improvement and efficient use of water resources.

As part of the assessment of sectoral water use, it is important to establish legislation on the monitoring and recording of the use of surface and groundwater in the industry sector, and on its efficient use and recovery. It is aimed under this action to monitor and record the use of surface and groundwater in the industry sector, to make efficient use of water used for cooling, process or production in the industrial energy and mining sectors, and to improve the reuse of used water.

WRM13. Ensure monitoring and recording of surface and groundwater use in line with the forthcoming legislation and the Water Efficiency Strategy and Action Plan (2023-2033). Promote efficient water use and recycling of water in industrial enterprises, industrial zones, and sites, as well as in the energy and mining sectors.

In order to protect against and mitigate the damage caused by floods, which occur from time to time as a result of heavy precipitation and whose effects are exacerbated by interventions in the riverbeds, consider nature-based solutions in flood protection works, disseminate flood forecasting and early warning systems, flood protection facilities in the framework of the actions listed below. The aim is to rehabilitate capacity, continue soil protection efforts in flood-prone and flood-hazard areas, and proceed with upstream flood protection works.

WRM14. Implement structural measures for flood protection with a focus on nature-based solutions. Expand flood forecasting and early warning systems and continue the rehabilitation of flood protection facilities. Accelerate soil conservation efforts in flood-prone and high-risk areas and promote upstream flood protection measures. Develop and expand drought forecasting and early warning systems to enhance resilience to extreme weather events.

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AGRICULTURE AND FOOD SECURITY

climate adaptation

Updating agricultural policies to ensure climate resilience, efficient use of technology, and alignment with basin product patterns and water budgets

Minimizing losses and damages to critical infrastructure such as irrigation systems, cold chains and storage facilities

Planning agricultural production based on agricultural basins or farms and revising agricultural support mechanisms to align with the objectives of these plans

Enhancing the agricultural insurance system to address the impacts of climate change

Promoting sustainable aquaculture practices in alignment with climate change adaptation goals

AGRICULTURE AND FOOD SECURITY

climate adaptation

4.1. GENERAL FRAMEWORK

Agriculture, as the primary sector responsible for food production, holds strategic importance. To ensure national food security and safety, it is essential that agriculture operates in an economically, socially, and environmentally sustainable manner. Maximizing farmers' share in prices and added value not only enhances competitiveness but also strengthens long-term sustainability.

Türkiye's climate and diverse natural resources makes it possible to grow many agricultural products. However, this diversity brings with it many different risks, options and scenarios in terms of climate change impact and climate change adaptation in the agriculture sector.

Agriculture is a significant sector in Türkiye, meeting the food needs of a population of approximately 85 million and accounting for 6% of the GDP and export and 17% of employment in 2021 (TURKSTAT, 2022). Türkiye is a significant agricultural producer and exporter in world markets and 7th largest agricultural producer in the world (OECD, 2016). In 2022, agricultural GDP in the country reached 58.7 billion USD (TURKSTAT, 2023). Agriculture sector plays a vital role for all actors in the agricultural food chain, including input providers, farmers, traders, processors, warehouses, transporters, retailers, etc., from production until consumption.

As of 2021, there is 23 million ha of cultivated agricultural land in Türkiye, producing more than 250 agricultural products. According to the latest agricultural census, there are approximately 3 million farms in Türkiye, most of which are small family farms that use family labour and own an average of 6 ha of land. Field crops are grown in the 18 ha of land which accounts for 80% of total cultivated lands, and the rest of the land is used for fruit and vegetable, viticulture and olive farming. The primary products grown in Türkiye are grains, which are grown in 60% of the lands. The rest of the cultivated land is used to produce other field crops such as sugar beets, cotton, sunflower, potato, beans, onions and vegetables (tomato, pepper,

cucumber, etc.); fruits and other perennial plants (apple, citrus fruits, grapes, fig, hazelnut, olives, tea, etc.) (TURKSTAT, 2022).

The area of agricultural lands in Türkiye has been decreasing over the years (the area of cultivated land, which was 28 million ha. in 1990, decreased to 23 million ha in 2021). In the case of grains, which have the largest area sown in the country, production amount increased from 30 million to 37 million tonnes despite the grain area sown decreasing from 13.7 million ha to 11.1 million ha in 1990-2021 (TURKSTAT, 2022). The main reason for this is the improvement of cultivation processes and use of inputs, particularly fertilizers.

Livestock breeding is also a significant agricultural activity in Türkiye. The livestock breeding subsector consists of cattle, sheep, goat and poultry breeding and is carried out traditionally and intensively. There were 18 million cattle, 42 million sheep and 12 million goats in 2021, with the number of cattle increasing by 50%, the number of sheep by 4%, and the number of goats by 11% compared to 1990. In the same period, poultry husbandry also experienced a rapid advancement, and the number of poultry increased by 166%. Broiler meat, in particular, became the sector that meets a large part of the animal protein needs of the population. As of 1990, the production of animal products such as milk, meat, eggs, etc., also saw a rapid increase in parallel with the increase in the number of animals as well as cultivated and crossbred cattle. In 2021, Türkiye produced 23 million tonnes of milk, 2.3 tonnes of broiler meat, and 2 million tonnes of red meat. Aquaculture is another activity that is a significant source of animal protein and economic contributor in the country. In 2021, a total of 800,000 tonnes of aquaculture product was produced, 328,000 tonnes of which was through hunting and 472,000 tonnes of which was through breeding (TURKSTAT, 2022).

Agriculture is a strategic sector due to food production. Therefore, it must be economically, socially and environmentally sustainable for food security. Agricultural production must favour means of production that utilize soil and water efficiently and clean and cause less GHG emissions. Furthermore, the agriculture sector must be competitive, as well. Price, quality, and farmers receiving high shares of value-added increase competitive ability as well as potentially enabling sustainability.

4.2. SECTORAL LEGISLATIVE FRAMEWORK AND RESPONSIBLE INSTITUTIONS

Numerous policy documents within the agricultural sector address the integration of climate change adaptation strategies to enhance resilience and ensure sustainable agricultural practices.

The key policy documents in the agriculture sector, i.e., Agricultural Law (2006), the Eleventh Development Plan (2019-2023), and the 2019-2023 Strategic Plan of the MoAF, emphasize and include actions related to climate change adaptation.

Agricultural Law was introduced in 2006 in Türkiye. It aims to identify and regulate the policies required to improve and support the agriculture sector and rural areas in line with development plans and strategies. Agricultural policies aim to increase the level of prosperity in the agriculture sector through developing agricultural production in line with national and foreign demands, protecting and enhancing natural and biological resources, improving productivity, strengthening food security and safety, improving producer organizations, strengthening agricultural markets, and achieving rural development. Sustainability, human health, and environmental sensitivity are stated to be one of the principles of agricultural policies.

According to the "Climate Change, Food Security and Efficient Water Use" subheading of the Eleventh Development Plan (2019-2023), Türkiye is among the countries that will be most affected by climate change and currently faced with increasing sudden and heavy precipitation, floods, and drought. Additionally, in line with Türkiye's position as a developing country, efforts continue to reduce GHG emissions and achieve climate change adaptation.

The Twelfth Development Plan, which will cover the 2024-2028 period, also includes subjects belonging to the agriculture sector. Another policy document, the 2023 Strategic Plan of the MoAF, sets the mission of "Mobilizing the ecological resources in the country in an efficient, productive and sustainable manner, from the perspective of a development model, and guaranteeing economic security, food supply security and human health through ecological, crop and animal added-value" and the vision of "Ecological resource management that serves as a model at the global scale" for Türkiye. The objectives stated in the 2019-2023 Strategic Plan are as follows:

- To increase prosperity in rural areas, and ensure stability in food supply by enhancing productivity and quality in agricultural production,
- To ensure food and feed security from production until consumption, and take the necessary measures for plant and animal safety and welfare,
- To protect and ensure the sustainable functioning of fisheries and aquaculture resources,
- To ensure the sustainable management of soil and water resources,
- To effectively combat climate change, desertification and erosion,

- To ensure the protection and sustainable management of biodiversity,
- To build institutional capacity.

The fifth objective laid down in the 2019-2023 Strategic Plan of MoAF concerns climate change and contains the following targets under it:

- To increase the capacity to combat climate change, erosion and desertification,
- To identify and prevent land degradation and erosion,
- To develop recommendations to measure and take action against the potential impacts of climate change on agriculture.

Additionally, the preparation works for MoAF's 2024-2028 draft Strategy Plan continue in line with the Twelfth Development Plan (2024-2028).

In addition to these key agricultural policy documents, there are many legal regulations and policy papers on climate change adaptation, including:

- Law No. 5403 of 03/07/2005 on Soil Conservation and Land Use
- Law No. 6537 of 30/04/2014 on Amending the Law on Soil Conservation and Land Use
- Türkiye's Strategy and Action Plan to Combat Agricultural Drought (2023-2027)
- Ecosystem-based Adaptation Strategy for Anatolian Steppe Ecosystems (2022-2036)

The 2022-2023 Strategic Plan of MoEUCC sets out the following targets that may be associated with the agriculture sector to achieve the objectives of protecting the environment and natural resources and combatting climate change, desertification and erosion.

- The capacity to combat climate change, desertification and erosion will be increased; a sustainable land management model will be developed for combating natural disasters.
- The number of protected areas will be increased; natural protected areas will be re-evaluated within the frame of eco-based scientific principles.

Türkiye has drafted adaptation actions on agriculture-related issues in its key policy papers on climate change, including:

- Türkiye's National Climate Change Strategy for 2010-2023
- Türkiye's National Climate Change Action Plan for 2011-2023
- Türkiye's National Climate Change Adaptation Strategy and Action Plan for 2011-2023
- Green Deal Action Plan (2021)
- Climate Council Decisions (2022)

4.3. CLIMATE CHANGE IMPACTS

Drought is projected to be the most significant climate change impact on Türkiye's agriculture sector. The provinces at greatest risk are located in the Central, Southeastern, and Eastern Anatolia Regions.

Agriculture involves producing raw materials using soil and seeds (plant and animal) and turning such raw materials into full or semi-products. It includes plant production, animal production, product processing, aquaculture and fisheries activities. It is a strategic sector as it produces the food needs to sustain human life. Therefore, every country supports their agriculture sector through appropriate policy instruments to ensure their food independence. In addition to food, many products such as feed, fiber, leather, fuel, and medical products are also produced by the agriculture sector. These products create employment during the stages of production, processing, storage, distribution and sale; generate export revenue; and contribute to economic development by creating personal income (Dellal, 2021a). In order to fulfil these duties and ensure production, it needs climate parameters such as temperature and precipitation. In addition, weather conditions must be suitable for the needs of plants and animals, and they must not be damaged by climate hazards such as drought, flood, hail and tornadoes (Dellal, 2021b).

A large part of Türkiye is under the influence of semi-arid climate conditions. Therefore, the changes in the amount and distribution of precipitation produce significant impacts on the agriculture sector in the context of water resources as well as arid farming which generally depends on precipitation. Since climate is the primary factor that enables agricultural production, agriculture is affected by the changes in temperature, precipitation and the carbon dioxide content in the atmosphere, increased extreme climate events, and sea level rise (Dellal and McCarl 2007, Dellal 2018, Dellal et al. 2020). Such impacts can be summarized as follows:

Plant Production

The changes in temperature, precipitation, and the carbon dioxide content in the atmosphere as well as increases in extreme climate events alter plant growth; water need; productivity; production amount and quality; procurement of production materials such as seeds, seedlings and saplings; and harvest time. More frequent and severe drought or excessive precipitation increase product losses. Such changes in production amount affect costs and, in turn, plant diseases and pests increase, more pesticides are required, number of agricultural spraying increases, and the spraying time is lengthened depending on the production schedule.

Soil

Besides temperature and precipitation; soil moisture, moisture storage capacity and soil productivity are also important for plant growth. The increase in temperature reduces soil moisture and more irrigation is required to meet the water needs of plants. However, higher evaporation due to temperature can complicate the irrigation process. Additionally, temperature increases the microbial composition in the soil, as well, affecting the nutritional elements in the soil negatively.

Animal Production

Animal production is directly or indirectly affected by climate change. Increased temperature can disrupt the balance between the production and utilization of heat in animals, changing the reproductive cycle, reducing reproduction rates, increasing miscarriages, increasing fatality rates, reducing feed consumption rates, reducing the transformation of feed into product, changing livestock weight, and reducing milk and meat productions. The changes in animal production quantities, in turn, affects production costs.

Water Use

The increase in temperature increases evaporation, which can decrease the volume of the water stored for irrigation purposes. Changes in the temperature regime alter snowfall time and period, leading to a failure to meet the water quantities required during summer periods. Other factors affected by this include groundwater amount and conversion rate. Non-agricultural water demand used in settlements, or some industries may increase with temperature. Intersectoral competition may arise regarding the use of water.

Other Impacts

In addition to the direct impacts of climate change, there are also factors that indirectly affect agricultural production. For example, sea level rise can lead to the loss of productive coastal areas and floods. Other indirect impacts such as weeds, pests, diseases, soil erosion, etc., can also increase with increased temperature.

The agricultural impacts of climate change can influence food security, development and international trade. As agriculture is an economic activity, in addition to supplying food, it largely affects markets. For example, decreased production can lead to increased food prices, higher costliness for consumers, increased import, and decreased export.

The most significant agricultural impact on climate change is expected to be decreased productivity. By 2080, it is estimated that merely the expected temperature and precipitation changes in Türkiye will reduce crop yields, by 8.3% for wheat, barley, rye and oats; 13.8% for corn; 11.8% for sunflowers; 11.8% for legumes (white beans, chickpea, green and red lentils); 19.7% for fodder crops; 15.8% for sugar beets; and 5% for cotton. More frequent and severe occurrence of extreme weather events such as drought, floods, hail, etc., is expected to result in greater productivity and production loss (Dellal et al., 2019). The agricultural impacts of climate change were studied at the regional level; in the Thrace region, for example, a decrease of 76% in wheat and 66% in sunflower yields were estimated under temperature and precipitation scenarios (TAGEM, 2021).

Agriculture is the sector most affected by climate change due to its dependency on nature. It is directly affected by the direct relationship between agricultural activities and ecosystems, such as water and forests; changes in climate parameters such as temperature, precipitation, relative humidity, wind, etc.; and increased frequency and severity of climate hazards such as drought, flood and storms.

Adverse climate change impacts are already observed in this sector which has high exposure and sensitivity. In addition, they are expected to increase, with significant implications in key areas such as sectoral production, consumption, international trade, employment, poverty, food security and social equality. For this reason, it is critical to enhance resilience and ensure adaptation to the potential adverse agricultural impacts of climate change.

The hazard component in the agriculture sector includes factors related to climate change and direct physical impacts. It implies the potential creation of climate-related impacts (short- and long-term) that may damage production and supply chains as well as ecosystems and natural assets such as soil, water, forests and biodiversity. Such hazard components also include the potential impacts on infrastructure and superstructures associated with agriculture, such as transport, irrigation, storage and energy. The secondary hazards that may affect the overall economy and urban through the food chain and the connection of agricultural inputs and outputs with other sectors are significant, as well.

Agriculture sector risk assessment: drought

Drought is estimated to be the most significant impact of climate change that is expected in the Turkish agriculture sector. For this reason, the impacts of drought on plant production and livestock breeding were analyzed as part of this study, followed by vulnerability and risk assessments, and risk maps were produced.

The impact chain in plant production (Figure 10) was produced through systematic association of climate-related risks and components, and identification of underlying factors. The most significant risks estimated for plant production included declining agricultural ecosystem services, reduced productivity, price increases, producer income and employment losses, and sectoral contraction.

Exposure of plant production was analyzed with data on total agricultural areas, pastures, number of enterprises and irrigation areas in provinces. It was identified that many provinces in the Aegean, Central Anatolia and Southeastern Anatolia Regions were exposed and highly sensitive to drought in 1990-2019.

Figure 10. Impact chain: relationship between agriculture-grains and drought

HAZARD		EXPOSURE
Climate Signal	**Climate Impact**	
Decrease in total precipitation amount	Drought	Proportion of agricultural areas
Average temperature increase	Decrease in precipitation amount and number of rainy days	Number of agricultural enterprises
	An Increase in the number of consecutive dry days	Proportion of irrigated areas
		Food chains*
		Regional economic linkages of the sector*
		Non-agricultural sector linkages*
		Producers and production*
		Soil and water ecosystems*

VULNERABILITY		RISK
Sensitivity	**Adaptation Capacity**	
Number of notifications paid per enterprise	Number of policies per enterprise	Decline in agriculture-related ecosystem services
Proportion of agriculture sector in GDP	Total number of tractors	Decrease and fluctuation in agricultural yields
Total grain production quantity	Proportion of irrigated areas with efficiency above 55%	Price increases
Total number of drought notifications	Proportion of irrigated areas with piped irrigation systems	Loss of producer income and employment
Amount of compensation insurance paid per agricultural enterprise	Proportion of land consolidation areas	Sectoral, regional, and macroeconomic contraction, inflation, and trade deficits
Agriculture and grain concentration indices	Proportion of continuously irrigated areas	Food insecurity and impoverishment
Yield variability of wheat, barley, and corn	Stakeholders' perception of risk and exposure*	Increase in social inequalities
Seasonal and crop growth phase sensitivities*	Human and social capital*	Increase in plant diseases
Sensitivity of agricultural yield to physical impacts*	Physical infrastructure and capital*	Food security risks due to price increases caused by yield and production losses
Sudden crop losses caused by extreme climate events*	Technological options and access*	Increased macroeconomic risks (inflation, trade deficit) due to sectoral price increases
Specific sensitivities of agricultural production and cropping patterns*	Decision-making processes related to critical institutions and resources*	Increased competition over land and water resources
Household agricultural income*	Risk management processes*	Loss of local biodiversity
Macro and regional economic linkages of the sector*	Information management and access to information*	

The (*) symbol denotes indicators excluded from the risk assessments.

One of the most significant factors determining economic sensitivity is the agricultural concentration profile of a province. Concentration in a single product boosts sensitivity. For a province, to concentrate in wheat production, for example, increases its sensitivity whereas increasing its product diversity reduces its sensitivity. Other indicators that establish the sensitivity of a province include the share of the agriculture sector in the provincial GDP, number of reports on drought, and the amount of losses paid for. As a result of the data obtained, the provinces in the Central Anatolia Region were determined to have very high and high sensitivity.

In terms of adaptation capacity in plant production; an analysis was conducted by considering data such as the number of policies per enterprise, irrigation efficiency, structure of irrigation systems in the province. It was determined that the Thrace, Central Anatolia and Southeastern Anatolia Regions, which are very significant especially in terms of supply security, have relatively high adaptation capacities.

A vulnerability analysis was conducted by evaluating sensitivity and adaptation capacity components together. According to the results, the Marmara and Aegean Regions and the provinces in the south of the country had low vulnerability whereas some

Figure 11. Risk map for current period: relationship between agriculture-grains and drought

provinces in the Eastern Black Sea and Eastern Anatolia Regions with high sensitivity had relatively high vulnerability.

When examining the drought risk for plant production in the agriculture sector, the drought risk for plant production was determined to be very high or high in the provinces in the Central Anatolia Region, despite them having high adaptation capacities. Drought risk was determined to be very high or high in most of the provinces with high sensitivity. Under current period conditions, Konya, Karaman, Sparta, Mersin, Giresun, Sivas, Malatya, Kahramanmaraş, Hatay, Kars, Ağrı and Van are the provinces with the highest risk (Figure 11).

Livestock breeding sector risk assessment: drought

Similarly, with that for plant production, the animal production impact chain was produced through the systematic association of climate-related risks and components and is shown in Figure 12.

The expected risks in livestock breeding can be listed as productivity loss, increased costs and prices, increased losses due to extreme climate events, reduced incomes, economic contraction in the sector, and food security risks.

Total livestock assets are the most important exposure indicator in the livestock breeding sector.

Figure 12. Risk map for current period: relationship between livestock breeding sector and drought

Figure 13. Impact chain: relationship between livestock breeding sector and drought

HAZARD		EXPOSURE
Climate Signal	**Climate Impact**	
Decrease in total precipitation amount	Drought	Proportion of total pasture areas
Increase in average temperature	Decrease in precipitation amount and number of rainy days	Total number of livestock
	Increase in the number of consecutive dry days	Number of pasture areas and enterprises exposed to extreme climate events*
		Proportion of feed price increases in total costs*
		Proportion of the sector in the regional/local economy*
		Number of animals affected by climate change-related diseases*

VULNERABILITY		RISK
Sensitivity	**Adaptation Capacity**	
Number of notifications paid per enterprise	Proportion of pasture areas	Diseases caused by increasing pathogens, parasites, and vectors
Proportion of agriculture sector in GDP	Proportion of total pasture improvement efforts	Scarcity of drinking water
Total milk production quantity	Number of policies per enterprise	Losses in animal productivity
Total number of drought notifications	Pasture adaptation plans*	Cost and price increases
Amount of compensation insurance paid per agricultural enterprise	Genetic development efforts with high climate adaptation capacity*	Increased damages caused by extreme climate events
Regional economic contribution of red meat and milk production value*	Sectoral and enterprise adaptation support resources/funds*	Enterprise income contraction and variability
Temperature elasticities of yields for red meat and milk*	Temperature stress management plan for cattle farming*	Sectoral economic contraction and employment loss
Damages from extreme climate events*	Number of enterprises with adaptation plan*	Food security risks due to price increases caused by yield and production losses
Susceptibility of animal breeds to diseases*	Number of enterprises investing in infrastructure against temperature rise and extreme climate events*	Increased macroeconomic risks (inflation, trade deficit) due to sectoral price increases
Climate index for real enterprise incomes*		Increasing competition over land and water resources
		Loss of local biodiversity

The (*) symbol denotes indicators excluded from the risk assessments.

High number of livestock is a factor that increases the exposure of provinces. In this context, Eastern and Central Anatolia provinces have high exposure. The ratio of pastures to the total geographic area was also determined as an exposure indicator in the livestock breeding sector.

The most important sensitivity components include the number of drought reports, animal production (only dairy production data was available), as well as loss claims paid per enterprise. Accordingly, the sensitivity was determined to be relatively high in Central Anatolia as well as Manisa and Kütahya provinces and lower in eastern provinces.
In terms of adaptation capacity, the only data available was on pasture lands and the areas where pasture rehabilitation works were undertaken. According to the results, adaptation capacity is relatively high in the Thrace and Central Anatolia Regions in general.

According to the vulnerability analysis results, the provinces in the Aegean and Mediterranean Regions stand out with a very high vulnerability level. Vulnerability is high in the west of the Central Anatolia Region and decreases towards the eastern part of the country.

When looking at drought risk in the livestock breeding sector, Konya and the provinces to its south, and the provinces in Eastern Anatolia have high levels of risk. According to current period data, drought risk is very high in Konya, Karaman, Aksaray, Niğde, Isparta, Antalya, Mersin, Kahramanmaraş, Malatya, Şanlıurfa, Elazığ, Diyarbakır, Muş, Ağrı, Erzurum and Kars (Figure 13).

4.4. CLIMATE CHANGE ADAPTATION MEASURES

Agricultural policy instruments will be reviewed and reformed, while sources of capital, infrastructure, technology, and information will be enhanced to facilitate climate change adaptation in the agricultural sector.

Measuring and enhancing human and social capital in agriculture, building physical capital stock, technological options and access to technology, the structure of institutions and decision-making authorities as well as supporting tools, access to financial risk management tools, information management and access to information are important topics in this regard.

Measuring and enhancing human and social capital in agriculture

The most decisive variables of adaptation capacity, which is one of the key socio-economic factors at the provincial level, is the status of human development which is scaled with the 2017 Socio-Economic Development Index (SEDI) score of a province. SEDI reports reflect the socio-economic development level of a province or district. In this framework, education and health investments in the provinces that are underdeveloped in terms of district-level education, health and economic development should be prioritized to enhance adaptation capacity.

The age, educational level, gender profiles of agricultural producers; the level of knowledge and education of the employees in stakeholder institutions associated with the agriculture sector are extremely important factors that determine adaptation capacity. In order to build an adaptation capacity specifically for the agriculture sector, the relevant information must be systematically collected at lower levels, i.e., agricultural enterprises, rural areas, villages, etc.; and health and gender equality services and investments should be prioritized in underdeveloped areas.

The sociological structure of the rural population, social and economic safety nets, protection and active use of social and individual rights, social engagement and equality, incidence of non-governmental organizations that provide support to agricultural and rural areas are critical variables in terms of adaptation capacity. Information regarding building adaptation capacity and prioritizing the underdeveloped administrative areas in resource and service distribution must be systematically collected at lower levels, i.e., on a provincial, district, village basis, etc., and adaptation action plans must be guided accordingly.

Land asset per enterprise is a significant adaptation capacity indicator. Works related to justice, social benefits and women-centred land aggregation are areas of investment that will enhance adaptation capacity. The provinces with low adaptation capacity and land per enterprise must be prioritized.

The associations that serve the agriculture sector must be supported in terms of climate change adaptation and capacity building.

Climate change directly impacts fishery which is important for some provinces. With the occurrence of climate impacts, measures should be taken with regard to the distribution of species and changes in annual catching amounts, which serve as the income source of the fisheries sector, and the entry, early detection, spread and methods of destruction of invasive species. Income support should be provided to groups engaged in family fisheries, which is common especially in provinces such as Muğla and Samsun, to compensate for increasing business and income risks, and investments should be made to create alternative sources of income. Strategies must be developed that also take into account the sustainability of decreasing resources and the socio-economic status and living conditions of fishers.

Building physical capital stock

The most important actions for the sustainability of agricultural production are to maintain and improve the current situation of existing water assets. In order to undertake protection and improvement planning,

current situation analyses must be undertaken for soil and water assets and actions must be developed in this direction. Agricultural lands must be prevented from being used for non-agricultural purposes, land consolidation efforts must be expanded, land use planning must be performed, and the application process which is performed in line with the planning must be monitored.

It must be ensured that agricultural land and grassland qualities and rural landscape are protected, grassland capacities and productivity are monitored, and options that will help water balance and boost productivity are determined and applied in grasslands.

Key infrastructure and superstructure stock including agricultural irrigation, transport, logistics, energy, etc., and their regional and local distribution are critical variables in terms of adaptation capacity. Decreasing precipitation and increasing drought under climate change impacts make the water problem extremely critical in agricultural production. For this reason, the expansion, efficiency and quality of the agricultural irrigation infrastructure are the most significant infrastructure requirements for adaptation.

Irrigation efficiency is key in terms of the sustainability of water assets and therefore the longevity of adaptation capacity. As targeted in the Regulation on Control of Water Use and Reduction of Water Losses in Irrigation Systems which was published in 2017 (Official Gazette, 2017), investments to boost irrigation efficiency must be prioritized in provinces where the ratio of irrigation areas with an irrigation efficiency of more than 55% are low compared to the total irrigation area in a province.

Physical climate change adaptation investments (modern storage, cold/cool chain systems, efficient transport infrastructure) that reduce exposure and boost efficiency in transport and logistics must be increased.

Increasing costs of livestock breeding can rise to significant levels for some regional and provincial economies. Investments in capacity building, ventilation and cooling to reduce heat stress must be supported. Building, energy and road infrastructure must be strengthened.

The sensitivity of each stage of the supply chain in the agriculture sector must be assessed, adaptation actions must be determined accordingly, and the multi-stakeholder agriculture sector must be addressed in an integrated manner. Vulnerabilities must be identified, and adaptation capacity enhanced in line with the Farm to Fork Strategy and the goal to make the chain fairer, more inclusive and sustainable.

Technological options and access to technology

Factors such as access to new biological, chemical, infrastructural and information technologies as well as the prevalence and distribution of such technologies are essential to build climate change adaptation capacity in agriculture.

Measures should be taken to reduce the vulnerability of the products that are significant for the province in the medium and long term. For example, in provinces with high vulnerability due to decreased productivity, the main factors that cause this must be identified and suitable measures (variety change, product pattern change, etc.) must be taken.

Efforts should be made to determine the most suitable product pattern and livestock breeding system that can ensure the efficient use of soil and water resources and protection of biodiversity in plant production and livestock breeding at the provincial and/or district levels.

The use of technologies, such as satellite-based and sensor-fitted early detection, monitoring technologies, agricultural practice technologies integrated with information systems that are rapidly expanding throughout the world should be invested in, and such technologies must be expanded in a way that prioritizes access by agricultural enterprises with low adaptation capacity.

Production losses and wastes are expected to increase, especially in plant production, due to increasing number and frequency of disasters such as drought, heavy precipitation, floods and storms. Provincial early warning systems must be expanded. Response and adaptation systems for drought, flood, hail, etc., the impacts of which are gradually increasing in Türkiye, must be improved, as well as their infrastructure.

Traditional or natural climate-friendly methods to enhance climate change adaptation capacity must be supported as much as the expansion of new technologies. In this context, it is critical to develop inclusive and integrative urban agricultural practices with the engagement of the society. Measures should be taken to increase the number of persons engaged in organic farming and good agricultural practices throughout the country and expand these practices across all provinces. Likewise, no-till farming practices, protective and regenerative agricultural practices, rainwater harvesting, permaculture, live wind curtain practices must be expanded.

TARSIM (Agricultural Insurance Pool Corp.) is one of the significant adaptation tools in terms of climate risks. Extreme heat and extreme cold events, number of consecutive dry days, as well as the intensity and frequency of floods, hail and storm are guaranteed by TARSIM in the framework of certain principles. This tool also provides significant capacity in terms of the management of production-related risks. Damage preventing and risk reducing systems such as the hail net and cover Systems (against hail), wind turbines (against frost), fogging systems (against frost), which are supported by TARSIM in the form of premium discounts, must be incentivized. The available data provide no detailed information on the technology use profiles of agricultural enterprises at the provincial or district level. In order to enhance adaptation capacity, the data related to different categories of technology must be systematically collected at provincial, district, village and farmer profile sub-levels, and technological investments must be prioritized accordingly.

Structure of institutions and decision-making authorities, and supporting tools

The prevalence and effectiveness of central and local institutions serving the agriculture sector, their competence in making and implementing decisions related to climate change, and their engagement in and impact on the decision-making processes of other components are significant factors in determining adaptation capacity.

Agricultural policies and legislation must be reviewed and updated to establish a sustainable and competitive agriculture sector that is resilient to climate change, that makes efficient use of technology and takes into account the product pattern and water budget of basins.

The quality and quantity of the support provided to agricultural enterprises must be prioritized and diversified in a way to reduce climate change exposure and increase adaptation capacity:

Agricultural income diversification support: Works to diversity income should be undertaken in provinces where agricultural income is concentrated in a single product.

Product pattern diversification support: Works to diversify products should be undertaken in provinces where agricultural income is concentrated in a single product group (wheat, barley, hazelnut, poultry, etc.).

Biodiversity support: Support should be provided to small family-owned businesses growing endemic species that are significant for the sustainability of biodiversity at the local, regional and national level.

Product support that reduces sensitivity to climate change: Local support schemes that will guide the transition from products with high to low climate sensitivity should be designed.

Non-agricultural income diversification support: To ensure that agricultural enterprises generate non-agriculture income sources is a significant adaptation method that reduces climate-related risks. Data should be collected in this regard (non-agricultural income profiles of households) and investments to develop alternative income opportunities should be made in rural areas.

Adaptation technology support: The resources allocated to technological investments in smart irrigation, smart product monitoring, early warning, etc., should be significantly increased.

Adaptation-oriented R&D support: The resources allocated to R&D studies that will enhance adaptation capacity, particularly seed development, should be significantly increased.

Medicinal plant production support: Common contagious diseases that are currently non-existent are expected to occur with climate change. For this reason, medicinal plants used for the treatment of diseases should be identified and supported in increasing their production amounts.

Green infrastructure support: The resources allocated to logistics, transport, efficient storage infrastructure investments, and particularly smart irrigation, should be significantly increased.

Nature-friendly agricultural practice support: Traditional and natural methods that enhance climate change adaptation capacity should be supported, as well. In this framework, organic farming, good agricultural practices, no-till farming, protective and regenerative agricultural practices, rainwater harvesting, permaculture and live wind curtain practices should be supported. Clear policy targets should be added to the adaptation actions determined with the Ecosystem-Based Adaptation (EBA) Strategy and periodic performance assessments should be undertaken.

Legume production and consumption support: Expanding legume production and consumption should be emphasized. Support should be provided to expand microbial fertilizer application during organic and regular legume farming.

Biological/natural reserve areas: The designated agricultural lands with low agricultural potential or that deliver critical ecosystem services should be considered as biological reserve areas. The producers working there should be provided with income support to protect these areas.

Apiculture: The capacity that must be built in apiculture is critical for adaptation. Apiculture adaptation efforts should be intensified in provinces where apiculture is widely practiced, and households and enterprises engaged in apiculture must be supported in this regard. While building its adaptation capacity, the apiculture sector's connection (risk relationship) with other sectors (especially fruit production and tourism) should be taken into account.

Fisheries: The changes in sea water temperature and water parameters, caused by climate change, affected aquatic biodiversity adversely, leading live resources to be faced with significant threat of extinction. Increasing sea temperatures alter economically significant factors such as the product efficiency, reproduction and survival rates of fish species. They also increase the risks to be produced by new diseases. Solution-focused works should be undertaken with regard to different or specific pollutants (emerging pollutants). Increased extreme climate events such as storms can damage facility infrastructure and require new investments. In light of such impacts and risks, infrastructural and scientific research support should also be provided to enhance the adaptation capacity of farm fisheries. Strategies to combat invasive species should be developed (combat through natural methods, etc.).

Women-centred adaptation support: Women farmers and agricultural workers, especially on the production side, are affected adversely by climate events. Specific support tools should be developed for women farmers and agricultural workers. Women farmers and workers who have high vulnerability and low adaptation capacity to climate hazards should be prioritized and their adaptation capacity boosted through support.

Applications and sanctions: It should be essential to support enterprises undertaking agricultural activities, in line with climate change adaptation methods. However, the obligations imposed on enterprises that operate without complying with such measures and harm natural assets in a way that threatens agricultural sustainability should be increased and, where necessary, penal sanctions should be established and implemented.

Revising trade policies in the framework of climate change adaptation objectives: Climate change impacts on export- and import-oriented products should be taken into account in determining international trade policies and relevant policy instruments (import taxes; aids; bilateral, regional and global trade relationships and agreements) should be used in a way to reduce the risks in this regard. Strategies and action plans should be drafted for products for which the country relies on foreign sources due to the failure of domestic production to meet internal demand and consequently the import of which has increased over the years.

Investments should be made to reduce dependency on food import and develop local markets and supply chains to obtain higher value from agriculture.

Protecting exported goods: Planning should be made to protect producers from import-related risks, and especially income loss shocks caused by extreme climate events; prioritize adaptation efforts in exported goods; and the regional and ecological distribution of products. Extensive reporting and projections should be undertaken especially on the export of plants with high water consumption, and investments to improve and expand the highly climate-resilient species and varieties should be increased.

Access to financial risk management tools

The capacity to respond to the risks at different links of agricultural supply chains; the structure of production, processing, trade and consumption networks, and the capacity to measure and reduce interconnected systematic risks should be developed. One of the most important adaptation tools against climate risks is agricultural insurance. The number of insurance policies per farm should be increased, and the provinces and/or products where this rate is relatively low should be prioritized in the context of the product pattern and production planning and support applications carried out by MoAF.

It should be ensured that, in addition to current applications, further detailed models are created with technology investments through TARSIM; the premium support for farmers and/or products based on vulnerability and risk level are increased as part of the product pattern and production planning and support applications carried out by MoAF; premium support is reduced for products not suitable for planning; compensation for loss is strengthened through tools such as exemption and joint insurance rules, and income guarantees are increased.

The socio-economic interactions, as well as the climate impacts of climate insurance should be monitored as a risk factor and insurance coverages should be diversified at the local level. As any development in this regard will create a budget load that would gradually increase given the climate risks that are expected to increase, finance planning should be undertaken dynamically, within the timetable and flexibility that can meet such loads.

Information management and access to information

The reliability of the information provided to decision-makers, as well as the ability of the state and private institutions in the agricultural sector to produce information, should be increased.

The exhaustiveness and depth of the university research studies on climate impacts and adaptation in the agriculture sector should be increased; and the ability to include existing scientific studies and data in decision-making processes should be improved. Additionally, universities should take on interdisciplinary approaches in this regard and develop solution-oriented and innovative strategies for problems related to climate change in the agriculture sector. Appropriate collaborations and aids should be provided in line with such strategies.
Climate sensitivity studies should be conducted on climate variables and main agricultural products in all regions.

Plant species and animal breeds with relatively less climate sensitivity should be developed; domestic breeds with high adaptation capacity should be protected, supported and expanded.

New plant and animal diseases and harmful organisms that may emerge due to climate change should be researched, and measures taken against the risks of disease and harmful organisms. A detailed study in which relative stakeholders and experts are involved should be undertaken to make a systematic assessment of Türkiye's capacity in this regard.

The number of personnel in provincial/district directorates of agriculture, and personnel capabilities to adapt to climate change should be strengthened. The underdeveloped provinces in this regard should be supported in terms of competent personnel.
Farmers throughout the country should be supported through extensive, short- and long-term training programmes on the observed and expected impacts of climate change. Product-based local training should be delivered on the adaptation works that farmers can undertake by themselves, and their advantages.

Training should be delivered on information and applications regarding government supported adaptation exercises. The local MoAF teams, local private sector representatives as well as leading farmers should be supported with training-of-trainers to expand this training.

To ensure the holism of the information and competences in the field of adaptation, extensive training on climate change and agriculture should be delivered to children and youth at the schools in rural and urban and universities through the Ministry of National Education (MoNE) and the Council of Higher Education (CHE).

All producers throughout the country should be supported with modern telecommunication networks and technologies, and a live and dynamic communication network from which they can receive information that will benefit them in their daily operations as well as long-term plans, in a healthy, accurate and reliable manner.

In light of such information and recommendation, three strategic goals were set for climate change adaptation in the agriculture sector, and twelve actions recommended to achieve them.

STRATEGIC GOAL 1

To develop policy and legal frameworks for the climate change adaptation of the agriculture sector; to strengthen institutional capacity, cooperation and awareness.

AGR1. Review and update agricultural policies and legislation to build a climate-resilient, sustainable, and competitive agriculture sector that leverages technology effectively and considers the crop pattern and water budget of basins.

AGR2. Plan agricultural production based on agricultural basins or farms and revise agricultural support mechanisms to align with the objectives outlined in these plans.

AGR3. Expand training, awareness-raising, and capacity-building activities for stakeholders in the agriculture sector to enhance adaptation to climate change impacts.

STRATEGIC GOAL 2

To ensure the protection, enhancement and sustainable use of ecosystems and natural resources in agricultural production.

AGR4. Conduct studies to identify appropriate crop patterns and livestock systems that promote efficient use of soil and water resources and safeguard biodiversity at provincial and district levels and prepare guidelines for farmers.

AGR5. Ensure the protection of cultivated agricultural land, grassland, and rural landscapes, monitor grassland capacity and productivity, and identify and implement strategies to maintain water balance and increase grassland productivity.

AGR6. Draft a nature-based solutions guideline for agricultural activities at the national level, develop an ecosystem-based food production model, and promote agroforestry practices in agricultural lands.

AGR7. Promote sustainable aquaculture practices that align with climate change objectives, protect and enhance aquatic biodiversity, and establish plans to combat invasive species in fisheries.

AGR8. Improve support for households and businesses engaged in apiculture, taking into account their interconnection with other sectors, such as fruit production, tourism, and honey forests.

STRATEGIC GOAL 3

To increase R&D studies on climate change impacts and adaptation in agriculture; to develop databases, information technologies and innovation applications in agriculture and perform agricultural activities accordingly.

AGR9. Support and enhance R&D studies on climate change impacts and adaptation in agriculture.

AGR10. Identify and monitor socio-economic factors that influence vulnerability in the agriculture sector at provincial, district, and village levels.

AGR11. Develop agricultural databases, information technologies, and innovation practices to guide agricultural activities and improve decision-making.

AGR12. Minimize losses and damages to critical infrastructure such as irrigation systems, cold chains, modern storage facilities, and transport infrastructure. Enhance the agricultural insurance system to incorporate the impacts of climate change.

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climate adaptation

BIODIVERSITY AND ECOSYSTEM SERVICES

climate adaptation

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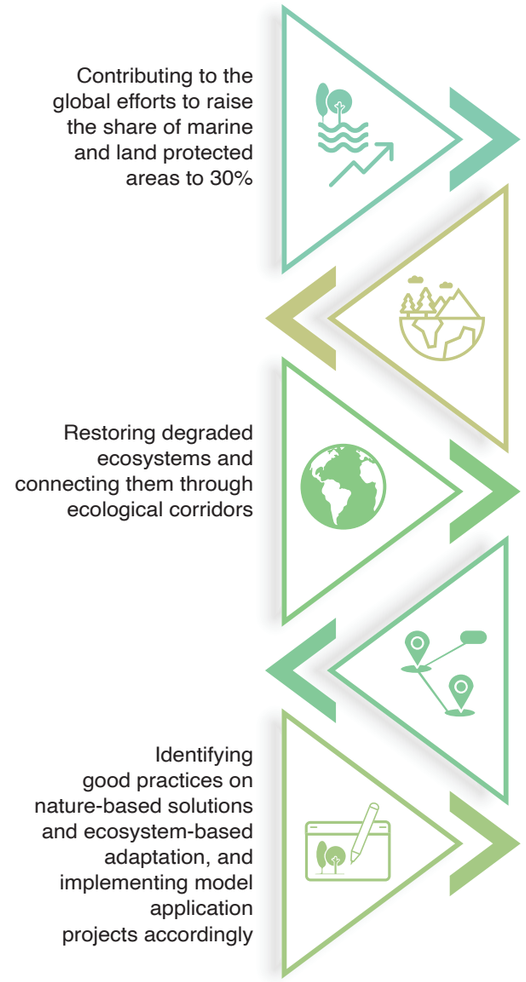


Contributing to the global efforts to raise the share of marine and land protected areas to 30%

Integrating biodiversity conservation, support for ecosystem services, and climate change adaptation into management and development plans for protected areas, as well as into species and habitat protection action plans

Restoring degraded ecosystems and connecting them through ecological corridors

Developing a roadmap to ensure the sustainable management and use of natural resources

Identifying good practices on nature-based solutions and ecosystem-based adaptation, and implementing model application projects accordingly

5.1. GENERAL FRAMEWORK

Türkiye needs to enhance research on biodiversity and raise public awareness of ecosystem services.

Having been on the migration routes of species in the glacial and interglacial periods, Türkiye is extremely rich in terms of species diversity. The country also has extremely varied climate characteristics; the diversity of bedrocks and the soils formed by such bedrocks; and the presence of flat hills, mountainous areas, rocks, dunes, steppes, lakes and rivers, enabling the species that migrate to Türkiye to use the country as a shelter in changing climate conditions. Furthermore, genetic diversity has increased, and new species have emerged as a result of evolution through geographic isolation, natural selection and mutations. Davis (1971) divides Türkiye into the Irano-Turanian, Euro-Siberian and Mediterranean phytogeographic regions (Türkeş, 2015). As farming began in the south of Türkiye, this region serves as the main source of numerous crop plants, the heirlooms of which are naturally still alive. Two of the eight gene centers designated by Vavilov for cultivated species are located in Türkiye (Mediterranean and Middle East) (FAO, 2019).
Although Türkiye has high species diversity, there are more studies on plants and vertebrates while studies on various groups including invertebrates and fungi are lacking. There is no current data source in which all species in the country are presented together. However, according to data compiled from various sources, the total number of taxa in Türkiye exceeds 42,000 (Table 4).

4,409 of animal taxa; and 3,507 of the taxa in groups such as plants, algae, lichens, etc., are endemic, with an endemism rate of 20% and 17%, respectively. Endemism rate for the 6 species groups examined as part of the Noah's Ark National Biodiversity Database Project, which is carried out by the General Directorate for Nature Conservation and National Parks, is 27.6%, 3.2% of which are local endemic taxa (GDNCNP, 2021).

Data on the provincial distribution of the taxa categorized by IUCN as critically endangered (CR), endangered (EN), and vulnerable (VU) is available on the Noah's Ark database. The taxa in these

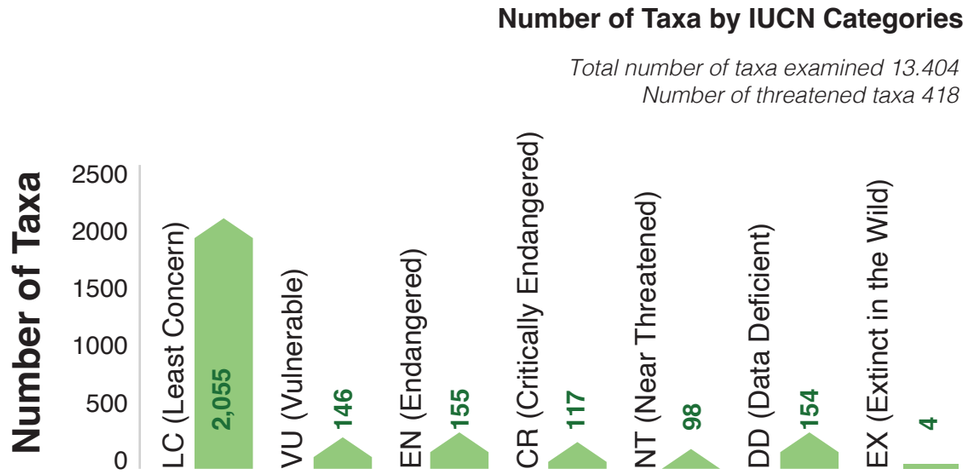
categories are described as threatened species. From the 6 different species examined on the database, there are a total of 13,404 taxa in Türkiye, 117 of which are categorized as critically endangered (CR), 155 as endangered (EN), and 146 as vulnerable (VU). Accordingly, the total number of threatened taxa in Türkiye is 418 (Figure 14).

Table 4. Number of taxa in Türkiye

Animals	Number of taxa	Number of endemic taxa	Plants	Number of taxa	Number of endemic taxa
Land mammals	175[1]	9[1]	Vascular plants	12.141[1]	3.497[1]
Marine mammals	11[2]	0	Mosses	910[6]	7[7]
Birds	500[1]	0	Ferns	101[6]	3[4]
Reptiles	146[1]	19[7]	Green and red algae	2.150[6]	Unknown
Amphibians	39[1]	15[1]	Lichens	1.000[6]	Unknown
Inland water fish	403[1]	163[1]	Algae	3.690[3]	Unknown
Sea fish	512[3]	0	Liverworts	168[4]	Unknown
Insects	20.000[4]	4.000[4]			
Molluscs	522[4]	203[4]			
Corals	24[5]	Unknown			
Total	**22.332**	**4.409**	**Total**	**20.160**	**3.507**

[1] (GDNCNP, 2021); [2] Dede &Tonay (n.d); [3] Bilecenoğlu et al. (2014); [4] (GDNCNP, 2019); [5] Topçu& Öztürk (2017); [6] GDNCNP (2008); [7] Ursavaş & Işin (2018); [8] Taşkın (2019)

Figure 14. Distribution of taxa in Türkiye by IUCN categories



In addition to genetic and species diversity, habitat and ecosystem diversity is very rich in Türkiye. However, awareness and number of scientific studies on these subjects, and especially on habitat diversity, is quite low.

There are some data sources produced using terrestrial measurements or satellite images regarding various ecosystems in our country, which has an approximate surface area of 78 million hectares, excluding seas. Among these, the CORINE (Coordination of Environmental Information) land cover classification produced by the MoAF stands out in terms of showing temporal change (MoAF, 2021). When the data is examined, it is seen that the areas suitable for agriculture are in the first place with 18.7 million ha, followed by heterogeneous agricultural areas with 11.4 million ha. Afterwards, there are sparsely vegetated areas and natural grasslands, with 9.3 and 8.9 million hectares, respectively. Between 1990 and 2018, the largest land cover change was in heterogeneous agricultural areas, with a decrease of 1.2 million ha. Significant decreases have occurred in sparsely vegetated areas, mixed forests, natural grasslands and bare rocks.

The ecosystems in the country produce many products such as food, water, wood raw materials, etc. Additionally, they contribute to the society through supporting ecosystem services including carbon storage, wastewater treatment, climate regulation and cultural ecosystem services such as tourism, recreation, transhumance.

5.2. SECTORAL LEGISLATIVE FRAMEWORK AND RESPONSIBLE INSTITUTIONS

All Turkish legislation related to land use is closely linked to biodiversity and ecosystem services; therefore, all relevant legislation must prioritise the protection of biodiversity to ensure effective conservation.

GDNCNP, GDFA and GDPNA are the institutions directly responsible for biodiversity in Türkiye, while GDF is responsible for some protected areas such as protection forests. The most important laws in this area include Law No. 2873 on National Parks and Law No. 2863 on the Conservation of Cultural and Natural Property. Law No. 4915 on Land Hunting, and Fisheries Law No. 1380 also includes provisions directly related to biodiversity. There are also laws on various ecosystems such as agriculture, forests and grasslands, including Forest Law No. 6381, Law No. 5403 on Soil Conservation and Land Use, Law No. 4342 on Pastures and Coastal Law No. 7121. According to Articles 16, 17 and 18 of Forest Law, other uses than forest are permitted and pursuant to Supplementary Article 16, unproductive, stony and rocky areas can be taken out of forest boundaries. Some provisions in various laws such as Law No. 3213 on Mining, Law No. 2634 on Tourism Incentives, Law No. 5346 on Utilization of Renewable Energy Resources for the Purpose of Generating Electricity, may directly or indirectly negatively affect biodiversity and ecosystems. Stakeholder institutions in this regard include MoAF, General Directorate of Fisheries and Aquaculture (GDFA), General Directorate of Plant Production (GDPP), General Directorate of Livestock (GDL), General Directorate of Water Management (GDWM), Directorate of General State Hydraulic Works (DGSHW), General Directorate of Agricultural Reform (GDAR) and General Directorate of Agricultural Research (TAGEM). Other important stakeholders under MoEUCC include General Directorate of Spatial Planning (GDSP), General Directorate of Combatting Desertification and Erosion (GDCDE), General Directorate of Environmental Impact Assessment, Permit and Inspection (GDEIAPI), General Directorate of Environmental Management (GDEM) and Turkish State Meteorological Service (TSMS). One of these actors and stakeholders, GDF, drafted a Strategic Plan for Climate Change Adaptation in Forestry. Additionally, the 2019-2023 Strategic Plan by MoAF includes the following objectives covering biodiversity and ecosystem services:

- Protecting and ensuring the sustainable management of biodiversity
- Protecting and ensuring the sustainable use of genetic resources
- Ensuring effective management of the protected areas governed by Law No. 2873 on National Parks and improving nature tourism
- Identifying areas with natural, historical and cultural resource values, declaring them protected areas and ensuring their sustainable management
- Ensuring the protection and continuity of biodiversity and conducting awareness-raising activities in this regard
- Ensuring sustainability of wildlife and hunting management

The United Nations Convention on Biological Diversity, to which Türkiye is a party, is directly related to this area. The United Nations Framework Convention on Climate Change and the United Nations Convention to Combat Desertification also include provisions related to protecting and preventing the degradation of ecosystems in the context of biodiversity and ecosystem services. Examples some other international conventions related to biodiversity are listed below.

- International Convention for the Protection of Birds (Paris)
- Convention on the Protection of the Mediterranean Sea against Pollution (Barcelona) and related protocols
- Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris)
- Convention on the Conservation of European Wildlife and Natural Habitats (Bern)
- Convention on the Protection of the Black Sea against Pollution (Bucharest)
- International Treaty on Plant Genetic Resources for Food and Agriculture
- Convention on Wetlands of International Importance especially as Waterfowl Habitat (RAMSAR)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Convention on Long-Range Transboundary Air Pollution
- International Convention for the Prevention of Pollution from Ships (MARPOL)
- Convention for the Protection of the Ozone Layer (Vienna)

Various European Union directives and Council Decisions are directly related to biodiversity, the most important of which are the Council Directive 79/409/EEC on the Conservation of Wild Birds, Council Directive 92/43/EEC on the Conservation Natural Habitats and of Wild Fauna and Flora, and Directive 2000/60/EC of the European Parliament and of the Council Establishing a Framework for Community Action in the Field of Water Policy.

Furthermore, the European Union has drafted various strategies for 2030, including Forest, Biodiversity, and Soil Strategies. The EU Nature Restoration Law, adopted on 22 June 2022, provides for the restoration of 20% of the degraded terrestrial and marine ecosystems in Europe by 2030, and all of them by 2050.

European Green Deal also includes statements regarding the protection of biodiversity and ecosystem services. The Nature Restoration Draft Law was passed at the European Commission on 12 July 2023.

The Turkish legislation should be recast according to the international conventions to which Türkiye is a party, non-compliances should be eliminated, and it should be ensured that the priority purpose of all relevant legislation is nature protection. The European Union Biodiversity Strategy for 2030 sets a target to establish protected areas for at least

30% of land and sea in the continent. Additionally, the Aichi Targets of the Convention on Biological Diversity updated the rate of protected areas, which was designated as 17% across the world, as 30%. Türkiye also views increasing the rate of protected areas in the country as a significant target and undertakes works in this direction.

5.3. CLIMATE CHANGE IMPACTS

The vulnerability of biodiversity and ecosystem services, already negatively impacted by various climate hazards, is further exacerbated by factors such as habitat changes, pollution, over-exploitation, invasive species, and low levels of awareness.

It is possible to say that thousands of species, dozens of habitats and ecosystems in Türkiye will be affected adversely by all climate hazards, from drought to temperature increases, from floods to storms, from forest fires to sea level rise. For example, temperature increases primarily affects the phenology of species. This results in earlier blossoming in spring and later leave shedding in fall. As increased temperatures will increase respiration and transpiration, plant growth cannot increase in arid conditions. In fact, defoliation or dying can occur in plants due to lack of water in summer and fall months. Sudden temperature decreases in spring and fall, on the other hand, can lead to frost damage. Temperature increases are expected to cause changes in migration times, earlier breeding periods, and shorter incubation periods in animal species. The sex of some species found in Türkiye depends on temperature. One of such species is the Caretta caretta; they bury their eggs in the sand and their sex is determined by the nest temperature. According to a study, it was determined that in this species, which nesting on coastal areas, the number of female individuals increases from 60% to 90% when the nest temperature increases from 29.7°C to 31.5°C (Sezgin, 2016). Temperature increases are also expected to cause plants to migrate and shifting their distribution areas latitudinally northwards and towards the mountain tops (Ustaoğlu, 2009; Zeydanlı et al., 2010; Akyol & Örücü, 2019; Dağtekin et al., 2020; López-Tirado et al., 2020; Ergin, 2022). Some studies suggest that some bird species will migrate a few hundred kilometers north while others will lose their breeding grounds (Abolafya et al., 2013). It is stated that due to the warming of sea waters, the distributions of many benthic and pelagic marine creatures will narrow, they will be forced to migrate, reproductive problems may occur, and species that prefer cold waters are especially vulnerable (Kayhan et al., 2015). Some invertebrate species can increase the number of offspring they produce in a year depending on the increase in temperature. However, this may cause harmful insects to multiply rapidly and expand their sphere of influence. It is highly likely that economic losses will also increase with increased pests especially in agricultural and forest areas. Temperature increases are expected to affect the various seagrass species in Turkish seas, as well. According to Chefaoui et al. (2018), 75% of the Posidonia oceanica seagrass may be damaged by mid-21st century and is threatened by complete extinction by 2100, according to the RCP8.5 (IPCC Climate Change scenarios) scenario. Similarly, Zostera marina, a species that favours cold waters, may become extinct with the warming of seas.

One of the most important impacts of temperature increases and drought events will be to increase the risk of forest fires spreading over large areas in short time. In 2021, 133,000 ha of forest, 26,000 ha of agricultural, and 2,300 ha of treeless forest areas were burnt in the fires that occurred on 28 July-15 August. Although the breakout of these fires was not influenced by climate change, their extinguishment was made difficult by the temperatures reaching 45°C, as well as long-standing droughts and severe winds.

Temperature increases may lead to negative effects such as an increase in the frequency and severity of agricultural droughts due to a change in the precipitation regime in agricultural areas and a decrease in precipitation, and a corresponding decrease in agricultural production, changes in sowing times, and an increase in the demand for irrigation water.

Due to temperature increases, it is predicted that snowfall will fall as rain, snow cover and glaciers will melt, and as a result, water flows in rivers will decrease. It is expected that fish species migrating from seas to fresh waters or inland waters will be negatively affected due to decreasing river flows. Eels and sturgeon species that migrate between the sea and freshwater may not be able to perform this migration if lakes or rivers are disconnected from the sea. It is expected that water levels will decrease, and the physicochemical properties of water will change due to increasing temperatures and increased evaporation on water surfaces. Species sensitive to temperature and water quality changes are expected to be negatively affected by these changes. If the amount of dissolved oxygen in the water decreases, fish deaths may occur. If the streams dry out completely, and if there are no small puddles called shelters left, fish, amphibians such as salamanders and some frog species, and invertebrate animal species such as dragonflies and damselflies may die completely, or their numbers may decrease significantly.

Another climate hazard, sea level rise, threatens the plant species living on coastal dunes. Rising sea levels can cause the breeding sites of species such as Caretta caretta and Chelonia mydas, that use dunes as breeding grounds to narrow (Kaska, 2021).

Species' response and adaptation capacities to climate change differ. However, in nature, species are not independent from each other and there are predator-prey, symbiotic, etc. relationships between them. Even if a species adapts to climate change, disruption in the food chain or disruption of synchronization between species can have negative effects.

Climate hazards such as extreme climatic events such as storms, snow, lightning and wet landslides can cause trees to tree overturning or stem breakage in forests. These climate hazards also negatively affect agricultural areas, especially greenhouses. Storms and hail events are the most common extreme climatic events in Türkiye, along with flood, and they cause great economic losses. In this context, dust storms in semi-arid areas can even negatively affect human health.

However, it is predicted that there will be an increase in the number of invasive alien species entering in Türkiye due to climate change. Even today, it is known that there are many invasive alien species in marine and terrestrial ecosystems, such as silver-cheeked toadfish (Lagocephalus sceleratus), common lionfish (Pterois miles), sea urchin (Diadema setosum), red-eared slider (Trachemys scripta elegans), and water hyacinth (Eichornia crassipes). The General Directorate of Fisheries and Aquaculture has started to implement a support program since 2020 in order to reduce the population of puffer fish species in the ecosystem by creating hunting pressure on invasive species and reducing their participation in the stock. To date, approximately 130,000 puffer fish have been caught within the scope of support, preventing their population and distribution areas from increasing in the Mediterranean and Aegean Seas. This situation has also contributed to the protection of biodiversity in the Turkish seas, in addition to benefitting the countries bordering the Mediterranean and Aegean Seas.

In addition to combatting the invasive toadfish species, a series of activities are undertaken to create hunting pressure on other invasive species with increased expansion in our seas, including common lionfish (Pterois miles), sea urchin (Diadema setosum), and the nomad jellyfish (Rhopilema nomadica), and bring them into the economy.

Finally, the products and services produced by species, habitats and ecosystems will inevitably be affected by climate change, as well.

Each of the thousands of species in our country is expected to be affected by climate hazards to different degrees. Because each species' ecological characteristics and demands, such as population sizes, adaptation capacities and colonization abilities, migration speeds, threats other than climate change, and feeding habits, vary. However, unfortunately, there is not enough data to analyze vulnerability and risk on a species basis. A similar situation applies to habitats and ecosystems. The climate hazards that each habitat and ecosystem will be affected by are different. For example, while islands and coasts will be more affected by sea level rise, forests will be affected by fires and drought; Wetlands may be affected by drought and heavy rains, and cities may be affected by heatwaves and floods. Again, factors other than climate change that increase the adaptation capacity and sensitivity of each ecosystem are also different. For this reason, vulnerability and risk assessments must be conducted separately for each ecosystem across the country. As part of this study, a vulnerability and risk assessment were performed for species diversity, carbon storage ecosystem service, and wetlands, on the basis of the drought climate hazard.

Biodiversity and ecosystem services sector risk assessment of species diversity: drought

The impact chain prepared based on the assumption that all species living on terrestrial ecosystems and inland waters will be affected adversely by drought events, utilizes the data on number of taxa in the provinces included in the Noah's Ark dataset as exposure indicators (Figure 15).

The fact that species are endemic or threatened according to IUCN increases the sensitivity of species. However, considering that some factors other than climate hazards (land degradations, forest fires, erosion, agricultural irrigation, population density, etc.) will increase the vulnerability of species, sensitivity indicators have been determined. For some indicators such as pollution and invasive species, data were not available at the provincial level. On the other hand, it is thought that the existence of protected areas and natural areas in the provinces will contribute to the protection of species and provide shelter for migrating species. While connecting fragmented habitats through ecological corridors is a factor to facilitate adaptation, this could not be used due to the limited number of studies in Türkiye. Similarly, effective implementation of species protection action plans or protected area management plans can help to protect species. These indicators were not used in the analyses due to inadequate number of species protection action plans and implementation studies, of which there are approximately 100 so far, or due to the fact that they are unrelated to climate change. The implementation of the existing species protection action plans is monitored in at least 5-year periods, and it is planned to include climate change scenarios in the species action plan works to be drafted in the future. Socio-economic indicators were used for the adaptation capacity component, estimating that education levels, number of associations engaged in environmental and nature protection, and increasing income levels would increase awareness of biodiversity.

When examining the exposure of species diversity by provinces, it is seen that exposure is higher in provinces with greater species diversity in general. The provinces in the Mediterranean and Central Anatolia Regions particularly stand out in this context. Similarly, the species diversity in the Marmara Region has high exposure to drought. The provinces in the Black Sea and Aegean Regions have high and moderate exposure. Exposure is very high only in Artvin and Giresun in the Black Sea Region, while the exposure of species diversity is lower in the Southeastern and Eastern Anatolia Regions compared to other regions.

When the sensitivity of species diversity is evaluated, the Mediterranean Region comes to the fore. This is caused by the high number of endemic and endangered taxa in the region, as well as various factors such as mining, forest fires, settlement pressure and population density which threaten the taxa. Likewise, sensitivity was determined to be very high in Konya, Karaman and Niğde provinces in the Central Anatolia Region. Sensitivity is very high or high in the coastal provinces in the Aegean Region except for Aydın, while sensitivity decreases in the Central Aegean Region.

Figure 15. Impact chain: relationship between species diversity in biodiversity and ecosystem services sector and drought

HAZARD		EXPOSURE
Climate Signal	**Climate Impact**	
Decrease in total precipitation amount	Drought	Plants
Increase in average temperature	Decrease in precipitation amount and number of rainy days	Plants
	Increase in the number of consecutive dry days	Mammals
		Fish
		Reptiles
		Amphibians
		Habitats*
		Species*

VULNERABILITY		RISK
Sensitivity	**Adaptation Capacity**	
Being classified as an IUCN threatened species	Proportion of protected areas	Damage to forest areas
Being endemic	Proportion of natural areas	Drying up of lakes and river systems and wetlands or reduction in water levels
Being locally endemic	Proportion of the population with a diploma or higher education	Drying up of annual plants in pastures and steppes
Presence or absence of land degradation (e.g., mining)	Number of environmental, wildlife, and animal protection associations	Decline in ecosystem services
Proportion of highways, railways, related areas, and airports	Individuals' income levels	Extinction of endemic and threatened species
Proportion of areas used for irrigated agriculture	Ecological corridors*	Disruption of intra- and interspecific relationships
Amount of erosion	Presence of effectively implemented management plans for protected areas*	Forced migration of organisms
Number of forest fires		Transmission of pathogens alongside organisms
Proportion of settlement and industrial areas		
Population density		
Pollution**		
Invasive species**		

The (*) symbol denotes the indicators not used in the risk assessments,
The (**) symbol denotes lack of data regarding the indicator.

According to adaptation capacity indicators, the adaptation capacity of the provinces in Eastern Anatolia and Southeastern Anatolia is at a low level. Similarly, the level of adaptation capacity is low in the provinces of Çorum, Yozgat, Kırıkkale and Nevşehir located in Central Anatolia, mostly due to the low socio-economic indicators in these provinces and the small number of protected areas. The provinces with very high adaptation capacity in terms of species diversity are developed provinces such as İstanbul, Ankara, İzmir, Antalya, Bursa, Muğla and Eskişehir. It has been determined that the adaptation capacity in terms of species diversity is at a high level in provinces such as Artvin, Rize, Erzincan and Tunceli due to the abundance of natural areas.

When the current drought risk results of species diversity are evaluated, the provinces in the Eastern Mediterranean, the middle and west of Southeastern Anatolia, and the provinces of Konya, Karaman and Niğde in the Central Anatolia Region stand out

Figure 16. Risk map for current period: relationship between species diversity in biodiversity and ecosystem services sector and drought

with high risk levels (Figure 16). Kars and Erzurum in the Eastern Anatolia Region; In the Black Sea Region, species diversity in Giresun has a very high risk of drought.

As previously explained, each species will be affected differently by climate hazards, as exemplified by the species diversity and drought vulnerability and risk assessments conducted in this study. Performing species-specific vulnerability and risk assessments, particularly for endemic and endangered species, is important for creating actions to protect them. However, analysis on a species basis requires various data such as the ecology of the species, pressure factors and protection measures.

When evaluating the drought risk for species diversity, it should not be assumed that species diversity in provinces where the risk is determined to be low is not under pressure. Since the risk of drought in the Black Sea and Marmara Region is generally lower than in other regions, species diversity in these regions will be less affected by drought than the southern regions. However, future changes in factors other than climate change could not be examined in this study, and land degradation that increases the sensitivity of species diversity or increases in the number of invasive species that cannot be evaluated due to lack of data may increase the risk of species diversity. On the other hand, species in these regions are also under pressure from other climate hazards. For this reason, measures must be taken to reduce sensitivity and enhance adaptation capacity in provinces where the risk is low.

Biodiversity and ecosystem services sector risk assessment of carbon storage: drought

Drought hazard negatively affects many ecosystem services delivered by ecosystems, such as food production, water production, habitat creation and carbon storage. As part of this study, the drought risk of the carbon storage ecosystem service was dealt with as an example and the relevant impact chain produced is shown in Figure 17. Because natural ecosystems, especially forests, wetlands, coastal areas and soils, are extremely important carbon sink areas. It is extremely important to protect and increase their area in order to achieve the 2053 net zero emission target with the low-carbon growth approach that focuses on the fight against climate change, which our country has set as a target and is included in the twelfth Development Plan.

Drought events can lead to the drying out of very important carbon sink areas, such as wetlands, and thus the deterioration of the function of the carbon stored there. The amount of carbon stored or annually accumulated by wetlands in our country could not be evaluated within the scope of the analysis because their measurements were insufficient. Factors such as excessive wood production from forests, land use changes and urbanization pressure can also be considered as exposure indicators, as they can lead to a decrease in the amount of carbon stored by ecosystems or taken from the atmosphere annually. Studies such as afforestation, rehabilitation of unproductive forests, and pasture rehabilitation to increase the amount of carbon stored in natural ecosystems can be evaluated as indicators of

adaptation capacity in the drought-carbon storage relationship. Similarly, erosion prevention studies or good agricultural practices can be used as an indicator of adaptation capacity as they will increase organic carbon stocks in soils.

When the drought exposure of the carbon storage ecosystem service is examined by province, it is seen that the Black Sea Region, which has a higher amount of forest area and therefore more growing stock and increment, comes to the fore. Exposure was also detected at high levels in the Mediterranean Region, which has a lot of forest areas. On the other hand, the low presence of forests in the Central Anatolia and Southeastern Anatolia Regions and the low organic carbon stocks in the soil due to intensive agriculture have brought the exposure to a very low level.

Sensitivity is quite high in the provinces where wood production is high and in the Aegean, Mediterranean and Marmara Regions where there is land use change (mineral extraction sites, settlements, etc.). The high amount of forest area lost due to forest fires in the provinces of the Aegean and Mediterranean Regions increases the sensitivity. In some provinces such as Artvin and Bayburt, the possibility of transport of soil organic matter increases the sensitivity due to high water erosion. However, in general, sensitivity was found to be low in the Eastern Anatolia, Southeastern Anatolia and Central Anatolia Regions, where forest areas are low, due to the forest areas damaged by fires and the low amount of wood production.

Adaptation capacity is high in the provinces with a high number of rehabilitated unproductive forests and rehabilitated pasture. Since data on newly established forest areas was not available, afforestation data could be used as an indicator. Accordingly, adaptation capacity was found to be at a high level in provinces such as İzmir and Denizli, which have high annual afforestation amounts. On the other hand, it has been determined that the adaptation capacities of some provinces in Thrace, Western Black Sea and Eastern Anatolia are low in terms of carbon storage.

When the analyzed drought risk of the carbon storage ecosystem service is examined, it is revealed that the risk in the provinces located in the Eastern Black Sea and Mediterranean Regions is at a high level. (Figure 18).

The risk has been detected at a very high level in Edirne, Çanakkale and Yalova in the Marmara Region. In the Aegean Region, the risk of carbon storage being affected by drought is at high and moderate levels. This is mostly due to the fact that forest areas, which are expected to be more affected by drought, cover larger areas in these regions. On the other hand, the risk is very low in Central Anatolia and Southeastern Anatolia, where the presence of forest areas is low. Although the drought risk in the Black Sea Region is lower today than in other regions, the higher risks caused by the disruption in carbon storage are due to the high wood production and erosion in these regions and the lack of activities such as afforestation, rehabilitation and pasture improvement.

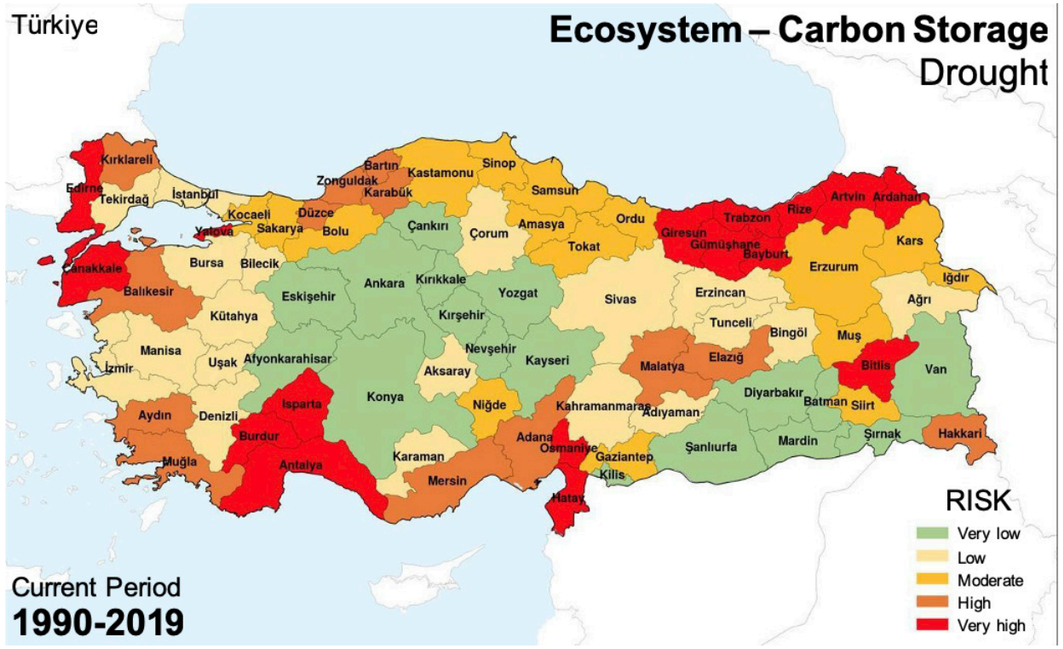


Figure17. Risk map for current period: relationship between carbon storage in biodiversity and ecosystem services sector and drought

Figure 18. Impact chain: relationship between carbon storage in biodiversity and ecosystems sector and drought

HAZARD		EXPOSURE	VULNERABILITY		RISK
Climate Signal	Climate Impact		Sensitivity	Adaptation Capacity	
Decrease in total precipitation amount	Drought	Excessive wood production	Excessive wood production	Afforestation	Slowing of tree growth in forests
Increase in average temperature	Decrease in precipitation amount and number of rainy days	Tree wealth in forests	Amount of erosion	Rehabilitation of closed forests with gaps	Drying up of wetlands or reduction in water levels
	Increase in the number of consecutive dry days	Soil organic carbon stocks	Presence or absence of land degradation (e.g., mining)	Improved pasture areas	Drying up of annual plants in pastures and steppes
		Proportion of natural areas	Burnt forest areas	Rate of change in forest areas	Decrease in the amount of CO_2 removed from the atmosphere by forests
		Shrubs, plants in steppes*	Proportion of settlement and industrial areas	Increasing soil organic carbon stocks through good agricultural practices*	Failure to achieve the net zero carbon emission target by 2053
			Areas subjected to overgrazing**	Preservation of genetic diversity through natural regeneration**	Decrease in yield increases due to reduced soil fertility
				Erosion control measures**	Forest fires that are increasing in frequency, severity, and range of impact
					Decrease in tree wealth and growth
					Inability to meet society's demand for timber raw materials

The (*) symbol denotes the indicators not used in the risk assessments,
The (**) symbol denotes lack of data regarding the indicator.

Biodiversity and ecosystem services sector risk assessment of wetlands: drought

The final evaluation between drought and the biodiversity and ecosystems sector was made specifically for wetlands. Wetlands are among the ecosystems that will be at risk due to the risk of drought, both the decrease in precipitation and the increase in evaporation in parallel with the temperatures, and the impact chain prepared for the analysis is given in Figure 19. The drought hazard can cause wetlands to dry out completely or water levels to drop. Accordingly, animals using these wetlands are forced to migrate and aquatic creatures lose their habitats. Along with drought, water use in irrigated agricultural areas and domestic water consumption increases the pressure on aquatic ecosystems. Land degradation and the increase in concreted surfaces increase the sensitivity of wetlands as they increase surface runoff and reduce the amount of water infiltrating the soil. Since water infrastructures built on streams can prevent the migration of aquatic creatures, additional measures such as the establishment of necessary migration routes should be considered to protect the species in wetlands. Although pollution was intended to be used as a sensitivity indicator in wetlands, it could not be included in the analysis due to lack of data. Therefore, it was considered as a sensitivity factor. On the other hand, the existence of natural areas and protected wetlands that facilitate the migration of species is also considered as an indicator of adaptation capacity in terms of protecting species. Again, most of our wetlands are used for the discharge of domestic and industrial wastewater. Therefore, the treated wastewater rate was chosen as an indicator of adaptation capacity. However, the quality of the treatment also becomes important here. To prevent water pollution, treatment must be advanced biological treatment. Similarly, reusing treated water can also prevent water pollution. When piped irrigation systems are used in agriculture, water withdrawal in aquatic ecosystems may decrease as water consumption decreases. It has been evaluated that as the level of education increases and the number of associations related to nature conservation increases, wetlands can be protected due to the increase in the level of awareness.

According to the exposure analysis, exposure was determined to be high in provinces in the Central Anatolia and the Lakes Region as well as around Lake Van, and provinces such as Kayseri, Adana, İzmir, Ardahan and Samsun with high rate of wetlands.

When the sensitivity of wetlands is examined, it has been determined that the sensitivity is high in the Central and Southeastern Anatolia Regions and the Aegean, Mediterranean and Marmara Regions, where irrigated agriculture is practiced. In the Black Sea Region, sensitivity was detected at a high level in Samsun province, which has Yeşilırmak and Kızılırmak deltas. In cities such as İstanbul, İzmir and Ankara, which have a dense population and large urban, the high pressure on water ecosystems has led to high sensitivity. On the other hand, sensitivity was determined to be low in most provinces of Eastern Anatolia and Black Sea Regions.

When looking at the adaptation capacity of provinces, the provinces with higher number of associations and rate of university graduates in the Aegean, Mediterranean and Marmara Regions, as well as Ankara and Eskişehir, stand out with high adaptation capacities. Likewise, adaptation capacity is also strengthened by the high rate of treated water in developed provinces. The presence of natural areas and extended piped irrigation systems boost adaptation capacity in some provinces such as Tunceli. Adaptation capacity in most provinces in the Eastern and Southeastern Anatolia Regions, on the other hand, is low.

According to the drought risk assessment for wetlands, the Central, Eastern and Southeastern Anatolia Regions involve higher risk in the current period (Figure 20). In the Black Sea Region, on the other hand, the level of drought risk in wetlands is low due to the lighter drought hazard in this region compared to southern regions as well as the low sensitivity of the provinces in the region. Wetlands in the Marmara (except for Edirne), Aegean and Western Mediterranean Regions have relatively low drought risk due to the high adaptation capacity in these regions.

Figure 19. Risk map for current period: relationship between wetlands in biodiversity and ecosystem services sector and drought

Figure 20. Impact chain: relationship between wetlands in biodiversity and ecosystem services sector and drought

HAZARD		EXPOSURE	VULNERABILITY		RISK
Climate Signal	Climate Impact		Sensitivity	Adaptation Capacity	
Decrease in total precipitation amount	Drought	Proportion of wetland areas	Presence of irrigated agricultural areas	Proportion of natural areas	Drying up of wetlands
Increase in average temperature	Decrease in precipitation amount and number of rainy days	Proportion of salt marsh areas	Presence of rice production areas	Ratio of treated wastewater to discharged wastewater	Changes in water levels in wetlands
	Increase in the number of consecutive dry days	Proportion of salt pans	Presence of irrigated orchards	Number of associations for environmental, wildlife, and animal protection	Changes in some physico-chemical properties of water
		Proportion of waterways	Presence of irrigated mixed farming areas	Proportion of areas under good agricultural practices	Migration of birds and other animals
		Proportion of water bodies (rivers, lakes, reservoirs)	Amount of residential and industrial areas	Proportion of population with an associate degree or higher education	Harm to aquatic organisms
		Proportion of coastal lagoons	Population density	Proportion of protected wetlands and Special Environmental Protection Areas (SEPA)	Decrease in the amount of CO_2 removed from the atmosphere by forests
			Presence or absence of land degradation (e.g., mining)	Proportion of areas with piped irrigation systems	Increase in floods and other disasters
			Presence of dams and ponds preventing migration		Decrease in ecosystem services such as fisheries
			Per capita average daily water withdrawal for drinking and utility use		Marsh fires
					Loss of biodiversity

5.4. CLIMATE CHANGE ADAPTATION MEASURES

Protecting biodiversity and ecosystem services is crucial for achieving climate change adaptation. In this context, responsibilities and powers related to biodiversity must be clearly defined, data gaps and low awareness must be addressed, and nature conservation should be prioritised in relevant action plans.

In Türkiye, the concept of climate change combatting is mostly understood to imply GHG mitigation efforts. The concept of adaptation, which is addressed in a separate column in Article 7 in the Paris Climate Agreement and which includes the steps required to deal with the impacts of climate change, is just as important as mitigation and requires higher awareness to be raised. In particular, adaptation measures with increasing significance across the world, including ecological restoration, nature-based solutions and ecosystem-based disaster risk reduction, are closely associated with biodiversity and ecosystem services. However, awareness of biodiversity is striking in that it appears to need improvement as much as the concept of adaptation to climate change. Effective nature protection is also the basis of sustainable economic development. Biodiversity loss and desertification are also among the global ecological problems that put our future at risk. In recent years, holistic approaches in which climate change, biodiversity loss and desertification issues are addressed together, and synergistic effects are highlighted have gained importance. For these reasons, four strategic goals have been determined to increase awareness and capacity to carry out adaptation studies in the field of biodiversity and ecosystem services, to make these issues a priority in legislation, to eliminate the lack of scientific data and monitoring studies, and to ensure the use of nature conservation in adaptation studies. Article 872.6 of the Twelfth Development Plan also emphasizes maintaining the research, monitoring and evaluation activities in this regard.

STRATEGIC GOAL 1

To raise awareness and enhance capacity on biodiversity, ecosystem services, nature-based solutions, and ecosystem-based adaptation; to ensure data and information exchange, prevent confusion of power, and strengthen cooperation among all stakeholders.

In order to enhance the awareness and capacities of the public and institutions on biodiversity, nature conservation, nature-based solutions and ecosystem services, as well as their contributions to climate change adaptation; it will be beneficial to diversify the training programmes organized by MoNE, TUBITAK and CHE, support projects in this direction, prepare films and brochures, and expand the in-service trainings organized.

BIO1. Undertake climate and nature literacy programmes as part of climate change adaptation efforts; update school and university curricula to focus on the skills and qualifications required for the protection of biodiversity and ecosystems; develop nature conservation projects; and organize communication campaigns using diverse tools tailored for different target groups.

BIO2. Enhance institutional capacities related to biodiversity and ecosystems; ensure coordinated data and information exchange among all stakeholders to avoid power overlaps and strengthen cooperation.

STRATEGIC GOAL 2

To ease the pressures caused by various factors that threaten biodiversity and ecosystem services, such as habitat change and fragmentation, pollution, over-exploitation.

Climate change currently ranks relatively lower among threats that threaten biodiversity and ecosystem services, such as habitat fragmentation and change, pollution, over-exploitation and invasive alien species. Yet it is recognized that in the future, with the exacerbation of its impacts, climate change can become more prominent and when combined with other pressure factors, result in the risk of extinction for significant part of species. Conducting studies only on the climate change adaptation of species and ecosystems may fall short in protecting biodiversity and ecosystem services. For this reason, eliminating or limiting the adverse impacts on biodiversity and ecosystems, and inspections were considered as adaptation options. The works that can be undertaken in this context include pollution prevention in ecosystems and updating pollution limit values by taking species and ecosystems into consideration. Additionally, there is a need for a legislation on prevention of noise and light pollution during breeding periods. Combatting illegal hunting, fishing and bio-smuggling can also be considered in this regard.

There are many national legislations on biodiversity and ecosystem services. The numerous international conventions signed by Türkiye require the protection of biodiversity. The presence of provisions facilitating land use changes in some national legislation sometimes affects nature conservation adversely. Such legislation

STRATEGIC GOAL 2

To ease the pressures caused by various factors that threaten biodiversity and ecosystem services, such as habitat change and fragmentation, pollution, over-exploitation.

must be reviewed to align with international conventions, and provisions misaligned with nature conservation principles must be removed. For example, the number of permits granted especially with Articles 16 and 17 of the Forest Law is too high. In fact, the number of permits granted to transform forest areas into renewable energy facilities increases day by day, and some of these serve mitigation purposes. Legislation on agriculture, tourism, coasts, etc., should be reviewed with a focus on nature conservation, as well.

The protection-utilization balance must be achieved in the protected areas in the country. The fact that there are two different institutions directly responsible for protected areas leads to confusion of power, and eliminating such confusion will ensure effective nature conservation.

Determining species diversity in all living classes in our country will ensure that all ecosystems containing endemic and threatened species have protection status and are taken into consideration as sensitive areas in EIA processes. Furthermore, prioritizing ecosystem services in EIAs and including issues such as biodiversity offsetting or land degradation neutrality (LDN) rather than planting a certain number of trees to replace those that were felled could mitigate the pressures on ecosystems. It is critical to integrate strategies on ecosystem services, land degradation neutrality and biodiversity offsetting in the EIA Regulation and include the impact mitigation hierarchy (Avoid>Mitigate>Compensate) in EIA Regulations to achieve this. The impacts of climate change on biodiversity, ecosystem services and land degradation are included in the policy and measures article no. 872.6 in the Twelfth Development Plan, stating that "Research, monitoring and evaluation activities will be continued".

BIO3. Update the legislation on biodiversity and ecosystem services with a focus on nature conservation; align protected area categories with international standards; and strengthen cooperation and coordination among relevant institutions to achieve effective management of these areas.
BIO4. Prevent, monitor, and inspect land and habitat changes and air, water, soil, plastic, and noise pollution that harm biodiversity.
BIO5. Identify sustainability challenges and develop a roadmap to address them, ensuring the sustainable management and use of forest, agricultural, animal, and water resources.

STRATEGIC GOAL 3

To explore, monitor and assess the impacts of climate change on biodiversity and ecosystem services.

Although it is stated that biodiversity in Türkiye is extremely rich, the research in this regard is mostly limited to formulating lists of flora and fauna. In fact, even lists of species for some classes including invertebrates, fungi and lichens are lacking. For this reason, we need to identify the species in all groups of living creatures in the country and research their ecological needs, relationships with other species, and exposure to climate change. There is also an increasing need for research on monitoring the current status of species, production of bases such as ecosystem services maps, and monitoring and combatting invasive alien species. On the other hand, establishing potential Natura2000 areas through assessments to be conducted as part of the European Nature Information System (EUNIS) Habitat Classification can contribute to increasing the volume of protected areas. Additionally, increasing the amount of carbon stored in forests has been gaining increasing prominence in the context of the target to achieve net zero carbon emissions by 2053. Forest fires, biotic (insects and fungal pests) and abiotic factors (storm and snowfall), excessive wood production, etc., reduces the carbon remove capability of forests. This situation, which could be perceived to be related to mitigation, also directly concerns adaptation, because biotic and abiotic pests and forest fires are expected to increase with climate change. As carbon storage is also an ecosystem service, increasing carbon storage in forests and other ecosystems will produce a synergic effect between mitigation and adaptation.

BIO6. Identify and catalogue all species across the classes of living creatures; explore the interactions between climate change, biodiversity, and ecosystem services; identify critical species and habitats, and implement projects to monitor their ecologies and populations; develop strategies and implement measures for the identification, monitoring (entry, early detection, spread), and control of invasive alien species.
BIO7. Determine and map the contributions of ecosystems and nature to human well-being through their products and services, and integrate these contributions into administrative plans; conduct studies to compile traditional ecological knowledge.
BIO8. Monitor biotic factors (e.g., insects and fungal pests) and abiotic factors (e.g., storms and snowfall) that harm forests due to climate change; build inventories of the affected areas and quantities of damaged wood; estimate long-term climate change impacts on forests and ensure the implementation of adaptation-based ecosystem management; prioritize preventive measures in forest fire management.

STRATEGIC GOAL 4

To increase the amount of protected areas for effective nature conservation, restore degraded ecosystems, and integrate climate change adaptation into management plans.

It is known that climate change will force species to migrate. Due to other pressure factors (habitat fragmentation and change, pollution, overuse, invasive alien species), the natural habitats of species are shrinking and they may enter the process of extinction. For this reason, there are targets to increase protected areas in both the European Union 2030 Biological Diversity Strategy and the decisions of the COP to the Convention on Biological Diversity. This target has been set as 30% of marine and terrestrial ecosystems in 2030. The ratio of protected areas to surface area in Türkiye is around 13%. In order to protect rich species, habitats and biodiversity and to improve ecosystem services, the rate of protected areas should be increased by ensuring the preservation of marine and terrestrial protected areas, thus contributing to the current situation in the world. Reducing biodiversity loss, combating climate change and benefiting from ecosystem services at global and local levels; Knowing that this is only possible by increasing and protecting protected areas, it is also of great importance to protect sink areas such as seagrass grasslands, which are resistant to the effects of climate change and have a very high carbon storage feature. It would be beneficial to integrate adaptation to climate change into scientific research, investigation and conservation studies such as biodiversity research, species and habitat monitoring activities, carrying capacity research and management plans carried out in land, coastal and marine protected areas.

The majority of the measures taken against extreme weather events in Türkiye are harsh adaptation measures such as building ponds against drought and enclosing streams in concrete beds to prevent floods. These are adaptation measures that are more construction-oriented and have limited impact. It can even be said that some of them cause maladaptation. Nature-based solutions that protect ecosystems and use biodiversity and ecosystem services in adaptation efforts are becoming increasingly important. It should be aimed to disseminate and prioritize good practice examples such as soil conservation studies against floods in Türkiye and windbreaks in the Central Anatolia Region.

Ecosystem degradation is gradually increasing due to reasons such as degradation of natural ecosystems and conversion to areas such as agriculture, pasture and settlement, excessive exploitation and pollution. The ecological restoration of these degraded ecosystems comes to the fore as a strategy all over the world to protect and increase biodiversity and ecosystem services such as carbon retention in sink areas, flood prevention, water production, and combating erosion. In this regard, with the EU Nature Restoration Law, it is envisaged that 20% of the damaged marine and terrestrial ecosystems in Europe will be restored by 2030 and all of them by 2050. Again, the Convention to Combat Desertification has given priority to land

STRATEGIC GOAL 4

To increase the amount of protected areas for effective nature conservation, restore degraded ecosystems, and integrate climate change adaptation into management plans.

degradation neutrality (LDN) in recent years. Bringing ecological restoration studies to the agenda in Türkiye will increase the synergy in mitigation and adaptation studies.

BIO9. Play an active role in contributing to global efforts to increase protected land and sea areas to 30%.
BIO10. Integrate biodiversity conservation, support for ecosystem services, and climate change adaptation into the management and development plans for protected areas, as well as into species and habitat protection action plans.
BIO11. Create inventories of degraded and fragmented ecosystems to guide efforts to restore degraded ecosystems across the country and connect these ecosystems through the establishment of ecological corridors.
BIO12. Identify national and international good practices on topics such as nature-based solutions and ecosystem-based adaptation and implement model application projects accordingly.

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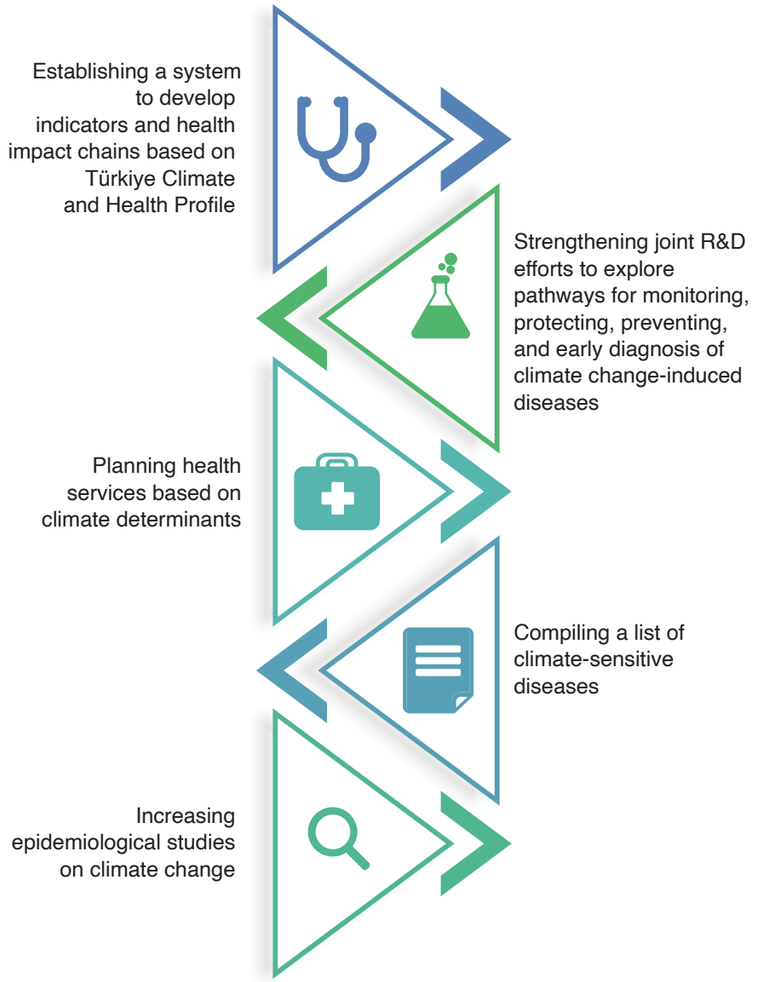
PUBLIC HEALTH

climate adaptation



PUBLIC HEALTH

climate adaptation

6.1. GENERAL FRAMEWORK

The healthcare system of the Republic of Türkiye, established by the Public Health Law enacted in 1930, has become a model for systems worldwide, drawing from its experiences over the years and the significant reforms implemented in recent times.

The healthcare system of the Republic of Türkiye, which was established on a solid ground with Law No. 1593 on Public Health published in 1930, has taken its place among the systems that are models in the world with the experiences it has gained over the years and the radical reforms carried out in the recent period. It has a very well-developed service network with primary health care services consisting of health houses, health centers, family health and community health centers spread especially to the most remote corners of 81 provinces, city hospital projects and public hospitals, university hospitals and private hospitals that have been strengthened in the recent period. The Ministry of Health's capacity, which is strengthened in line with today's needs and the realities of the country, with its holistic threat approach (all hazards approach) preparedness and response systems for health emergencies, also hosts the world's largest National Medical Rescue Teams (UMKE), which consist of health volunteers, and stands out as an international model in this respect. All reforms introduced in the health sector aimed to deliver quality, effective and eligible services. In this regard, significant ground was covered as part of the objective of universal health coverage which considerably mitigates the inequalities in health financing, access to health services, and final health indicators. Such plans and policies are developed and implemented, given the needs of society, and geographical characteristics, population structure and culture of the country, as well as global trends and scientific and technological advancements.

The above-mentioned developments made a positive impact on key health indicators of Türkiye within years. Infant and under-five mortality declined regularly. In 2022, the infant mortality rate corresponded to 9.1 per thousand. The maternal mortality rate, which was 18.4 per one hundred thousand in 2009, fell to 12.6 per one hundred thousand in 2022 (T.R. Ministry of Health General Directorate of Health Information Systems, 2023). Türkiye already features one of the most extensive vaccination programmes across the world.

Childhood immunization programmes are executed quite effectively and virtually the whole child population is vaccinated in the country. According to the Health Statistics Yearbook 2021 prepared by the Ministry of Health, the number of physicians, dentists, pharmacists, nurses and midwives per 100.000 population amounts to 217, 47, 43.9 and 343, respectively (Health Statistics Yearbook 2021). With respect to health human resource, one of the primary parameters of health systems, priority is given to the policies set to improve the number, qualifications and rights of health practitioners. Within this frame, actual and influential policies are developed in order to upgrade Türkiye's position among global rankings, particularly OECD further. Lastly, the White Reform was launched in 2022. The relevant Reform covers the introduction of the law on violence in healthcare, medical malpractice law and the new retirement and incentive system which reconstitutes personal rights.

Türkiye, which is in the category of developing countries with an aging population, has a disease burden that follows this path. In this context, cardiovascular diseases, cancer and non-communicable diseases (NCDs) constitute the most important disease burden in Türkiye. In Türkiye, the top three causes of death in 2019 were circulatory system diseases, cancer and respiratory system diseases. Life expectancy at birth in Türkiye was 78.6 in 2017-2019. Life expectancy, which is 81.3 for women and 75.9 for men, has been increasing over the years. While healthy life expectancy in Türkiye was 58.3 years at birth (59.9 for men; 56.8 for women) in 2016-2018, it was 57.3 years in 2017-2019. (59.1 for men; 55.4 for women) (Life Tables, 2017-2019). Although life expectancy has increased in recent years, the negative impact of NCDs on healthy life expectancy is observed.

Increasing the level of health literacy in society has recently found an important place among health policies. According to the data from the Research on Health Literacy Levels of Türkiye and Related Factors which was published in 2018 by the Ministry of Health, General Directorate of Health Promotion, only 23.4% of the society has a sufficient level of health literacy (Ministry of Health, 2018).
Ministry of Health has substantial responsibilities for climate change which is regarded as the greatest global threat of the 21st century and defined by the World Health Organization (WHO) as a health crisis. The primary duty in undertaking the adaptation activities for health impacts belongs to the General Directorate of Public Health (GDPH). Climate change and health issues need to be discussed with a multi-disciplinary and holistic approach to their nature. For this reason, all relevant central and provincial units of the Ministry, particularly the General Directorate of Emergency Health Services (GDEMS), General Directorate of Health Investments (GDWM), General Directorate of Health Promotion (GDHP), General Directorate of Health Services (GDCA), General Directorate of Public Hospitals (GDPH), General Directorate of Health Information System (GDHIS), General Directorate of EU and Foreign Affairs (GDEUFR) and General Directorate of Border and Coastal Health (GDBCH) own significant duties which should be fulfilled through the coordination of GDPH.

Activities got started to update the National Programme and Action Plan for Reducing Negative Impacts of Climate Change on Health which was published in 2015 by the Ministry of Health with the aim of ensuring rapid application of the national regulations about the health impacts of climate change. As a first step, a revision workshop was held on 12-13 October 2021, and update work continues in parallel with global climate and health policies.
"Health and Climate Change: Country Profile 2022: Türkiye" report was prepared by the WHO in cooperation with the Ministry of Health to indicate the current situation regarding potential health benefits of mitigating the country-specific climate hazards, climate-sensitive health risks and impacts of climate change. The profile was introduced in a side event organized on 8 November 2022 as part of the Twenty-sixth Conference of the Parties (COP27) to the United Nations Framework Convention on Climate Change.

Within the scope of the Paris Agreement, our country's National Contribution Declaration (NDC) was updated on 13 April 2023, and a new commitment has been added to the new updated text within the framework of "Sustainable health systems resilient to the climate crisis" in terms of the Ministry of Health's field of work. In line with this development, Türkiye has been among the countries that have made a health commitment to improve climate and health action within the scope of the implementation of the Paris Agreement. In this context, the Türkiye scorecard for the main environmental and health indicators that contribute to measuring and monitoring the progress of the countries and presenting an image of the current situation has been created by the WHO.

As part of the global climate health developments, Türkiye joined the "Climate-Resilient Health Systems" group under the Alliance for Transformative Action on Climate and Health (ATACH), an initiative established by the WHO. In COP28 held in Dubai from 30 November to 12 December 2023, Türkiye became a party to COP28 Declaration on Climate and Health with the participation of its Deputy Minister in the meeting of Health Ministers which was organized for the first time in COP history. The declaration was accepted at the end of the meeting.

6.2. SECTORAL LEGISLATIVE FRAMEWORK AND RESPONSIBLE INSTITUTIONS

Türkiye has the infrastructure for monitoring, assessing, and reporting the health impacts of climate change, along with a current state profile and strategy. The establishment of a climate-sensitive disease list, training of human resources in climate and health, and the implementation of a public health early warning system will enhance the existing infrastructure.

Article 56 of the Constitution and Article 1 of the Public Health Law have given the responsibility of protecting public health to the state. The state carries out this duty through the Ministry of Health according to the Presidential Decree No. 1 (Official Gazette: 10.07.2018/30474). Studies on the health effects of climate change are defined in the duties of the various departments (Environmental Health Department, Infectious Diseases and Early Warning Department, Public Health Reference Laboratories Department) working under the General Directorate of Public Health (HSGM) as stated in the Directive on the Service Units and Duties of the General Directorate of Public Health. In the provinces, studies are carried out through Provincial Health Directorates, Community Health Centers, District Health Directorates and Family Health Centers. The duties of the Environmental Health Department include "taking or having taken necessary measures regarding air pollution and climate change." Health Threats Early Warning and Response Department" was merged with the Communicable Diseases Department in 2021 and became the Communicable Diseases and Early Warning Response Department. Its structure includes the duty of "coordinating cooperation with national and international scientific institutions on Early Warning-Response and Field Epidemiology" (Communicable Diseases and Early Warning Department Job Description).

Syndromic Surveillance of Acute Gastroenteritis (emergency service data for ICD-10 codes set) in 81 provinces, districts and hospitals can be monitored instantly via IZCI system within the Early Warning & Response unit. Verification, risk assessment, identification of research and sources, intervention and responses can be evaluated according to the signals received (Ministry of Health, 2022). In addition, a protocol was drawn up in 2019 in the framework of the ongoing cross-sectoral coordination and cooperation with the aim of laying down the principles for providing the data on meteorological measurements, estimations and warnings required in studies of the Infectious Diseases Surveillance and Early Warning System (IZCI) by TSMS, and for using such data by the General Directorate of Public Health. Data sharing is performed within this framework. Works regarding integration of the meteorological data about climate change and IZCI monitoring system continue (Ministry of Health, 2022). Under the "Health Security in Türkiye Project" of the Early Warning Unit, prioritization, risk assessment and risk mapping studies regarding all threats (biological, chemical, environmental, radiological and nuclear), including climate change go on also with the participation of other sectors (Ministry of Health, 2022). The Ministry of Health provides services in accordance with the International Health Regulations (IHR) of WHO which were introduced in 2005 and need to be applied all around the world (WHO, 2008). IHR Stakeholder Countries should timely report all incidents that may pose potential threat to public health, and should respond these incidents instantly. The necessary capacity is known as Early Warning and Response (EUC). IHR is the legal agreement drawn up between countries in order to cooperate for the global health safety of countries. IHR is not restricted to any specific disease. It encompasses any kind of incidents that may threaten human health. Decision no. 2119/98 of the European Parliament and of the Council of 24 September 1998 contains prevention of the infectious diseases and development of their control at the union level, establishment of epidemiological surveillance network for developing the cooperation and coordination between member states and formation of an early warning and response system for the diseases listed in annex of the decision. Scope of the decision no. 1082/2013 of 22 September 2013 was broadened in a way that will also touch on a range of other health threats related to other biological or chemical substances or environmental incidents, including climate change as well as infectious diseases. Besides, it was decided to implement a wider approach coordinated with health safety at the union level.

"National Programme and Action Plan for Reducing Negative Impacts of Climate Change on Health" which was published in 2015 by the Ministry of Health, which was triggered in 2010 and published in 2015, is counted as the single official regulation regarding the impacts of climate change on health (T.R. Ministry of Health, Turkish Public Health Institution, 2015). The Ministry of Health contributes to health section of the national documents about climate change which are prepared by the other institutions and organizations. In order to implement the national regulations about health impacts of climate change, it is planned to update the National Programme and Action Plan for Reducing Negative Impacts of Climate Change on Health which was published in 2015. First, a revision workshop was held on 12-13 October 2021. Activities for updating the relevant action plan got started in 2021. In November 2022, the Türkiye Health and Climate Change Country Profile was published.

The National Climate Change Strategy (2010-2020) and Climate Change Action Plan (2011-2023) published by MoEUCC aim to investigate effects of extreme weather events on human health and the interaction between infectious diseases and health risks, consolidate the infrastructure in risky zones and raise capacity of medical institutions (Climate Change Strategy (2010-2020)) (Climate Change National Action Plan 2011-2023). In health section of CCASAP of Türkiye (2011-2023), it was prioritized that current and future impacts and risks of climate change on human health will be identified and capacity of the national health system to combat climate change-induced risks will be raised.

The health section of Türkiye's Seventh National Communication includes the impact of extreme

climate events, current status evaluation about vector- and rodent-borne diseases and content of the national health impacts report (MoEUCC, 2018). "Parliamentary Inquiry Commission Established to Minimize the Impacts of Global Climate Change and Specify the Measures to Be Taken for Fighting Against Drought and Ensuring Efficient Use of Water Resources" started to work in March 2021 in Turkish Grand National Assembly after the entry of Paris Agreement into force. The commission took expert opinions on the health impacts of climate change. In its minutes, the commission also gave coverage to boosting the efforts for combatting climate change, mitigation of GHG emissions and climate change adaptation; preparation of climate and health profile of Türkiye, early warning, being prepared, responding instantly and increasing the level of public awareness.

6.3. CLIMATE CHANGE IMPACTS

Climate change will affect the social determinants of health, as well as individual and public health, and the health interconnections with other sectors. Given that the changing climate may increase the national disease burden in Türkiye, the health sector should be central to the sectoral risk assessment of climate change.

The prominent hazards for Türkiye are drought, heavy precipitation, heatwaves and strong winds. Hazards of the health sector are discussed under six titles:

1. Extreme Weather Events
2. Change in Water Resources
3. Rising Sea Level
4. Heat and Cold Waves
5. Change in Air Quality
6. Increasing Ultraviolet Radiation

Relevant hazards may make six impacts on the individual and public health.

1. Diseases associated with hot and cold weather
2. Side effects of ultraviolet radiation
3. Health problems led by the changing air quality
4. Food- and water-related diseases
5. Changing factors of infectious diseases
6. Vector-related diseases
7. Mental health problems
8. New and re-emerging diseases

Impacts of climate change will not surface only with individual and public health problems. It will affect all components of the health sector either singly or collectively in the form of cumulative impacts due to multiple hazards. The impact of human mobility related to climate change on the climate-health relationship is also expected in this context.

The existing activities about management of climate-sensitive diseases within health legislation and health management will be improved with an eye to the new models and scenarios. Just as climate change units are established in municipalities, there will be a need to strengthen units and management mechanisms that will manage the relationship between climate change and health in the central, provincial and district organizations of the Ministry of Health. In addition to population, the risks and hazards of climate change should also be taken into account in health service planning. The coefficients used in health level indicators will need to be converted into coefficients compatible with climate threat indices.

One of the sectors most affected by the negative effects of climate change is the health sector. Sectoral target populations may change numerically. For example; the number of people working in agriculture, the number of people receiving services from the energy sector. If sufficient food products are not grown, if there is no energy for the processing, preparation and presentation of food, malnutrition and related diseases will be a problem for the whole society. Therefore; it is planned to increase the studies on increasing, developing, harmonizing and making resilient the capacity of the health sector (human resource, health facilities, budget, information systems).

In order to achieve all this, a climate-sensitive health sector strategy document needs to be prepared.

The impact of the COVID-19 pandemic should not be ignored in the projections and scenarios to be designed regarding the effects of climate change on the health sector. In addition to those who became ill and died due to the COVID-19 agent, it is known that there are prolonged COVID-19 cases (other diseases seen in people who had COVID-19 or were affected). In addition to these; those who have mental health problems due to ecological stress, anxiety and grief, those who are disconnected from work and social life, those who are unemployed and destitute have caused an increase in the number of vulnerable groups in society. The health effects of possible climate change hazards may occur at a greater rate than expected.

The points that the health sector in Türkiye plans to develop against climate change are as follows:

- Introducing the national consultation mechanism under the coordination of the Ministry of Health for combatting climate change in health sector with One Health approach
- Including the data processed with the national and local climate-sensitive disease list and monitoring system, in health statistics yearbook together with the vulnerability and risk maps and climate change scenarios after making an assessment in cooperation with all institutions
- Developing the existing health information systems in a way that will track health impacts of the climate change, and their integration into the national climate change monitoring systems
- Extracting and/or sharing health indicators that may be related to climate from existing health data collection systems
- As in the fight against vectors, the current monitoring systems should be transferred to the Geographic Information Systems (GIS) infrastructure; the disease, control method, and breeding areas should be monitored together with climate hazard indicators, and

the provinces should be integrated with other relevant institutions and organizations

- Establishing the interdisciplinary and cross-sectoral epidemiology teams which search the relationship between climate change and health, of scientific board/commission which will contribute to setting of policies, as well as the coordination mechanism
- Creation of training modules for the training of personnel who will take part in the health effects of climate change
- Strengthening human resource, budget and time planning in the face of the possibility that the seasonal, monthly, annual periods of the current combat programs may be extended to the entire year
- Strengthening the communication of the health sector with other sectors; conducting studies to create a common language in the climate and health relationship for different disciplines and sectors
- Increasing academic studies and academic support to increase the number of studies on new and re-emerging diseases due to the effects of climate change
- Conducting studies to create a qualitative and quantitative evidence pool for Türkiye that reveals the relationship between climate and health
- Undertaking activities to increase the awareness of climate migration with a focus on the impact of climate & health relationship on movements of migration
- Taking actions for the population which have become vulnerable due to the reasons such as extreme climate events, disasters and long-term effects of COVID-19
- Making efforts for giving broader coverage to health section in sectoral action plans
- Undertaking activities to prepare action plans about health and climate change at local level
- Taking actions for the availability of structured programmes on climate change and its health impacts, at the schools in other disciplines of health sector, especially medical faculties
- Organizing training about climate change for physicians in order to ensure that environmental history of the patient is routinely obtained together with health history, and preparing a curriculum structured for the importance and requirements of obtaining environmental history during examination
- Creating awareness of public opinion regarding climate and its health impacts, and developing easy-to-access procedures for anyone who may be exposed to health impacts
- Introducing local and international studies to include the climate change code in ICD
- Undertaking activities to review the current condition of health infrastructure against climate crisis
- Promoting awareness of UMKE and 112 teams about climate emergency and supporting their response capacity
- Playing a more active role by defending further inclusion of health topics in global climate negotiations at international level.

Health sector risk assessment: heatwaves

Like clean air, clean drinking water, adequate food and safe shelter, climate change influences social and environmental determinants of health. Primary hazards in Türkiye are drought, heavy precipitation and heatwave. Vulnerability and risk assessment of the health sector in Türkiye was conducted on the basis of heatwaves in order to set an example and provide evidence.

Climate change affects social and environmental determinants of health, such as clean air, clean drinking water, adequate food and safe shelter. The prominent threats in Türkiye are drought, excessive precipitation and heatwaves. The vulnerability and risk assessment of the health sector in Türkiye was conducted on the heatwave in order to provide evidence and to set an example for future studies. The impacts that may arise as a result of the heatwave, the groups that will be exposed to the impacts, Türkiye's vulnerability level (sensitivity and adaptation capacity) and the extent of the resulting risk are presented in the following impact chain (Figure 21).

In general, population, population density, urban population, child population (aged 0-14, 0-4, under 1, %), elderly population (aged +65, %), rate of female population aged 15-49, population aged under 5 (aged 0-4, %), number of the houses comprised by only female population and number of the houses comprised by only the population aged above 65. Population density was grouped and evaluated in the exposure analysis conducted on a national scale. The analysis showed that exposure is high in the provinces with significant population density throughout Türkiye whereas exposure of the provinces with a low population density is also low. Provinces found to have very high exposure are as follows: İstanbul, Kocaeli, Sakarya, Yalova and Bursa in Marmara Region; İzmir in Aegean Region; Hatay in Mediterranean Region; Ankara in Central Anatolia Region and Gaziantep in Southeastern Anatolia Region. Besides, Tekirdağ in Marmara Region, Düzce, Zonguldak, Karabük, Samsun, Ordu and Trabzon in Black Sea Region, Manisa and Aydın in Aegean Region, Antalya, Mersin, Adana and Osmaniye in Mediterranean Region and Şanlıurfa, Diyarbakır and Batman in Southeastern Anatolia Region own high exposure.

The following indicators can be utilized for sensitivity analysis of the health sector: crude birth rate, life expectancy at birth, rate of access to safe drinking water, population provided with sewer network/treatment plant, urban-rural gap, population growth, education level, dependency ratio, old age dependency ratio, child dependency ratio, rate of female population aged 15-49, social inequality rate, deaths, cause-specific mortality rate (especially mortality from circulatory diseases), diseases and loss of functions and disability. In the sensitivity analysis which was conducted for Türkiye on a national scale, crude birth rate, population growth rate, rate of the population with primary completion and below to the population aged above 15, population dependency ratio, rate of female population aged 15-49, rate of mortality from circulatory diseases to total number of deaths, and baby mortality rate were used. As a result, it was seen that sensitivity on

a national scale rises most due to crude birth rate and baby mortality rate, but population growth rate and rate of female population aged 15-49 are not effective so much. One of the sensitivity indicators, the rate of mortality from circulatory diseases to total number of deaths was found to be highest in Aydın, Denizli and Kırıkkale. Current heatwave hazard is high in Aydın, very high in Denizli and moderate in Kırıkkale. It is observed that sensitivity to heatwaves is high and very high in Eastern and Southeastern Anatolia Regions, excluding a few provinces. In other regions, Afyonkarahisar and Sinop provinces have a very high level of sensitivity because of the rate of mortality from circulatory diseases and low education level.

Health service and management capacity, health literacy rate, population provided with sewer network/treatment plant, population provided with water network/treatment plant, education level, cooling system capacity, safe physical activity area and duration/population, availability of social networks and communication, years of life lost (YLL) and economic status are used as indicators for the analysis on adaptation capacity of the health sector in Türkiye. In this study, population per emergency ambulance, number of specialist physicians per 100000 people, rate of high school education and above and gross national product per capita were evaluated.

It is seen that overall adaptation capacity of health sector fells towards east on a national scale. In particular, the provinces in Eastern and Southeastern Anatolia Regions have the lowest adaptation capacity. Moreover, sensitivity is very low in Sinop and Bartın in Black Sea Region. The provinces with the highest adaptation capacity are Ankara, Antalya, Artvin, Bolu, Çanakkale, Edirne, Erzincan, Eskişehir, Isparta, İstanbul, İzmir, Kırıkkale, Kocaeli, Muğla, Tunceli and Yalova.

Adaptation capacity is especially lowest in the provinces with a high level of heatwave hazard when looking at the adaptation capacity in the face of heatwave hazard. These provinces give red alarm for the upcoming periods, because their adaptation capacity is very low although level of heatwave hazard is high. According to analyses, the most important reasons for very low adaptation capacity by provinces are income level, number of specialist physicians and low number of people with high school education and above.

In vulnerability analysis of the health sector, it was revealed that the provinces with highest level of vulnerability are those in the Eastern and Southeastern Anatolia Regions with an overall low adaptation capacity. These provinces are followed by Afyonkarahisar, Aksaray Sinop, Çankırı, Çorum, Niğde and Yozgat which own high level of vulnerability.

A risk assessment was conducted for health sector by assessing exposure and vulnerability of the provinces to heatwave hazard together. In this regard, risk levels of the Eastern and Southeastern Anatolia Regions, which have a quite high level of vulnerability, were discovered to be highest. On the other hand, Aegean and Mediterranean Regions have moderate risk level and above. Excluding the provinces in Eastern and Southeastern Anatolia Regions, Aydın and Manisa feature the highest level of heatwave risk while the relevant risk is high in Uşak, Denizli, Afyonkarahisar, Konya and Niğde provinces. Furthermore, a moderate risk is observed in the health sector in İzmir, Muğla, Burdur and Antalya. In Marmara Region, Balıkesir and Tekirdağ stand out with a high-risk level whereas Çanakkale and Bursa have a moderate risk level. It is seen that the level of heatwave risk is moderate and below in Central Anatolia Region (Figure 22).

The primary conclusion drawn from the risk assessments is that the provinces in Eastern and Southeastern Anatolia Regions are of first priority concerning the adaptation policies to be implemented in the health sector against the heatwave hazard in Türkiye.

Figure 21. Risk map for current period: relationship between health sector and heatwaves

Figure 22. Impact chain: relationship between health sector and heatwaves

HAZARD		EXPOSURE
Climate Signal	**Climate Impact**	
Increase in average temperature	Heatwave	Population density
Increase in the number of extremely hot days	Increase in the number of consecutive hot days	Population living in the city centre*
		Proportion of children aged 0-14*
		Proportion of elderly population aged 65 and over*
		Number of female-only households*
		Number of households consisting only of individuals aged 65 and over*
		Unemployment rate in the agricultural sector*

VULNERABILITY		RISK
Sensitivity	**Adaptation Capacity**	
Dependent population ratio	Per capita GDP	Deterioration in healthy, quality life and well-being
Proportion of female population aged 15-49	Population per 112 emergency health service unit	Decline in air quality
Deaths from circulatory system diseases	Number of specialist physicians per 100,000 people	Water scarcity and difficulties in accessing safe and clean water
Crude birth rate	Proportion of population with high school education and above	Degradation of soil quantity and quality, and challenges in accessing healthy and safe food
Infant mortality rate	Population served by the sewer network/treatment facility*	Changes in vectors
Proportion of population with primary education or below	Population served by the water network/treatment facility*	Dehydration (thirst)
Population growth rate	Management capacity*	Increase in kidney diseases
Life expectancy at birth*	Health literacy rate*	Malnutrition (mother, infant, child) (lack of breastfeeding, stunting)
Proportion of population with access to safe drinking water*	Cooling system capacity*	Increase in allergies, respiratory, cardiovascular, eye, ear, nose, and throat diseases
Urban character*	Proportion of safe physical activity space and time relative to population*	Increase in infectious diseases and epidemics
Social inequality rate*	Availability of social networks and communication*	Mental health problems
Cause-specific mortality rate*	Years of Life Lost (YLL)*	Changes in non-communicable diseases
Diseases*		Water and foodborne diseases
Loss of function and disability*		Injuries
		Inadequate general hygiene conditions
		Changes in zoonotic diseases
		Changes in the rates of functional and disability loss
		Increase in labour loss
		Increase in vector-borne diseases
		Deaths

The (*) symbol denotes indicators excluded from the risk assessments.

6.4. CLIMATE CHANGE ADAPTATION MEASURES

The most fundamental conclusion from the risk assessment is that provinces in the Southeastern and Eastern Anatolia Regions should be prioritised in the adaptation policies to be implemented against heatwave hazards in Türkiye, particularly in relation to the health sector.

Adaptation measures in the health sector are discussed under the following titles: giving evidence-based decisions, health impact assessment compatible with climate change, leadership with a public health perspective, adaptation policies providing healthy life environments, achieving the adaptation of health sector to health impacts of climate change, common climate-sensitive language and communication between sectors, and ensuring the climate change adaptation of health facilities.

Giving evidence-based decisions

First of all, valid evidence is required for ensuring the adaptation of health sector to climate change. With this aim, the scientific methods which will help analyzing the climate & health relationship, should be used and results of the studies with a high level of evidence should be evaluated.

Discipline of epidemiology analyses the scientific methods in health sector that are based on evidence. Epidemiology is a methodology which contains the scientific methods utilized to scrutinize the problems both in clinical medicine and social medicine sciences from several aspects. To give a more detailed definition, epidemiology refers to a discipline which includes all scientific methods used to identify place, person and time characteristics of the events/problems in health, to specify causes and/or risk factors of these problems and to formulate the methods that produce solutions for risk factors of the causes specified (Tezcan, 2017). Descriptive, analytical and experimental/interfering research are used to search the health issues in medical science. Descriptive research is an observational study conducted to unveil place & person & time characteristics in detail while identifying the health problems. This type of research incorporates the ecological studies used to assess the relationships between case presentations & series utilized in rare diseases, and human groups and their environment. Secondly, analytical research refers to the studies that aim to discover cause and effect relationship of the problems detected. They are case-control, cross-sectional and cohort studies. Thirdly, the experimental research contains the studies in which evidence level of cause-and-effect relationship is raised and solution-oriented interventions are applied. In a field like climate change where multi-disciplinary and multi-sectoral approaches are utilized collectively, epidemiology cannot be used singly without getting blended with the analysis methods of other disciplines.

There are numerous studies in the area of environment and health which were conducted by the Ministry of Health, other sectors and academicians. It will be useful to restructure and prioritize such studies in terms of climate and health relationship and climate and health adaptation. An ecological study was conducted in Aydın in 2018 in order to search the relationship between cancer and environment. In this study, four groups of basic environmental risk factors (air, water, soil and food) in Aydın province and spatial distribution of cancer cases recorded in Aydın Adnan Menderes University Application and Research Hospital were identified, and the relationship between the cancer cases and the environmental risk factors where cancer patients live was examined. Geographic Information System (GIS) was used for spatial distribution and the correlation between the air, water, soil and food samples taken from certain places specified based on cancer incidence was analyzed (Karagülle & Evci Kiraz, 2018).

Another study which may be used to evaluate health impacts is cohort type research. This category provides data with a high level of evidence and shows the real risk. However, it takes time and is more costly than other research types. Climate change will be a part of life, so cohorts should be formed quickly and started to be examined. Cohort refers to a group of people with a shared characteristic. There will be a great number of groups who need to be monitored and studied on, namely cohorts in order to ensure climate change adaptation of the health sector. Cohort study will start at the places with the highest vulnerability and focus on the groups living in these places, because they are the most vulnerable groups. With the ecological or cohort type research, an evidence pool should be formed by combining human, health factors, all determinants of health, living spaces and all indicators of climate. Accessibility to the data of such evidence pool will pave the way for advanced studies. It is possible to ensure gradual sharing (such as raw data, confidential, public, academic and informing of society) of all sectoral data and evidence regarding climate & health relationship in line with ethical rules and principles on the protection of personal data.

All studies are conducted to protect public health, take measures against adversities and improve health. For this reason, they need to be matched with the studies related to other sectors and the existing early warning systems need to be developed together with the health data and relevant messages in a way that public will be the final user.

Health impact assessment compatible with climate change

It is useful to cover targets, strategies and action plans in health impact assessment (HIA) before and during the setting of climate change adaptation policies (Evci Kiraz E., 2018). HIA is a tool particularly suitable for decision makers. HIA stages can be used to have the city-dwellers who understand health impacts of climate change, join the plans made to mitigate the impacts, is aware of the future measures and implement them, and leads the society for application of such measures. In brief, HIA consists of screening, scoping, decision making,

implementation, monitoring & assessment and restructuring phases. SED should be implemented to avoid leading to new climate changing actions even though the basic aim is protection from negative impacts of climate change.

Leadership with a public health perspective

Fundamental principles of leadership with a public health perspective are as follows (Türkmen & Evci Kiraz, 2021):

- Health should be placed at the center
- Health for all
- Health in all policies
- One health
- Good health and well-being
- Being an example in public health

Within the framework of these principles, the following questions should be answered: The following questions should be answered in the framework of these principles:

- What are/will be the elements of climate change which affect health in Türkiye/city?
- How/to what extent was/will health (social determinants of health, human, society, system) in Türkiye/city affected/be affected?
- How is the sensitivity of Türkiye/city?
- How is the adaptation capacity of Türkiye/city (plan, project, human resource, education, finance, buildings, system)?

In national/local action plans of WHO, it is requested to strengthen the sections which promote health. For this purpose, health should be a specific section in national and local adaptation plans made by the leaders who have a public health perspective, and/or national/local climate and health adaptation plans should be prepared.

Adaptation policies providing healthy life environments

In Türkiye, climate change adaptation policies will be introduced more quickly if they are approached along with the cities which are familiar with the health concept (Evci Kiraz E., 2021). Türkiye has a national healthy cities network under WHO's Healthy Cities Project. The national network is currently coordinated by the Turkish Healthy Cities Association (SKB).

The items below make up the framework of the city health concept:

- To protect city health
- To monitor city health
- To evaluate city health
- To identify the risks in cities and take measures
- To be prepared for emergency cases in cities
- To set plans, programs, projects and policies that will improve city health, plan services, improve human resource and prepare and/or renew the curriculum.

It will be helpful to monitor climate change-induced migration movements in the country and prepare the migration-receiving locations as resilient and healthy living spaces depending on their spatial and health indicators. Rural areas and smart systems should be re-evaluated and consolidated in line with the future risks.

Achieving the adaptation of health sector to health impacts of climate change

Adaptation planning and policy setting in health sector will be more complicated than those in the other sectors. Health sector intersects with the other sectors to some extent. It should be noted that adaptation studies of other sectors are aligned with health.

Actions to be taken for an adaptation policy compatible with the health impacts of climate change are given below:

- To work with the health impact chains based on the Health Profile of Türkiye
- To prepare Climate Change Adaptation Plans for Urban and Rural Health
- To make planning with a focus on the climate determinants of health
- To monitor diseases/health problems surveillance system together with meteorological data, climate signals, scenarios, projections and vulnerability and risk assessments of other sectors
- To establish spot, spatial, social and individual early warning and swift response mechanism at regional, urban and neighbourhood level
- To work quickly and continuously in an integrated manner with the other programmes without making the process a burden
- To detect the spot, spatial, social and individual risk at regional, urban and neighbourhood level
- To reduce and prevent the risks and anticipated health impacts, protect society from the impacts and be ready for unanticipated cases
- To develop special fighting mechanisms specific to the factors in the list of climate-sensitive diseases
- To be aware of, monitor and mitigate the vulnerabilities and be prepared for the worst
- Flexible, short- and long-term objectives, strategies and activity plans
- To identify the necessary and/or missing data for climate & health relationship through prudential epidemiology such as tele-epidemiology and the analysis methods specific to other sectors along with the spatial work intelligence (CBS based) and to apply them
- To embrace a research perspective that can alter at the same rate as the risks change and meet the need
- To blend scientific and institutional approaches
- Educated and employed human resource who develop themselves, focus on up-to-datedness and have a culture of working with different disciplines and sectors
- To allocate budget
- To make schedule

Common climate-sensitive language and communication between sectors

A common language and communication systems need to be created to ensure that health sector understands the other sectors properly and clearly and other sectors understand the health sector and its health approach in the same way.

Training courses throughout the country and provinces should be speeded up following revision of the 2015 National Programme and Action Plan for

Reducing Negative Impacts of Climate Change on Health. Training should also cover the other sectors and the topics such as climate change, impacts of climate change on health and sectoral adaptation should be learned together.

Following arrangements should be put on the agenda: briefing the vulnerable groups about common incidents in Türkiye led by climate change, providing them training if necessary, arranging their living spaces, increasing awareness of these groups about early warning systems, bringing experience to them in order to quickly make them ready for the incidents and achieve that they give the desired responses, directing them to the areas from which they can receive service instantly, and ensuring that they get preferred service.

Common language of physicians is the International Classification of Diseases (ICD) which is an international disease coding system. ICD system should be updated in accordance with the list of climate-sensitive diseases. For this purpose, studies on the list of climate-sensitive diseases should be started for Türkiye. The list should be prepared at the country, regional, provincial, district, neighbourhood, residential and household levels. The relationship between climate risks and diseases should be established. Significance of relationships needs to be questioned via scientific studies and the research results with the highest significance between dependent variable and independent variable need to be used as evidence. Since Türkiye has different risks regionally and within itself, health services in the country should be provided through the list of climate-sensitive diseases while waiting for the ICD update.

There is a lack of knowledge regarding how the health of people employed in the vulnerable sectors in Türkiye will be affected by climate change. Employee health should be discussed in the adaptation action plans to be prepared. In the action plans, impacts of climate change on the employee health need to be assessed separately by sectors [sectors where employees work in open spaces (agricultural workers, security staff, archaeologists, excavation and construction staff, geology engineers etc.); sectors where employees work in confined spaces (bakers, employees of steel industry, glass industry, food industry and office employees etc.); and the sectors which employ the groups requiring special policies)].

Data bases, social media, digital networks and smart applications are used more often for communication. Türkiye needs a data base that reflects the relationship between climate change and health, is compatible with other climate data bases and nourishes them. Utilizing such data, communication networks should publish and share the relevant information in an accurate, continuous and firm manner.

As the common language and communication increase, scientists, academicians, decision-makers and practitioners can cooperate with each other further for more projects, scientific publications, innovations, R&D, investments etc. Besides, legislation should be reviewed in terms of climate change and its health impacts, revised with a common language and the new legislation should be grounded on a public health-centred development.

Ensuring the climate change adaptation of health facilities

In health facilities, renewable and sustainable energy use should be first promoted. The existing practices such as green hospital, city hospital and Leadership in Energy and Environmental Design (LEED) certification should be gathered under a single roof from the perspective of health impacts of climate change. It is recommended that participation in the accreditation programmes is encouraged in health facilities.

To protect public health from climate change, it will be helpful to embrace two preferential strategic goals in adaptation actions when the seven titles above are examined.

STRATEGIC GOAL 1

Strengthening the infrastructure for evidence-based analysis, assessment and reporting on climate change in the field of health and increasing R&D studies

PHE1. Developing a list of indicators based on Türkiye Climate and Health Profile and health impact chains; establishing a system to collect, ensure continuity and analyze data, and harmonize such work with existing applications such as reporting, early warning etc.
PHE2. Increasing epidemiological studies on physical, mental and social impacts of climate change; identifying places and populations highly vulnerable to possible hazards at regional and city level; and planning health services in accordance with climate determinants.
PHE3. Preparing legislative infrastructure in the context of Health Impact Assessment of the measures taken against climate change.
PHE4. Enhancing joint R&D studies with other sectors and disciplines to identify pathways for monitoring, protection against, prevention and early diagnosis of climate change-induced diseases (related to hot and cold weather and ultraviolet light; depending on the deterioration in water, air and food quality; animals and vectors-based; new and re-emerging infectious diseases; mental health).

STRATEGIC GOAL 2

To strengthen the capacity, cooperation and awareness across national and local institutions and organizations for a climate change and health perspective.

PHE5. Establishing a higher coordination unit which will undertake the activities such as monitoring and communication, working groups and climate and health ethics committees.

PHE6. Setting the periodic agenda item of Public Health Boards in provinces as climate change and its health impacts or protecting city health from negative impacts of climate change.

PHE7. Drawing up and using a list of climate-sensitive diseases; identifying climate-sensitive diseases across country; and preparing a climate and health glossary for disciplines and sectors.

PHE8. Commencing, developing and promoting activities for climate and health literacy, and training the labour force in health sector.

PHE9. Rearranging curricula and application guides about environment, urban , climate and health with perspective of climate change and health.

PHE10. Acquiring accreditation for health facilities as climate-resilient facilities.

PHE11. Increasing the number of plans, programmes and projects about climate and health which are introduced in cooperation with national/ local public and enhancing public participation in adaptation efforts.

PHE12. Reviewing the legislation on Occupational Health and Safety (OHS) in terms of occupational safety, occupational diseases and public health related to climate change impacts and adaptation, thereby identifying and updating risks.

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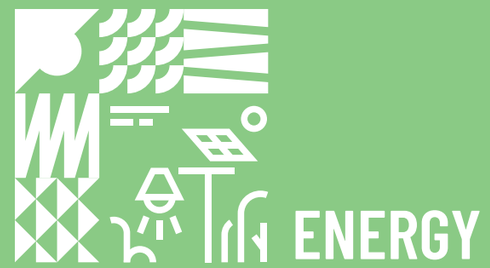
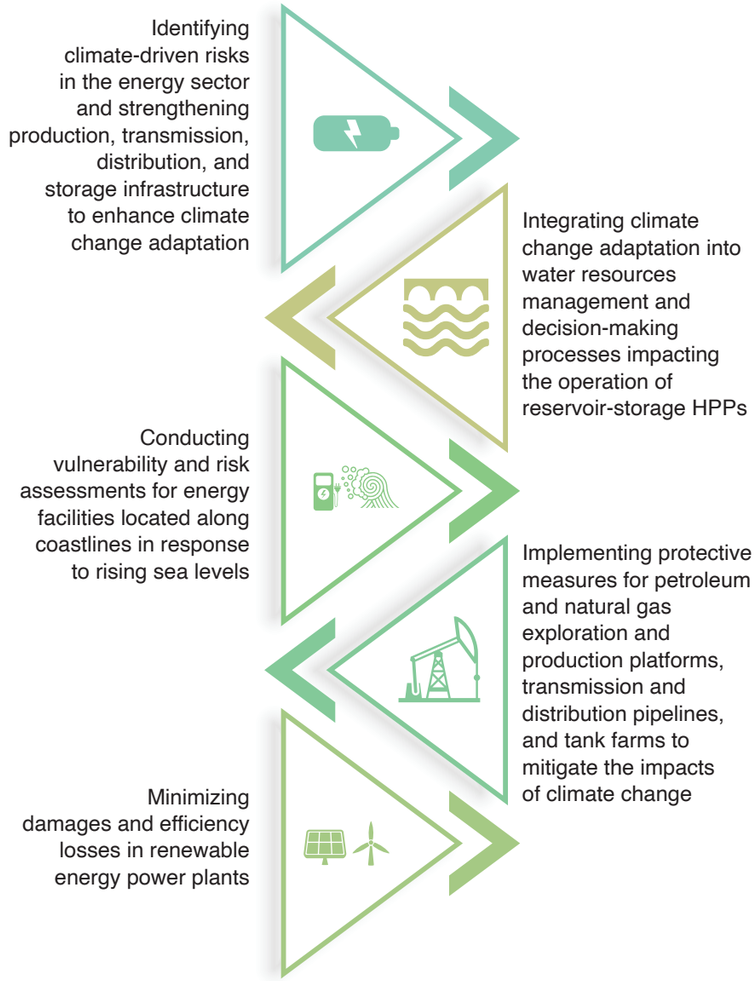


ENERGY

climate adaptation



ENERGY

climate adaptation

7.1. GENERAL FRAMEWORK

Türkiye, which aims to reduce its reliance on fossil fuels, is at the forefront of increasing the capacity of global renewable energy resources.

Türkiye tripled power generation from renewable energy resources in the last decade, thereby making significant progress and diversifying its domestic energy supply resources. However, Türkiye is reliant on other countries with respect to fossil fuel needs with a rate of 93% in petroleum, 99% in natural gas, and 30% in coal. The current account balance of the country is affected adversely by this situation. Economic growth and population lead to rising energy demand and keep energy import at a high level due to insufficient domestic energy resources.

Türkiye National Energy Plan was published on 19 January 2023. In recent years, Türkiye has invested further in renewable energy which contributes to both reduction of GHG emissions and climate change adaptation. Approximately 78% of the installed power plants commissioned within the two-years, 2021–2022 concentrated on renewable resources.

With the renewable energy-oriented policies implemented in the last years, the share of coal-fired thermal power plants in installed electricity capacity gradually falls in Türkiye, whose total installed electricity capacity has surpassed 100,000 MW. On the other hand, Türkiye should execute its policies and efforts for emission mitigation and climate change adaptation interactively through renewable power plants based on wind and sun and, particularly water.

It is significant for climate change, sustainability and economic impacts that Türkiye, which set the target net zero emission for its energy and climate policies for 2053, considers the interactive mechanisms of adaptation and mitigation in its relevant targets and works. Even though the energy sector is a key element for reduction, it should be a structural component of adaptation actions and efforts. In the energy sector, the capability of success and synergy generation will be increased by enhancement of the knowledge base as well as human, institutional and organizational capacity, which are related to adaptation.

7.2. SECTORAL LEGISLATIVE FRAMEWORK AND RESPONSIBLE INSTITUTIONS

In Türkiye, it is vital for decision-makers in the energy sector to enhance their adaptation capacity and incorporate adaptation into their key policy documents, in line with their increasing awareness, to create a resilient energy sector in the face of climate change.

Türkiye has created a significant impact on the reduction of GHG emissions by making substantial investments in numerous sectors, especially the energy sector since 2015. As in many other countries, the energy sector owns the highest share of GHG emissions among all sectors. For this reason, the policies and measures for reducing GHG emissions increasingly concentrate on energy policies, particularly in the energy sector which contain obvious goals for renewable energy generation. Türkiye maintains its efforts to further increase this rate. The energy policy of the country prioritizes the utmost use of renewable energy resources while boosting the security of supply and reducing import dependency. The major reduction policy of Türkiye in the energy sector for 2030 is the utilization of energy efficiency and renewability potential at the highest level possible also with an eye to feasibility, market conditions and energy security. The By-law on Renewable Energy Resources Support Mechanism (YEKDEM) and Renewable Energy Resource Areas (YEKA) contributed significantly to the promotion of renewable energy investments, especially in wind and solar energy.

Türkiye has a total installed electricity capacity of 102,281 MW as of September 2022. With 55,630 MW, renewable energy resources make up 54% of the installed power capacity for electricity generation. This year, Türkiye has been listed among 14 countries with an installed power of over 100,000 MW. The said 54% ratio is constituted by the shares of hydro, wind, solar, geothermal and biomass which are 30.9%, 10.9%, 8.8%, 1.6% and 1.8%, respectively. Renewable energy resources account for 97% of the energy resources commissioned in the last two years, and the rest is cogeneration, which is a quite favourable practice of efficiency. In 2021, about 3,000 MW of solar and wind power was commissioned in 2021. In this regard, Türkiye is one of the pioneer countries.

Türkiye ranks number twelve in the world and number five in Europe in terms of renewable installed capacity. Besides, it comes first and second in Europe in terms of geothermal and hydraulic installed capacity, respectively. The share of wind and solar energy in total production went beyond 15.5%, reaching the highest ratio in the Asian continent. Furthermore, according to the International Energy Agency 2022 Renewable Energy Statistics, Türkiye is the second country in the world concerning the intensity of energy recovery systems.

Primary directing policy documents and sectoral legislation for the energy sector are given below:

- Energy Efficiency Law (2007)
- Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy (2005)
- Geothermal Resources and Natural Mineral Waters Law (2007)
- Electricity Market Law (2013)
- Natural Gas Market Law (2001)
- Law on Establishment and Operation of Nuclear Power Plants and Energy Sale (2007)
- Regulation on Certification and Promotion of Renewable Energy Resources (YEKDEM) (2013)
- Regulation on Increasing Efficiency in the Use of Energy Resources and Energy (2011)
- Türkiye's Hydrogen Technologies Strategy and Its Roadmap (2023)
- Energy Efficiency Strategy Paper and National Energy Efficiency Action Plan (2017-2023; it will be updated)
- Türkiye National Energy Plan (2022-2035)

Organizations regarding and associated and affiliated with the Ministry of Energy and Natural Resources are the principal bodies responsible for the energy sector in our country.

7.3. CLIMATE CHANGE IMPACTS

The HPPs that generate electricity and are typically supplied by snow cover on high mountains are at significant risk due to rising average temperatures and drought.

The energy sector in Türkiye is among the sectors that will be affected by climate change. It is occasionally subjected to various natural disasters such as drought, floods, forest fires, earthquakes and landslides. Although significant damages and disruptions have not occurred to date because of climate hazards, it is estimated that extreme climate events of increasing severity and frequency will result in considerable difficulties and damages in the future. It is also forecasted that the fragility of thermal and renewable energy infrastructure against a series of climate hazards such as drought, extreme temperature, storms heavy precipitation and rise of sea level will raise the affectability of the energy infrastructure.

In the energy sector, most of the practices and studies regarding climate change focus on the contribution of GHG emissions to climate change as well as the impact of the emission mitigation policies on the energy sector. Nevertheless, the studies on the effects of climate change on the sector which develop actions and policies to adapt to such effects have not become prevalent, yet.

To achieve climate change adaptation in Türkiye, first of all, the effects of climate change on the energy sector should be analyzed and a comprehensive assessment should be conducted. In this sense, it needs to be recognized that climate change leads to alterations in; (1) the amount of existing primary energy and energy balance (2) capacity of providing energy to consumers and (3) energy consumption models.

Refineries where crude oil is processed are located by the shores of İzmir and İzmit. There are also refineries on land in Kırıkkale and Batman. It is anticipated that rising sea levels, floods and heavy storms will influence such facilities adversely. Moreover, according to forecasts, the prevalence of extreme temperatures, strong wind, drought, floods, storm surges and forest fires will increase and toxic emissions, oil spills, fires, or explosion hazards (Natech accidents) may bring negative consequences (European Commission, 2012 and Necci et al., 2018). The requirement of taking precautions to ensure the solidity of oil infrastructure, investments in the oil industry and the safety of people and the environment shows up, given that climate hazards are the most critical factors that may heighten the possibility of any Natech accident (natural hazards triggering technological accidents) (Hasan and Foliente, 2015).

In addition to the impacts of climate hazards on power generation potential, they may negatively affect the capacity of power systems to convert the potential into final energy for end users to provide different energy services. Relevant impacts can be divided into as follows: impacts on the energy conversion technologies and impacts on the transmission, distribution and transfer of energy. Examples of energy conversion technologies are given as follows: hydropower plants with reservoirs constructed which are not designed to manage the flows rising because of seasonal change (Vicuña et al., 2007), thermal power plants the outputs and productivity of which will be influenced by ambient temperature and humidity (Arrieta and Lora, 2005) or differences in quantity and/or quality of water resources for competitive utilization (Feeley et al., 2008; Durmayaz and Söğüt, 2006) and power plants on bottom lands situated by the shores which will be subjected to storm surges and shore erosion (Neumann and Price, 2009).

HPPs in Türkiye are reservoir-storage or run-of-river facilities, having a higher vulnerability to climate change. The most significant climatic characteristic that has an impact on hydropower resources is the average annual precipitation amount as well as the seasonal and annual variability of precipitations. In addition to low precipitation levels, heavy precipitation may damage the turbine and related components of the run-of-river HPPs, thereby hindering electricity generation. Surface runoff spoils the effect of precipitation on the river course considerably with the precipitation amount. Besides, changing climate may threaten hydropower generation in the basins in the north and east which are predominantly under snow, because of the decreasing snow cover that also reduces river water levels. For example, surrounding areas of Erzincan province which lies in the Euphrates River, are quite vulnerable to the water from melting snow, and the negative effects of floods.

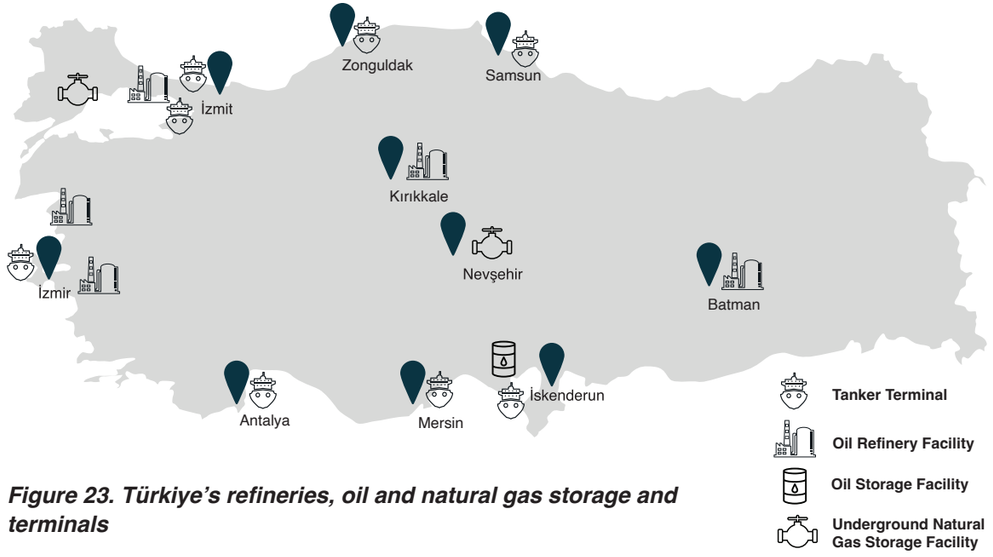


Figure 23. Türkiye's refineries, oil and natural gas storage and terminals

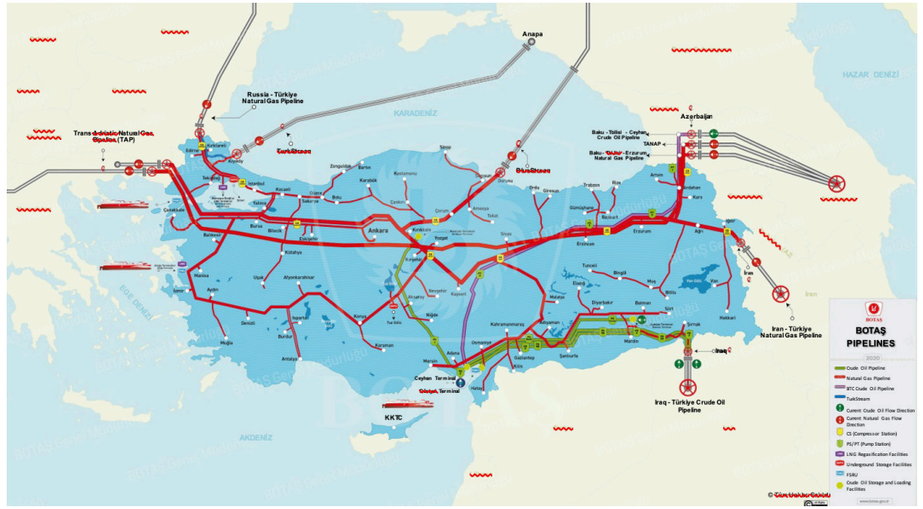


Figure 24. Crude oil and natural gas pipelines

Similar to all solar energy resources, the power plants that generate electricity with photovoltaic technology are affected by the changes in sunshine duration and cloudiness level. Moreover, the efficient operation of wind turbines requires consistent wind speed at a definite level. A wind speed of at least over 7 m/s is needed for an affordable wind power plant (WPP) investment. The wind with a speed of 20 meters per second runs the turbine at full capacity.

However, in case of higher wind speed, the turbine may halt automatically. This situation indicates the vulnerability of wind power plants to strong wind, one of the extreme weather events. Türkiye has a wind potential based on different levels of wind speed at sea and on land. The wind blowing at 7 meters per second and above is strong and observed at the Aegean Sea, in the west of the Black Sea and at the Mediterranean Sea between Mersin and Cyprus. On the other hand, the wind on lands with a speed below 7 m/s can be observed in all regions, which makes the electricity generation from wind possible.

Although the share of thermal power plants based on coal, natural gas, liquid fuels and multiple fuels in the total installed power-generating capacity of Türkiye is 48.3%, a rate close to half, this figure goes down gradually. In 2020, the active thermal power plants in our country drew 8.2 billion tons of water, 56% of which was obtained from the sea, and the rest was withdrawn from wells, dams and rivers (TURKSTAT, 2021). To illustrate, several thermal power plants consume either seawater or water from streams whereas some of the natural gas cycle power plants utilize the dry cooling system and seawater.

Extreme weather events induced by climate change may affect energy transmission by damaging the energy infrastructure of Türkiye. Floods, avalanches, landslides, heavy wind, ice loads and other extreme weather events may have an impact on both energy transmission lines and gas transmission systems (Vlasova and Rakitina, 2010). Energy distribution may be also influenced by fires, falling trees, or heatwaves which may lead to the breakdown of power transformers and losses in the capacity of transformer stations (Sathaye et al., 2011). Unusual high and low temperatures, damage in materials and thermal expansion or contraction may affect the above-ground part of the pipelines which meet the average annual natural gas consumption of about 50 billion m3 (Figure 24). On the other side, heavy precipitation may damage and uncover underground pipelines.

Energy sector risk assessment: heatwaves

The impacts of heatwaves on power systems are not limited to the supply side. Since final energy use can be affected by changing temperature, higher temperature results in more demand for cooling. Besides, temperature rise may influence electricity demand in industry, and irrigation-purpose water and electricity demand in agriculture. In Türkiye, the increase in average temperature, and heatwaves raise the demand for electricity used in agricultural irrigation, industry, residences and businesses and occasionally may account for the peak demand. Heatwaves also negatively affect transformer stations which distribute electricity, causing their deactivation. Figure 25 shows the impact chain prepared with an eye to rising temperature and heatwaves.

A risk assessment was conducted for the energy sector by assessing hazards, exposure and vulnerability of provinces collectively in terms of the heatwave hazard across Türkiye. The relevant risk map is indicated in Figure 26. It was found that the energy sector in the provinces of Northern Türkiye has a lower risk while the risk is higher in the provinces located in the south. Even though critical power facilities are not available in the northern provinces with relatively low levels of economic and social development such as Kastamonu and Çankırı, energy demand as well as the electricity transmission lines and transformer stations which meet the related demand may heighten the risk. In the provinces with thermal and renewable power plants, a fall in efficiency is expected due to increasing temperature. Compensation for the decreasing electricity generation through the escalation of installed power capacity will lower the regional vulnerability level. A significant number of lignite-fired power plants in the provinces such as Çanakkale, İzmir and Kahramanmaraş give rise to high and moderate risk levels. Nevertheless, the provinces with high vulnerability such as Uşak, Aydın and Tekirdağ are quite risky. In particular, the density of transmission

Figure 25. Risk map for current period: relationship between energy sector and heatwaves

Figure 26 .Impact chain: relationship between energy sector and heatwaves

HAZARD		EXPOSURE
Climate Signal	**Climate Impact**	
Increase in average temperature	Heatwave	Fuel and natural gas stocks
Increase in the number of extremely hot days	Increase in the number of consecutive hot days	Lignite reserves
		Electricity demand in industry
		Electricity demand for agricultural irrigation
		Electricity demand in trade
		Transformer stations and electricity transmission lines
		Energy transmission and distribution systems*

VULNERABILITY		RISK
Sensitivity	**Adaptation Capacity**	
Efficiency in electricity generation at thermal power plants	Socio-Economic Development Index score	Reduction in power plant efficiency and existing production capacity
Efficiency loss in wind power plants (WPPs)	Existence of a Local Climate Change / Energy Plan	Increased electricity demand for cooling
Efficiency loss in solar power plants (SPPs)	Ease of access to financing within energy facilities	Decrease in demand for fuel oil, coal, wood, and natural gas for heating
Production loss due to evaporation in hydroelectric power plants (HPPs)	Ease of grid access for power plants	Damage to hydropower plant (HPP) infrastructure due to flooding
Efficiency loss in geothermal power plants (GPPs)	Changes in the costs and market values of energy facilities*	Reduction in water volume at hydropower plants (HPPs)
Electricity distribution and transmission losses		Sagging in transmission lines and reduction in their capacity, conductivity, and efficiency
Frequency of outages per customer		
Number of stations		
Efficiency loss at transformer stations		
Increased fuel demand for vehicle air conditioning*		
Increased electricity demand for cooling due to higher water temperatures in thermal power plants*		

The (*) symbol denotes indicators excluded from the risk assessments.

lines and the climbing vulnerability led by the escalation in energy demand pose a very high risk in the provinces in the Mediterranean Region such as Antalya, Mersin, Adana, Osmaniye and Hatay. In Eastern Anatolia and Southeastern Anatolia Regions, the low adaptation capacity of Malatya and Batman results in high risk. On the other hand, the risk reaches high levels in the Central Anatolia Region owing to the abundance of thermal and renewable power plants in Ankara and Konya provinces.

Energy sector risk assessment: drought

Drought may affect the operation of existing hydropower systems and even jeopardize the feasibility of the investments planned. For this reason, the alterations in the precipitation regime induced by climate change raise the uncertainty in the operation of hydropower systems which is already obscure.

Significant seasonal variation is observed in river flow. Small-size run-of-river hydropower plants have low operational flexibility and are more vulnerable to climate change. Reservoir storage capacity aligns electricity generation with power demand by balancing seasonal or annual changes in the water flow. Therefore, the reservoir may function as a buffer that stores energy and helps cope with climate change. Another substantial impact of drought on the power systems can be seen in the need of thermal power plants and oil refineries for cooling water, which consequently affects electricity generation. Coal, natural gas, nuclear, geothermal and biomass power plants are vulnerable to such impact. Figure 27 demonstrates the impact chain related to drought hazards in the energy sector.

A risk assessment for the energy sector was conducted for the energy sector by assessing the exposure and vulnerability of provinces in terms of drought hazard. The relevant risk map is given in Figure 28. Three parallel lines are seen in the risk map about the critical power facilities of Türkiye. On the eastern line, the electricity generated by the hydropower plants established on the largest rivers of Türkiye such as Tigris, Murat and Euphrates Rivers have declined and even come to a stopping point, so Erzurum, Bingöl, Elazığ, Diyarbakır and Şanlıurfa provinces are under a very high risk. It is seen on the second line that Sivas through which Kızılırmak and Yeşilırmak pass, as well as Kahramanmaraş, Adana and Hatay where important hydropower and thermal power plants in need of water for functioning are located, have a quite high-risk level. A third smaller parallel line at a very high-risk level which contains the thermal power plants in Çanakkale and Tekirdağ and exploration and production activities for natural gas can be included in these regions. Between the second and third lines, Central Anatolia Refinery situated by Kızılırmak River and the thermal power plant in Kırıkkale keep the risk level of the province pretty high.

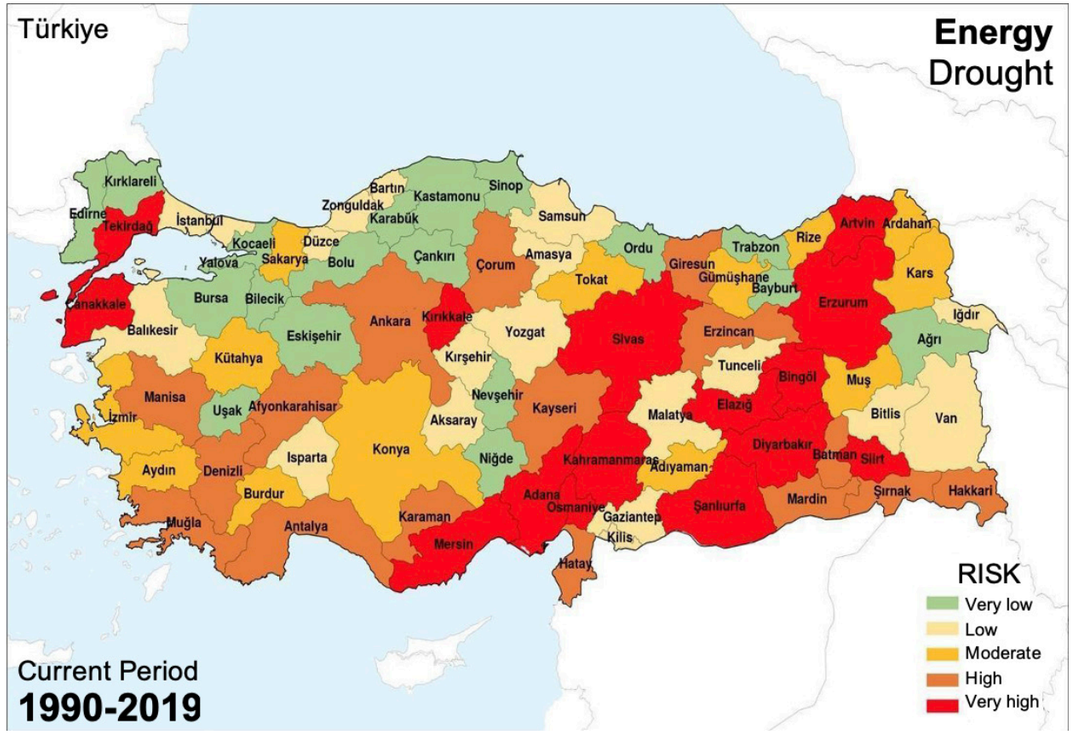


Figure 27. Risk map for current period: relationship between energy sector and drought

Figure 28. Impact chain: relationship between energy sector and drought

HAZARD		EXPOSURE
Climate Signal	**Climate Impact**	
Decrease in total precipitation amount	Drought	Installed capacity of thermal power plants
Increase in average temperature	Decrease in precipitation amount and number of rainy days	Installed capacity of HES facilities
	Increase in the number of consecutive dry days	Biomass power plants
		Number of petrol refineries
		Electric power plants*
		Coal/lignite power plants*
		Natural gas power plants*

VULNERABILITY		RISK
Sensitivity	**Adaptation Capacity**	
Water loss in thermal power plants	Socio-Economic Development Index score	Decrease in the production capacity of HES facilities
Production loss in RES facilities	Facilities located on the coast and the provision of cooling water from the sea*	Risk of competition among water users
Production loss in HES facilities	Local climate change/energy plans being in place	Decrease in cooling efficiency in thermal power plants and consequently production
Production loss in JES facilities	Flood prevention measures in HES facilities*	
Water competition	Multipurpose use of HES facilities*	
Production loss due to cooling water requirements in thermal power plants*		
Water requirements for oil and natural gas drilling and production*		
Increase in costs in thermal power plants*		

The (*) symbol denotes indicators excluded from the risk assessments.

7.4. CLIMATE CHANGE ADAPTATION MEASURES

To ensure a reliable energy supply for the country, it is essential to develop the highest possible level of climate resilience in the energy sector.

Adaptation to the impacts of climate change gradually rises in importance as a supplementary response strategy for the reduction of GHG emissions. While the fundamental aim of the strategic adaptation goals and actions of these goals is to ensure the safety of people and assets, the primary purpose of power systems is to assure energy supply and to balance production and consumption within the frame of time and place. Two strategic goals were set for the energy sector.

STRATEGIC GOAL 1

To develop policy and legal frameworks for the climate change adaptation of the energy sector; to strengthen institutional capacity and cooperation; to increase the production and sharing of data and information.

ENR1. Provide necessary training and conduct awareness-raising activities for decision-makers in public institutions and the private sector in the energy sector to develop institutional capacity and information networks regarding climate change adaptation.
ENR2. Identify and assess needs for climate services and climate change-driven risks in the energy sector.
ENR3. Incorporate climate risks and climate change adaptation into policy documents prepared in the area of energy and energy resources.

STRATEGIC GOAL 2

To strengthen the production, transmission & distribution and storage infrastructure in energy resources, considering necessary designs and enhancing flexibility in power systems in order to achieve climate change adaptation.

Although climate change will not affect the actual amount of fossil fuels directly, it may have an impact on the access to fossil fuel reserves as well as exploration and extraction of these resources.

Exploration, production and storage of energy resources

Lignite reserves and stocks can be affected in the face of floods led by peaking of excessive precipitation, and erosion hazard. In addition, excessive precipitation increases trace contaminants that leak out from layers of soil.

It can be said that another significant energy asset, geothermal energy resource has a pretty high potential. Rising average ambient temperature and water temperature lower the efficiency of power plants that utilize hot water extracted naturally or produced through drilling in geothermal areas located in all regions, particularly Aydın province.

Exploration, search, drilling and production equipment and platforms for petroleum and natural gas prospecting activities on land and at sea are influenced by heavy storms. Therefore, models that forecast extreme wind and sandstorms should be developed, and drilling rigs should be strengthened with durable materials.

Petroleum and natural gas storage facilities

A large number of oil ports and terminals located on the coastline of Türkiye, provide access to the goods imported by sea from the Mediterranean and Black Sea regions. In case of extreme weather conditions such as heatwaves, floods and storms, insulation, drainage, early warning, redesign and engineering solutions need to be applied against climate hazards, because the products in storage tanks are explosive and combustible. Structural design thresholds should be reviewed, given the strong storms that may happen in tank farms of oil stocks. Besides, lightning protection systems should be developed, oil spills should be eliminated quickly, and drainage systems should be designed to cease spills and to ensure fire protection.

Natural gas pipelines

Heavy wind and storms may damage pipelines and relevant equipment in open sea and on lands and also bring structural damage by lifting heavy objects and making them hit the pipelines. Moreover, they may impair valves, pump stations and river crossings as well as lead to gas leaks, ignition of gas, fire and air pollution. In the

STRATEGIC GOAL 2

To strengthen the production, transmission & distribution and storage infrastructure in energy resources, considering necessary designs and enhancing flexibility in power systems in order to achieve climate change adaptation.

event of lightning, pipelines may be punctured, giving rise to fires or explosions. It is recommended that more durable and structurally flexible oil and gas pipeline designs are preferred against such impacts and upgraded design standards for the newly constructed equipment are embraced and adapted. Since natural gas is transferred underground through steel pipes, the vulnerability of the pipes to precipitation and extreme temperatures is low.

Thermal power plants

Thermal power plants lose their efficiency when ambient temperature rises, and drought hazard emerges. In these cases, they require more cooling water, so the following adaptation actions need to be taken; design of dry cooling systems, reuse of wastewater, recovery of the evaporative water in circulation systems and improvement of water cooling. On the other side, embankments and other protective barriers may need to be heightened to avoid the increasing risk of physical damage and interruption at coastal facilities in the event of peaking excessive precipitation and rising sea levels.

Instead of fossil-based power plants, the share of renewable energy resources in generating electricity and meeting related needs of industry and self-consumption will go up gradually in line with the net zero emission target. On the demand side, efficiency-enhancing actions and innovations come to the fore in electricity and fuel oil consumption. Flexibility in production can be discussed in the form of hydropower plants, wind power plants, solar power plants and biogas power plants.

Hydropower plants

HPPs with a high capacity in the area of hydropower are located on the Tigris, Murat and Euphrates Rivers which are based on snow and rainwater coming from highlands of the Eastern Anatolia. This situation demonstrates the sensitivity and vulnerability of the HPPs. With climate change, turbines and their components are pressurized based on the melting period and speed of snow cover, and rubbles and sediments form due to the drift of tree parts, stones and soil toward the reservoir embankment. Furthermore, altering climate may threaten hydropower generation, especially in snow-covered basins in the north and east where decreasing snow cover on mountains affects the river levels. It should be noted that the flooding impact of the river branches such as the Euphrates and Murat Rivers in Erzincan province originating from rapidly-melting snow may affect the snow water-based HPPs negatively.

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The hazard of increasing average temperature, heatwaves and drought reduces the current production capacity of 685 hydropower plants in Türkiye with an installed power of 31,336 MW and leads to operational changes. For this reason, boosting their storage capacity may reduce the impact of water loss arising from low precipitation and evaporation at high temperatures. Similarly, a decrease in snow cover gives rise to a dropping in current production capacity and operational changes. In this sense, the following adaptation actions need to be taken; improvement of short-term water flow estimations, setting of water management strategies and establishment of additional storage capacity, enhancement of turbine flow capacity and implementation of the operational strategies which manage the formation of snow cover.

In case of heavy precipitation and flood risks, particularly run-of-river HPPs will be subjected to physical damage and related operations will be altered. Such HPPs without a reservoir or water storage basin are more vulnerable to flood and erosion, so various discharge or alternative methods against flood should be planned. In addition to boosting storage capacity, resistivity of dam walls and turbines should be raised, and elimination of sedimentation should be organized.

Wind power plants

Wind potential is comprised of different levels of wind speed in seas and on land. Ministry of Energy and Natural Resources worked on the distribution of wind

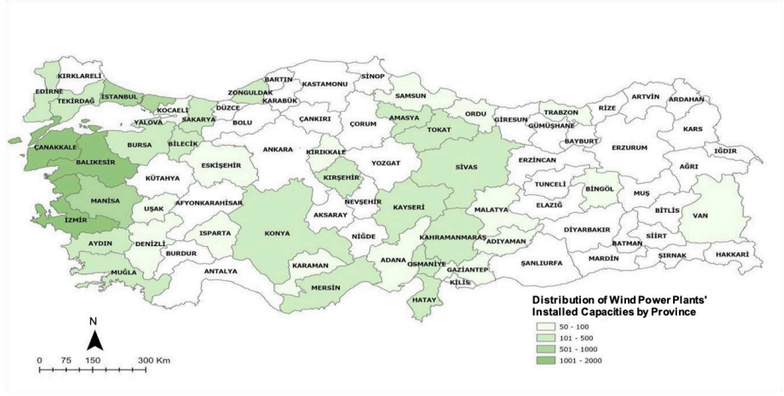

Figure 29. Installed power distribution of wind power plants by provinces

potential by provinces and regions. The highest wind speed which corresponds to 7 meters per second and above is observed in the Aegean Sea, in the west of the Black Sea and between Mersin and Cyprus in the Mediterranean Sea. Additionally, the wind on lands with a speed below 7 m/s spread to all regions, providing the opportunity for electricity generation. In Türkiye, wind power density, which is the power available per square meter (Watt), corresponds to 200-400W per square meter on average on land. The areas with a power density of 500-600 W/m2 are in the Aegean Sea where wind speed is 7 m/s and above. Figure 29 shows the installed power distribution of wind power plants, which are either active or under construction, by provinces.

Alternations in wind frequency create uncertainty about the operation of WPPs with a total installed power of about 12,000 MW that are commissioned together with the wind power plants, the installation activities of which continue. A wind turbine can become inoperative owing to strong or low wind. In the face of this situation, power outages should be taken into account in power system planning, or spare capacity should be created and stored.

Rising average temperature leads to lower air density, hence electricity generation efficiency in wind power plants may fall.

Figure 30. Installed power (MW) distribution of solar power plants in Türkiye by provinces

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Solar power plants

According to the Solar Power Map of Türkiye (GEPA), the solar power potential of the regions below the Ardahan-İzmir line is quite high corresponding to 1,600 kWh. Heatwaves and rising average temperature, which are among the climate hazards, diminish panel efficiency, and accordingly energy output of the solar power plants (SPPs) with a total installed power of over 10,000 MW. In the event of a high average temperature, the capacity of underground conductors falls as well. At this point, cooling facilities can be established to lower the efficiency losses depending on the amount of lost electricity and the costs of alternative cooling options. Air flow under the installation structure can be improved and heat-resistant PV cells and their module components can be preferred to reduce the loss and raise the outputs. The distribution of SPPs in Türkiye by provinces is given in Figure 30.

Extreme weather and climate events such as heavy fall of snow and hail, and strong winds may affect solar panels negatively. Accumulation of snow on the panels lowers efficiency while hail gives harm to them. The debris carried by wind may spoil the collecting surface areas. Such problems can be solved by choosing a module surface that is suitable for self-cleaning and preferring locations with a lower possibility of dust, sand and snow if possible. Besides, a more solid installation structure should be used, flood-proof locations should be selected and cables and their components should be reinforced in order to hinder the physical damage of extreme climate events such as heavy precipitation and lightning, to elements of the system and the decrease in output.

Biogas, biomass, waste heat and pyrolysis oil power plants

As of the end of April 2023, installed power of the biogas, biomass, waste heat and pyrolysis oil power plants in Türkiye in total is 2,385 MW, 2,071 MW of which is registered as licensed. The distribution of the registered power plants by provinces of Türkiye is indicated in Figure 31. İstanbul, Ankara, Balıkesir and İzmir provinces have the highest capacity. The thermal and water efficiency of these power plants may drop in the face of the heatwaves and rising average temperature. In this regard, energy planning of the power plants utilized to convert waste in various industrial branches into energy should be grounded on spare or hybrid resources to ensure planning of the losses in electricity generation and to avoid disruption of the generation activities. Moreover, the requirement for more process and cooling water under increasing temperatures should be envisaged.

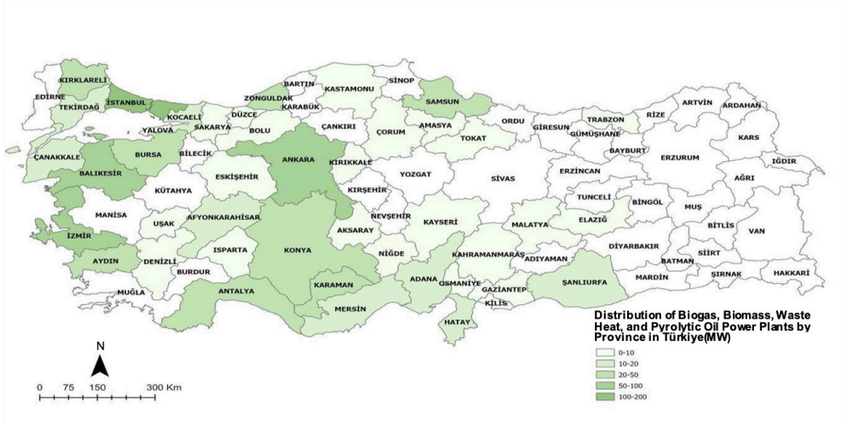

Figure 31. Distribution of biogas, biomass, waste heat and pyrolysis oil power plants (MW) in Türkiye by provinces

STRATEGIC GOAL 2

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Electricity transmission & distribution infrastructure

Atmospheric conditions affect the power flow level of the transmission and distribution lines. The temperature of conductors is influenced by the electrical heating effect as well as ambient temperature, insulation and wind speed. Therefore, higher temperature causes an increase in the losses of transmission lines and the loosening of transmission line cables. As a result, the risk of forest fires goes up. An adaptation method is to cut the vegetation cover below and around the conductors. Even though another option can be to replace overhead lines with underground cables in forestlands, underground cables cost approximately ten times more than overhead lines do because of their installation and maintenance which are more challenging (Parsons, 2012). The cost difference is smaller for lower voltage. However, the majority of the distribution networks in Türkiye, especially those except province and district centers are comprised of overhead lines, so their cost will be a considerable amount. According to data from the Energy Market Regulatory Authority (EMRA), the length of distribution lines is 1,204,979 km. Of this length, 967,378 km and 237,601 km belong to overhead lines and underground lines, respectively. Similar to lines, transformers may overheat and disengage. In this context, active coolants can be included in the transformers.

Extreme weather conditions are problematic for transmission systems. Events such as frost and icing may result in sparks on insulators, switchgears and transformers,

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hence design of insulators should be improved. Strong wind, severe precipitation and any lightning may lead to breakdowns in the system. For this reason, lines should be redirected across open spaces or roads, vegetation cover should be regularly kept to a safe distance and investment should be made in more appropriate storm and hurricane prediction instruments. In line with the expectation that extreme weather conditions will be more frequent and more severe, the system may sustain more damage, so that failures in supply may happen (Wood 2003).

It can be said that extreme temperatures and heatwaves trigger fire and affect high- and medium-voltage lines in areas covered with dense forests and trees.

Energy loss in electricity transmission and distribution lines shows up owing to the rising average temperature as well as strong wind. According to the report published by National Grid (2010), capacity in overhead lines may fall by 10%, underground cables by 4%, and transformers in distribution networks by 7.5%. It is estimated that an increase in the loss of electricity for aluminum and copper conductors based on rising temperature corresponds to about 0.4% per °C (Haynes 2010). Such transmission losses which rise in parallel with the changing climate need to be included in the calculations of maximum temperature for upgraded and newly constructed transmission and distribution lines or in design calculations for rating.

Figure 32. Distribution of electricity consumption by provinces

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Electricity and fuel demand

The total consumption in 2020 in Türkiye was 233.437 GWh including consumers connected at the distribution-voltage level and those connected at the transmission-voltage level. The distribution of such consumption by provinces is given in Figure 32. İstanbul has a consumption amount of 38.49 TWh which corresponds to 16.49% of the total consumption. İstanbul is followed by İzmir (6.53%), Ankara (6.04%), Bursa (5.50%) and Kocaeli (4.88%).

Rising temperatures will probably boost electricity demand for cooling while reducing liquid fuel and natural gas demand for heating (US DOE, 2013). Energy demand may be affected by numerous factors, including temperature and other weather conditions, population, economic conditions, energy prices, consumer behaviour and characteristics of energy-based equipment (USGCRP, 2009). Even though it is hard to forecast the impacts of rising temperature on aggregate energy demand, an increase in demand (largely electricity) may be anticipated at the locations in Türkiye where cooling makes up the highest share in energy use in residential, commercial and industrial buildings as the temperature exceeds 40°C in summer. Furthermore, natural gas and coal are utilized for heating in winter.

Figure 33. Distribution of liquid fuel sales by provinces

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On the other hand, power outage is affected by wind speed, humidity, precipitation and cloud cover as well as temperature. These factors influence air-conditioning, space heating, cooling and water pumping loads which will raise both peak and 24-hour demand. In the event of extreme temperatures, power systems may be forced to meet demand, so peak demand is particularly substantial. Electricity demand is reduced with the following actions: labelling and certification programmes for end users of electricity, buildings and significant devices and minimum energy performance standards for new commercial buildings and electrical appliances (lighting, air-conditioning and cooling) are obliged; access to legislation and financing is developed to improve the efficiency of electricity; incandescent lamps are replaced by much more efficient light-emitting diodes (LEDs); ISO 50001 which is a global energy management standard is adopted; and evaporative cooling and absorption cooling systems are preferred.

Demand for petroleum products, natural gas and coal

Petroleum products are produced in refineries and distributed to dealers. The percentage distribution of the dealers' sales to consumers is shown in Figure 33. Distance for carrying petroleum products from refineries through road tankers and the distance between gas stations become more of an issue in terms of the floods and landslides on roads, led by the adverse impacts of climate change. Effects of climate change on all petroleum products, including LPG can be described as follows: roads for transporting the products from distributing companies or warehouses of importers to gas stations may be subjected to extreme weather events such as heavy precipitation, flood, erosion or landslide, so that transport process may be disrupted, the stations which need to give 24/7 service cannot sell fuel and accordingly, consumers cannot find fuel.

The vulnerability of the sale or consumption of petroleum products to climate change will be distinguished with the rising demand for petroleum products owing to the increasing use of air-conditioning in cars aiming to heat or cool the vehicle under extreme heat or extreme cold. It is better to mention that a change in average temperature will alter fuel consumption by affecting the use of air-conditioning both in buildings and vehicles. Fuel consumption is positively correlated to temperature and 0.01 to 0.03 liters more fuel is consumed for every 1°C increase (Roujol, 2009). It is estimated that air-conditioning usage lowers the efficiency of vehicles on highways by approximately 12% (Parker, 2005).

Industrial energy demand is not critically vulnerable to climate change (Scott and Huang, 2007). Most of the processes operate relatively at constant ambient

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temperature values and have a more stable energy demand. Nevertheless, for example, continuous cooling processes related to food processing and storage have relatively small temperature differences, so they are more dependent on outside temperature (particularly because such cooling processes usually make heat exchange with the outside temperature). In this sense, it can be anticipated that some part of base load electricity demand depends on temperature (Hekkenberg, 2007).

Lastly, problems may arise during the transport of petroleum products when floods occur due to heavy precipitation. Distance may be significant for carrying petroleum products from warehouses to stations.

ENR4. Integrate climate change adaptation into water resources management and decisions that affect the operation of reservoir-storage HPPs; enhance their water holding capacity or prefer pumped-storage HPPs; improve the durability of reservoir embankments and power plant equipment and boost the productivity of turbines.
ENR5. Take necessary precautions to protect open lignite mines and stocks from climate hazards such as floods and heatwaves.
ENR6. Conduct vulnerability and risk assessments in the face of rising sea levels for energy facilities located by the coastline and take necessary precautions.
ENR7. Take precautions to prevent damage to overhead electricity transmission and distribution infrastructure due to climate hazards.
ENR8. Take precautions in petroleum and natural gas exploration and production platforms, transmission and distribution pipelines, and tank farms against the impacts of climate change.
ENR9. Reduce damages and efficiency losses in wind power plants (WPPs).
ENR10. Establish early warning and response systems for energy management to improve maintenance programmes and rapidly meet post-disaster recovery needs.
ENR11. Promote the use of new and efficient devices and district heating/cooling systems directly from building design to improve energy efficiency in buildings.

Interaction with other sectors

Effects of climate change on power systems may be indirectly seen in both the energy sector and other economic/natural systems. Likewise, impacts on the economic and natural systems may create changes in the energy supply and demand. The effects of climate change need to be evaluated in a holistic manner with an eye on the relations between sectors. Allocation of scarce water resources to sectors is a key cross-sector effect. The majority of the climate change impact assessments focus on scarcity or availability of water. For this reason, a well-rounded climate change adaptation strategy requires an integrated water management plan.

Heatwaves and drought raise the amount of water needed by power systems while multiple uses of water resources (such as their consumption by humans and animals, irrigation, ecosystem maintenance and wastewater control) bring considerable complexity to power systems. Meanwhile, strong wind may damage overhead electricity lines and directly result in losses of power-supply sources in all sectors, especially energy intensive sectors in the economy. In this case, production may be delayed or disrupted. Similarly, the growing of agricultural products will be affected negatively by power outages in the region where agricultural irrigation is performed.

To illustrate, floods may affect the production of a hydropower plant, leading to power outage in the relevant area. The absence of electrical power may influence the critical units such as communication and telecommunication infrastructure served by public bodies.

It is of capital importance in combatting climate hazards that the modern tools and models, which utilize the vulnerability of the energy sector and adaptation measures, are designed under the coordination of the Ministry of Energy and Natural Resources in order to evaluate the trade-offs between various energy generation procedures and different adaptation measures and between climate change adaptation objectives and other relevant national priorities.

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TOURISM
CULTURAL
HERITAGE

climate adaptation

Drafting guides to identify and manage climate risks to movable and immovable cultural heritage elements and areas

Enhancing technical capacity on the impacts of climate change on tourism and cultural heritage, and strengthening adaptation measures

Developing region-specific architectural design and implementation guidelines for constructing resilient tourism facilities against climate risks

Updating the National Tourism Strategy to incorporate climate change adaptation actions

Identifying niche tourism types in specialized themes to reduce the sector's vulnerability to climate impacts

TOURISM CULTURAL HERITAGE

climate adaptation

8.1. GENERAL FRAMEWORK

Except in the years of economic crisis, the tourism sector in Türkiye has been growing, with an increasing share in national income. It is aimed that this situation will continue in the future. Sectoral sustainability must be ensured and natural and cultural heritage must be protected from climate risks.

The contributions of the tourism sector in Türkiye to national income (4.6% in 2019; TURKSTAT, 2021) and employment (7.7% in 2018; 2.2 million people; OECD, 2020) have long been increasing. Tourism, which is among the fastest growing sectors in the country affects 54 subsectors directly (AKTOB, 2014). In 2018, travel expenses comprised 51.9% of total services export in Türkiye (OECD, 2020). The number of international arrivals and tourism revenues have been on an increasing trend starting from the 2000s, except for the crisis years, and reached 51.9 million and 38.9 billion USD in 2019 respectively. Average tourist expenditure per capita of inbound tourists, on the other hand, remained low and followed a fluctuating course (751 USD in 2019; TURSAB, 2020; TURKSTAT, 2021). The sector was heavily struck in the pandemic period in terms of revenues and human resource, but quickly recovered and maintained its top rankings in terms of tourist numbers and revenues. Russia and European Union countries comprise the external markets from which Türkiye receives the largest number of tourists. Following a similar increasing trend, domestic tourism activities involved 126.4 million travels in 2018 (62.1% overnight stays; 37.9% daily excursions; OECD, 2020). Tourist expenditures should be much higher given the resources offered for the sustainability of tourism in the country. The increase of sectoral share in national income as well as the impact of climate risks in addition to the existing ones on the sector may affect the sustainability of the national economy. Türkiye is striving to maintain its ambitions for the tourism sector in the next term. In both the National Development Plan (PSB, 2023) and the sectoral National Strategy Document (TTS, 2023), medium- and long-term objectives were set as diversifying tourism activities and

increasing the length of tourism season and stays, service quality, the number of inbound tourists providing higher average tourist expenditure per capita and outside-accommodation expenditures. The tourism types planned to be developed in the future include the tourism activities that can produce higher revenues but may be affected by climate hazards. It is evident that natural and cultural assets can be exposed to overexploitation and degradation in case of maintaining the current tourism practices and approaches and achieving policy objectives; therefore, the sustainability principles must be taken into consideration in terms of the access to food, water, energy and the services like transport and communication. Climate hazards can cause the changes in the spatial and temporal suitability of the current tourism activities as well as the emergence of new destinations and the requirement of additional financial and natural resources. Strategies proposing new tourism activities will be required to benefit from the idle capacity of facilities and human resource that may emerge in the current destinations which may become unpopular in the future. The emergence of convenient seasons in target market countries brings forward market diversification. The sector may experience challenges in integrating tourism types and increasing tourist expenditures, accomplishing the desired occupancy rates in businesses, and maintaining balanced income and employment, due to seasonal shifts (EUROCONTROL, 2021).

Türkiye is home to diverse civilizations whose history dates back to thousands of years ago. Such a potential imposes universal responsibilities on the country in terms of protecting historical, cultural and natural environments. Natural and cultural heritage (historical structures, archaeological protected areas, monuments, etc.), museum artefacts and intangible cultural heritage assets which also serve tourism purposes are non-renewable natural resources. Climate hazards pose a global threat to natural, cultural and mixed heritage that are currently affected adversely by disruptive environmental elements (IUCN, 2017). Climate hazards cause physical and chemical changes on such heritage, affecting their sudden and long-term decay and contributing to new appearance of decay phenomena (Bertolin, 2019).

8.2. SECTORAL LEGISLATIVE FRAMEWORK AND RESPONSIBLE INSTITUTIONS

Although the Ministry of Culture and Tourism is the only institution directly responsible for tourism and cultural heritage, the legal and administrative aspects of the sector are multi-faceted, involving numerous stakeholders throughout its value chain.

The Ministry of Culture and Tourism is the only institution directly responsible for tourism and cultural heritage. Different general directorates (e.g., General Directorate of Cultural Assets and Museums and General Directorate of Foundations) under the Ministry are in charge of tourism and cultural heritage on a sectoral basis, as required by their purview.

The most important legal regulation related to tourism and cultural heritage is the Law No. 2634 on Tourism Incentives. It is a guiding legal basis that contains detailed definitions and clarifies the application procedures in tourism and cultural heritage sector and also describes the Culture and Tourism Conservation and Development Areas, Tourism Centers, and the classification and certification of tourism facilities. A certification program, The TGA Türkiye Sustainable Tourism Programme Certificate, applied by Law No. 7183 on Türkiye Tourism Promotion and Development Agency deals with the topics that will enhance the adaptation capacity related directly to climate hazards and risks, such as making tourism facilities sustainable and environment- friendly and protection and reutilization of natural tourism resources. The secondary legislation based on Law No. 2634 also contributes to the contents related to climate change in practical terms; for example, the Communiqué on Issuance of Environment-Friendly Accommodation Facility Certificates issued by the Ministry of Culture and Tourism in the Official Gazette of 19 June 2017 deals with awarding certificates to suitable facilities upon their applications. Apart from the legislative regulations, there are technical recommendations on the impacts of climate change on tourism and cultural heritage. The Recommendation No. 146 of the Climate Council is as follows "The impacts of climate change on tourism and cultural heritage assets must be determined, and the adaptation of tourism activities to climate change and the sustainability of tourism must be ensured".

Another legal framework related to tourism and cultural heritage includes the Law No. 2873 on National Parks and the Law No. 2863 on the Conservation of Cultural and Natural Property. These laws contain significant provisions on the facility establishment and land use decisions for tourism purposes. The Forest Law No. 6831, Law No. 5403 on Soil Conservation and Land Use and Law No. 4342 on Pastures also constitute a significant legal framework for land-use decisions, which must be considered in the establishment of tourism facilities. The EIA Regulation is also a significant legislation in terms of tourism activities.

Among others, MoEUCC is the primary stakeholder institution which must cooperate with the Ministry of Culture and Tourism. The Units of MoEUCC, General Directorate of Spatial Planning (GDSP); General Directorate of Environmental Impact Assessment, Permission and Inspection (GDEIAPI), and General Directorate of Environmental Management are also among the important stakeholders. Other tourism- related entities, NGOs and CBOs, like the newly established Türkiye Tourism Promotion and Development Agency, TURSAB, Hotel Association of Türkiye (TÜROB), Tourism Investors Association of Türkiye (TTYD), Anatolian Tourism Administrators Association (ATID) and those engaged in awareness-raising activities and projects on the protection of cultural heritage, etc. are influential stakeholders in the sector.

Türkiye is not a party to any international agreement addressing directly the impacts of climate change on tourism sector. On the other hand, provisions regarding the sustainability of the tourism and cultural heritage sector are derived from the articles and actions under the Paris Climate Agreement and the European Green Deal. The Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona) and the Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris) are the documents related indirectly to the tourism and cultural heritage sector. In 2017, the World Heritage Committee, which decides the cultural assets to be added in the UNESCO World Heritage List, drafted the Climate Vulnerability Index (CVI) framework in a meeting jointly held by ICOMOS, IUCN, the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM), World Heritage Centre and German Federal Agency for Nature Conservation (BfN), in order to update the World Heritage Convention. This index holistically evaluates climate vulnerability of the Outstanding Universal Value of world heritage sites and the associated communities.

8.3. CLIMATE CHANGE IMPACTS

Therefore, it is crucial to identify the current and future vulnerabilities of stakeholders involved in ensuring tourist satisfaction within the tourism value chain to climate hazards, in order to maintain the consistency of actions.

The development level of the tourism sector in Türkiye varies from province to province. The top five provinces in tourism development account for more than half of total employment and the number of facilities and tourists. Such a situation increases the size of risks in the tourism sector.

The risks arising from the climate hazards are expected to impact the human capital (investors-business owners/managers, locals), tourism assets (natural and cultural assets and events), service quality (social capital, accessibility and facility establishment) and finally, the number of tourists and tourism incomes in the tourism value chain (Table 5).

Human capital, which refers to the tourism sector investors, business managers, employees and local people, is a significant factor for quality service delivery and consequently, the maintenance of tourist numbers and revenues. Investor or business manager profile can affect the institutionalization of business establishments as well as the capacity to develop measures against climate risks and leveraging incentives and financial support.

The number and qualification of tourism employees contributes to the sector's adaptation to climate risks. While the female and young labour force with post-secondary education is advantageous in terms of service quality in the tourism sector, vocational and on-the-job training are also significant in terms of enhancing human resource qualifications against climate risks (ISKUR, 2021a).

The rate of employment with SSI registration in the activity segments related to the tourism sector (NACE Rev.2; Code: 51, 55, 56, 79, 90, 91, 93) is 6.8% throughout the country (SSI, 2021). 31% of total tourism sector employment is in İstanbul and 10.5% in Antalya, followed by Ankara, İzmir, Bursa and Muğla. 61.1% of those employed in tourism-related sectors is located in the top 6 provinces. Tourism is the sector that accounts for the highest employment rate in Antalya and Muğla.

According to the Labour Market Survey (ISKUR, 2021), 6.9% of total employment throughout the country is engaged in the tourism-related "accommodation and food services" and "culture, arts, entertainment, recreation and sports" activities. 7.8% of female and 6.6% of male employees are engaged in these sectors, whereas the rate of employment within the sector is 32.0% for women and 68.0% for men (ISKUR, 2021).

In terms of the enterprise size, the majority of the tourism enterprises (87.5% and 91.4%) have 2 to 9 employees whereas the rate of those with 10-19 and more than 20 employees range from 4% to 7.5%. "Accommodation and food service activities" is the third sector where it is difficult to supply the labour force due to "unavailability of employees with adequate work experience", "inability to find applicants with requisite occupational skills/ qualifications" and "insufficient number of job applications to this occupation" (ISKUR, 2021).

Sectoral employment is concentrated in certain provinces. In Türkiye, tourism employment rate is lower compared to other sectors.

Local people may serve as qualified human resource and potential tourism entrepreneurs for the sustainability of tourism. The existence of trained population aged 15-34 is advantageous in terms of the conservation of tourism assets and tourism entrepreneurship. The employment of trained female human resource should be high in provinces with intensive touristic activities.

Tourism Assets (Attractions) include natural and cultural assets, local delicacies, and creative products and events that can direct tourist motivation

Table 5. Impacts of climate change on tourism value chain

HAZARD	EXPOSURE	VULNERABILITY		RISK
		Sensitivity	Adaptation Capacity	

1. Cultural and Faith Tourism, 2. Sea, Sand, and Sun Tourism, 3. Winter and Mountain Tourism, 4. Medical, Health, and Thermal Tourism, 5. Nature, Adventure, and Sports Tourism, 6. City Tourism, 7. Business Travel (MICE), 8. Interest-based and Creative Tourism (e.g., Gastronomy), 9. Eco, Agro, and Rural Tourism

APPROACH TO TOURIST SATISFACTION

HUMAN CAPITAL		
Investor / Operator	**Tourism Employee**	**Local Community**
Registered Tourism Businesses	Employment Rates in Tourism	Age Distribution
	Characteristics of the Employed	Gender (Male - Female)
	Distribution of Insured Workers	Social
	On-the-Job Training	School Enrolment Rates
		Literacy
		Education Level

TOURISM ASSETS (ATTRACTIONS)			**SERVICE QUALITY**						**WAGE**
Creative Industries	**Tourism Assets**	**Events**	**SOCIAL CAPITAL**		**Accessibility**		**Facilities Development**		Number of tourists
Handicraft Producers	Natural Assets	Local Guides	**Promotion and Marketing**	**Quality Assurance**	**Service (Infrastructure)**	**Transportation (Transport)**	**Food and Beverage**	**Accommodation**	Tourism revenue
Souvenir Production	Cultural Assets	Organisers	Seyahat Acenteleri	Rating System	Water	Airlines	Restaurant	Facilities According to Licences	
Souvenir Sales		Animators	Travel Agencies	Certification Bodies	Energy	Bus	Café - Bar	(Operation	
Local Artists			Public Institutions		Communication	Cruise & Ferry	Patisserie	Investment	
Local Markets			Tourism NGOs		Health	Railway	Local Food Producers	Municipality)	
					Banking	Taxi			
					Shopping	Airports			
					Waste	Car Rental			

and preferences and enable touristic activities. Establishing all processes related to tourism values and products in line with the principles of sustainable tourism and increasing the number of awareness-raising activities can improve adaptive capacity to climate risks.

In terms of Natural and Cultural Assets, Türkiye has a significant richness and competitive edge in terms of tourism with its cultural heritage, coastal lines, forest assets, and favourable weather and topographic conditions. A protection-utilization balance needs to be established with regard to enhancing the resilience of natural and cultural heritage to climate risks. Detailed studies must be conducted on such resources, as they can be exposed to climate hazards such as extreme weather events, forest fires, sea level rise, in addition to chemical and biological impacts caused by increasing temperatures. Tourism activities must be controlled in order to avoid the pressure of overexploitation in these areas. For the sustainable and planned tourism development, MoCT designated 234 "Tourism Centers and Culture and Tourism Conservation and Development Areas", most of which are located in Antalya, İstanbul, İzmir and Muğla (MoCT, 2022). Indicators for immovable cultural assets requiring protection, the number of protected areas, and protected area/provincial area ratios (MoCT, 2022a) are significant in terms of recognizing the areas that could be affected by climate risks in the context of tourism. Efforts are undertaken to achieve the planned tourism development by protecting and using the significant number of cultural and natural heritage assets across the country for tourism purposes. This situation serves the purpose of enhancing the sector's resilience to climate hazards and risks.

Tourism products offered at tourism destinations, such as tours and events, increase the length of stays and tourist expenditures, as well as impressing tourism to local people. It is important that the guides and organizers that offer such services are competent in terms of vocational skills and climate risks.

Service Quality offers significant indicators in terms of provincial climate risk adaptation capacities when addressing social capital components (in the context of promotion and quality assurance) in the sub-headings of access to services and physical infrastructure and establishment of facilities.

Social Capital, which covers the themes of cooperation and coordination among the actors in the tourism value chain as well as their ability to establish a control mechanism for quality service delivery, take common action and engage in joint promotional and marketing activities, contributes to the sustainability of tourism by building highly remarkable adaptation capacity against the impacts of climate hazards. Private sector tourism associations, responsible public institutions, local press and media, professional organizations with public institution status, and profit-oriented or non-profit NGOs established for tourism and cultural heritage conservation purposes must be included in this synergy and ultimately assume an institutional identity such as a destination management organization. Among the actors that could be involved in this synergy, the number

of certified agencies as of March 2022 is 12,818 throughout the country. Approximately 70% of tourism agencies in the country are located in the top five provinces (MoCT, 2022b). The number of local newspapers is high in the provinces that are prominent in the tourism sector (national average is 1.5 per 100,000 persons; BIK, 2022). The number of tourism-related cooperatives and associations is the highest in the top five provinces. The rate of tourism development cooperatives is 3% throughout the country (MoT, 2022). The number of tourism, environment, sports, culture and arts, and cultural heritage themed associations is lower than expected in significant tourism centers such as Muğla and Antalya. The country-wide rate of arts and culture and tourism associations is around 5% (Directorate General for Relations with Civil Society of the Ministry of Interior, n.d.).

Accessibility refers to the infrastructure services in the tourism value chain such as energy, water, waste management, etc., and the access to support services such as healthcare, banking and shopping. It also refers to alternative means of transport to destinations.

Access to Infrastructure and Support Services refers to access to services such as water, energy, communication, healthcare services, banking infrastructure, shopping and waste management. There is no significant unfavourableness across the country in terms of these indicators. In the high tourism seasons, over-use of water and wastewater discharge are significant sustainability problems in the tourism sector. Physical infrastructure must be constructed and improved especially for the treatment and recycling of water used in pools and for domestic purposes, and the use of rainwater must be considered. Waste management should not harm the environment. Recycling projects in this regard should be supported and the adverse impacts of waste on the ecosystem must be minimized. Additionally, educational campaigns and awareness-raising activities must be organized to raise public awareness to expand sustainable waste management applications. Local governments must be supported to ensure adequate and uninterrupted municipal services in highly favoured destinations during the tourism seasons. Electrical energy is used to produce products and services in the tourism value chain. Uninterrupted energy must be provided to fulfil a variety of support services including heating, cooling, kitchen and housekeeping services, food and beverage services, and lift infrastructure in ski resorts, etc. The increasing energy demand and challenges in diversifying energy resources throughout the country cause energy problems in the tourism sector, as well. The use of electricity produced from fossil fuels increases carbon footprints in the tourism sector and harms tourism values. In this context, it is critical to expand the concept of green tourism and applications which support the use of renewable energy resources and energy efficiency. Tourism will suffer problems in uninterrupted energy supply due to excessive energy use and infrastructural damages caused by the impacts of climate hazards. Such problems reduce sectoral service quality and take a heavy toll on the public image of destinations. Apart from the three major Turkish cities, Bursa and Kocaeli stand out in terms of electrical energy consumption due to their industrial production and they are followed by the tourism-intensive province of Antalya. In the context of electricity usage rate in public and private sectors and other subscriber groups, Antalya has the third highest provincial usage rate of 54.4%, while this rate is 7% across the country. This type of usage rate is also high in other tourism-intensive provinces of Muğla and Aydın (EPDK, 2022). While infrastructure indicators are changing for the better in terms of communication services, the damages from climate hazards must be taken into consideration in infrastructure investments.

Tourists' access to healthcare services is important in terms of health tourism as well as tourist health. Healthcare service delivery to foreign patients increases revenues while emergency treatment for tourists is significant in terms of destination image (SBKHGM, 2022). Health indicators throughout the country are close to OECD averages. As extreme weather events will increase the cases of injury, drowning, heatstroke, etc., emergency response teams must be deployed in touristic regions. Additionally, teams specialized in the new and potential health problems caused by climate change must be raised.
Banking is another significant service to which tourists must have access at a destination. Having a robust digital and physical banking infrastructure against climate risks will contribute to the resilience of the tourism sector. In addition, ensuring that banks provide value chain actors with convenient financing opportunities to enhance environmental sensitivity and take action for the adaptation to climate risks contributes to the tourism sector, as well.

Transport services in the context of tourism refer to access to destinations and tourism attractions. An improved spatial accessibility in the tourism sector helps benefit from tourism values and contributes to competitiveness of the destinations. However, the construction of transport infrastructure should not harm natural and cultural tourism values. Special attention should be paid to diversify the transport modes to access destinations and attractions, reduce carbon emissions, use environment-friendly applications and build suitable structures for transport capacity. The intensive use of public and private vehicles in transport largely using fossil fuels increases the sector's carbon footprints. For this reason, use of railways and maritime lines for touristic travels should be increased. Road, airway, railway and maritime transport infrastructure should be resilient to climate hazards, and those built by filling the sea should be reviewed.

Tourism facilities and businesses in Türkiye are mostly located in İstanbul (27%), according to the number of enterprises registered with the SSI (NACE Rev.2; Code: 51, 55, 56, 79, 90, 91, 93). İstanbul is followed by İzmir, Ankara, Antalya and Muğla, respectively. Tourism is the sector with the highest number of facilities and businesses in Muğla and Antalya. The highest number of tourism businesses engaged only in "accommodation" and "travel agency, tour operator and other reservation service and related activities" (NACE Rev.2 Codes 55 and 79) are located in İstanbul (24.6%), followed by Antalya and Muğla (11.9% and 8.4%, respectively). The provincial distribution of tourism businesses registered in SSI records is not balanced throughout the country, with the rate of businesses in the top 5 provinces being more than half of the country's

Figure 34. Impact chain: relationship between tourism and cultural heritage sector and heatwaves

HAZARD		EXPOSURE	VULNERABILITY		RISK
Climate Signal	Climate Impact		Sensitivity	Adaptation Capacity	
Increase in average temperature	Heatwave	Population density	Proportion of tourism in total employment	Per capita deposits	Decrease in tourist satisfaction
Increase in the number of extremely hot days	Increase in the number of consecutive hot days	Proportion of total number of tourists	Number of natural and urban conservation sites	Proportion of insured individuals/ participants in on-the-job training	Inability to conduct outdoor tourism activities
		Number of accommodation facilities*	Proportion of beds certified by municipalities	Proportion of women with mandatory insurance	Damage to tourism assets (cultural, natural)
		Number of cultural assets*	Proportion of overnight stays	Proportion of population with high school education and above	Decline in service quality and assurance
		Number of food and beverage facilities*	Proportion of population aged 15-64*	Number of active associations	Difficulty in accessing services
		Number of land, air, sea, and rail passengers*	Number of insured persons in the tourism value chain*	Number of cooperative members	Reduction in accessibility
			Occupancy rate of facilities*	Number of local newspapers	Deterioration of destination image
			Number of cancelled, diverted, and delayed flights*	Number of transportation modes*	Decrease in the number of visitors
			Per capita tourism revenues*	Number of cultural and tourism protection and development areas	Decrease in tourism revenue
				Number of certified facilities*	Exits from the sector
				Number of local product markets*	Decline in employment
				Sectoral distribution of employment*	Social and economic problems
				Tourism-related investment incentive certificates*	

The (*) symbol denotes indicators excluded from the risk assessments.

average (50.4% in the first group and 54.9% in the second group). Accumulation of tourism businesses in certain provinces and the lower share of these businesses compared to the total number of businesses in the provinces seem to be shortcomings in terms of the sectoral resilience to climate risks.
The ratio of investment incentives granted to the activity groups related to the tourism sector (MoIT, 2022) was the highest in Muğla and Antalya (31.4% and 26.8%, respectively) in 2001 and 2022. On the provincial basis, the tourism sector received less incentives compared to other sectors due to the lower number of businesses and the voids in institutional capacity to leverage state incentives and other types of support in the provinces except for those sheltering higher tourism capacity. The tourism businesses with higher institutional capacity, capital accumulation, and therefore, resilience to risks in Türkiye are, again, concentrated in the top five provinces. These provinces have received 52.1% of total tourism investment incentive certificates.

The top 5 provinces account for 49.1% of certified accommodation facilities by the MoCT and the municipalities and 66.5% of rooms in such facilities (MoCT, 2020c). The number of environment-friendly establishments increases in the provinces sheltering the higher number of accommodation facilities. Dissemination of the environment-friendly tourism facility practices by MoCT can reduce the level of sectoral climate vulnerability while increasing the adaptive capacity (MoCT, 2022c). The number of certified tourism facilities out of accommodation is an important indicator for ensuring the quality standards and the sectoral resilience to climate hazards (MoCT, 2022d). The number of Blue Flag Award-winning marine facilities, beaches and marinas and such types of ratings can contribute to the preparedness of destinations in terms of adaptation to climate risks. The number of blue flags by province and facilities is higher in Antalya, Muğla, İzmir and Aydın (Blue Flag, 2022).

It is expected that tourism facilities can be affected by climate hazards to varying degrees depending on their features like their location, the tourism types they serve, tourist profile and the business size. It is also estimated that particularly the accommodation facilities may have challenges in keeping up with the competitive conditions due to increasing input costs like energy demand and costs, food prices and labour cost.

Among the actors in the tourism value chain, tourism businesses are expected to be the parties which can face the largest negative impacts from the potential fluctuations in the number of tourists and the length of stays due to the changing snow depth and suitable seasons in winter tourism and the worsening thermal comfort conditions in summer tourism. They may be forced to make new investments due to the potential losses and damages to be experienced in the tourism source values caused by rising sea level, reaching suitable snow cover at higher altitudes, the depletion of water reserves serving tourism activities and deforestation. Additionally, it is critical within the context of enhancing the climate change adaptation of accommodation facilities that these facilities should be built resiliently to the disasters caused by extreme weather events, existing facilities should be reinforced for the same aims, site selection for the facilities and their orientation should carefully be done, and their architectural design should be made by considering the environmental characteristics.

It is a necessity to encourage the use of local building materials, which can be obtained through a short supply chain and are convenient with climate characteristics, and the low-carbon production systems in the construction of facilities.

Türkiye ranks the top fourth country to host the highest number of tourists and the seventh for the highest tourism income in 2022 (UNWTO, 2023) in the context of tourist number and tourism revenue. Lower per capita tourist expenditures in return for the longer stays increases the risks in the economic sustainability of the tourism sector (MoCT, 2022e). It is required to develop national tourism policies targeting to increase the tourism revenues by taking climate risks into account. There is a need for the adoption of environment- and climate-friendly tourism types which can generate a larger amount of revenue. The importance of the source market countries (sending tourists) has considerably increased due to the impacts of climate hazards. Some source market countries began to offer suitable regions for summer tourism activities due to temperature increases and heatwaves. Turkish destinations preferred densely by the tourists from these countries need to focus on this issue. In addition to those mentioned above, other tourism types may also suffer from the decline in tourist number and tourism income as a result of the losses and damages in the tourism assets. The top 5 Turkish provinces host 59.61% of incoming tourists and more than 70% overnight stays.

Tourism and Cultural Heritage Sector Risk Assessment: Heatwaves

The economic and social indicators in the tourism value chain regarding tourist satisfaction have been determined for actors. The risks are accepted to be the losses in the indicators like the number of tourists, tourism income and employment in the impact chain prepared for an exemplary climate hazard, heatwave, and presented in Figure 34.

The exposure of the tourism sector to climate hazards was determined to be higher in the provinces hosting the higher number of tourists and sheltering more tourism facilities. Therefore, exposure is “very high” in the Aegean and Mediterranean coastlines and the provinces in the Northern and Eastern Marmara Regions while “high” level of exposure is prevalent in the inner Aegean, South Marmara and Eastern Mediterranean Regions as well as Diyarbakır, Mardin and Batman provinces in Southeastern Anatolia, and Western and Central Black Sea Regions.

The sensitivity component was analyzed based on the value chain components such as human capital and service infrastructure which can provide service quality in tourism. It shows inter- provincial variations due to the differences in the factors such as the number of visitors, facilities, the length of stay and the distribution of tourism assets. According to the results, the provinces representing the highest sensitivity are İstanbul, Çanakkale and Balıkesir in the Marmara Region; İzmir, Aydın and Muğla in the Aegean Region; Antalya and Mersin in the Mediterranean Region; Eskişehir, Afyonkarahisar,

Ankara, Konya, Aksaray and Nevşehir in the Central Anatolia Region; Şanlıurfa in the Southeastern Anatolia Region, and Rize in the Black Sea Region. The adaptation capacity of provinces was analyzed using the indicators representing the presence of social and thematic sectors which can contribute to the tourism sector, the development level of the civil society, and the performance of the private sector. In this respect, adaptation capacity was determined to be the highest in İstanbul, Kırklareli, Edirne, Balıkesir and Bursa in the Marmara Region; İzmir, Muğla, Denizli in the Aegean Region; Antalya in the Mediterranean Region; Eskişehir and Ankara in the Central Anatolia Region; Düzce, Samsun, Ordu, Giresun and Trabzon in the Black Sea Region while it reaches the lowest level int the Eastern and Southeastern Anatolia Regions.

The vulnerability component is the function of sensitivity and adaptation capacity. From this point of view, the factors taken into account include the presence of natural and cultural heritage assets, the number of visitors and sectoral employment represent the sensitivity side on one hand and the social, human and monetary capital, which are needed to reduce the sensitivity level are thought to represent adaptive capacity on the other hand. In this respect, vulnerability of the tourism sector is expected to be higher in the provinces, where the sector is less developed. The provinces, where the vulnerability level of the tourism sector is the highest, are distributed in the southwest and east of the Central Anatolia Region. Mersin, Kahramanmaraş and Hatay in the Eastern Mediterranean, and Şanlıurfa and Diyarbakır in Southeastern Anatolia are also included in this group. Vulnerability is high in Çanakkale and Aydın in the west; Kütahya in the Central Aegean; Burdur in the Mediterranean; Bartın, Kastamonu and Rize in the Black Sea; Adana and Gaziantep in the south; Tokat in the Central Anatolia; and Van in the west and northeast of the Eastern Anatolia Regions. All regions and provinces, where the tourism activities are forefront, reflect low vulnerability level. This is caused by the fact that although these areas show higher sensitivity due to higher sectoral indicator values, they also have higher adaptation capacity.

Distribution of risk in the tourism sector caused by the heatwave is shown in Figure 35. According to the distribution map, the risk is seen to be the highest in Aydın and Muğla in the South Aegean Region; Antalya, Mersin, Adana, Hatay and Kahramanmaraş in the Mediterranean Region; Konya, Niğde, Nevşehir and Kayseri in the Central Anatolia Region; and Gaziantep, Şanlıurfa and Diyarbakır in the Southeastern Anatolia Region.

The reason why these provinces reflect the "very high risk" level is that the mentioned area is expected to have high level of heatwave hazard exposure and sectoral activities. Since both of the given indicator groups have high values, they aggravate the threat on the sustainability of natural and cultural assets. For this reason, the risk level is generally lower in the provinces further north, where the tourism activities are performed denser.

The risk level is high in an area starting from Tekirdağ in the Thrace Region towards Çanakkale in the South Marmara; İzmir, Manisa, Uşak and Afyonkarahisar in the Aegean; Ankara and Sivas in the Central Anatolia; Bartın and Karabük in the Black Sea; Malatya, Elazığ, Adıyaman and Van in the Eastern Anatolia; and Mardin and Batman in the Southeastern Anatolia Regions. The risk is relatively higher in the provinces where the indicators like the concentration of tourism assets, the number of tourism businesses, tourists and facilities have higher values. Therefore, the adaptive capacity must be improved in these provinces.

The factors thought to increase the risks in the case of provinces are the higher concentration of tourism activities and assets. In spite of this higher concentration, low institutional capacity and human, social and monetary capital that can mitigate the impacts of climate hazards increase the level of risks. It should not be withdrawn from these results that the provinces, such as İstanbul and İzmir, which are not in the high-risk group and rank the top tourism destinations in the world will not be impacted by climate hazards.

Figure 35. Risk map for current period: relationship between tourism and cultural heritage sector and heatwaves

8.4. CLIMATE CHANGE ADAPTATION MEASURES

The climate resilience and adaptation capacity of the Turkish tourism and cultural heritage sector will be strengthened, ensuring the sustainability of the sector.

According to the World Tourism Organization, the emphasis on climate change must be strengthened in national tourism development strategies. Vulnerability to climate hazards is higher in the countries where tourism has, and is expected to have, a high sectoral share in the national GDP (Scott et al., 2019). The share of the Turkish tourism sector in the GDP is on an increasing trend. Furthermore, increasing the contribution of the tourism sector is among the priorities set in medium- and long-term national and regional development plans. It is expected that climate risks may reduce tourism's contribution to the national economy and make it difficult to achieve sectoral strategic goals. The early climate change adaptation of the tourism sector will enable it to become more competitive at the global level. Achieving this adaptation, on the other hand, will be possible through the adaptation actions that will be formulated and implemented with the participation of all actors in the tourism value chain. The scope of the actions to be formulated to achieve the strategic goal of enhancing the climate resilience and adaptation capacity and ensuring the sustainability of the tourism and cultural heritage sector in Türkiye has been determined by taking into account the current status and vulnerability levels of the value chain components. In this context, the four components that were addressed at the highest level are human capital (investors-business owners/managers, locals, tourism employees), cultural heritage and natural tourism values (creative industries, tourism assets, events), service quality (social capital, accessibility, facilities), and tourism incomes and number of tourists. It is projected that the content of the actions presented will support these four components. The three strategic goals that were formulated accordingly are presented below, together with the descriptions of why they are required and the relevant actions.

STRATEGIC GOAL 1

To enhance the climate change adaptation capacity of tourism investments and enterprises in terms of infrastructure.

Tourism investments, facilities and establishments are unprepared for the risks that will be caused by climate hazards in the context of current tourism activities and their physical structures. Destination-specific and regional measures should be designated to improve and adapt their physical structures to climate change and its potential risks. In the context of institutional structures, adaptation must be ensured through capacity building by conducting training and awareness-raising activities related to climate change and its potential risks. Additionally, the physical structures as well as the tourism activities of existing and new establishments should be made compliant and, to begin with, constructed in line with climate risks. In this regard, the recommended actions should include those that cover the topics of transformation and building climate adaptive establishments, in addition to the sustainability and environment-friendly certification applications arising from the current legislation and practices. Consequently, it is a significant requirement to build physical and institutional adaptation capacity against climate risks in the context of investments, facilities and establishments.

TUR1. Develop criteria for the construction of resilient tourism facilities against climate risks, rehabilitate existing ones, and increase their adaptive capacity.

TUR2. Outline a legal and institutional framework to rehabilitate, construct, and supervise existing and new tourism facilities in accordance with the determined criteria, and provide financial support to enterprises for these purposes.

TUR3. Implement training programs and provide technical support for tourism enterprises and destinations to encourage sustainable tourism practices nationwide.

STRATEGIC GOAL 2

To improve social infrastructure to develop adaptive capacity to climate change in the tourism and cultural heritage sector

Enhancing qualified human resource capacity in the tourism and cultural heritage sector and the existence of joint action in the case of destinations will boost service quality as well as provide the sector with significant contributions in terms of sustainability. Training and employment of human resource equipped with vocational and technical know-how and an adequate level of knowledge and awareness of climate hazards and risks is crucial in terms of adaptation capacity. Organizing training and awareness-raising campaigns and providing cooperation opportunities, in addition to activities by formal educational institutions, will be considerably positive steps to be taken in this regard. Training and awareness-raising campaigns related to the impacts of climate risks on the tourism sector and relevant adaptation actions should be determined for the human resource in the tourism value chain, and studies should be undertaken to ensure common action by the relevant actors and establish a destination organization. It is important to designate the subjects, qualifications and legal framework for vocational training subjects in tourism, which also include topics related to climate change; and to deliver training programmes on the impacts of climate change on tourism, hazards and risks, and familiarizing with and using environment technologies at pre- and post-graduate schools and centers that offer tourism training. Efforts to improve human resource should be undertaken, including meeting the need for expert staff at responsible institutions to ensure the timely and correct performance of all kinds of response, particularly restoration and conservation efforts, to make cultural assets resilient to climate risks undertaking efforts to increase the level of awareness of current workers; having the institutions dealing with cultural heritage establish a common expert pool on climate change and defining the roles, powers and responsibilities of the relevant staff.

Other significant requirements include implementing legislative provisions to preserve the universal value of cultural heritage and meet their physical protection conditions; having national and international institutions cooperate to benefit from exemplary international protection applications; and transferring human and finance resources to build capacity in the responsible institutions. In order to make cultural heritage resilient to climate change; institutions that take part in decision-making processes should jointly use digital data platforms such as MUES (Museum National Inventory System) and TUES (Immovables National Inventory System), a climate vulnerability index should be formulated to identify the level of vulnerability of cultural heritage assets against climate change and impact assessments and risk assessments should be conducted in coordination with active field staff, priority response areas and needs should be designated, the financial and technical climate change adaptation capacity of relevant institutions and organizations in charge of cultural heritage should be enhanced in order to perform timely and correct responses.

STRATEGIC GOAL 2

To improve social infrastructure to develop adaptive capacity to climate change in the tourism and cultural heritage sector

Visitor planning should be made by considering the protection-utilization balance and carrying capacities; virtual tour opportunities should be provided through digital applications; contributions should be made to minimize climate risks in heritage sites by supporting coordinated efforts with local governments and NGOs; efforts should be undertaken to have relevant and responsible institutions to add the topic of climate change to their own areas of priority and strategic plans; projects should be developed that enable international institutions such as UNESCO, ICOM, ICOMOS, UNDP, etc., central and local governments and NGOs to make efficient use of national and international funds.

Undertaking promotional activities that can take climate hazards into consideration and limit the use of natural resources, avoid building destination images and tourist motivation on consumption, and contribute to the expansion of a responsible tourism approach will contribute to the enhancement of the tourism sector's adaptation capacity. Ensuring that tourism promotion and marketing activities are designed to create an image of sustainable tourism for tourists and updating the target markets that will change due to climate change after their tourism preferences and motivations are also significant in terms of enhancing adaptation capacity.

TUR4. Conduct training and awareness-raising programs on the impacts of climate change on tourism and cultural heritage, along with adaptation actions, at official educational institutions, responsible authorities, and sector-related NGOs, to enhance their technical capacity.

TUR5. Establish destination management organizations/offices to ensure local ownership, common action, and cooperation among stakeholders, and boost climate change adaptation capacity at tourism destinations.

TUR6. Prepare guidelines to identify climate risks and requirements for movable and immovable cultural heritage elements and sites and define priority responses.

TUR7. Establish local, national, and international cooperation and collaboration, along with inter-institutional coordination, to determine and reduce climate vulnerability levels and conserve cultural heritage and assets.

TUR8. Utilize specific materials aligned with changing tourist motivations and preferences, target market conditions, and sustainable and responsible tourism approaches, for country- and destination-specific promotional activities.

STRATEGIC GOAL 3

To consider climate change adaptation as a topic in the decisions of strategic and spatial plans related to tourism and cultural heritage and establish of inter-institutional coordination

Ensuring inter-institutional coordination on drafting spatial and strategic plans and implementing decisions relating to tourism and cultural heritage will provide significant advantages in building a protection-utilization balance. New plans must include climate risk adaptation measures and interinstitutional cooperation is required to implement the legislation. In this regard, it is critical to update the national tourism strategy by also considering climate change adaptation actions; building a coordination structure between central and local governments to prevent confusion of powers over the areas with protection status in existing and planned tourism destinations; and supervising, at the local level, the drafting and implementation of spatial plans that also consider climate hazards in order to prevent land demands and rent-seeking as a result of the improvement of the tourism sector in existing and planned tourism areas.

Other significant requirements include starting planning for sustainable tourism activities in new areas that will result from the shifting of tourism areas and seasons due to climate change; ensuring coordination in the planning of tours and events in a manner that will not cause overexploitation in certain regions and supporting travel agencies in the implementation phase; and undertaking planning and strategy development efforts to develop niche types of tourism in special themes and areas (international thematic routes such as EuroVelo and Cultural Routes of the Council of Europe, creative tourism activities based on intangible cultural heritage, events such as mountain tourism, etc.).

Moving away from the current tourism approach and applications that are based on the overexploitation of natural resources, ensuring the transformation of tourism in line with the principles of sustainability, and reasserting a responsible and sustainable tourism approach in the value chain are required to build resilience for the sector as well as the resources used by the sector. For this reason, expanding environmental technologies, eco-innovation and other eco-friendly applications, starting from establishments, and developing alternative and high income-generating types of tourism in line with tourist motivations and preferences are critical for the mitigation of climate risks.

Türkiye should formulate medium- and long-term action plans to expand sustainable tourism applications in lieu of the existing ones that create pressure on natural resources; make legal and administrative/ institutional regulations and regulate the incentive system; include climate risk assessments that consider climate change and hazards in tourism intended investment decisions; and evaluate and monitor the tourism value chain components and destinations on the basis of the sustainability criteria under the Türkiye Sustainable Tourism Programme. Other significant topics

STRATEGIC GOAL 3

To consider climate change adaptation as a topic in the decisions of strategic and spatial plans related to tourism and cultural heritage and establish of inter-institutional coordination

include reducing potential climate risks that may occur in existing tourism activities; enabling taking action by forecasting extreme weather events; being capable of providing the infrastructure and human resource required; building early warning systems in tourism regions to be prepared for situations that could result in physical harm, tolls and injuries; strengthening search and rescue teams; encouraging the use of environment friendly modes of transport in intra-destination transport and tours; meeting the needs of areas with technical infrastructure requirements due to climate change; and providing financial resources and additional funds to ensure that municipal services are delivered in line with the principles of sustainability in destinations with increased population during the tourism season.

TUR9. Update the strategic goals for the preservation and transmission of cultural heritage to future generations by integrating climate change adaptation actions into the preparation process of the new national tourism strategy.
TUR10. Incorporate climate change adaptation as a topic in spatial plans for potential tourism areas where suitability for certain tourism types may increase due to climate change, and ensure sustainable land use practices.
TUR11. Identify focal points suitable for niche tourism types in specialized themes and fields and develop sustainable tourism strategies to reduce the sector's climate vulnerability.

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INDUSTRY

climate adaptation

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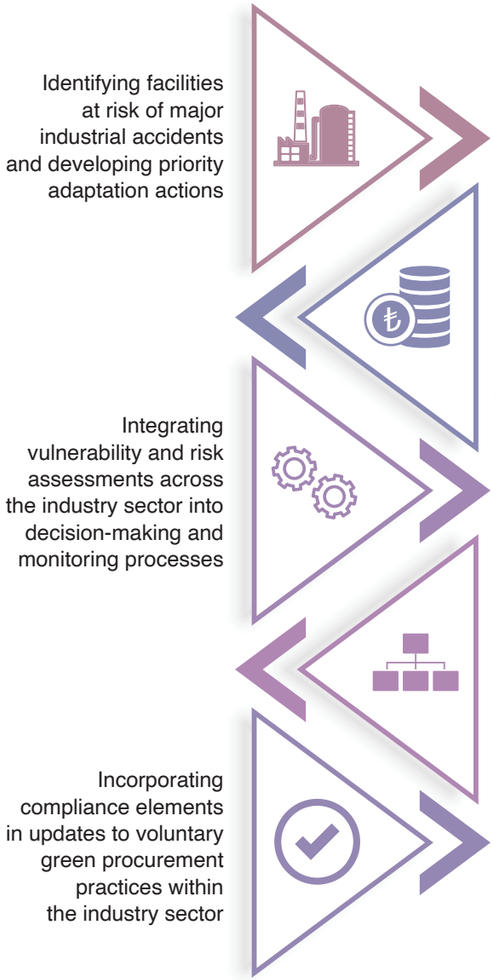
climate adaptation



9.1. GENERAL FRAMEWORK

One of Türkiye's primary goals is to further develop industries that produce intermediate and final goods, particularly those focused on exports. To achieve these objectives and adapt to climate change, the state of the technical infrastructure and the transformation processes within the sector are of critical importance.

The industry sector is one of the major components of the Turkish economy, with the largest share belonging to the manufacturing industry.

Based on the 2022 data, considering the sectoral activities that make up the GDP, the manufacturing sector is the second largest branch of activity after the services sector (TURKSTAT, 2020). As for the change in the share of the industry sector in Türkiye's GDP over the years, although there were fluctuations between 1998 and 2019, there was no significant shift in its share, which was an average of 17.6% (Figure 36).

According to TURKSTAT data, examination of the number of employees by economic activity between 2009 and 2021 demonstrates that the number of employees in the manufacturing sector grew by around 60%, while its share in the total number of employees did not change significantly (29% on average). (TURKSTAT, 2022).

According to the Electronic Data Transfer System statistics of the Central Bank of the Republic of Türkiye (CBRT), the capacity utilization rate, which is one of the main indicators for monitoring changes in production activity, reached approximately 78% between 1998 and 2021. The lowest capacity utilization rate was 66.9% in 2009 as a result of the global financial crisis and 61.6% in April 2020 as a rebound from the Covid-19 pandemic. Focusing on the production value by economic activity in the same years, the share of manufacturing, which was 43% in 2009, had risen to only 47% in 2020.

According to the Organized Industrial Zones Senior Organization (OSBUK), there are 332 Organized Industrial Zones (OIZs) approved by MoIT and 31 Agriculture-Based Specialized Organized Industrial Zones approved by MoAF in Türkiye. In terms of the value added of Turkish manufacturing, food manufacturing ranked first in 2020.

While the number of high tech and medium-high tech manufacturing enterprises in 2020 is 0.5% of the total, their share of business volume is 3.4%, around six times as high. Medium-high-tech enterprises again account for 27% of business volume, around 2.5 times the number of enterprises. While the share of medium-low technology enterprises remains unchanged, low technology enterprises, which represent more than half of all industrial enterprises, account for only 38% of business volume (TURKSTAT, 2021) (Figure 37).

As part of Türkiye's Twelfth Development Plan, the aim is to develop industries that produce intermediate and final goods, mainly for export. The technology profile of the industry sector will be a key determinant of the cost of low-carbon development and adaptation to climate change.

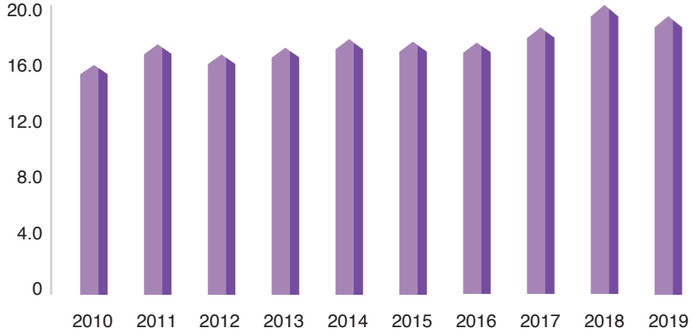


Figure 36. Share of value-added of manufacturing industry in GDP (in %)

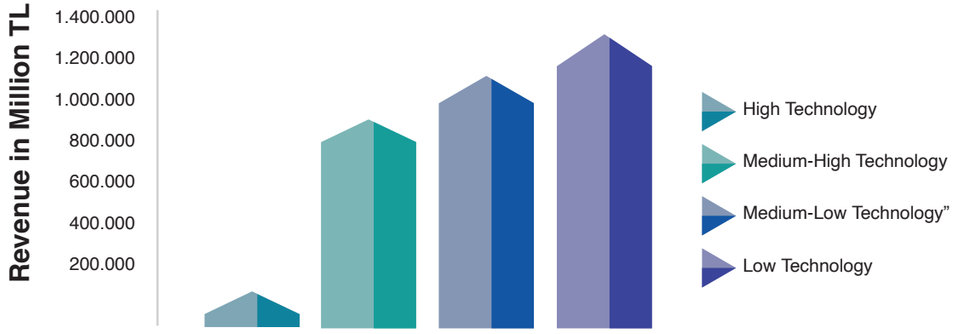


Figure 37. Distribution of business volume by technology readiness level

9.2. SECTORAL LEGISLATIVE FRAMEWORK AND RESPONSIBLE INSTITUTIONS

Achieving the medium-term (2030) and long-term (2053) GHG emission reduction and climate change adaptation targets in the industrial sector will require significant transformations over time. This process will drive efficiency, savings, innovation, and the adoption of nature-based solutions within the sector.

Upon entry into force of the Paris Agreement, Türkiye submitted its first NDC in 2015 and became a Party to the Paris Agreement in 2021. It submitted its updated first NDCs to the UN Framework Convention on Climate Change in 2023. Work in the buildings, energy, industry, transport, waste, agriculture, and forestry sectors is being undertaken under the NDC.

Coupling economic growth and climate change agendas gained momentum with the implementation of the 11th Development Plan (2019-2023), which designated the United Nations (UN) 2030 Sustainable Development Goals as a priority area, and this approach is sustained in the Twelfth Development Plan. The macroeconomic benefits of integrating renewable energy and energy efficiency, investing in infrastructure, and shifting financial resources to low-carbon solutions have also begun to be mainstreamed.

The Medium-Term Programme for 2024-2026 stipulates that green transformation will be given importance in all areas and sectors of the economy, taking into account the multi-faceted effects of climate change in the environmental, social and economic realms and the framework of development priorities. Unless solution-oriented steps are taken, there is a substantial risk that climate change-related problems, which are closely linked to the future of the global economy, will become even more challenging in the future.

Türkiye's CCASAP 2011-2023 focuses on five areas: water resources management; agriculture and food security; ecosystem services, biodiversity and forestry; natural disaster risk management; and human health. Although the industry sector is not listed under these five priority areas in terms of vulnerability, it is included as a stakeholder in many efficiency-oriented activities under measures identified based on highly vulnerable sectors and issues.

Türkiye's 2023 Industry and Technology Strategy was prepared under the vision of "National Technology, Strong Industry". The strategy is divided into five main components and 23 sub-policies: (1) High Technology and Innovation, (2) Digital Transformation and Industrial Movement, (3) Entrepreneurship, (4) Human Capital and (5) Infrastructure. The strategy aims to increase the number of software engineers in Türkiye from 140,000 to 500,000 by 2023. It aims for Türkiye to offer at least 23 smart products or services based on game-changing technologies on a global scale by

2023. Finally, the strategy estimates that the number of start-ups that have been launched at the venture stage and have reached a valuation of $1 billion or more will reach at least 10 by 2023.

Climate risk assessments have been carried out for the industry sector as part of the Climate Change Adaptation Strategy and Action Plan.

Borsa İstanbul's BIST Sustainability Index, the Carbon Disclosure Project (CDP) and voluntary sustainability and integrated reports prepared by organizations incorporate GHG reduction measures, climate change risks and planning activities. In addition, over the past few years, some reports appear to have addressed climate change risks in the framework of the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD).

Türkiye recognizes that curbing demand growth through increased energy efficiency is a critical foundation for enhancing energy security. To this end, the National Energy Efficiency Action Plan 2017-2023 aims to reduce Türkiye's primary energy consumption by 14 % compared to ordinary course of business levels in a range of sectors, including industry and certain cross-cutting fields.

The Green Deal, announced by the European Union in December 2020, sets complementary targets to those set out in the Paris Agreement, with the aim of making Europe carbon neutral by 2050 and reducing GHG emissions by 55% by 2030 compared to 1990 levels. The agreement is financed by the European Green Deal Investment Plan, which aims to mobilize at least €1 trillion of public and private investment over the next decade.

The European Union has proposed several strategies to achieve its goals under the Green Deal, one of which is the Carbon Border Adjustment Mechanism (CBAM). The CBAM legislation, officially proposed by the European Commission on 14 July 2021, was signed by the European Parliament and the Council on 10 May 2023, published in the Official Journal of the EU on 16 May 2023 and officially became applicable on 17 May 2023. Under the terms of the agreement, the European Union expects its importers to pay a carbon tax on the carbon emissions of their goods. This mechanism aims to prevent carbon leakage and create a global incentive for low-carbon production. After the transition period, European Union importers will purchase allowances equal to the embodied emissions of the goods they import. Consequently, the transitional implementation of the CBAM will start with the obligation to report GHG emissions in the iron and steel, aluminum, cement, fertilizers, electricity and hydrogen sectors as of 1 October 2023, and the financial obligations, which will be considered as carbon taxes, will be enforced as of 2026. The current EU ETS will be modified to support economic development in the face of potential competitiveness losses that could lead to carbon leakage. The relocation of producers to countries where carbon pricing does not exist will be on the agenda for countries such as Türkiye, which sends a significant proportion of its exports to the European Union.

As part of the fight against global climate change and to ensure the green transformation of the Turkish economy, the Green Agreement Action Plan has been prepared in cooperation with relevant institutions, organizations, NGOs and universities under the coordination of the Ministry of Economy and was published on 16 July 2021. The Action Plan includes 32 targets and 81 actions under 9 main headings, ranging from carbon border regulation to the establishment of a green and circular economy, from clean and safe energy to sustainable transport, and from sustainable agriculture to green finance, which is key to the realization of this transformation. For the implementation and further development of the Action Plan, studies will be carried out within the Green Deal Working Group and 20 Specialized Working Groups will be established with the participation of all relevant stakeholders. To implement and advance the Action Plan, studies will be carried out within the Green Deal Working Group and 20 Specialized Working Groups will be established with the involvement of all relevant stakeholders.

The key actions in the Green Deal Action Plan are grouped under the following headings:

- Limiting carbon emissions,
- A green and circular economy,
- Green financing,
- Clean, economic and secure energy supply,
- Sustainable agriculture,
- Sustainable smart travel,
- Combating with climate change,
- Establishing the principles of diplomacy,
- Raising awareness for the Green Deal.

Taking into consideration that exports to European Union countries constitute the main target market for Turkish exports, the CBAM is expected to have a significant impact on emission-intensive Turkish exports. Within the scope of the Green Deal Action Plan, significant progress has been made in the work to determine our country's roadmap and activities to support the reduction of GHG emissions in priority manufacturing sectors that may be subject to the Border Carbon Regulation, which is being coordinated by MoIT. In this context, roadmaps for the steel, aluminum, cement and fertilizer sectors are expected to be finalized in the near future.

Strengthening the technological infrastructure for green transformation is also a priority. In this context, under the coordination of the Scientific and Technological Research Council of Türkiye (TUBITAK) and MoIT, preparatory work for the "Green Growth Technology Road Map" is being carried out in cooperation with the "Technological Transformation Specialized Working Group", which includes all relevant institutions, potential manufacturing and technology development companies, and universities. 6 pilot sectors have been identified, namely iron-steel, aluminum, cement, chemicals, plastics and fertilizers, and the Green Growth Technology Roadmap studies are expected to be completed in 2023.

9.3. CLIMATE CHANGE IMPACTS

While climate change increasingly threatens the sustainability of Türkiye's industrial sector and raises the risk of Natech accidents—industrial risks triggered by natural hazards—the sector's awareness and adaptation efforts remain in their early stages.

Industry puts pressure on the atmosphere, water and soil - in short, on the receiving environment - through the consumption of natural resources, waste and pollutants in general. regulations to control the impacts of industry on the environment globally are becoming more widespread and relatively tightened each year the consequences and costs of industrial pollution remain significant. The social costs or externalities associated with the pollution caused by the sector remain significant, affecting human health, ecosystems, infrastructure and the climate.

While many companies are now identifying and analyzing specific risks and impacts related to climate change, such as increasing water scarcity, through overall sustainability plans, environmental management systems, risk management frameworks and product research and development teams, they have not yet developed a comprehensive response to the need for adaptation. However, this approach is making a positive contribution to creating "no-regret" compliance measures for companies. A limited number of companies appear to be taking a comprehensive and focused approach to climate risks and opportunities and developing a specific adaptation strategy as part of their overall approach to climate change. To effectively benefit from the synergies between adaptation and mitigation, especially for the industry sector, long-term adaptation goals should be set together with mitigation planning. Mobilizing the investment needed for adaptation requires greater awareness and cooperation at the stakeholder level, as it is an area that is less constrained or regulated by legislation than mitigation.

At this stage, it is of utmost importance to plan medium- and long-term actions for both sectors in a coordinated manner. Adaptation measures can provide additional mitigation benefits while contributing to the achievement of socio-economic objectives. This is also true for mitigation initiatives that can provide additional adaptation benefits. It is important that the synergies between adaptation and mitigation are considered and taken into account in the process of preparing the NDC that countries are required to submit pursuant to the Paris Agreement. Mitigation policy recommendations that are incompatible with adaptation objectives should only be considered if they are the only option.

Planning for disaster protection as well as reducing the already occurred damages is also critical. While the primary goal is to establish early warning and forecasting systems and to coordinate the necessary actions with all relevant stakeholders, preparing for the possible consequences of climate hazards is also a necessity for the protection of critical infrastructure, water and food safety, and industrial safety issues such as Natech accident risks.

Natural disasters may trigger Natech accidents, which potentially have major social, environmental and economic impacts, but are often overlooked. Natech accidents can lead to multiple and simultaneous releases of hazardous materials over large areas, damage safety barriers or systems, or even destroy systems. They can also cause damage to lifelines, which are often needed to prevent and mitigate accidents. Therefore, specific methodology and guidance are required to mitigate the effects of natural disasters.

Despite their local nature, Natech accidents need to be addressed in national risk assessments. Climate change, industrial growth and rapidly developing and changing demographics will increase the likelihood and impact of such disaster risks in the future.

The risks posed by climate change should be perceived by businesses as commercial risks. To support sustainable development, business should adopt a strategic approach to climate risks, taking into account the link between the needs of businesses and the needs of society. By doing so, adaptation to climate change and its risks can be achieved through a more inclusive and robust preparation (Figure 38).

Figure 38. Strategic nexus for private sector adaptation efforts

Business measures to adapt to climate change led to many advantages. These are listed below:

- Ability to mitigate and effectively manage risks
- Ensure sustainability of activities
- Prevent damage to assets or interruption of input supply
- Financial benefits (reduced costs, new revenue streams)
- Penetrating new markets
- Social license to operate
- Reputational benefits to external stakeholders, including meeting the current and future expectations of customers
- Competitive advantage over companies that do not adapt to climate change

Besides these benefits, there are future opportunities to benefit from adaptation efforts, in particular the development of products and services that facilitate adaptation and support the development of adaptive capacity, by accessing new public funding streams earmarked for adaptation to climate change.

Policymakers have a key leadership role in accelerating, facilitating and supporting business engagement in climate change adaptation. These efforts need to be scaled up where they are most needed and supported by policy decisions (Figure 39).

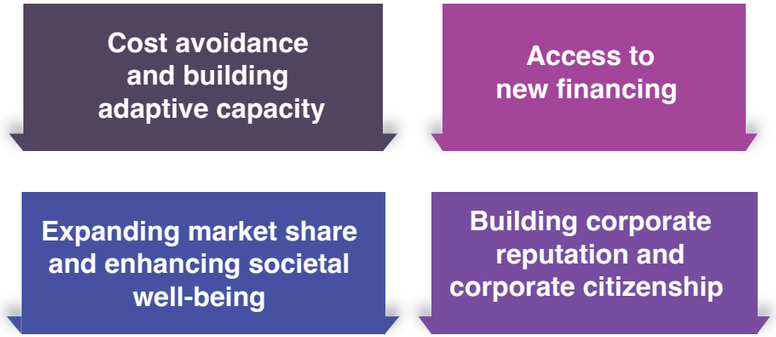


Figure 39. Benefits of adapting to climate change for business community

In terms of identifying climate change risks and adaptation measures to be taken, precautions should be taken such as developing sectoral policies according to national climate change adaptation targets, making smart water management mandatory in infrastructure projects, establishing early warning systems for disasters and disseminating climate change awareness. It is very important for businesses to be involved as key stakeholders in defining climate change adaptation solutions.

Established in 2016 under the auspices of the G20, the Task Force on Climate-related Financial Disclosures (TCFD) has published draft recommendations for companies to provide voluntary, consistent, comparable, reliable and transparent disclosure of climate-related financial risks to creditors, insurers, investors and other stakeholders. These recommendations incorporate measures such as GHG emissions and energy and water efficiency, as well as financial sector measures. The TCFD's recommendations are of great assistance to financial sector analysts in pricing climate-related risks and opportunities.

Furthermore, it is crucial to disaggregate the impact on the supply chain in terms of establishments operating in the sector, by sub-industry and location. As the characteristics of supply chains will vary between industries and even between establishments due to many factors such as company size, location, product and logistics diversity, and trading network, it would be beneficial to scale them up based on the results obtained on a national basis.

Industry sector risk assessment: heavy precipitation

To analyze the climate risks for the industry sector at the provincial level in Türkiye, an impact chain was created according to the risk of heavy precipitation, as shown in Figure 40. In the impact chain, relevant indicators were selected to assess the risk of the sector, but the analyses were carried out with the data available within the scope of the study.

Should the exposure of the industry sector in Türkiye be assessed, it is evident that exposure in the western half of the country is generally at high and very high levels. In the eastern part of the country, exposure is relatively low.

Overall, it can be concluded that the provinces with very high and high exposure stand out in terms of the number of OIZs and employment parameters in industry. It is noteworthy that the provinces of İstanbul, Bursa, İzmir, Kocaeli, Ankara and Tekirdağ, where very high levels of exposure were recorded, are also located in regions where water use is relatively intensive and agricultural-based industries such as food and textiles are predominant.

Nevertheless, the CORINE Land Cover Classification includes, under Industrial and Commercial Units, the largest areas of land used primarily for industrial processing and manufacturing, trade, financial activities and services, as well as associated land and access infrastructure, including expanding industrial facilities, additionally, exposure is either very high and/or at a high level in their provinces.

In terms of the vulnerability of the industry sector to heavy precipitation in the provinces, it was determined that vulnerability is higher in the western half of the country and in the metropolitan areas. Overall, more than half of the 81 provinces appear to have moderate or higher sensitivity. The eastern provinces exhibit very low levels of sensitivity.

In assessing the adaptation capacity of the provinces, it was determined that it was generally at a high level in the provinces of the Marmara region, the Aegean and Mediterranean coasts, the eastern Black Sea coast and the western Central Anatolia region, but at a relatively low level, especially in the Southeastern provinces and the southern provinces of Eastern Anatolia.

Considering the components of sensitivity and adaptive capacity of Türkiye at the provincial level in combination, and assessing the level of vulnerability of the provinces to heavy precipitation, it is observed that the level of vulnerability is high in the provinces of the Central Black Sea and its inner parts, in the provinces in the east of Central Anatolia, in the provinces generally located in the inner part of the Aegean region, and in the provinces of the Eastern Mediterranean region.

The risk map obtained by analyzing the exposure, vulnerability and hazard components at the provincial level in Türkiye is shown in Figure 41. It demonstrates that almost half of the 81 provinces exhibit a moderate or high level of risk. This risk is particularly severe in the provinces of Balıkesir, Manisa, Aydın, Denizli in the Aegean region, where vulnerability is considered high; in Mersin, Adana, Hatay in the Mediterranean region; in Gaziantep in the Southeastern region; and in Sakarya, Kastamonu, Samsun, Amasya, Ordu and Giresun in the Black Sea region where precipitation is predicted to remain very high.

Figure 40. Risk map for current period: relationship between industry sector and heavy precipitation

Figure 41. Impact chain: relationship between industry sector and heavy precipitation

HAZARD		EXPOSURE
Climate Signal	Climate Impact	
Increase in precipitation amount and frequency	Flooding	Number of OIZs
	Increase in the number of heavy rainfall days	Proportion of industrial and commercial units
		Number of employees in industry
		Number of industrial capacity reports

VULNERABILITY		RISK
Sensitivity	Adaptation Capacity	
Scaling by number of employees (Micro)	Number of active associations	Increase in production costs
Industry's share in GDP	Number of R&D and design centres (TGM)	Loss of market share
Facilities with major industrial accident risks (lower tier)	Proportion of facilities with WWTPs to total facilities	Losses in jobs and productivity
Total number of floods and inundations experienced	Proportion of population with high school education and above	
Exports by province	Loss of market share	

Industry sector risk assessment: drought

A vulnerability and risk assessment of the drought hazard was conducted for the industry sector, specifically for the provinces. The impact chain used in the analysis is shown in Figure 42. As the set of indicators used in the drought risk assessment is remarkably similar to the heavy precipitation hazard, a drought risk map was prepared for the industry sector (Figure 43).

Consequently, the risk was determined to be at a higher level, especially in the southern half of the country. Balıkesir, Manisa, Denizli, Afyonkarahisar, İzmir, Aydın in the region of the Aegean; Konya, Karaman, Sivas, Malatya, Kahramanmaraş, Ankara, Kırıkkale, Aksaray, Niğde in Central Anatolia; and Şanlıurfa and Diyarbakır in the Southeastern and Erzurum in the Eastern Anatolia has been classified as high-risk provinces.

Based on the evaluation of the results, the adaptive capacity of provinces characterized with high exposure should be strengthened as a matter of priority, especially with regard to the textile industry, which is based on agriculture and is generally sensitive to water supply.

In light of the assessments made in terms of the size of the industry sector and the sub-sectoral distribution in the high-sensitivity provinces, it is considered important to increase the adaptive capacity in the medium term by prioritizing water and energy saving practices and by reorienting the industrial portfolio to shift the sub-sectoral distribution towards relatively higher value-added and less resource-intensive sectors.

In provinces identified as highly vulnerable, it is critical to focus on information activities aimed at strengthening adaptive capacity, primarily through OIZs, and to ensure the sustainability of the industry sector by providing technical and appropriate financial support to establish the necessary infrastructure.

Figure 42. Risk map for current period: relationship between industry sector and drought

9.4. CLIMATE CHANGE ADAPTATION MEASURES

Data-driven risk assessments will enhance the climate resilience of the industrial sector, improve insurability, foster collaboration, and integrate climate adaptation elements into green procurement criteria.

For the industry sector, it is necessary to identify vulnerability factors as three primary stages including core operations (such as physical assets, the efficiency of production processes, cost of operation and maintenance activities, health and safety, human resource and labour productivity), value chain (such as the ability to supply raw materials and services, customer demand for specific products and services) and extended network (infrastructure required for export or import, public services such as energy and water services) (Figure 44).

In this context, vulnerability and risk assessments should be carried out based on the priority sectors to be identified. The results of these analyses will form the basis for many applications, from updating the local site-specific contingency plans prepared by AFAD to insurance regulations.

Figure 43. Impact chain: relationship between industry sector and drought

HAZARD		EXPOSURE
Climate Signal	Climate Impact	
Increase in average temperature	Drought	Number of OIZs
Decrease in total precipitation amount	Decrease in precipitation amount and number of rainy days	Proportion of industrial and commercial units
	Increase in the number of consecutive dry days	Number of employees in industry
		Number of industrial capacity reports

VULNERABILITY		RISK
Sensitivity	Adaptation Capacity	
Scaling by number of employees (Micro)	Number of active associations	Impact of increased temperatures on working conditions in production processes
Industry's share in GDP	Number of R&D and design centres (TGM)	Impact on raw material and product storage conditions, leading to increased need for climate control
Number of registered food product manufacturers	Proportion of facilities with WWTPs to total facilities	Disruption of production due to lack of water supply
Facilities with major industrial accident risks lower tier	Proportion of population with high school education and above	Loss of productivity in production
Exports by province		Increase in costs
		Loss of labour

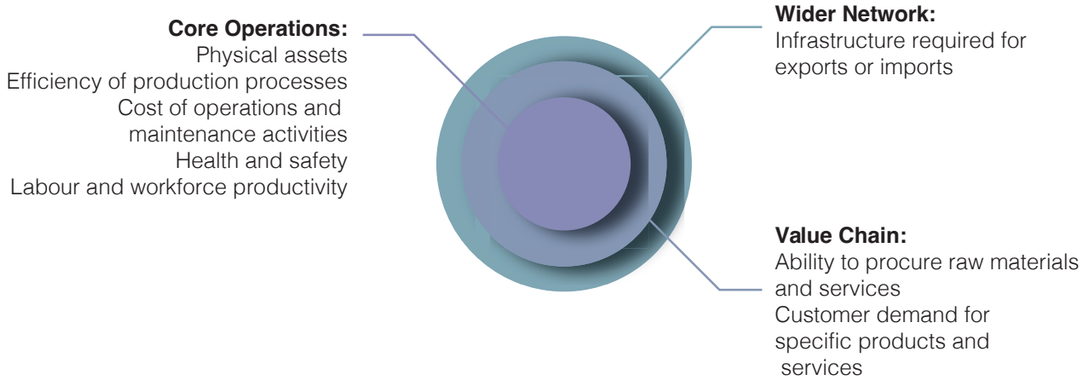


Figure 44. Vulnerability factors in industry sector

It is assumed that the data that will form the basis for planning adaptation measures specific to the industry sector at national and local levels will not be sufficient for the research and analysis that needs to be done. The industry sector, which is incorporating climate change issues into its agenda with a focus on GHG reduction, needs to monitor data on very basic indicators such as water consumption by source and recycling rates. As discussed in the Twelfth Development Plan, it is essential to increase water efficiency in industry, particularly by improving existing techniques. In this context, the flow of data through the proposed indicators will allow for detailed analyses specific to sub-sectors, organizational scales and locations.

[5] 880.4. Sanayide mevcut en iyi tekniklere geçilerek su verimliliği artırılacaktır.

STRATEGIC GOAL 1

To identify the facilities exposed to the technological risks triggered and major industrial accident risks.

Technological risks such as fires, explosions and spills caused by natural disasters such as floods, landslides and lightning, which have a potential domino effect, are an issue of strategic importance to the industry. Triggered technological risks can arise from chemical processes, pipelines and facilities that process, store or transport hazardous substances, and their impact on other infrastructure can cause fires, explosions and toxic or radioactive spills.

Disaster risk reduction measures may not always take into account technological hazards in industry, and chemical accident prevention measures may not necessarily cover certain aspects of the technological risks involved. This implies a need for specific methodologies and guidance for risk assessment and management for industrial facilities.

Technological risks that are initiated can have major cascading social, environmental and economic impacts. These risks may lead to multiple and simultaneous releases of hazardous substances over large areas, damage or destruction of safety barriers or systems, and damage to lifelines that are often needed to prevent and mitigate accidents. In addition, emergency response teams may be inadequately equipped and trained as they often have to respond to multiple incidents at the same time and react to the consequences of natural hazards in tandem.

STRATEGIC GOAL 1

To identify the facilities exposed to the technological risks triggered and major industrial accident risks.

By adopting a proactive approach to minimize business interruptions and the associated economic losses, taking into account the possible impact of climate change on the severity of extreme weather events, the business community can develop a series of measures specific to the structure of facilities on its own initiative, in addition to its legal obligations. Indicators of a regulatory framework to control induced technological risks may include components such as land-use planning, security incidents, emergency planning, and rules, guidelines and standards prescribing how the framework is to be implemented. Frequent evaluation of safety standards, particularly in relation to the effects of climate change, will also make an important contribution. The inclusion of triggered technological risks in environmental risk management frameworks, alongside technological risk regulation, would be a potentially important adaptation measure.

During the design phase of a hazardous facility, it is crucial to consider the risks that may arise from natural hazards. In addition, the organization of training and awareness-raising activities to assist stakeholders in recognizing the vulnerability of hazardous facilities to natural disasters will play a critical role in increasing adaptive capacity.

IND1. Re-evaluating facilities at risk of technological risks and/or major industrial accidents triggered by climate change-related disasters, based on climate projections and vulnerability and risk assessments.
IND2. Reviewing the risk assessment and contingency plans of each facility in the context of climate change adaptation, completing the necessary updates, identifying priority adaptation actions and implementing the identified actions.

STRATEGIC GOAL 2

To evaluate and monitor the impacts of climate change on investment and that of investment on the climate prior to investment projects.

Before investment projects, it is important for long-term planning that measures are taken to update existing legislation and to monitor the provisions currently in place to assess and subsequently monitor the impact of climate change on investments and the impact of investments on the climate. Although the potential environmental impacts are assessed in detail in the content of the documents prepared according to the applicable Environmental Impact Assessment legislation, the regional carrying capacity of the receiving environment and the physical climate risks of the region should become decisive in the investment decision-making phase.

Safety and environmental considerations should be paramount in decisions relating to land use and the location of hazardous industrial activities. It is extremely important to take appropriate safety measures in industrial facilities and to ensure that they are not built in areas prone to natural disasters and other risks. In this context, it is of utmost importance to assess the potential environmental and health risks posed by hazardous industrial facilities, to raise awareness of these risks and to identify the safest and most sustainable alternatives through intersectoral dialogue. Thus, there is a continuous need for improved integration of industrial safety, land-use planning and environmental assessment procedures to enable coordinated decisions on accident prevention and risk reduction.

Moreover, green transformation requirements in newly established organized industrial zones must take into account compliance criteria such as site selection and regional capacity of ecosystem services.

IND3. Reviewing investment incentive legislation and practices (primarily allocation of investment sites) from a climate change adaptation perspective, taking into account vulnerability and risk assessments across the industry sector in decision-making and monitoring processes.

STRATEGIC GOAL 3

To make the necessary updates after reviewing the insurance legislation with to increase insurability against the impacts of climate change.

Given that climate change is increasing the frequency of extreme weather events, the probability of being unable to adapt to them in a timely and appropriate manner is also increasing. In this case, insurance premiums will inevitably come into play and companies will hedge their bets.

The insurance gap is an issue that can be directly linked to the sustainability of businesses, especially for SMEs in regions prone to extreme weather conditions and events. Many businesses do not yet consider this area to be covered by insurance. On the other hand, even if they are fully aware of the risks, the potential high premiums may be a deterrent for many businesses. In this context, the development of instruments to provide financial support to SMEs will be crucial to increase uptake. Insurance coverage is equally important for facilities at risk from industrial accidents and natural disasters. In the event of an accident, compensation could be financially devastating for these facilities. In addition to preventive measures, the compensation that organizations receive from insurance can be crucial to their continued sustenance after exposure to physical climate risks.

For companies that can afford the premiums at all, details such as correctly defining the scope and adapting the company's internal procedures (accident definitions, instructions, etc.) will be crucial to claims settlement.

IND4. Monitoring insured industrial assets at risk from climate change-related catastrophes and climate hazards.

STRATEGIC GOAL 4

To ensure quick and practical access to national projections and databases for the studies to be carried out by the industry sector.

Access to national projections and databases by sectoral organizations and scientists working in this area will provide valuable input to the process in the following aspects:

- Conduct detailed vulnerability and risk assessments at the organizational level
- Provide rapid and practical access to climate projections and use them in industry sector studies
- Support the work of industry organizations toward science-based targets with national databases
- Develop nature and technology-based adaptation solutions for industry, national/international organizations, research centers and universities.

Additionally, it is essential for comprehensiveness and complementarity that all studies in the country are based on the basic analyses of the month.

IND5. Identifying sub-sectors of industry most vulnerable to climate change and developing adaptation guidelines for these sectors.

STRATEGIC GOAL 5

To encourage cooperation within the sector (mentorship system and training of trainers).

Discussions during stakeholder engagement activities have indicated that a significant proportion of companies and sectoral NGOs have only elementary information about climate change.

In general, the main source of information for micro and small enterprises on many issues is communication with similar and correlated enterprises. Exchanging experiences and advice with other businesses often works better than using online searches or public information websites.

Creating platforms to support SMEs to access and discuss industry-specific information and to collaborate with other companies on climate-related risks and opportunities will be one of the key communication areas to facilitate this process.

It will be necessary to support the SME sector, including start-ups, by providing clear and specific information on current and projected climate-related risks to businesses, and to assist businesses in identifying and adopting the most appropriate approach to managing climate risks and opportunities.

IND6. Organizing a training programme for trainers through the sector.
IND7. Strengthening the capacity of industrial enterprises, in particular SMEs, concerning technical know-how for adaptation to the effects of climate change.

STRATEGIC GOAL 6

To encourage the inclusion of climate change adaptation components in green procurement criteria.

As part of this strategy, it is recommended that compliance-oriented items be included in the Green Procurement Guide. In addition, a transition plan can be presented, starting with the priority sectors (e.g. construction) and the large-scale producers that supply them with their main goods (e.g. cement, steel producers). Increased use of alternative raw materials and fuels are additional benefits that can be offered in this context.

Establishing mechanisms for technical and financial support for investments in technological transformation at the commercialization stage for producers of materials that will be subject to green procurement criteria can be put on the agenda.

IND8. Providing information on the inclusion of compliance elements in the updates to be made for voluntary green procurement in the industry sector.

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TRANSPORT COMMUNICATIONS

climate adaptation

Ensuring the resilience of urban vehicle, bicycle, and pedestrian roads, as well as all public transport infrastructure, to climate-related risks

Planning and expanding green and blue infrastructures in urban to increase permeable surfaces and to improve drainage, while mitigating the effects of heatwaves across all transport modes, including bicycle lanes and pedestrian paths

Developing a flexible transport infrastructure with strong modal diversity and intermodal integration in cities

Strengthening the resilience of data centres, base stations, and electronic communications infrastructure to climate-related risks within the communications sector

Integrating smart and mobile applications into early warning and transportation information systems for climate hazards

TRANSPORT COMMUNICATIONS

climate adaptation

10.1. GENERAL FRAMEWORK

Despite significant investments and achievements in regional and urban transport, as well as communications, Türkiye's transport system offers limited modal diversity, and its transport and communications infrastructure remains open to further development.

Türkiye has an advanced highway infrastructure. Although the country had initially invested in railways during the first period of the Republic, there has been a strong investment trend in the expansion of highways since the 1950s. Over the last 20 years, however, investments in railways have increased again with a view to developing and expanding the high-speed and fast-track railway network. In addition, modernization investments are being made to upgrade the existing conventional lines and make them suitable for electric-powered transport. Air transport has also benefited from a significant share of investment since the 1990s, and the number of airports in the country has increased markedly. The use of rivers and canals in maritime transport is limited, but the country has ports that play an important role in national and international transport.

In parallel with these infrastructure opportunities, 93% of passenger transport is by road, with the railways accounting for less than 1% (Figure 45). While the share of airlines is 6.3%, the share of maritime is almost negligible in passenger transport, but the latter has a share of 6% in freight transport. Railways have a higher share in freight transport when compared to passenger transport, although that share is less than 5%. Highways also dominate freight transport with a share of 89.4% (MoTI, 2022). When pipelines are included in this analysis, the share of highways in freight transport amounts to 80% due to the estimated share of pipelines around 10% (MoTI, 2011).

In urban transport, walking still has a significant share. Although it varies according to the physical and geographical characteristics of cities as well as their spatial size and the resulting travel distances, 30 to 50% of urban trips are made by pedestrians.

In fact, this trend is a characteristic of cities in developing countries where car ownership is relatively low. While the number of cars per 1000 people in developed countries is between 400-600, in our country it is 167 (MoIT, 2022). The rate of growth in car ownership and use, on the other hand, is very high. While in 1990 there were only 25 cars per 1000 people in the country, since then it has increased 6 times.

Despite the increase in car ownership and use, the predominant mode of transport in our cities is public transport. It seems that local governments have adopted the principle of developing and improving public transport and ensuring that an increasing proportion of journeys are made by public transport. Investment in metros, light rail and trams is widespread; regional rail services are being developed making use of the existing rail network; and applications such as trolleybuses, electric buses and dedicated bus lanes are increasing. In cities with maritime and water features, there are practices to develop and promote waterborne public transport systems, such as sea buses, ferries and boats. Transport services provided by small-scale private enterprises is also among the services that can be classified as public transport. In addition to privately operated bus services, paratransit systems such as minibuses and "dolmuş" also play an important role in urban circulation.

Although the use of bicycles as a means of urban transport has been limited to certain cities, in recent years Bike Transportation Master Plans (BTMP) have been prepared and bike-sharing systems have been established in many cities. The use of e-scooters as a shared system is likewise becoming more widespread.

As for the communications sector, it is critical to develop technology and communications infrastructure for the information society, which stands as a national goal in this sector. In our country, the mobile phone ownership rate is 102%, and the subscriber rate for 3G and 4.5G, which are high-speed mobile Internet technologies, is 99.5% (High Council for Telecommunication, 2022). Since the fixed broadband penetration rate is 21.4%, which is far below the relevant rates compared to the number of mobile phone owners and high-speed internet users, it is evident that studies are needed to increase the use of fixed broadband. Increasing the percentage of fiber optic infrastructure in fixed broadband is also important for high speed and high-capacity access, and this percentage is 27%. High-quality access conditions for both mobile and fixed broadband and increasing the number of subscribers are important for all people to be able to use communication tools and access information efficiently. In addition, the availability, quality and penetration of these technologies are important issues for early warning and emergency response during disasters, including those related to climate hazards.

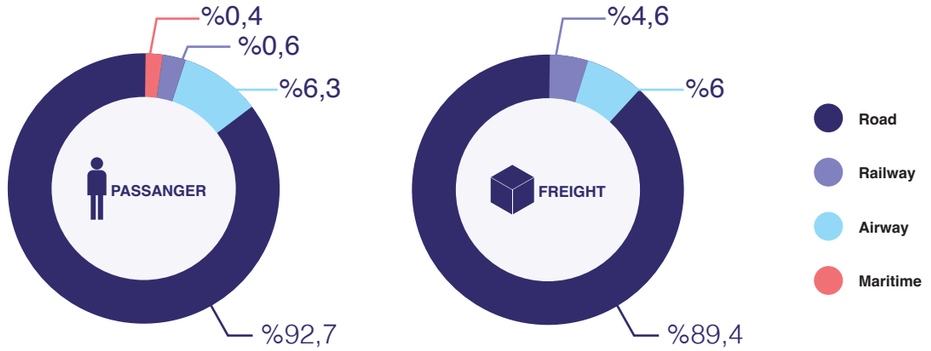

Figure 45. Domestic passenger and freight shares by modes of transport in Türkiye (2021)

10.2. SECTORAL LEGISLATIVE FRAMEWORK AND RESPONSIBLE INSTITUTIONS

In the transport sector, climate change has primarily been addressed within the framework of GHG reduction strategies in Türkiye. As a result, there is a substantial body of knowledge on climate change mitigation, accompanied by numerous policy and strategy documents.

The organizations responsible for the transport and communications sector at national level are the Ministry of Transport and Infrastructure and its affiliated and related organizations (General Directorate of Highways, General Directorate of State Railways of the Republic of Türkiye, General Directorate of Maritime Affairs, General Directorate of Civil Aviation, General Directorate of State Airports Authority, Information and Communication Technologies Authority, etc.). At the local level, municipalities are responsible for urban transport, but the decision-making and planning authority for infrastructure of national importance (ports, airports, railway stations, highway crossings) lies with the aforementioned national institutions. Municipal responsibilities include the provision of public transport, traffic regulations, parking areas, pedestrian ways and biking paths. In settlements granted metropolitan status, the metropolitan municipalities are responsible for the preparation of transport master plans, the provision of public transport services throughout the city, and the regulation of motor vehicle, bike and pedestrian traffic on main arteries and streets, while the district municipalities are responsible for lower hierarchy roads and neighbourhood-scale streets, parking areas, etc. In addition, in cities with metropolitan

status, there is an institutional structure, the Transport Coordination Center (UKOME) created within the metropolitan municipalities, that allows for joint and coordinated decision-making.

The legislation that constitutes the legal framework in the sector is generally the laws and regulations that vest the above-mentioned institutions with the responsibility for carrying out transport activities and developing the necessary infrastructure. In addition, the Regulation on Procedures and Principles for Increasing Energy Efficiency in Transport includes measures to reduce energy consumption and ensure energy efficiency in transport at national and local levels.

As reflected in the Regulation's emphasis on energy reduction, climate change issues related to the transport sector are mainly addressed in the context of GHG emission reduction, i.e. climate change mitigation strategies. The transport sector accounts for around 25% of global emissions of CO2, the leading GHG implicated in climate change. Reducing these emissions created in the transport sector is of vital importance in the fight against climate change in order to reduce GHG emissions and curb climate change. For this reason, climate change issues have been tackled in the sector predominantly through the lens of mitigation strategies whereas strategies for adapting to the effects and risks of climate change have only recently begun to be addressed. This predominance of mitigation strategies as opposed to adaptation has been the case for the transport sector throughout the world as well as in Türkiye.
As a result, there is a considerable reservoir of knowledge and numerous policy and strategy documents to reduce GHG emissions in the sector. Development Plans are at the forefront of this, and since the 1970s strategic goals have been adopted to develop multi-modal transport, ensure integration between different modes and thus change the highway-dependent transport system in the country. In urban transport, the emphasis on developing urban transport systems based on public transport has been included in the aforementioned plans since the same period. With the 8th Five-Year Development Plan for 2001-2005, environmental impact and negative externalities of transport have started to be addressed, and the need to reduce GHG emissions from the transport sector have become prominent objectives. Consequently, the Development Plans have consistently proposed the further development and expansion of railways and more effective use of maritime transport, improvement of conditions for pedestrians and cyclists, as well as development of high-quality public transport systems and services.

Another important policy document at the national level is the Transport Master Plan. The first national master plan study was carried out in 1982, and in this plan which is for the period 1983-1993, it was emphasized that the share of railways and maritime transport should be increased through investing in these modes, and that the infrastructure for urban transport should be built in such a way as to promote public transport. A Communications Master Plan was also prepared for the same period, which emphasized the need for infrastructure investment using new technologies for a modern communications infrastructure.
The Transport Master Plan Strategy 2005-2015 highlighted the impact of the sector on climate change and adopted targets to reduce GHG emissions and develop environmentally sustainable transport systems. In the National Transport Master Plan 2015-2017, under the heading of environmental sustainability, rail passenger transport is emphasized, targets such as the priority of pedestrians in urban transport, the shift from the use of private cars to public transport are adopted, and the goal of reducing the carbon footprint is emphasized.

The Transport and Communications Councils convened in our country also steer policies and investments by defining national strategies in their conclusions. In this context, in order to reduce GHG emissions in the sector, emphasis is placed on the development and promotion of railway infrastructure throughout the country, public transport, bike and pedestrian transport in urban, as well as the increasing the number of vehicles that use clean energy. In the field of communications, the focus is on creating a modern and advanced communications infrastructure in the light of technological developments.

In the scope of the National Climate Change Action Plan (NCCAP) that was prepared for the years 2011-2023, the transport sector has been considered as a sector for which mitigation strategies have been developed. Consequently, the plan proposed the development of an intermodal transport system to ensure a balanced use of modes in freight and passenger transport; the restructuring of urban transport infrastructures and systems through the principles of sustainable transport; expanding the use of alternative fuels and clean vehicle technologies; and increasing energy efficiency in the sector. In Türkiye's CCASAP 2011-2023 which was prepared during the same time, the transport and communication sectors were not addressed under separate headings, but it was stated that the transport sector will be affected by the hazards of climate change and therefore the costs of the impacts should be taken into account in transport plans and that the sector should adapt to climate change.

In the document titled "Türkiye Transport and Communication Strategy Target 2023" drafted in 2021, the issue of climate change is underlined in the framework of mitigation strategies. Although it is stated that the sector will be affected by climatic conditions, strategies for the reduction target have been adopted. In the Transport and Logistics Master Plan 2053, prepared in 2022, strategies to reduce GHG emissions come to the fore, in line with environmental awareness and energy efficiency targets. However, although not defined as an adaptation strategy, the need to take measures to increase the flexibility and resilience of transport and logistics activities has been emphasized.

The Accessible Transport and Communication Strategy document underlines equal access for everyone as a requirement of the principle of inclusiveness and foresees projects to improve accessibility and communication opportunities for disaster preparedness.

The transport sector was also included in the recommendations of the Climate Council held in February 2022. Here, the sector was discussed on the agenda of the GHG Reduction Commission and hence measures for climate change mitigation have

been identified. The recommendation also states that "the synergy between the mitigation strategy and the adaptation strategy should be captured in the transport sector and the vulnerability of the sector should be minimized". Furthermore, the recommendation affirming that "to adapt to climate change, early warning systems should be established and developed on a sectoral basis and designed to work in an integrated manner" draws attention to the role of the transport and communication sectors in this field.

Although not directly related to the transport and communications sector, there is emphasis both on mitigation and adaptation in the Regulation on Environmental Impact Assessment (EIA) which is a legal process effective on transport investments. The EIA Regulation, published in the Official Gazette of 29 July 2022, No. 31907, under the title "Chapter III: Environmental Impacts of the Project and Measures to be Taken during the Construction and Operation Phases", in the section ANNEX-3 General Format of the Environmental Impact Assessment, discusses the project's impact on the climate (the nature and extent of GHG emissions), with an article on how the project will be affected by climate change and the risk of disaster or accident related to the project due to climate change. In addition, as part of the Strategic Environmental Assessment (SEA) Regulation, published in the Official Gazette dated 08.04. 2017 with the No. 30032, under the section ANNEX-4 Information to be included in the SEA report, it is stated that the report should include the impact of the plan/programme on biodiversity, population, health, fauna, flora, soil, water, as well as social and economic impacts, possible significant effects on the environment, including weather, climatic factors, physical assets, cultural heritage (comprising architectural and archaeological heritage), landscape and the interrelations between the above factors (stating that these impacts may be secondary, cumulative, mutually strengthening, short, medium and long term, permanent and temporary, positive and adverse); and hence there is a reference to adaptation to climate change.

10.3. CLIMATE CHANGE IMPACTS

The primary focus of risk assessment in the sector is to identify the most vulnerable users and critical transport and communication infrastructures. This includes prioritising infrastructure of strategic importance to Türkiye, as well as those handling the highest volumes of passengers and freight, which therefore present the greatest levels of exposure.

The transport and communications sector is one of the sector most exposed to climate risks. When assessing the impact of climate change on the sector, it is necessary to assess both the impact on infrastructure and on transport and communication activities, i.e. passenger and freight transport, data transmission and communication. The transport and communication sectors are also critical for early warning, emergency response, intervention and evacuation capabilities before and during climate hazards; and hence the negative impact of hazards on the sector also reduces the emergency management capacity.

All climate hazards affect transport and communications. Floods caused by heavy precipitation have a serious impact on infrastructure and access and communication facilities. Extreme weather events such as storms and high winds also affect these sectors, while heatwaves are emerging as a climate hazard that can cause severe deformation of infrastructure, adversely affect transport and communication activities, and pose a grave threat to the health of passengers.

Risk assessment in the transport and communications sector is discussed under three headings: regional transport, urban transport and communications. Although comprehensive assessments are made for each title, priority is given to analysis of vulnerable users as well as users and infrastructures with high sensitivity. This approach will ensure that measures are implemented taking into account "universal design standards", which consider the needs of users with reduced mobility (such as people with disabilities, the elderly, pregnant women, children, etc.) when developing recommendations for action. In addition, one of the priority issues in risk assessment is the identification of critical infrastructures in the sector, by determining the infrastructures of strategic importance to our country, and by focusing on those which are the most highly used and therefore likely to affect the greatest number of users.

Climate Change Impacts on Long-Distance Regional Transport

The fact that up to 90% of regional and national freight and passenger transport in our country takes place on highways indicates that the number of people and transport activities exposed to the effects of climate hazards on highways will be high. This situation can, of course, negatively affect the tourism sector as well as industry, agriculture and trade through freight transport. The fact that multi-modal transport infrastructure has not yet been implemented throughout the country suggests that alternative modes of transport may not be available in the face of possible disruptions on the highway.

Regions where the transport activity is spatially concentrated are particularly vulnerable. In line with the population density, location of industrial centers and port areas in the country, the highest density of highway transport takes place in the Eastern and Southern Marmara region, with a focus on İstanbul-İzmit-Sakarya-Bursa, followed by Ankara, İzmir, Antalya, Konya, Eskisehir, Gaziantep areas, Samsun-Trabzon corridor and centers and the Mersin-Adana-Hatay corridor.

The Eastern and Southern Marmara regions, where the transport activity and infrastructure are most concentrated, are also the regions where climate projections indicate that heavy precipitation and an increase in windy days are most likely to occur. These two climate hazards also apply to the Eastern Black Sea region, and this region stands out in terms of exposure as it is a corridor where transport is concentrated. In terms of strong windy days, the

projections point to the Aegean, Marmara and Eastern Black Sea regions, and the concentration of transport in this region is also an area of concern. Therefore, it is important to take precautions against the risk of flooding and strong winds on highways in these busy transport corridors and centers.

Considering the freight transport in the Central Anatolian region and the Adana-Osmaniye-Hatay corridor, the risk of high heat and heatwaves are also significant concerns: According to climate projections, these are the regions where temperature increases and heatwaves are most likely to occur and where the risk of fire is high. As corridors where freight transport is concentrated, issues such as asphalt melting/bleeding and the suitability of the landscape along the road for fire risk will be critical for uninterrupted transport activity and traffic safety. In addition to the general traffic flow and volume analysis of the highway network, the analysis that takes provincial boundaries into consideration reveals that İstanbul has a much higher density than other provinces in terms of passenger and freight traffic. The passenger-km density of İstanbul is almost double that of the provinces of İzmir and Ankara. It should be noted here that the review is based on the highway network and does not take into account the full density of urban transport connections. This situation calls for careful consideration of adaptation efforts to climate hazards in İstanbul, which appears to be the most exposed city due to this high-density traffic.

The fact that highways are the most congested mode of transport in our country has led to a policy of continuous expansion of the road network (including motorways). It should be noted that investment in roads and highways to meet intense demand is a factor that increases the surface area of asphalt, reducing the permeable surface, and therefore increasing the risk of flooding in the event of heavy precipitation. In this context, the provinces have been assessed in terms of the areas covered by roads and highway infrastructure within the provincial area, taking into account that sensitivity may increase in provinces with relatively large highway surfaces. Based on this analysis, the share of highway area within the provincial borders of İstanbul is significantly higher than in other provinces. If urban roads are included in this calculation, the proportion would increase significantly. İstanbul province is followed by Kocaeli and Yalova, which are located in the same region, and then by İzmir, Sakarya, Trabzon and Hatay. İstanbul, Kocaeli, Yalova, Sakarya and Trabzon, located in the Marmara and Black Sea regions, where the increase in total precipitation is expected to be the highest, are the most vulnerable provinces in this respect.

Although the use of modes of transport other than highways is limited in our country, given the increasing trend of air transport in passenger transport, it can be concluded that the impacts of climate change will also increase in this sub-sector. İstanbul province is the province with the highest number of airway journeys, with two airports within its borders. In addition, the airports of Antalya, Ankara, İzmir, Adana, Muğla and Trabzon are densely used, and hence these airports, which are not only high-cost investments, but also vital to the tourism sector, stand out as critical infrastructure.

Although the share of railways in passenger transport in our country is low, the High-Speed Rail routes, with their strategic importance for the country's transport policy and their high investment costs, are considered to be critical infrastructure. Attention should be paid to the risks of climate change in the provinces through which the High-Speed Rail routes pass. In this context, the provinces of İstanbul, Kocaeli, Sakarya, Bilecik, Eskişehir, Ankara, Konya, Karaman and Sivas are the provinces that should be evaluated in terms of the resilience of this infrastructure that they host within their provincial borders.

Although the share of domestic maritime transport in our country is limited, we have ports that are of critical logistical importance in freight transport and are frequently used. Especially considering the density of freight activity in Kocaeli, İstanbul, Tekirdağ and İzmir Aliağa ports, their resilience is an important issue, and hence they can be defined as critical infrastructure. Due to the location of the first three ports, the risk of floods comes to the fore in the face of expected heavy precipitation, and for İzmir Aliağa Port, the fact that the number of extremely windy days is expected to increase in this region is an important issue for port services, ships en route and in dock.

Climate change impacts on urban transport

The fact that pedestrian travel is still a significant part of urban transport in our country, and that pedestrians are the most vulnerable users in the face of extreme weather events and heatwaves, makes this issue a priority. There is a need to improve the resilience of pedestrian infrastructure, to take protective measures against climatic conditions, and to develop engineering or nature-based solutions that provide shade and shelter. Bicycle transport is still limited, but all the measures taken can protect both cyclists and pedestrians from risks.

In our country, public transport is the second most used mode of urban transport after walking. Therefore, if public transport systems are affected by climate risks, the number of people exposed to these risks will be high. In addition, especially during heatwaves, the temperature effect and the associated health risks may increase further due to the high occupancy rate of public transport systems that have a relatively high number of ridership.

It can be expected that the level of sensitivity will be even higher for users of paratransit public transport systems, such as minibus and dolmuş, because in these vehicles, which are generally smaller, the effect of the increase in the number of passengers on comfort and temperature conditions is amplified, while the lack of standard practices regarding the presence and use of air-conditioning in vehicles remains an important matter.

For cities characterized by the presence of water features, the adverse impacts of extreme weather events are inevitable on routes where public transport is provided by vehicles such as ferries, boats and sea buses.

The rapid growth of car use in our cities makes urban corridors with high traffic density and congestion more sensitive. The main cause of congestion in these corridors is the sheer number of cars, but all users are affected. Evacuation options are limited on roads and highways where congestion occurs during floods due to excessive precipitation. In cities where grade-separated junctions have been built in parallel with the increase in car use, it has been observed that these investments are not only inefficient in solving traffic congestion, but also posing high risks to human life since they quickly fill up during floods caused by heavy precipitation, making it extremely difficult to evacuate.

The population size of cities is also an important indicator when assessing the level of exposure. In densely populated settlements, mobility and the number of trips is relatively high. Population density is also a factor that can increase traffic density, i.e. congestion. In addition, population density entails building density and thus may mean that there is less permeable surface in the city in the event of heavy precipitation. In this respect, in the provinces of İstanbul, Kocaeli, Yalova, Bursa and Sakarya in the Marmara region, where the increase in heavy precipitation is expected to be greatest, the vulnerability to flooding will increase due to the population density and lower rate of permeable surface, and there may be evacuation constraints due to the probability of traffic density and congestion. In fact, recent experiences already indicate these problems and risks for these cities. The Black Sea region is also a region where an increase in precipitation is expected, and the relatively high population density in the provinces of Zonguldak, Trabzon, Samsun and Ordu should be evaluated in this context.

Another factor that may increase traffic density is the number of vehicles in the provinces, which, as expected, also highlights the province of İstanbul. However, to assess the problem of traffic congestion, the number of vehicles must be assessed in relation to the population. The provinces with the highest car ownership rates (cars per 1000 people) are Ankara, Muğla, Antalya and Burdur. These provinces are high-risk cities in terms of traffic density, so evacuation may be complicated in the event of an emergency.

The cities recording the lowest levels of car ownership tend to be lower-income cities. It would not be unreasonable to assume that the people living in these cities are largely dependent on walking, biking and public transport. The users of these modes are at serious risk from all types of climate hazards, but heatwaves are of particular concern for their health. It is anticipated that the highest temperature increases will occur in Eastern and South-Eastern Anatolia and Central Anatolia, and that heatwaves will occur in Southeastern Anatolia in particular. Should this be the case, all provinces in Eastern and South-Eastern Anatolia, where the modal share of walking, biking and public transport is relatively high, should provide access conditions for pedestrians and cyclists that are resistant to heatwaves, and take the necessary precautions in public transport vehicles.

Cities with high quality, high capacity and high service level public transport systems are deemed to have high adaptive capacity. In particular, urban rail systems are considered to be elements that increase adaptive capacity due to their characteristics such as air-conditioning, navigational comfort and immunity from traffic congestion. These systems are also extremely costly investments and should be assessed in the context of critical infrastructure that needs to be protected from climate hazards.

The presence of a transport master plan for cities is also of relevance to adaptive capacity. In addition, there is significant potential for adaptive capacity in cities that have adopted transport systems management approaches, including demand management, traffic management and intelligent transport systems applications. Although this capacity is often developed to manage and reduce traffic congestion, it can also be used as an effective tool to ensure emergency management in the face of climate change hazards and to direct demand to safer corridors and modes. Obviously, the effectiveness of these measures will also depend on the quality of the communications infrastructure.

Climate change impacts on the communications sector

In terms of the use of communications infrastructure and facilities in our country, the provinces with the lowest mobile phone ownership and the lowest rate of 3G and 4.5G subscribers, which are high technology mobile internet speeds, are Şırnak, Muş, Bitlis, Van, Siirt, Batman, Mardin, Şanlıurfa, Iğdır and Gümüşhane. The provinces with the lowest penetration rate, which is the ratio of the number of Internet subscribers to the population, are Şanlıurfa, Diyarbakır, Van, Bitlis, Şırnak and Muş. It should be noted that these provinces, which are concentrated in Eastern and South-Eastern Anatolia, have high sensitivity and a significant lack of capacity in terms of early warning and communication capabilities before and during disasters caused by climate change hazards.

The ratio of fixed broadband Internet subscribers to the number of broadband Internet subscribers indicates that the user's activity based on information technologies may be more, that transactions can be processed or can be executed with more and higher volume of data, and therefore the development potential in the field of information technologies and the prevalence or potential of informatics and R&D institutions may be high. In terms of this indicator, there is high sensitivity and a significant lack of capacity in the Eastern and Southeastern Anatolian provinces.

The ratio of fiber-optical infrastructure subscribers to fixed broadband Internet subscribers is important in terms of the quality of the connection and the potential for business volume based on Internet technologies. Regional differences in the number of subscribers to fiber infrastructure are limited, yet this infrastructure element is considered to be a critical infrastructure that needs to be protected due to its high cost and the important role it plays in the provision of quality services in the communications sector. Therefore, its resilience should be ensured.

Another important issue in terms of critical infrastructure is data centers in the communications sector. These centers are most densely located in the Marmara region. The resilience of these data centers is a key issue, specifically considering that in this region the amount of heavy precipitation and the number of windy days are expected to increase.

Transport and communications sector risk assessment: heavy precipitation and heatwaves

In relation to heavy precipitation and heatwaves, which are the major climatic hazards affecting the transport and communications sectors, the various indicators examined separately above were evaluated together on a provincial basis, creating impact chains; and then these evaluations were modelled together with climate projections on a provincial basis to create a risk assessment on a national scale. The impact chain used in the assessment is shown in Figure 47.

Relating to the risk assessment of heavy precipitation in the transport sector, elements such as population density, the density of highway use, ratio of highway and highway surface area to provincial surface area, the number of motor vehicles, the presence of critical infrastructure such as airports, ports, High-Speed Rail lines, as well as the form and continuity of settlement in the provinces were taken into account to assess the exposure level.

Factors that are predicted to raise vulnerability to heavy precipitation include the proportion of provincial water surfaces, car ownership, population growth rates, and the number of floods experienced. Naturally, the quality of infrastructure and its drainage characteristics, the presence of closed stream beds in the surrounding area, the quality of engineering structures at flood and stream bed crossings, and the presence of transport infrastructure in wetlands will also increase sensitivity. However, these are indicators for which there is not yet a comparable data infrastructure for our provinces.
The adaptive capacity included the ratio of green areas in settlements, the ratio of mobile phone subscribers, the ratio of urban population served by the sewage treatment plant, and the ratio of urban population served by the sewer network. In our country, General Directorate of Highways (KGM) and Turkish Republic General Directorate of State Railways (TCDD) take into account climatic conditions in the design of highways and railways, and hence, there is a capacity for adaptation. However, as these are issues that cannot be compared on a provincial basis, they are highlighted as information in causal chains that are not included in the risk assessment. Ensuring modal diversity and route diversity will also create significant adaptive capacity, while early warning, information and intervention capacity can be increased through the preparation of disaster management plans.

In light of these data, according to the transport sector Risk map for current period, shown in Figure 47, it is seen that although there is a high level of risk in the provinces of İstanbul, Kocaeli, Yalova and Tekirdağ in the Marmara region, there is the highest level of risk in the provinces of Sakarya and Balıkesir. Manisa and Muğla in the Aegean region, Mersin, Osmaniye, Hatay, Kahramanmaraş and Diyarbakır in the south and Konya in Central Anatolia also stand out as the provinces with the highest risk. In the north, a risk zone in the form of a continuous

Figure 46. Risk map for current period: relationship between transport sector and heavy precipitation

corridor appears to have formed in the central and eastern Black Sea.

Similar indicators such as population density and settlement structure and continuity were used in the risk assessment of the communications sector against the risk of heavy precipitation, and the length of the fiber-optical cable, which is considered to be critical infrastructure, was also taken into account in determining the exposure level. Although not considered due to lack of data, the nature of the communications infrastructure and the likelihood of this infrastructure being exposed to the surface as a result of heavy precipitation and associated damages are also important issues, as shown in the impact chain diagram in Figure 48.

Data such as the number of sectors and enterprises that make intensive use of the communication infrastructure in the provinces should also be evaluated, if there is a reliable, comparable database. In terms of adaptive capacity, the inclusion of drainage in project planning and the existence of Internet support systems and plans in the provinces are also important, as emphasized in the impact

Figure 47. Impact chain: relationship between transport sector and heavy precipitation

HAZARD		EXPOSURE
Climate Signal	**Climate Impact**	
Increase in precipitation amount and frequency	Flooding	Population density
	Increase in the number of heavy rainfall days	Total passenger transportation on highways
		Total freight transportation on highways
		Proportion of road and highway surface area
		Number of motor vehicles
		Proportion of continuous urban
		Airports, railway lines, and ports*

VULNERABILITY		RISK
Sensitivity	**Adaptation Capacity**	
Proportion of water surfaces	Proportion of green urban	Deterioration in traffic safety
Number of cars per 1000 people	Proportion of mobile phone subscribers	Deterioration in public health
Population growth rate	Proportion of municipal population served by wastewater treatment facilities	Economic losses: access and infrastructure
Total number of floods and inundations experienced	Proportion of municipal population served by the sewer network	Disruption in emergency service access
Quality of infrastructure and drainage features*	Design of stream bed crossings, drainage, and engineering structures by KDD and TCDD based on meteorological data*	Increase in costs
Provinces with the highest amount of impervious asphalt surfaces*	Variety of modes and routes*	Loss of labour
Closed stream beds in the surrounding area*	Disaster Management Plans*	
Quality of engineering structures at floodplain and stream bed crossings*	User information and demand management*	
Transportation infrastructure located in wetlands*		

The (*) symbol denotes indicators that are not used in risk assessment. [6]

[6] These indicators have not been used in the risk assessments given the lack of comparable data, but they are considered to be useful indicators to be taken into account in future studies.

Figure 48. Impact chain: relationship between communications sector and heavy precipitation

HAZARD		EXPOSURE
Climate Signal	**Climate Impact**	
Increase in precipitation amount and frequency	Flooding	Population density
	Increase in the number of heavy rainfall days	Length of fiber optic cable
		Proportion of continuous urban
		Communication infrastructures: Exposure to the surface due to damage or collapses*
		Sectors and companies heavily reliant on communication infrastructure*

VULNERABILITY		RISK
Sensitivity	**Adaptation Capacity**	
Proportion of discontinuous urban	Proportion of green urban	Economic losses: infrastructure
Proportion of water surfaces	Proportion of forest areas	Disruption in emergency service access
Population growth rate	Proportion of mobile phone subscribers	Public health
Total number of floods and inundations experienced	Proportion of municipal population served by wastewater treatment facilities	Disruptions in airways and traffic safety issues
Quality of infrastructure and drainage features*	Proportion of municipal population served by the sewer network	Increase in costs
Sewer and stormwater systems*	Importance given to drainage in project design*	Loss of labour
Amount of permeable surfaces	Infrastructure plans*	
Closed stream beds*	Disaster Management Plans*	
Provinces with the highest amount of high-cost fiber optic cable infrastructure*	Internet support systems and plans*	

The (*) symbol denotes indicators excluded from the risk assessments. [7]

[7] These indicators have not been used in the risk assessments given the lack of comparable data, but they are considered to be useful indicators to be taken into account in future studies.

chain, but there is no comparable data infrastructure for this indicator either.

In light of these data, the risk map obtained for the communication sector for the risk of heavy precipitation is shown in Figure 49. According to this, Sakarya and Düzce as two neighbouring provinces in the Marmara and Western Black Sea region, Samsun, Ordu, Giresun, Trabzon, Rize as the Central and Eastern Black Sea provinces, Manisa in the Aegean region, Mersin, Osmaniye, Hatay, Kahramanmaraş, Diyarbakır and Şırnak in the South are the provinces exposed to the highest level of risk. Looking at the high- and moderate-risk provinces, there is a concentration in the coastal regions, while a relatively high risk is observed in Konya and Kayseri in the inner Anatolia.

Indicators used to determine exposure in the transport sector risk assessment for temperature increases and heatwaves include population density, passenger and freight transport volumes and settlement type (due to the urban heat island effect). In addition, the number of intercity bus and rail passengers should also be taken into account provided that a reliable database is created to enable such an analysis. In the sensitivity analysis, car ownership was considered as an indicator that could provide information on the corresponding usage of public transport, walking and biking. Plus, the settlement type, the proportion of road and motorway surfaces in the province's total surface area, and the population growth rate were included in the analysis. In the presence of comparable data on a provincial basis, bus occupancy rates and average travel times, the state of air-conditioning and vehicle equipment on buses, traffic density, road paving material and its effect on heat, and roadside landscape features should also be considered. In terms of adaptive capacity, indicators similar to heavy precipitation have been used; plus indicators that may increase adaptive capacity in the future include the regulation of public transport vehicle occupancy rates in settlements, air-conditioning and vehicle exterior conditions in vehicles, the presence of tree-lined and shaded roads, roadside landscape features and road paving materials. Issues such as these are also underlined by the prepared impact chain diagram (Figure 50).

The risk assessment map created based on these data is shown in Figure 51, which assesses the heatwave risk in the transport sector. According to this, most of the provinces in the Southeastern Anatolia region have been identified as very high-risk provinces. In addition to these provinces, Aydın, Bolu, Konya, Manisa, Mersin, Muğla and Tekirdağ are also identified as extremely high-risk provinces. Considering the high and moderate risks, there is a concentration in the western and southern regions of the country and a low risk level in heatwaves in the eastern part and the Black Sea provinces.

In the heatwave risk assessment for the communications sector, the exposed infrastructure and users and the indicators that amplify heat sensitivity are similar to those in the transport sector. In addition, although there is no comparable data on a provincial basis, the effective use of communication technologies and tools in early warning, emergency intervention and relief are stressed in the impact chain as important indicators for future studies. As aviation is a sector that makes extensive use of communication infrastructure and facilities, it can also be included in the assessments. In terms of adaptive capacity, the presence of green spaces in settlements is important in terms of microclimate

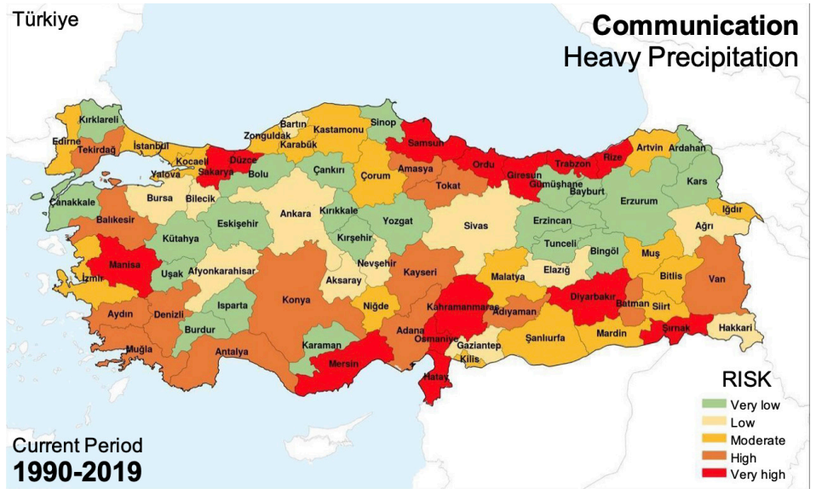

Figure 49. Risk map for current period: relationship between communications sector and heavy precipitation

Figure 50. Risk map for current period: relationship between transport sector and heatwaves

Figure 51. Impact chain: relationship between transport sector and heatwaves

HAZARD		EXPOSURE
Climate Signal	Climate Impact	
Increase in average temperature	Heatwave	Population density
Increase in the number of extremely hot days	Increase in the number of consecutive hot days	Total passenger transportation on highways
		Total freight transportation on highways
		Proportion of continuous urban
		Intercity bus and train passengers*

VULNERABILITY		RISK
Sensitivity	Adaptation Capacity	
Proportion of discontinuous urban	Population growth projection	Decline in travel comfort and health conditions
Proportion of road and highway surface area	Proportion of green urban	Asphalt melting
Number of cars per 1000 people	Proportion of mobile phone subscribers	Deterioration in traffic safety
Population growth rate	Regulation, inspection, and enforcement of occupancy rates*	Deterioration in public health
Bus occupancy rates*	Climate-sensitive retrofitted bus fleet: air conditioning and external roof surface*	Disruption in emergency service access
Bus travel time and distance*	Tree-lined and shaded roads*	
Traffic congestion affecting travel time*	Regulation of road material standards varying by climate*	
Bus air conditioning conditions and other technical specifications*	Pavement material*	
Road surface materials*	Roadside landscape design approach*	
Roadside vegetation characteristics*		

The (*) symbol denotes indicators excluded from the risk assessments [8]

[8] These indicators have not been used in the risk assessments given the lack of comparable data, but they are considered to be useful indicators to be taken into account in future studies.

Figure 52. Impact chain: relationship between communications sector and heatwaves

HAZARD		EXPOSURE	VULNERABILITY		RISK
Climate Signal	Climate Impact		Sensitivity	Adaptation Capacity	
Increase in average temperature	Heatwave	Population density	Proportion of discontinuous urban	Population growth projection	Loss of communication signals
Increase in the number of extremely hot days	Increase in the number of consecutive hot days	Length of fiber optic cable	Proportion of road and highway surface area	Proportion of green areas	Fires
		Proportion of continuous urban	Population growth rate	Proportion of mobile phone subscribers	Disruption in emergency service access
		Communication systems*	Critical importance of communication for emergency response and disaster communication*	Disaster Management Plans*	Disruptions in airways and traffic safety issues
		Sectors and companies heavily reliant on communication infrastructure*	Airline systems heavily reliant on communication infrastructure*		

The (*) symbol denotes indicators excluded from the risk assessments. [9]

[9] These indicators have not been used in the risk assessments given the lack of comparable data, but they are considered to be useful indicators to be taken into account in future studies.

and cooling effect on the relevant infrastructures, as well as the extensive use of mobile phones for emergency communication.

Given the possibility of data center collapse and fire due to heatwaves, the existence of contingency plans is obviously an important capacity component, and the impact chain prepared with this information is shown in Figure 52. [9]

In this regard, the risk assessment map of the communications sector for the heatwave hazard is shown in Figure 53. It is seen that most of the provinces of the Southeastern Anatolia region are very high- or high-risk provinces. It is noteworthy that the provinces of Kayseri, Konya, Mersin and Niğde, which border this region, are identified as being subject to very high risk too. In addition, Aydın, Denizli and Manisa in the Aegean region and Tekirdağ in the Marmara region are among the provinces flagged as very high risk. As in the case of transport, a low risk level is indicated for heatwaves in the eastern part of the country and in the Black Sea provinces.

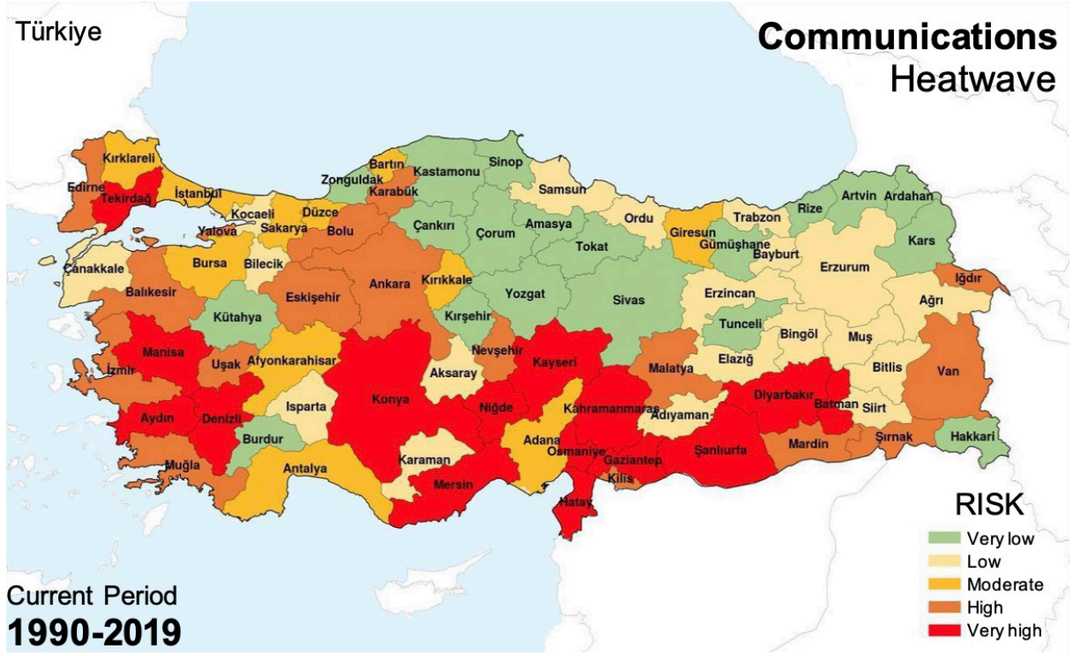

Figure 53. Risk map for current period: relationship between communications sector and heatwaves

10.4. CLIMATE CHANGE ADAPTATION MEASURES

The resilience of critical infrastructure will be strengthened; passenger health and safety will be safeguarded, and the efficient, uninterrupted operation of transport and communication activities will be ensured, recognising the sector's vital role in climate-related disasters. Additionally, synergies between mitigation and adaptation strategies will be fostered within the sector.

It is of utmost importance to ensure resilience to the risks of climate change in the transport and communications sector, which plays a vital role in the economic and social development of our country, as well as in public health, safety and quality of life. In addition, it is extremely important to ensure the health of passengers and to ensure the uninterrupted operation of transport and communication activities that affect many sectors of the economy. Furthermore, transport and communication are critical for early warning, emergency response, evacuation and communication in the face of climate hazards. Therefore, climate change adaptation measures should ensure the adaptation, resilience, and efficient and effective functioning of these sectors.

In our country, the impact of the transport sector on climate change has been extensively discussed and assessed; and many policy and strategy documents as well as legislations have proposed mitigation strategies, actions and measures for this sector, which plays a major role in GHG emissions. However, the impacts of climate change on the transport sector and ensuring the sector's resilience to these impacts, i.e. adaptation actions, have remained limited. On the other hand, there is a high potential for synergy between climate change mitigation and climate change adaptation strategies. For example, as part of the strategies to reduce GHG emissions, our country's policy documents propose to develop the railways with a view to increasing their share in passenger and freight transport, whereas this is only possible if the railways are resilient to climate risks, can provide uninterrupted freight and passenger transport, and can maintain a level of service that ensures the health of passengers, taking into account climatic conditions. Similarly, ensuring that public transport systems and biking and walking conditions are adapted to climate change and hence climate-resilient in the face of heavy precipitation and heatwaves, which are the leading climate hazards for the transport sector, can encourage the use of these modes. In particular, due to the critical role of urban rail systems in achieving the mitigation targets, these infrastructures should be protected from climate hazards by ensuring their resilience. Another issue of great importance in terms of GHG reduction is modal diversity in both national/regional and urban transport, and this action has strategic importance

in terms of adaptive capacity too: The existence of a multi-modal, multi-alternative, flexible transport infrastructure and operating system would not only help reduce GHG emissions by changing and shifting transport trends based on utilising the roadway and automobiles, but also provide the capacity to manage and direct access and transport demand during the emergencies experienced due to climate hazards.

For this reason, the main strategic goal of the transport and communications sector in the CCASP is defined as follows:

The aim is to increase the resilience of critical infrastructure, to safeguard the health of passengers and transport and communication activities, to provide efficient and effective transport and communication in the event of climate change-related disasters, and to create synergies between climate change mitigation and adaptation strategies. In line with this main objective, four strategic sub-objectives have been identified, under which adaptation actions have been developed:

STRATEGIC GOAL 1

To ensure the resilience of critical transport and communications infrastructure.

This strategic goal incorporates actions that focus on increasing the resilience of critical infrastructure, ensuring that infrastructure is better prepared and more resilient to the hazards of climate change through technological interventions and engineering solutions. Although there is a need to ensure the resilience of all infrastructure, some infrastructures and some regions and corridors can be prioritized according to their level of exposure, i.e. intensity of use, and resilience can be increased by integrating newly developing technologies. In addition, there is a need to protect and ensure the resilience of infrastructures that serve the country's economic and social development objectives and environmental protection policies. In line with these two criteria, certain infrastructures have been identified as critical infrastructures with detailed explanations given in the previous sections. Therefore, the priority areas for action are to protect and increase the resilience of those critical infrastructures that are most used and of strategic importance for our country, against climate change hazards, taking into account the regions at high risk in terms of climate hazards.

In this context, three basic actions have been identified for the resilience of regional transport, urban transport and communications infrastructure.

Within the scope of the first action, it is envisaged that critical routes and infrastructures in highways, railways, ports and airports, for which needs are determined in line with future climate projections, will be made resilient to the risks of floods, sea level rises, heatwaves, fires, high winds and storms.

STRATEGIC GOAL 1

To ensure the resilience of critical transport and communications infrastructure.

As part of this action, one of the important steps will be to carry out a study to analyze the current situation and carry out a needs assessment study for all infrastructure. In addition, some of the findings of this study can also guide and shed light on the prioritization and staging decisions.

For example, to increase the resilience of highways to floods, infrastructure interventions such as flood and overflow culverts, evacuation pumps, protective barriers and ditches can be used on highways in the Marmara region, Aegean region, Eastern Black Sea region and Samsun, where the highways are used the most and where heavy precipitation is expected the most. With regard to the risk of temperature increases and heatwaves, the use of road materials that are resistant to the risk of melting/bleeding in asphalt should be considered as a priority intervention throughout the Central Anatolian and Mediterranean regions, and especially in the Konya-Mersin and Adana-Osmaniye-Hatay corridors where these climatic events are expected to occur most frequently.

The railways, which are an integral part of the country's strategies, need to be resilient to floods caused by heavy precipitation, which they are most vulnerable to. Protective barriers and ditches need to be implemented where needed in line with future climate projections, both on High-Speed Rail and Rapid Rail lines and on conventional lines, and the use of monitoring technologies with sensors need to be expanded. Having such measures in place for current climate conditions on High-Speed Rail and Rapid Rail lines is a valuable capacity component, and needs assessments studies should be carried out considering future climate projections.

Arrangements should also be made to ensure uninterrupted rail-ferry services. Taking into account the process of Van Lake becoming shallower due to climatic impacts, certain interventions should be implemented to ensure the continuous and safe operation of the railway ferry service on the lake. These interventions include the dredging of the seabed in the Van Pier area and the rehabilitation of the dock ramps, which have already been planned by the responsible institutions, and hence should be swiftly implemented as part of this action.

The development of maritime routes is also a critical issue in terms of the multi-modal transport strategy that our country has been pursuing for many years. Precautions should be taken against the risks of floods, strong winds and storms in the ports of Kocaeli, İstanbul and Tekirdağ as well as in İzmir Aliağa, and their climate resilience should be ensured by evaluating the technical parts of vehicles used in domestic and international ferry services throughout the country.

STRATEGIC GOAL 1

To ensure the resilience of critical transport and communications infrastructure.

Airports are also critical infrastructures that need to be made more resilient. The airports in the provinces of İstanbul, İzmir, Muğla and Trabzon, which are located in regions where heavy precipitation, strong winds and storms are expected, should take infrastructural measures against these risks, and drainage should be assessed and engineering measures should be taken, both on account of the location of Milas-Bodrum airport in the Güllük delta and wetlands and on account of the location of Samsun Çarşamba Airport.

The second action concerns the resilience of urban transport infrastructure. In the face of the risk of heavy precipitation, additional structural elements should be built at road and river crossings for vehicles and pedestrians in cities; evacuation pumps should be installed at grade-separated junctions; and road drainage systems should be improved. The selection of the pilot province for this action can be determined according to the results of the risk assessment carried out for this study. Balıkesir, Diyarbakır, Giresun, Hatay, Kahramanmaraş, Konya, Manisa, Mersin, Muğla, Ordu, Osmaniye, Rize, Sakarya, Samsun and Trabzon, which are the provinces with the highest risk in terms of the impact of heavy precipitation on the transport sector, can be considered for implementing pilot projects.

It is important to ensure the resilience of urban transport infrastructure to heatwaves too, and hence to use heat-resistant materials. The provinces of Southeastern Anatolia and Aydın, Bolu, Hatay, Kahramanmaraş, Konya, Manisa, Mersin, Muğla, Osmaniye and Tekirdağ, which are deemed to be the most vulnerable to heatwaves in the transport sector, should be evaluated for pilot implementations.

Additionally, it is important that infrastructure is protected from, and resistant to, wind and storm hazards. All infrastructure, varying from those for pedestrian and bike transport to cars and public transport (including modes of public transport using maritime transport facilities) should be considered for this action. Protective barriers and ditches should be used to protect roads from storms and tidal waves, especially in coastal cities.

As mentioned above, in cities that have invested in urban rail systems, which are critical infrastructures, these systems need to be made resilient to all kinds of climate risks, and hence this issue is also emphasized in this action.

The third action addresses the resilience of critical infrastructures in the communications sector. Constituting a high-cost investment, all electronic communications infrastructure, especially fiber-optical cables, are critical infrastructures and need to be made resilient to climate hazards. In addition, in the

STRATEGIC GOAL 1

To ensure the resilience of critical transport and communications infrastructure.

Marmara region, where data centers are concentrated, the resilience of these centers to all climate hazards should be increased.

TRNS1. Ensuring the resilience of critical routes and infrastructures in highways, railways (High-Speed Rail, Rapid Rail and conventional lines), ports and airports against the risks posed by climate change where needed in line with future climate projections.
TRNS2. Making vehicle roads, bike and pedestrian roads and all public transport (rail, bus, maritime) infrastructure in cities resilient to risks arising from climate change.
TRNS3. Making data centers, base stations and electronic communications infrastructure in the communications sector resilient to risks caused by climate change.

STRATEGIC GOAL 2

To safeguard transport activity and passenger health by reducing the level of vulnerability.

This strategic goal is to minimize the vulnerability of both infrastructure and users and includes measures to ensure the health of passengers through nature-based solutions and various engineering measures and to ensure the continuity of transport activity and communications services.

The major factors that increase vulnerability to heavy precipitation, floods, which are among the principal hazards affecting the sector, are the decrease in permeable surfaces in parallel with urbanization and with the development of transport networks. Therefore, increasing the number of permeable surfaces will limit the destructive effect by reducing runoff during heavy precipitation and hence increasing the absorption of rainwater. For this reason, highly permeable paving materials should be used on the hard surfaces of roads, sidewalks, squares and car parks in urban, provided that they do not adversely affect the road stabilization conditions.
In addition, expanding the permeable surface by building green infrastructure in cities is one of the areas of action that will be effective in this regard. Green infrastructure includes not only green spaces, but also elements such as green roofs in cities (including the roofs of public transport stations), green facades, and trees and landscaping along roads. Planning these green systems in continuity can also help them function as drainage channels.

STRATEGIC GOAL 2

To safeguard transport activity and passenger health by reducing the level of vulnerability.

In addition to green infrastructure, blue infrastructure can also provide drainage. Many riverbeds in our cities have been closed and covered over time as part of the urbanization process, significantly increasing the level of vulnerability. The fact that some riverbeds have been closed and converted to asphalt causes flooding along these roads during heavy precipitation as well as in other parts of the city due to the movement of water that cannot find its riverbed. Therefore, daylighting, i.e. the opening up and restoration of closed creeks, streams, rivers and canals in all our settlements and planning them as green and blue infrastructure areas with landscaping around them will significantly reduce vulnerability.

Green and blue infrastructures function as wind corridors as well as drainage channels and can reduce vulnerability to heatwaves too. For this reason, this action focuses on green and blue infrastructure to mitigate the impact of both heavy precipitation and heatwaves.

The health of passengers in vehicles is a critical issue during heatwaves. Therefore, as a further measure, air-conditioning and ventilation systems should be provided both in buses and minibuses used in intercity passenger transport and in urban public transport vehicles. In addition, measures should be taken such as renewing the outer surfaces of the vehicle roof tops using materials and light colours that do not allow high levels of heat to penetrate inside the vehicle, and hence offer extra insulation. According to the risk assessment, the Southeastern Anatolia region and the provinces of Aydın, Bolu, Hatay, Kahramanmaraş, Konya, Manisa, Mersin, Muğla, Osmaniye and Tekirdağ, which are the provinces with the highest risk for the transport sector in terms of heatwaves, should be considered with priority for possible pilot projects.
Another measure that can mitigate the impact of the heatwave on passengers and help reduce the fire risk is the use of cool pavement materials on roads and the use of landscaping elements. The repaving of highways and roads with paving materials ("cooler pavements") that reduce surface temperature should be considered in regions with high temperatures and in places where the heat island effect occurs in the city. It would be appropriate to consider the abovementioned provinces for pilot implementations.

Regions exposed to high temperatures along highways are also the regions where the risk of fire increases. Therefore, identifying roadside landscape elements that increase the risk of fire and replacing them with appropriate alternatives is an important issue for transport , communication, and passenger health and safety. The issue of roadside landscaping should also be evaluated in terms of providing sheltered and shaded roads in urban. The construction of tree-lined and sheltered roads for vehicles, pedestrians and cyclists can reduce vulnerability to heatwaves. In

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addition, sheltered and shaded areas should be created with materials that include trees or green roofs at intersections and passages where cyclists and pedestrians can wait. Needless to say, it is important to choose appropriate landscaping for bike paths and sidewalks so that the plants' and trees' roots will not adversely affect the road surface.

While implementing these actions that aim at ensuring the health of passengers, "universal design standards" that take into account the needs of users with reduced mobility (such as disabled people, the elderly, pregnant women, children, etc.) should be considered and the requirements of the principle of fair and equal access for all should be met.

TRNS4. Using pavements with high permeability on the hard surfaces of roads, sidewalks, squares and car parks in urban.
TRNS5. Planning and expanding green and blue infrastructures in urban with a view to increasing permeable surfaces and drainage opportunities as well as mitigating the impact of heatwaves.
TRNS6. Ensuring presence of air-conditioning and ventilation systems in public transport vehicles, school buses, and buses and minibuses used in intercity passenger transport, and renewing private and public transport vehicle fleets through the use of materials and vehicle roof top colours that do not transmit high levels of heat.
TRNS7. Using materials that reduce surface temperature ("cooler pavements") in high temperature areas of highways and urban roads, constructing tree-lined and sheltered roads for vehicles, bikers and pedestrians, and replacing landscape elements that increase the risk of fire with appropriate alternatives.

STRATEGIC GOAL 3

To enhance the emergency management and response capacity by developing means of accessibility, communication and evacuation during climate-related disasters.

The objective is to improve accessibility, communication and evacuation to enhance emergency management and response capacity in the event of climate-related disasters. For this purpose, the key issue is a transport system that provides infrastructure for modal diversity and consequently the multi-modal transport. The development of a flexible transport infrastructure with a high degree of modal diversity and intermodal integration opportunities throughout the country, and in particular the development of rail and maritime alternatives where possible, will serve both mitigation strategies and facilitate effective management of travel demand and traffic in emergency situations, hence enhancing quick response and evacuation capabilities. For instance, during the fire hazard in Muğla and Antalya provinces in July 2021, it was evident that maritime evacuation possibilities were a vitally important capacity component. Changing the road-dependent transport system is therefore an action that provides synergy between mitigation and adaptation strategies.

The same applies to urban transport. With the development of modal diversity and intermodal integration in cities, the response and evacuation capacity in emergency situations increases significantly, and an efficient and effective emergency traffic management becomes possible.

In order to realize this action that aims at creating modal diversity in transport both nationally and in cities, investments should be made for the development of rail and maritime transport, and maritime transport alternatives should be developed as an integral component of urban transport in coastal settlements. This implies the integration of systems such as maritime transport, land public transport and micro-mobility such as bicycles and e-scooters. Similarly, biking infrastructure should be developed and integrated with public transport. The integration of automobiles and public transport is also one of the interventions to be considered for modal diversity and intermodality.

The role of well-developed and high-quality public transport systems in ensuring modal diversity in cities is extremely important. In this context, it is significant to plan rail systems that provide a high level of service and a relatively healthier experience of transport in the face of heatwaves (provided that their construction is supported and justified by urban transport demand forecasts, of course). In addition to rail systems, bus rapid transit systems and dedicated bus lanes provide a fast and effective transport alternative in case of emergency in urban transport, as often emphasized in the international literature, and hence this technology should also be evaluated in the scope of this action.

Modal diversity and integrated transport constitute an important capacity component that increases emergency response and evacuation capacity and reduces the number

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of users affected by traffic density, congestion and possible accidents. Consequently, a more extensive use of pipeline infrastructure for the transport of fuels should also be evaluated in line with the principle of modal diversity. In particular, during heavy storms and precipitation, as well as during heatwaves, vehicles carrying fuel may have accidents due to climatic hazards, creating serious risks. As highways are already a heavily used transport infrastructure, the number of users affected by this situation, i.e. the level of exposure, is high. Shifting the transport of these hazardous fuels from roads to pipelines can contribute to the goal of multi-modal transport and mitigate negative impacts on road-based emergency response and access .

A further action to improve emergency management and response capacity to climate-related disasters is, obviously, the preparation of Transport, Communications and Climate Change Emergency Action Plans. These plans should be prepared at both national and urban levels and should adopt the principle of improving emergency management by prioritizing vulnerable groups.

Under this action, early warning and information systems for climate hazards should be developed, taking into account transport and communications infrastructure. In this context, long-term (15-day), medium-term (weekly) and short-term (daily/hourly) weather forecasts and early warnings for all types of climate hazards should be developed, and the information system should be differentiated. As part of the development of early warning capacity, the possibility of deploying wind and other climate sensors along critical transport routes should be explored.

Smart City and Smart Transport Systems should also be considered as important tools for early warning and quick dissemination of critical information. Developing applications related to travel routes and options to include climate hazards and emergency notifications, with features to manage travel demand, is also emphasized within the scope of this action.

It goes without saying that uninterrupted operation of communication systems is essential for the effective use of such smart city applications, as well as for early warning, emergency notification and response-evacuation capabilities. Therefore, another action under this strategic goal is to provide infrastructural support for additional power supply, especially for data centers, internet, cameras, etc. The aim is to ensure that the communication tools work effectively and without interruption.

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To enhance the emergency management and response capacity by developing means of accessibility, communication and evacuation during climate-related disasters.

TRNS8. Creating a flexible transport infrastructure with a high level of modal diversity and intermodal integration, both across the country and in cities.
TRNS9. Developing early warning for climate hazards and transport information systems by including smart and mobile applications.
TRNS10. Providing infrastructural support for additional power supply to ensure uninterrupted operation of communications systems such as data centers, fixed/mobile base stations, internet, cameras, etc.

In addition to early warning and emergency management capacity, developing planning capacity is also crucial.

STRATEGIC GOAL 4

To enhance planning capacity in the field of transport and communications in line with the climate change adaptation objective.

This strategic goal incorporates actions to improve planning capacity in line with the goal of adapting to climate change in the field of transport and communications.

Although two comprehensive actions have been identified for the transport and communications sector, it should also be noted that there are horizontal areas of action to be addressed that are common with other sectors.

The first action to improve planning capacity is to develop legislation that will increase the resilience of transport and communications infrastructure and reduce the vulnerability of infrastructure and users to climate change risks. As mentioned above, the current EIA and SEA regulations contain important statements and clarifications on this issue. For planned new infrastructure investments, detailed legislation should be introduced to assess the impact of climate change on investments and to include adaptation and resilience issues in Environmental Impact Assessments, Strategic Environmental Assessments and feasibility studies.

The need to revise the bike regulation in relation to local transport planning and management issues and the development of a legal framework that includes standards and inspection mechanisms for vehicles used in public transport services are also within the scope of this action.

Another comprehensive action is specifically related to improving local planning capacity. Design guides should be prepared to be used as a handbook in transport planning studies of local authorities and in particular in the preparation of Urban

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Transport Master Plans. For example, the development of design guidelines for the creation of tree-lined, shaded and sheltered streets and green infrastructure on streets and avenues, as well as guidelines for the use of permeable pavement materials, will be important components of capacity building. Furthermore, adaptation to climate change should be mainstreamed and effective strategies at the local level should be devised through Urban Transport Master Plans, Sustainable Urban Mobility Plans (SUMPs) and BTMPs.

As mentioned above, it is also necessary to underline some areas of action that are common with other sectors. Although it is not mentioned here as a separate action because it is not a specific issue for the transport and communications sector, the establishment of an institutional structure to ensure inter-institutional coordination at national and local level is extremely important in terms of investment and management of transport planning and communications systems. The preparation of urban infrastructure plans and flood management plans, which is an important issue for the urbanization sector, will also help reduce the vulnerability of critical transport and communications infrastructure. Besides, the creation of a comparable and reliable data infrastructure, regularly collected at the level of provinces, districts and neighbourhoods, shared with open access and including big data opportunities, is extremely important for the transport and communications sector, as well as for all sectors, in order to increase planning capacity. The provision of on-the-job training at national and local level on the impact of climate change induced extreme weather events on transport and communications infrastructures, intervention and adaptation is also of great importance for capacity building. In addition, social awareness-raising campaigns and informing the public at large about the impact of climate change on transport, accessibility and communication are important for the transport and communications sector, and also included in the scope of horizontal cross-cutting actions.

TRNS11. Implementing legislation that reinforces the resilience of transport and communications infrastructure and reduces the vulnerability of infrastructure and users to the hazards of climate change.
TRNS12. Developing design guidelines to be used as resources in transport plans for the planning and expansion of green infrastructure and use of permeable pavement materials on streets and avenues and developing climate change adaptation strategies in the context of Urban Transport Master Plans, Sustainable Urban Mobility Plans (SUMPs) and BTMPs.

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SOCIAL DEVELOPMENT

climate adaptation

Incorporating social development elements into the 2053 long-term climate change strategy

Developing social protection policies to strengthen individuals' resilience to climate change

Supporting local development programmes that address the impacts of climate change on all segments of society

Promoting academic research on the relationship between social development and climate change

Identifying the benefits of assessing women's vulnerability to climate change and their adaptation efforts

SOCIAL DEVELOPMENT

climate adaptation

11.1. GENERAL FRAMEWORK

The impacts of climate change must be assessed through the lens of social equality and human rights, as they create new areas of poverty, deepen inequalities, and exacerbate societal challenges such as housing, nutrition, health, and displacement.

Climate change is the common concern of countries. However, in this combat, the responsibilities to be assumed by states for the policies of mitigating emissions and adapting to impacts differ according to the level of their socio-economic development. On international climate negotiation platforms, low-income and developing countries should receive, especially financing support from developed countries in order take measures against the negative effects of climate change.

In addition to seek solutions for such future problems related to climate change by triggering the global policies on level of states, low-income countries increasingly need to reduce vulnerability of society/individuals, discuss the possible actions to be taken to raise resilience by consolidating their adaptation capacity, and conduct analyses regarding the impact of climate change on social life with an eye to social development policies of countries. It is because individuals and societies lie behind combatting climate change, as the target audience.

It is particularly stated that social aspect is a significant integrating element of the climate change adaptation policies in the studies intended to mitigate the vulnerability of societies to climate change, boosting resilience and adaptation capacities and addressing the impact of climate change on social development policies of countries. In the international literature and good practices in this area, first of all, direct/potential impacts of climate change on community health care are mainly scrutinized as a social determinant, society's loss of work and income is addressed only to a certain extent; and it is seen that other factors that increase social inequalities are generally ignored. Nevertheless, nowadays,

inequality-oriented issues, especially poverty have started to surpass as the factors of society's indirect vulnerability to climate change.

As in all developing countries, it is still early to mention the presence of holistic interaction (macroeconomic and macroecological policies and integration with all sectors) in Türkiye in measuring the resilience and adaptation of individuals and society, and therefore to perceive climate change as a social development issue when looking at the country's climate change adaptation action in terms of the social development policies. Low number of the related international and local research calls attention in literature reviews regarding Türkiye. It is seen in these studies that environmental sociology is addressed theoretically. Besides, it is understood that the approach of climate sociology (or "climate in sociology") is not examined although it is currently on the agenda in the light of the conceptual and theoretical developments in environmental sociology. Connection between climate change and social development has recently gained currency at theoretical and practical level in our country. For this reason, the following questions have not been answered satisfactorily: what may be the impacts of combatting climate change on social development policies and goals in Türkiye and in which framework its reflection on society should be assessed.

Looking at the value chain of social development from the aspect of climate change means regarding the issue as a critical area of structural transformation.

Considering that social development policies compass broader policies and practices even though they are not the primary/direct objectives in combatting climate change, it becomes inevitable to evaluate the processes focused on the climate change adaptation of society and particularly eliminating vital concerns of vulnerable segments arising from the disasters, which happened/will happen because of the impacts of climate change, with a holistic approach.

This situation results in the requirement for identifying the effects of climate change on individuals/various segments of society and developing innovative strategies and policies for adaptation action.

Within the context of climate change and social development in Türkiye, social protection and aid policies mostly come to the forefront. Losses and damages of the society and especially vulnerable groups are compensated after climate hazards. It is observed that higher policies related to prevention of climate change-induced disasters in Türkiye rather concentrate on managing the emerging crisis. In this regard, the legislations, policies, planning and practices with a primary focus on post-disaster management are on the docket. Nevertheless, risk management-centred social development policies need to be adopted for a successful climate change adaptation action.

11.2. SECTORAL LEGISLATIVE FRAMEWORK AND RESPONSIBLE INSTITUTIONS

Inclusion is essential for effective climate change adaptation, and all segments of society must be actively involved in the process.

The following section discusses legal and institutional structures and strategic approaches for establishing a link between climate change and daily life and future expectations of society in Türkiye and assessing the social development policies within this frame.

Leading research on climate change and social vulnerability in Türkiye with the title "Vulnerability Assessment of Participants" was conducted in the framework of the preparations for the CCASAP (2011-2023).

In "Climate Change National Communication Strategy and Action Plan (2019)", special target groups who are critical and preferred for communication in combatting climate change were selected, and the communication strategies specific to these target groups were set. In particular, the plan emphasizes the need for an approach grounded on joint efforts, dialogues and cooperation with any segment of society for climate combat.

The "Report of the Parliamentary Inquiry Commission Established to Set the Measures Required to Be Taken to Minimize the Impacts of Global Climate Change, Fight Drought and Ensure Efficient Use of Water Resources" which were discussed at the Grand National Assembly of Türkiye (GNAT) on 1 February 2022 underlined that mitigation of the adverse results on populations led by climate change or their capacity to adapt to such results are shaped by the factors such as income, race, class, gender, financial factors and political representation; vulnerable segments of society are exposed to these impacts more; the climate change-originated risk factors may lead to financial loss and decline in welfare, harm to health, decreasing productivity of labour, poverty and involuntary forced migration and generate substantial difficulties in ensuring decent works. Concepts of fair transformation, fair transition and fair adaptation were also clarified in the report with the aim of minimizing the impacts of climate change and enabling societies to adapt to these effects economically and socially.

The need for a number of new institutions as well as 22 members of CCACB, an important organization for making high-level decisions may be envisaged to address the climate change adaptation action in the framework of the social development policies. Among CCACB members, it is worth noting that there is a lack of several ministries and institutions which would help direct the impacts of climate change on society and social development, and hence help develop required adaptation policies.
The Ministry of Justice is a ministry recommended for being the permanent member of CCACB. It is the ministry holding principal responsibility for implementing the Human Rights Action Plan of the Republic of Türkiye. The Ministry of Justice

has worked on this area since the beginning of the 2000s (e.g. the relevant legislation: "Regulation on Foundation, Duties and Working Principles of the Provincial and District Human Rights Boards, Official Gazette of 23 November 2003 issue 25298). It is anticipated that vulnerable groups, particularly children, women, persons with disabilities and elderly will suffer from the negative impacts of climate change more, so such impacts should be mitigated, and climate change adaptation of the society should be ensured. The measures to be taken within this scope are expected to affect fundamental human rights, especially the right to live, and many rights such as the right to privacy, right of property and freedom of travel.

The objective of "Impacts of climate change on the fundamental human rights will be analyzed, and public policies will be set in view of the outcomes" is included in the Human Rights Action Plan of the Republic of Türkiye (Free Individual, Strong Society; More Democratic Türkiye, March 2021 Presidential Circular).

This objective is the first and most significant initiative for approaching social aspect in a right based manner in combatting climate change in Türkiye. The MoEUCC was decided as the institution responsible for monitoring and implementation of the efforts associated with this objective.

Undertaking of each activity in the Human Rights Action Plan within the stipulated period is under the responsibility of the ministries and public authorities or entities in charge of the related activity. The item "Responsible ministries or institutions/ organizations will specify the ministries, institutions and organizations for making cooperation under the relevant activities" was incorporated into this Plan. Through this item, the institutions in charge of undertaking a total of 393 activities were identified in the plan with explanations of their duties and spans of authority. Moreover, it was envisaged that relevant activities would be performed with the cooperation of all related Ministries, institutions and organizations under the coordination of the responsible entities.

Within this context, the MoEUCC and the Ministry of Justice were determined as institutions which are authorized and responsible for executing and coordinating the works related to the activities regarding climate change effectively and continuously from a holistic perspective with the participation and collaboration of all relevant stakeholders, because climate change is a multi-disciplinary and multi-faceted subject with multiple actors.

It is observed that the right to a healthy and liveable environment, which is another aspect of the right to social welfare, is not guaranteed in the documents of fundamental human rights prepared to assure human rights. However, the view that this right is a fundamental human right, so it needs to be guaranteed in the documents of fundamental human rights has become widespread and is recognized

[10] Presidential Circular no. 2021/9, OG of 30 April 2021 issue 31470.

internationally. As part of this, the Drafting Group on Human Rights and Environment (CDDH-Env) was established in the Steering Committee for Human Rights (CDDH) of the Council of Europe, and international meetings have already been followed by the Ministry of Justice and the Ministry of Foreign Affairs. According to the Ministry of Justice, the number of the applications about human rights aspect of climate change before national and international authorities, especially the Constitutional Court may rise in the upcoming periods, so results of the decisions to be made by the Constitutional Court and international human rights mechanisms, particularly the European Court of Human Rights (ECtHR) may affect the policies related climate change.

In the Agricultural Drought Strategy and Action Plan included in the Presidential Decree on Combatting Agricultural Drought and Studies on Drought Management published on 2 February 2022, it was specified that "All kinds of measures for financial and social supports will be taken with the plan" (T.R. Ministry of Agriculture and Forestry General Directorate of Agricultural Reform, 2022). In the First Water Council held in October 2021, several decisions were taken to promote the farmers who make production by using the seeds of drought-tolerant species.

Support mechanisms managed by the MoAF are implemented within the frame of the legislations "Law No. 2090 on the Assistance to Farmers Who Have Suffered Losses Due to Natural Disasters" and "Law No. 4081 on Protection of Farmers' Properties" and relevant practices to minimize the impacts of drought. Several legal regulations are also in effect for the purpose of providing the opportunity to postpone agricultural loans of the farmers affected by natural disasters. Besides, losses of the producers who suffer from drought in provinces are compensated as part of the Agricultural Insurance Pool Corp. (TARSIM). More agricultural producers are encouraged to register with TARSIM Pool.

The effective legal ground for a response of social services to disaster victims in the areas where natural disasters occurred, is the Law no. 2828 on Social Services.

The vulnerability of society to climate change and its climate change adaptation were discussed directly and extensively for the first time in the "Commission of Migration, Fair Transition and Other Social Policies" at the first Climate Council held in February 2022 with the aim of forming the background of the legislation and policies on combatting climate change in line with the "Target 2053 Net Zero Emission" announced following Türkiye's entry into the Paris Agreement in November 2021. This commission worked on the climate vulnerability and adaptation of the society by addressing various social determinants and elements of social inequality (migration, poverty, income distribution, inequality of opportunity for women and men, etc.), established a link between combatting climate change and social protection and social services, and received numerous recommendations about these subjects.

Social dimension of combatting climate change was scrutinized and several recommendations were

submitted by other Commissions of the Council. A few of such recommendations are as follows: recommendation of Climate Change Adaptation Commission of the Council "Adaptation actions should be identified and implemented to ensure social resilience against the impacts of climate change" and decision of the Commission for Local Administrations "In case of local disasters, risk management model should be adopted, hence facilitating a transition from crisis management, and within this context, human, administrative and financial capacity should be developed, and the scope of legislation should be consolidated" (T.R. Ministry of Agriculture and Forestry, 2022).

11.3. CLIMATE CHANGE IMPACTS

Demographic and socio-economic factors such as social inequality and injustice, gender, age, disability, poverty, and financial hardship shape people's exposure and vulnerability to climate hazards.

To analyze the impact of climate change on various segments of the society, it is essential to draw a detailed and reliable picture of social determinants (inequality/equity, income distribution/poverty, equality of opportunity in education, unemployment/job loss), which groups are vulnerable, and which consequences affect the capacity of people to adapt to the impacts of climate change (loss of life and property, nutrition, housing problems, health etc.).

It is particularly important that fair transition perspective should be applied while designing the social development policies for workers whose profession will cease or alter in terms of content and who will face the risk of losing their job due to the measures and policies implemented against the climate change, and for the new vulnerable groups which will emerge owing to the reason above. Regulation of the work life and improvement of employment are under the responsibility of the Ministry of Labor and Social Security in accordance with the Article 86 of the Presidential Decree no. 1 on Organization of the Presidency. In this regard, the Ministry of Labor and Social Security is responsible for conducting analyses about work life depending on the direct and indirect impacts of climate change, making necessary regulations in legislation and monitoring their implementation, informing sectors, unions, related institutions and stakeholders and the persons and groups to be affected by climate change and green transformation processes and taking measures for ensuring their participation in decision making and implementation processes. In line with this responsibility, the Ministry started activities for raising the awareness of fair transition, designing this process and coordinating the relevant efforts with a focus on the reflections of climate change and green transformation on work life.

A significant component of these efforts is comprised by "Specialized Working Group of Fair Transition Policies" established to assist Green Deal Working Group which was formed with the Presidential Circular no. 2021/15 published in the Official Gazette of 16.7.2021 issue 31543. On the other hand, the Ministry works on achieving the green transformation in labour markets, developing fair transition policies and ensuring participation of stakeholders. Given these developments, the presence of the Ministry of Labor and Social Security in CCACB becomes a crucial issue with respect to the importance of fair transition theme in climate change and green transformation and its role in training human resource, employment, social protection, occupational health and safety.

Abnormally low or heavy precipitation in Türkiye affects different segments of society and particularly, the vulnerable groups. Identification of such impacts is also extremely important.

Detailed data about social development needed for the impact analyses on climate change could not be attained during preparation process of the plan, so it has been impossible to conduct risk assessment. However, new/additional indicator sets were identified about the data required to provide guidance in order to ensure performance of these studies in the future as given in Table 7.

These indicators are necessary for assessing the impacts of climate change on social development in Türkiye with an inclusive and holistic approach. It is crucial to conduct and support a series of research which will meet such need and help the practice. Conducting risk assessment after obtaining data on the indicators given in tables will be more useful.

Research and studies have been conducted by expert institutions and several countries at the level of theories and policies since the beginning of this century with the aim of making the social vulnerability profiles of various sections clearly understood under the responses for the vulnerability and risk management of climate change. In these studies, a wide range of methodologies are utilized to assess the impact of climate hazards and past disasters on vulnerable population groups. Nevertheless, it is still early to claim that social vulnerability methodologies are integrated with the climate change and disaster risk management processes systematically.

Numerous studies included in the risk assessment of climate change are deprived of the social aspects of standardized, comparable and measurable vulnerability. It seems quite challenging to directly measure how climate change affected/will affect the segments of society in these studies which are usually restricted to the "hazard evaluations" of climate change.

For this reason, such restriction comes to the fore as an important constraint for proper risk assessment. Inability to define social vulnerability simply due to the presence of a series of factors complicates risk assessment. For example, it is required to collectively evaluate a set of factors such as the visibility of social vulnerability experienced in case of disasters and uncertainty of indicators (e.g. it is not considered while prioritizing the indicators of poverty that wealthy households can also be affected significantly by disasters) or requirements for measuring the individual characteristics related to the conditions

that make people less (such as social economic status) or more vulnerable (such as disability).

In some cases, spatial location is not sufficient alone, given that climate hazards and disasters occur in the areas where people live. At this point, spatial analyses should be addressed along with a set of general factors and vulnerability and risks assessment should be conducted. For example, location of a house in a coastal area or in a stream bed may indicate its vulnerability to climate hazards, but socio-economic status (poverty, inequality, access to resources, insurance etc.) may change the sensitivity or adaptation capability of that house to climate hazards in a positive or negative way.

In particular, women farmers involved in agricultural production, women who work in the food production processes and women and girls in low-income segments of the society directly face the impacts of climate change. Therefore, it is apparent that it will be useful to analyze the indicators identified and possible impacts related to the indicators in gender discrimination.

In data management, the most basic constraints for analyzing the vulnerability of society to climate change and risks are listed as follows:

- Inclusivity of the data which are generated traditionally and present demographical and socio-economic characteristics is limited. Such data cannot respond to secure planning of services.
- It is not adequate to conduct risk assessment with the existing data within the context of social protection/aid/service policies. New indicators are required for obtaining the necessary data.
- It was seen that the data attained in line with several policies on ranking and assessment of socio-economic development do not support mitigation of climate hazards. Such data were generated in line with indicators that are not climate-friendly. For instance, some of SEGE data were created by using such indicators as SEGE/Countryside Asphalt-Concrete Village Road Ratio , the number of households that are provided with coal aid as part of social aids etc., are not climate-friendly but considered as a support for socio-economic development.
- Although it is underlined in the literature that static quantitative approaches are not sufficient for measuring social vulnerability and the important thing is to capture dynamic nature of vulnerability, the fundamental constraint in practice is the lack of a holistic perspective and accompanying problems of data supply.
- In general, the typologies developed for social vulnerability indices may sometimes be specific to the vulnerability of a household resulting from its location in a coastal area or in a stream bed in line with the climate hazards. However, such vulnerability assessments need to be evaluated along with the classifications centred on fairness and equality for segments of society such as poverty, health, labour and access to resources. In the literature, these evaluations are made through the use of social vulnerability indices obtained by scaling with a set of specific indicators. Such practices are performed commonly in many countries. They focus mostly on theories. Limited number of data-centred practices is one of the leading difficulties.
- Generation of data which are sensitive to vulnerable segments of the society in the face of climate change becomes functional when it is considered that applications and services of every sector may create different impacts. The data for vulnerable groups are produced for the purpose of setting the policies that enable such differences to be noticed numerically and to ensure equality. It is necessary to generate the data with this approach.
- Another significant challenge in social vulnerability and risk assessments is the usual assessment of the factors which will affect vulnerability, and adaptation capacity together with the individual quantitative data. For example, it is not adequate to evaluate participation just with numerical rates in climate meetings.
- Data are not generated in a gender-sensitive manner.
- Data are not generated based on statistics in certain intervals. This situation makes it difficult to carry out comparisons in analyses.
- Data are not collected under a single roof, and hence various stakeholders are not aware of the data collected by each institution.
- Since the need for generating and sharing data with reciprocal support on a common ground increase gradually, it is recommended that the mechanisms regarding data sharing of institutions with other entities are used effectively.
- Technical capacity of data collection and analysis needs to be consolidated at national and local administration levels. Moreover, institutional/legal/managerial infrastructure which will generate the social data required for the adaptation of segments of society to impacts of climate change in Türkiye should be strengthened.
- In addition to qualitative data, quantitative data are needed for social vulnerability and risk assessments. However, experiential knowledge of individuals/society is not taken into account sufficiently in field works and there is no system that will allow the utilization of such knowledge.
- Another constraint in identification of social vulnerability is the need for high resolution in regional climate projections. This is an important bottleneck, considering the requirement for working on the impacts of climate change on society at micro scale.
- Sources and information/data accessed are limited to the public web pages rather than official data bases. Scientific research-originated sources are also quite limited.
- Most of the information/data accessed are not directly related to the main focus point in social vulnerability and risk assessment.

Impacts of climate change on society are interdisciplinary, so complex data bases which contain intersections of vulnerable population groups is needed in order to analyze the resilience and adaptation of the vulnerable. In assessments, common classifications such as “poor and

[11] “İllerin ve Bölgelerin Sosyo-Ekonomik Gelişmişlik Sıralaması Araştırması SEGE-2017”, Sanayi ve Teknoloji Bakanlığı, Kalkınma Ajansları Genel Müdürlüğü, Ankara, 2019.

Table 6. Indicator set recommended for risk assessment of drought

HAZARD		EXPOSURE
Climate Signal	Climate Impact	
Decrease in total precipitation amount	Meteorological drought	Decline in per capita national income (Agriculture)
	Hydrological drought	Family farming (micro) enterprises (smallholder family farmers)
	Agricultural drought	Female farmers registered in the farmer registration system
		Single-parent household (by gender)
		Female population aged 65+
		Unemployed population (by occupational registration, age, and gender)
		Poor population dependent on natural resources for livelihood
		Vulnerable groups
		Pregnant women

VULNERABILITY		RISK
Sensitivity	Adaptation Capacity	
Seasonal/temporary agricultural worker (by age and gender)	Arable land in urban-rural areas	Water scarcity
Working-age population aged 15-49	Land allocated for agriculture in Metropolitan Municipalities (land cover)	Food scarcity
Shepherd population	TURKSTAT Sustainable Development Indicators (2020) and those to be developed	Livelihood difficulties
Population receiving social aid (by age and gender)	Environmental Indicators	Job loss
Number of families receiving in-kind aid	Environmental Sustainability Index	Loss of income, livelihood difficulties
Number of families receiving cash aid	Proportion of poor population	Housing problem
Poor population (by age and gender)	Proportion of undernourished population	Nutrition problem, access to food
Rate of change in crop yield	TURKSTAT Life Satisfaction Survey	Health problem
Investments causing maladaptation	Agricultural biodiversity	Deepening inequality
Distribution of employment in agricultural micro-enterprises (by age and gender)	Number of young farmers	Forced migration due to decline in production
Public health	Stability and control of input (feed, etc.) prices	Access to education for family members
Change in crop yield (due to insufficient water supply)	Farmer population adapting to crop variability	High cooling expenses
Female working population by sectoral categories (agriculture and sub-sectors: fisheries, dairy, food, etc.)	Population with postgraduate degrees (master's, doctorate)	
Small greenhouse farmers	Number of small farmers applying good agricultural practices	
Agricultural land allocated for non-agricultural purposes (ha)	Number of small farmers engaged in organic farming	
Low efficiency in irrigation systems	Farmers' capacity to grow drought-resistant crops	
Constraints in existing legislation	Amount of farmer support in agricultural regions	
Lack of data on vulnerable groups in local institutions	Number of social services experts	
	Farmers registered in the TARSIM insurance pool (by gender)	
	Number of agricultural research institutes	
	Agricultural cooperatives (e.g., women's cooperatives)	
	Number of projects related to traditional knowledge	
	Smart agriculture projects	
	Addressing social vulnerability in local climate action plans	
	Digital policies and tools in agriculture	
	Government support for smart agriculture projects	
	Funding opportunities allocated for these topics	
	Rate of mobile phone/internet use (disaggregated by gender)	
	Female representation in municipal councils	
	Fair adaptation projects	

Table 7. Indicator set recommended for risk assessment of heavy precipitation

HAZARD		EXPOSURE	VULNERABILITY		RISK
Climate Signal	Climate Impact		Sensitivity	Adaptation Capacity	
Decrease in total precipitation amount	Meteorological drought	Decline in per capita national income (Agriculture)	Seasonal/temporary agricultural worker (by age and gender)	Arable land in urban-rural areas	Water scarcity
	Hydrological drought	Family farming (micro) enterprises (smallholder family farmers)	Working-age population aged 15-49	Land allocated for agriculture in Metropolitan Municipalities (land cover)	Food scarcity
	Agricultural drought	Female farmers registered in the farmer registration system	Shepherd population	TURKSTAT Sustainable Development Indicators (2020) and those to be developed	Livelihood difficulties
		Single-parent household (by gender)	Population receiving social aid (by age and gender)	Environmental Indicators	Job loss
		Female population aged 65+	Number of families receiving in-kind aid	Environmental Sustainability Index	Loss of income, livelihood difficulties
		Unemployed population (by occupational registration, age, and gender)	Number of families receiving cash aid	Proportion of poor population	Housing problem
		Poor population dependent on natural resources for livelihood	Poor population (by age and gender)	Proportion of undernourished population	Nutrition problem, access to food
		Vulnerable groups	Rate of change in crop yield	TURKSTAT Life Satisfaction Survey	Health problem
		Pregnant women	Investments causing maladaptation	Agricultural biodiversity	Deepening inequality
			Distribution of employment in agricultural micro-enterprises (by age and gender)	Number of young farmers	Forced migration due to decline in production
			Public health	Stability and control of input (feed, etc.) prices	Access to education for family members
			Change in crop yield (due to insufficient water supply)	Farmer population adapting to crop variability	High cooling expenses
			Female working population by sectoral categories (agriculture and sub-sectors: fisheries, dairy, food, etc.)	Population with postgraduate degrees (master's, doctorate)	
			Small greenhouse farmers	Number of small farmers applying good agricultural practices	
			Agricultural land allocated for non-agricultural purposes (ha)	Number of small farmers engaged in organic farming	
			Low efficiency in irrigation systems	Farmers' capacity to grow drought-resistant crops	
			Constraints in existing legislation	Amount of farmer support in agricultural regions	
			Lack of data on vulnerable groups in local institutions	Number of social services experts	
				Farmers registered in the TARSIM insurance pool (by gender)	
				Number of agricultural research institutes	
				Agricultural cooperatives (e.g., women's cooperatives)	
				Number of projects related to traditional knowledge	
				Smart agriculture projects	
				Addressing social vulnerability in local climate action plans	
				Digital policies and tools in agriculture	
				Government support for smart agriculture projects	
				Funding opportunities allocated for these topics	
				Rate of mobile phone/internet use (disaggregated by gender)	
				Female representation in municipal councils	
				Fair adaptation projects	

unemployed", "farmer and landless", "person with disability and vulnerable household", "old woman and seasonal worker", "child and immigrant" and "widow and poor" should be considered.

It is inevitable for children to be exposed to impacts of climate change. As mentioned in UNICEF report dated 2021 "Climate Crisis is a Child Rights Crisis: Children's Climate Risk Index", each outcome of climate change affects children and their access to own rights directly. Within this frame, the Ministry of Family and Social Services (General Directorate of Child Services/Department of Child Rights) recommend particularly that analyses on social impacts of climate change should be conducted based on child rights and the adaptation process for the children in vulnerable groups, who need special policies, should be maintained, and relevant policies should be developed.

Poor households are not capable of compensating the losses and damages originating from the disasters led by extreme weather events (the crops raised by them become unproductive due to severe drought), therefore their poverty level may rise. In several regions, poor households may be the most vulnerable section whereas the wealthier segments of society in other regions who own more properties and may suffer from higher monetary loss in case of a flood are more vulnerable.

Even though poverty is usually associated to the rising climate risk, it may not be the single possible indicator of sensitivity by itself. Wealthy households may be also sensitive to climate risks. High-cost investments may result in higher losses. In several cases, it may take longer for wealthy segments to recover after disasters compared to middle-income or poor households.

Situation of the social adaptation capacity and external factors (legal and institutional structures, presence of policies and action plans, sectoral vulnerability, ecologic systems, resilience of cities etc.) is significant while analyzing the impacts of climate change. Like vulnerability measures, adaptation measures may alter and diversify.

The climate change literature highlights the complexity of developing adaptation capacity indices that comprehensively account for all factors influencing adaptation and resilience to climate hazards. The difficulty in creating simple, standardized typologies is also well-documented. The primary reason for these challenges lies in the scarcity or absence of sufficient field studies to establish robust empirical foundations.

11.4. CLIMATE CHANGE ADAPTATION MEASURES

To achieve climate change adaptation in Türkiye, priority will be given to seamless and supportive actions, including the renewal of legislation, enhancement of managerial, institutional, policy, and planning frameworks, as well as training focused on awareness, capacity development, and stakeholder consultation. These efforts will aim to strengthen the society's adaptation capacity by embedding social transformation within the climate change agenda.

Basic actions which will illuminate reinforcement of the conceptual link between social development and combatting climate change in Türkiye can be listed as follows: i) strengthening climate change adaptation of groups at risk against social and economic injustices that will be created by climate change as a priority, ii) adoption of a management mentality for climate change adaptation that looks after the interests of the nature and society, iii) in climate change adaptation and social development policies and practices, consideration of determinants of social justice (even if they may be indirectly related to climate change) in order to create integrated and multiple benefits or co-benefits, and iv) integration of social conditions regarding equal opportunities for women and men (equality, justice, poverty etc.) into climate change adaptation policies at national and local levels by embracing a fair adaptation approach.

It is anticipated that the acknowledgement of these issues will promote Türkiye's efforts for combatting climate change, especially in the long term and will create a significant opportunity to attain the goals of Green Development Revolution.

It is important to calculate the benefits of studies regarding climate change adaptation to the society. Climate change adaptation action plan and each of the practices planned to be implemented at sectoral level will bring opportunities to society. Calculation of the envisaged benefits is therefore necessary.

From a societal perspective, local communities play a substantial role in combatting climate change. It is important to strengthen the cooperation between society and other related institutions is important for stabilizing the climate system, recognizing the inner link between biodiversity and climate change, and maintaining the biodiversity. In this sense, it will be useful to i) encourage mentality change in order to restore the health of all ecosystems timely and in a culturally appropriate manner and ensure their sustainability and ii) utilize various information systems and applications, incorporating local knowledge, in order to transform the global approach on climate change and biodiversity.

STRATEGIC GOAL 1

To include the social life impacts of, and measures against, climate change in the socio-economic development and ecosystem protection strategies at all levels (national, regional, local) and to incorporate the social development component into the climate change adaptation policies, planning and implementation processes of all sectors.

SDV1. Ensuring that the multi-faceted impacts of climate change on social development is taken into consideration in higher policy documents such as Long-Term Climate Strategy of Türkiye.
SDV2. Producing statistics which will allow for demographic and socio-economic analyses on individuals employed in sectors vulnerable to climate change.

STRATEGIC GOAL 2

To develop social protection policies to strengthen public resilience and adaptation to existing/potential climate hazards.

SDV3. Developing social assistance and social service programmes that are implemented within the frame of social protection policies, with a particular consideration of provinces with high social vulnerability so that the vulnerability of individuals/households to the impacts of climate change can be reduced and their resilience strengthened.
SDV4. Promoting research efforts and implementing findings in practice in order to formulate climate friendly alternative social assistance policies in the framework of social protection policies.

STRATEGIC GOAL 3

To abandon the crisis management mindset and facilitate transition to the risk management model to ensure public adaptation to climate change and strengthen the legal, institutional, administrative, scientific, social and financial capacity required in this context.

SDV5. Conducting analyses on how climate change affects all segments of society, particularly vulnerable groups (elderly, children and persons with disabilities) and introducing development programmes supported by local administrations considering various needs of such groups.

STRATEGIC GOAL 4

To implement the national climate change adaptation policies by focusing on a rights- and benefits-based approach and equal opportunities to ensure the well-being of all segments of society.

SDV6. Identifying the benefits of measuring women's different levels of vulnerability to climate change and of their climate change adaptation by taking into consideration the adaptation actions of related SDGs and sectors.

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DISASTER RISK REDUCTION

climate adaptation

Prioritizing investments to strengthen resilience against climate-related disasters in critical sectors

Improving the process for identifying losses and damages, and establishing the Turkish Loss and Damage Platform

Enhancing the insurance mechanism to support compensation for losses and damages

Developing a Multiple Hazard Early Warning System to provide foresight, warnings, and response actions that reach all segments of society and involves

Considering the potential displacements due to climate-related risks in the National Migration Policy and action plans, incorporating climate change adaptation into migration management processes

DISASTER RISK REDUCTION

climate adaptation

12.1. GENERAL FRAMEWORK

The increasing frequency and scale of climate-related disasters are diminishing social resilience, exacerbating existing vulnerabilities and social inequalities, and contributing to the emergence of new ones.

Climate and disaster risks are increasing across the world, with climate-related disasters becoming more frequent in the last 50 years (World Meteorological Organization, 2021). In the last 5 years, the number of those who suffered from or lost their lives due to climate-related disasters have increased compared to the previous 5 years. While climate and disaster risks are increasing at an unprecedented pace, Türkiye is being addressed in the latest studies as one of the most disaster-prone countries in the European region and the Mediterranean Basin which have the severest experience of extreme climate events and climate change.

In 2019, in addition to the earthquake which affected the population and infrastructure, 936 extreme events including heavy precipitation/floods (%36), storms (27%) and hail (18%) resulted in an annual average loss of 0.20% of the GDP (TSMS, 2020). The average loss for the Organization for Economic Cooperation and Development (OECD) was on the other hand 0.09% (International Finance Corporation, 2022). According to the Annual Average Loss (AAL) values calculated for Türkiye, drought has the largest share as it accounts for 1.6% (12.352 billion USD) of the GDP, followed by earthquakes (0.3%), indirect losses (0.2%), and indirect environmental risks (0.1% each). The index 17.35 billion USD for all climate-related disasters or current AAL value for climate change account for 2.2% of the GDP for 2021. The rate of such losses is much higher when calculated according to RCP4.5 and RCP8.5 scenarios, accounting for 21.5 billion USD or 2.8% of the GDP in the first scenario and 24.31 billion USD or 3.2% of the GDP in the latter scenario (ESCAP, n.d.).

"Türkiye's geographic, climate and socio-economic conditions make the country extremely vulnerable to the impacts of climate change and other environmental hazards. For this reason, adaptation and resilience are significant priorities for Türkiye.

The most important causes of such vulnerability include climate factors, population exposure (e.g., rate of population exposed to floods and forest fires), and socio-economic factors (e.g., share of agriculture in economy)" (The World Bank, 2022).

In 2021, which is when Türkiye suffered from forest fires much higher than annual averages, 2,793 forest fires occurred across the country, damaging 139,503 ha of forest areas. (Ministry of Agriculture and Forestry, 2021).

The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) lists the top three natural disasters in Türkiye in 1970-2021 as floods, earthquakes, and heatwaves. Indeed, 43 flood disasters occurred in 1970-2021, affecting approximately 1,805,000 persons. Furthermore, the floods that occurred in this period resulted in a loss of 2.8 billion USD. The damage caused by drought in Türkiye, on the other hand, was calculated to be 1.2% of the GDP (ESCAP, n.d.).

According to AFAD's Natural Phenomena Statistics for 2022, 450 floods, 18 avalanches, 859 landslides, 13 sinkholes, 21,054 earthquakes, 137 rockfall, and 451 other disaster events occurred in 2022 (AFAD, 2023).

Between 2010 and 2021, a total of 8,274 meteorological disasters occurred, affecting Antalya, Balıkesir, İzmir, İstanbul, Konya, Mersin, Ordu, Van, Muğla, Aksaray, Çorum, Bursa, Elazığ, Kayseri, Manisa, Kastamonu, Nevşehir and Aydın provinces. The three most frequent meteorological disasters in this period were storms (32%), heavy precipitation (30%) and hail (17%). Extreme temperature events are also experienced in recent years; in the case of Cizre, which is located in the Southeastern part of the country, the temperature measured at +49.1°C in July 2021 broke the country's temperature record. The previous highest temperature was recorded at +49°C in 1962, and the second highest temperature at +48.6°C in the same city on 30 July 2000 (TSMS, 2022).

Various small-scale disasters continuously repress social resilience and consume limited resources and capacities. Climate risks, however, are distributed unequally throughout the country and vary depending on hazard type, exposure and vulnerability level, and the capacity of the disaster risk management system to cope.

According to climate projections, this trend is expected to increase further in the future, given the expected impacts of climate change, unfavourable environmental conditions and increased pollution, continuously increasing urbanization, increasing migration patterns and other risk factors. Eventually, it is projected that the frequency, intensity and impact of climate-related disasters will increase, exacerbating current situations of vulnerability and social inequality in addition to creating new ones and significantly affecting the resilience of national and local communities, and particularly women, youth, elderly and other vulnerable groups.

According to the Climate Change 2022: Impacts, Adaptation and Vulnerability Report of the United Nations (UN) Intergovernmental Panel on Climate Change (IPCC), Türkiye is one of the most vulnerable countries in Europe in the context of extreme weather events.

In the CCP4 section focusing on the Mediterranean, the IPCC 2022 Report emphasizes that the severity of drought will be extremely high in the Mediterranean Region.

It also mentions that Lake Beyşehir, the largest freshwater lake in Türkiye, may be completely dried up by 2070.

Türkiye's disaster risk management system has critical requirements such as having the process, which mostly focuses on post-disaster response, also focus on pre-disaster; clear distribution of duties and responsibilities among key stakeholders; improving risk governance at national and local levels; enhancing intersectoral coordination and cooperation and ensuring sustainable and consistent financing towards risk mitigation. Categorized as a very high risk (16.23) country, Türkiye ranks 30th in 192 countries in terms of "very high exposure, lack of coping capacity, moderate sensitivity and very low adaptation capacity" indicators (World Risk Index 2022) (World Risk Report 2022, n.d.).

Therefore, resilience must be enhanced and adaptation actions for all levels must be designed and implemented. In this context, Türkiye aims to enhance social resilience through strengthening climate change adaptation especially at sectoral and urban levels with the Enhancing Adaptation Action in Turkey Project.

12.2. SECTORAL LEGISLATIVE FRAMEWORK AND RESPONSIBLE INSTITUTIONS

Türkiye has established a comprehensive disaster risk management system to prevent and mitigate the impacts of both current and emerging climate and disaster risks.

Despite some gaps and various challenges that persist to build and operationalize a systematic mechanism to reduce climate and disaster risks, this is a significant point of sustainable and resilient development. In this context, policy and regulatory frameworks were formulated together with key documents, such as the Eleventh Development Plan (2019-2023) and Twelfth Development Plan (2024-2028), disaster risk reduction regulations, Integrated Urban Development Strategy and Action Plan (KENTGES) (2010-2023), Provincial Disaster Reduction Plans (PDRRPs), Türkiye Disaster Response Plan (TDRP) (2014), National Earthquake Strategy Paper and Action Plan (NESAP) (2012-2023), Green Deal Action Plan (2021), Türkiye Disaster Risk Reduction Plan (TDRRP) (2022), Climate Change Action Plan of the Ministry of National Education (2022), Climate Change Strategy (2010-2023), National Climate Change Action Plan (CCAP) (2011-2023), Türkiye National CCASAP for 2011-2023, Seventh and Eighth National Communication under UNFCCC, first NDC (2015), and updated first NDC. The relevant structure is shown in Figure 54.

"Türkiye has started to lay a solid foundation for building adaptation and resilience through planning and policy development at various levels of government and in various sectors. There has also been progress in mainstreaming climate change adaptation and disaster risk reduction into national development processes, but more needs to be done to establish and fund priority actions and develop strategies and capacity to build resilience and strengthen preparedness" (The World Bank, 2022).

Social and economic losses caused by weather and climate-related extreme events and disasters have been increasing in many parts of the world, including Türkiye, with significant regional and inter-annual variability. The nature, intensity and impact power of extreme weather and climate events and disasters closely depend on economic, social, geographical, demographic, cultural, institutional, and governance (e.g., adaptation) factors, environmental and ecological factors, as well as exposure and vulnerability levels varying at spatial and temporal scales. A large part of Türkiye is located in the subtropical Mediterranean climate zone with dry summers. Türkiye is a country with moderate to high risk of climate change and future climate risks. In this context, there is a need for studies on the issues of climate monitoring, climate change vulnerability and risk assessments as well as adaptation measures to reduce the adverse impacts of climate change (UNFCCC, 2023).

AFAD was established to achieve integrated disaster risk management through implementing comprehensive policies, measures and actions, and coordination among the relevant institutions and organizations in all governance levels. Disaster and Emergency Management Directorates were established in 81 provinces; these directorates are governed by and directly responsible to the governorship. The National Disaster Risk Reduction (ARA) Platform was established under AFAD, with a view to "raising public awareness of disasters, ensure coordination and cooperation for the sustainability of disaster-related topics, assess needs, monitor and evaluate the applications implemented to contribute to the integration of disaster risk reduction policies into sustainable development plans and policies at all levels" (UNDRR, n.d.). Additionally, disaster management policies and priorities are determined in the Development Plans, Medium-Term Programmes and Presidential Annual Programme, in line with which the Public Investment Programme and budget are formulated (AFAD, 2022).

Policies and measures on climate-related disasters were determined in the Twelfth Development Plan. Policies and measures, such as "Drafting guidelines, differentiated at the regional level, regarding disaster risks arising from climate change and measures related thereto (833.5); Ensuring enhanced climate change resilience through educational and awareness-raising exercises on extreme weather events, desertification, erosion, water and soil conservation (833.6); Utilizing, at a maximum level, nature-based solutions and green infrastructure facilities as part of disaster risk reduction (833.7)", were included under enhancing social resilience by strengthening adaptation capacity (Objective 833).

Disaster Risk Reduction Strategies in Türkiye

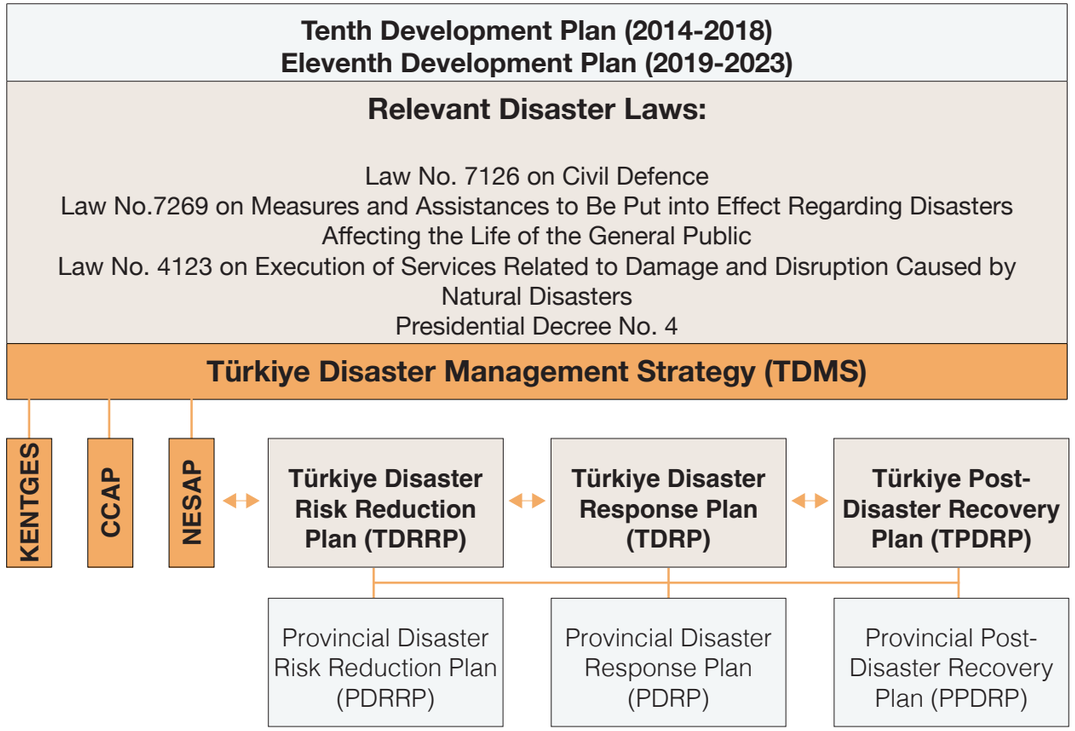

Figure 54. Disaster risk reduction strategies in Türkiye

Source: (id. p.15)
Note 1: Türkiye Post-Disaster Recovery Plan (TPDRP), Provincial Post-Disaster Recovery Plan (PPDRP), and Türkiye Disaster Management Strategy (TDMS) are at the drafting stage.
Note 2: The Twelfth Development Plan (2024-2028) was published in Official Gazette of 01.11.2023 issue 32356-bis and includes matters related to climate change and disaster risks under the heading "Disaster Resilient Living Spaces, Sustainable Environment" (For further detail, see: https://www.resmigazete.gov.tr/eskiler/2023/11/20231101M1-1-1.pdf)

12.3. CLIMATE CHANGE IMPACTS

Türkiye must develop and implement adaptation solutions to address the anticipated impacts of climate change effectively.

Türkiye is substantially affected by disasters due to its geological, topographic and climate characteristics and carries high risk due to its location. The disasters that affect the country the most are earthquakes, in particular, and floods, rockfalls, landslides, avalanches and forest fires. In 2020-2022 alone, an earthquake in Elazığ, a flood in Giresun, an earthquake in İzmir, floods in Rize and Artvin, forest fires in Antalya and Muğla, and floods in Sinop, Bartın and Kastamonu claimed significant losses of life and property. These recent disasters extended over a large area in terms of their spheres of influence and frequency (op. cit., p. 6)

The climate risk and vulnerability classifications for 6 countries including Türkiye, published in the report by the World Bank, are shown in Figure 56 (The World Bank, 2022).

According to INFORM which is led by the European Commission Joint Research Centre, with a medium (4.7) INFORM Risk Index rate (DRMKC, n.d.), Türkiye ranks 45th in a list of 191

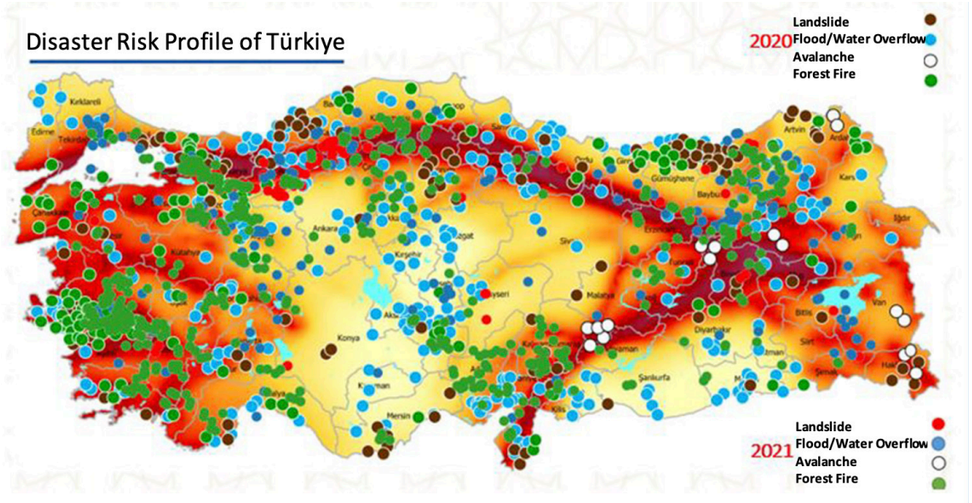

Figure 55. Risk profile of natural disasters occurring in Türkiye

Table 8. Main natural disasters that occurred in Türkiye (GFDRR, n.d.)

River flood	High
Coastal flood	High
Urban flood	High
Earthquake	High
Landslide	High
Forest fire	High
Drought	High
Extreme temperatures	High

countries in which the highest rated countries have the lowest risk. While risk level increases depending on the multi-year trend regarding the country's risk level, the current situation is generally improving in terms of risk reduction. However, according to the newly created INFORM Climate Change (CC) Tool[13] assessment, Türkiye has an INFORM CC Risk score of 4.9. Although the same level of INFORM CC Risk is projected for 2050 and 2080 under RCP4.5 and RCP8.5 scenarios, the severity of exposure, vulnerability and projected hazards increase (DRMKC, n.d.).

The provinces with the highest risk of flood, that have been exposed to many disasters in the last 70 years, are Erzurum (440 flood events), Sivas (319 flood events), Van (265 flood events), Bitlis (247 flood events), and Kayseri (215 flood events) (AFAD, 2020). "Floods occur in this region, due to various causes including sudden and heavy precipitation, deforestation, urbanization on valleys, sedimentation blocking river flow, and narrowing of riverbeds due to construction activities" (AFAD, 2022).

Landslides triggered especially by precipitation are at the top of the disaster risk profile. A significant part of the settlements in Türkiye, i.e., 5,472 or 15.31% of total settlements, are exposed to this risk. "When examining their spatial distribution, landslides frequently occur in the Eastern Black Sea Region (Trabzon and Rize provinces and peripheries) and Central and Western Black Sea Regions (Karabük, Bartın, Zonguldak, Kastamonu and peripheries) due to surface and topographic conditions. (AFAD, 2020). Erosion severity classifications, different land use types, and erosion sensitive areas in terms of different slope groups, as well as annual average soil losses in these areas, were identified and mapped with the DEMIS software developed by GDCDE.

Forest fires, caused by heatwaves as well as human beings, have become more frequent in recent years. 65% of the forests in Türkiye consist of sensitive forests. The impact of climate change and global warming decreases the moisture content in combustible substances, resulting in large forest fires in non-fire-sensitive forests, as well. For example, Antalya and Muğla provinces experience more frequent and larger scale fire disasters, by which local communities and ecosystems are particularly

[13] INFORM Climate Change Tool provides foresight regarding climate change risk assessment results, helping users to easily navigate through combinations of different scenarios and different points in time and study risk, hazard and exposure variables and potential changes in vulnerability difference and population.

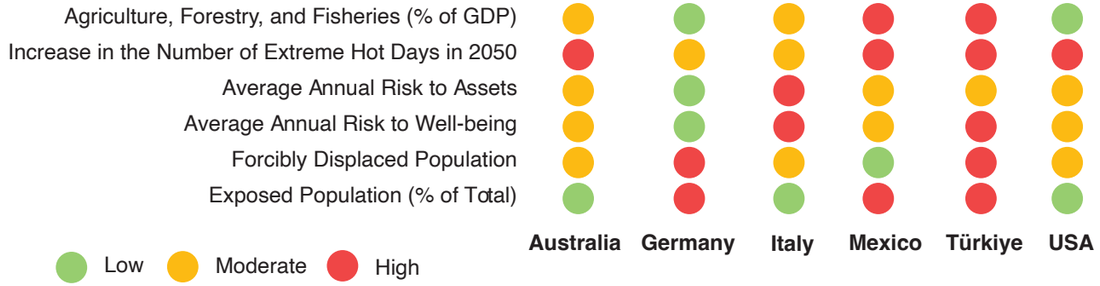

Figure 56. Climate risk and vulnerability for Türkiye and selected countries

affected. Forests suffer from soil loss due to erosion and climate change impacts. This situation disrupts the water regime and leads to other disasters such as desertification, flooding, landslides, drought and avalanches. (AFAD, 2022). At the same time, other climate-related hazards have been increasing in frequency, intensity and severity in recent years. Some examples of such hazards include extreme temperatures, heatwaves, storms, and heavy precipitation causing coastal flooding, etc.

Storms occur especially in the Northern Aegean and Central Mediterranean Regions. Strong winds and storms are frequently experienced in Balıkesir, İzmir, Konya, Kayseri, Kars and Elazığ provinces. When looking at distribution over the years, there is a rapid increase in storms since 1998. (AFAD, 2022). Furthermore, the changes in the surface and groundwater levels and precipitation regimes often result in the formation of sinkholes in some provinces such as Konya. "Although in the past they did not use to be perceived as threats due to low population density and limited agricultural and industrial areas, sinkholes presently threaten human life due to having been extended over larger areas." (op. cit.).

According to the Annual Areal Precipitation across Türkiye data of TSMS, 2008 was recorded as the year with the least precipitation, followed by 2013, 2017, 2020 and 2021 (TSMS, n.d). The impacts of drought also affect overall food security, extending beyond agriculture, water management and relevant sectors. As part of the Enhancing Adaptation Action in Turkey Project, climate hazards including drought, heavy precipitation, heatwave, forest fire, cold wave and severe wind were analyzed for eleven priority sectors, under the optimistic RCP4.5

and the pessimistic RCP8.5 scenarios, by 2100. In this context, the highest meteorological drought values[14] in the last two decades are seen in Konya and Karaman provinces, followed by Hatay and Kahramanmaraş. Meteorological drought was determined to be higher in the Eastern Anatolia Region compared to Türkiye in general. Under the RCP4.5 scenario, a 20% decrease is expected in drought intensity in the Western Black Sea Region and in the east of the Marmara Region, while drought is estimated to be on an increasing trend in the rest of the country. The RCP8.5 scenario, on the other hand, projects an average of 40% increase in drought intensity in the Southern Aegean Region and more than 80% increase in the eastern and Southeastern parts of Türkiye.

The number of floods[15] and the subsequent damages are significantly increasing as a result of climate change, industrialization and irregular urbanization. In the current period, the annual total heavy precipitation amount reaches 280 mm along the Taurus Mountains and Antalya, Mersin and Adana provinces in the Mediterranean Region, and assumes the highest value of around 360 mm in Giresun, Trabzon, Rize and Artvin provinces in the Eastern Black Sea Region. In general terms, the total precipitation amount is projected to increase in the north and decrease in the south of Türkiye under both scenarios. In addition, both scenarios estimate that the sharpest decline will occur in the Mediterranean Region in the 2061-2100 period. The regions with the highest increase in total precipitation amount as a result of heavy precipitation is Eceabat in Çanakkale province under the RCP4.5 scenario, and the Eastern Black Sea Region, especially Artvin and Ardahan provinces, under the RCP8.5 scenario. A 100% increase is projected in the regions with the highest increase in total amount of precipitation caused by heavy precipitation whereas a 60% change is expected in the regions with the highest decrease rate. In conclusion, it is foreseen that the amount of total precipitation caused by heavy precipitation will increase in the north and decrease in the south of the country.

The highest heatwave frequency[16] value in the current period is observed near Mersin in the Mediterranean Region, with an average of 12 days a year. Heatwave frequency increases from the north towards the south of the country. Under the RCP8.5 scenario, the increase which is projected to be up to a maximum of 30 days in the first future period will be at least 90 days especially in Şırnak, Van and Hakkari provinces in the Eastern Anatolia Region in the final future period.

Furthermore, both scenarios estimate an increase of approximately 60 days in the Southern Aegean and Mediterranean Regions especially in the 2060s. The places where heatwaves will increase the least under both scenarios are estimated to be the coasts of the Black Sea and the provinces in the southern shores of the Marmara Sea.

Almost 60% of the forest lands in Türkiye are exposed to forest fires[17]. Through erosion, deforestation leads to desertification which potentially causes loss of soil, flood, landslide, avalanche, and drought. According to the Canadian Fire Weather Index representing the fire conducive weather for the current period, the highest value of fire risk in Türkiye is seen in Şanlıurfa, Mardin and Gaziantep in Southeastern Anatolia. Fire risk is moderate-low in the Aegean, Marmara and Eastern Anatolia Regions and the lowest in the Black Sea Region. For the future, the RCP4.5 scenario projects a +/- 20% change throughout the country. By the end of the century, fire conducive weather conditions are projected to increase by 40% compared to the current period in Artvin, Ardahan, Iğdır and Kars in the northeast of the country, and decrease by 15% in the Marmara Region. Additionally, a 30% increase in Antalya and Burdur in the Mediterranean and Çankırı and Çorum in Central Anatolia, and a 20% increase in the Southeastern Anatolia Region are expected to occur in 2081-2100.

In terms of heatwaves in the current period (UNDP, 2022), the number of days when the lowest temperature is below 2°C in a year on average is a total of 240 days in Ardahan and Van provinces and covers approximately 8 months throughout the year. The highest cold wave frequency values are observed in the Southeastern and Eastern Anatolia Regions at approximately 18 days. Furthermore, cold wave frequency is approximately 16 days in Ankara and Yozgat in Central Anatolia and the west of the Mediterranean Region. It is estimated that cold wave frequency will be on a continuous downward trend in the future. Both emission scenarios project a gradual decrease in the change in future cold wave frequency from the east to the west of the country.
The threshold values used to determine severe wind in the current period (UNDP, 2022) are the highest in Marmara and Central Anatolia Regions.

No major difference between the two emission scenarios is projected for the future. It is estimated that the number of severely windy days will increase in Marmara, Western and Central Black Sea, and Northern Aegean Regions, and decrease in the Mediterranean and Eastern Anatolia Regions.

[14] [15] [16] Taken from the Türkiye Sectoral Vulnerability and Risk assessment drafted under this study.

[17] Taken from the Türkiye Sectoral Vulnerability and Risk assessment drafted under this study.

12.4. CLIMATE CHANGE ADAPTATION MEASURES

Transformative risk governance will be established by enhancing the understanding and knowledge of disaster risk, ensuring adaptation to the anticipated impacts of climate change. Resilience will be achieved through capacity building, awareness raising, and consistent, sustainable investments.

Türkiye is exposed to a great variety of natural hazards including drought, heavy precipitation and floods, extreme heatwaves, forest fires, cold waves, storms, earthquakes, landslides, erosion, sinkholes, etc. The frequency, intensity or severity of all risks other than earthquake is increasing with the impact of climate change. Climate hazards emerge directly or as chronic stress factors affecting the resilience and disaster of industrial and technical facilities. In addition to the impacts produced by other risk factors, the expected increase in the number of events and the resulting losses and damages will significantly impact Türkiye's sustainable and resilient development, by which vulnerable groups will be the most affected.

For this reason, certain adaptation actions aiming to contribute to resilience building across the country are being designed and planned to be implemented. Such actions will not only strengthen the mutual connection between climate change adaptation and disaster risk reduction but also ensure the adoption of an uninterrupted approach, based on the whole government and all segments of society, to reduce current climate and disaster risks, and anticipate and mitigate the adverse impacts of new and emerging risks. It is also important to emphasize that these actions are fully aligned with the country's current risk reduction priorities, the international obligations under sustainable and resilient development frameworks and mechanisms, and general efforts towards adaptation to potential climate change impacts. The said adaptation actions are grouped under different strategic goals, as follows.

STRATEGIC GOAL 1

To strengthen the understanding of and information infrastructure for climate change and disaster risks for sustainable and resilient development.

Climate change aggravates the impacts and severity of climate-related hazards leading to complex and gradual risks that increase losses and damages, wear down the society, and make it difficult to achieve sustainable development efforts in general. Furthermore, poverty, inequality, urbanization, environmental degradation, demographic changes, lack of risk-based policies and the need for updated legislation, pandemics, and the expanded range of disaster risk-increasing factors emphasize the need to transform the approach of understanding current and new risks.

For this reason, the first action involves the comprehensive understanding of the developing, systematic, dynamic and interconnected nature of climate and disaster risks. It is also associated with the risk assessments and recommendations on relevant issues, as laid down in TDRRP Strategic Goal 1 (Strategic Priority 1: Understanding Disaster Risks) which concerns determining and evaluating disaster hazards and risks at the local and national levels, and Türkiye's Voluntary National Report for the Midterm Review of the Implementation of the Sendai Framework for Disaster Risk Reduction. Current risk and hazard assessments will be further improved by taking a preventive approach to risk assessments and integrating long-term climate change scenarios and models. In order to improve foresights to prevent the risks that are expected to occur soon or in the future, in addition to improving risk-based planning and decision-making processes, it is critical to integrate climate change projections into the current studies and assessments which are based on analyzing past climate and disaster events. Therefore, technical guidelines that guide the comprehensive and systematic analysis and evaluation of risks in the context of climate change must be developed, with a view to supporting decision-makers, practitioners and relevant stakeholders in improving climate change and disaster risk reduction policies and development based on risk reduction. In order to support the evaluation process, various studies and action plans will be drafted on the priority climate hazards (e.g., storms, hail, erosion, desertification, forest fires, etc.) for the most affected provinces. The National Climate and Disaster Risk Assessment Report will summarize the evaluation of all relevant risks and hazards that serve as a basis for the decision-making, planning and extension processes related to disaster risk reduction (DRR) and climate change adaptation across sectors, in order to ensure risk-based policy making and sustainable and resilient development. In addition to completing all flood risk assessments and river basin management plans for better visualization and integrated analysis, it is planned to prepare and publish integrated risk and hazard maps to extend risk information to wide audiences. Lastly, the government's efforts and actions to respond to increasing challenges such as degraded ecosystems, biodiversity loss, climate change and increased frequency of extreme weather events, as well as Ecosystem-based DRR and Nature-based Solutions, must be implemented in the framework of an adaptation plan. This is aligned with the "leave no one behind" principle supported by Türkiye's Voluntary National Report for the Midterm Review

STRATEGIC GOAL 1

To strengthen the understanding of and information infrastructure for climate change and disaster risks for sustainable and resilient development.

of the Implementation of the Sendai Framework for Disaster Risk Reduction and provides a basis for the implementation measures to achieve this.

The final action under the relevant strategic goal concerns an early warning system which is a strong adaptation action tool that will help communities to prepare for climate-related hazards. It emphasizes a multiple hazard early warning system for fast- and slow-growing disasters, aiming to reach all members of the society and involving preventive and post-disaster responses. This action will also support the country's alignment with the Sendai Framework, and particularly Objective G regarding early warning and risk information, and the reporting to the Sendai Monitoring Mechanism.

DRR1. Conducting comprehensive risk assessment and planning studies to establish climate change risks more clearly.
DRR2. Developing a Multiple Hazard Early Warning System, including warning systems for fast- and slow-growing events, that aims to reach all segments of society and involves foresight and response actions.

STRATEGIC GOAL 2

To ensure transformative risk governance to strengthen climate and disaster resilience.

Following the previous one, this action set aims to support climate and disaster risk management in transitioning from mainly a response-oriented reactive management approach to preventive management while transforming risk governance in general. Its starting point includes examining the key national and local frameworks related to sustainable and resilient development with a sensitive perspective on climate change and disaster risks. The starting point is followed by extending these actions across key development planning sectors. To that end, development of national guidelines for integrating and mainstreaming CCA and DRR into national development planning can be supported, using the recently drafted UNDP's regional "Risk-Informed Development: A Strategy Tool for Integrating Disaster Risk Reduction and Climate Change Adaptation into Development". As a result of doing so, the policy and regulatory frameworks identified through functional reviews can be updated. The extension process does not end with the integration of these issues; it continues with implementing tools that support scaling up, such as cost-benefit analyses, multi-criteria analyses and other tools related to climate change adaptation, in the decision-making processes as well as existing and new programmes and projects across sectors and in

STRATEGIC GOAL 2

To ensure transformative risk governance to strengthen climate and disaster resilience.

all levels of government. Such tools are related to various areas such as identification and comparison of different policy options for climate and disaster resilience, and identification, formulation and implementation of gender-responsive regulations and actions related to adaptation. The TDRRP paper includes seven objectives and 30 actions regarding climate change risks, and there are 1,151 actions in 36 provincial plans regarding the meteorological and climate-related disasters addressed in PDRRPs. In practical terms, a methodological framework and technical guidance will ensure that spatial planning will support the TDRRP objectives on strengthening the implementations in this regard in a climate- and disaster-sensitive manner.

In order to implement all of these actions, it is aimed to enhance institutional cooperation and coordination and encourage partnerships among various traditional and non-traditional stakeholders involved in enhancing resilience. It is especially important to gather the studies by existing coordinating organs on climate change and disaster risk reduction and create sectoral working groups. In parallel with this, it is critical to expand the business scope and portfolio of the National DRR Platform with climate change adaptation topics, in a way to ensure that the platform serves as a multi-hazard, multi-risk and multi-sectoral communication, networking and information development mechanism in which all relevant stakeholders can better interact to achieve disaster and climate resilience. In order to achieve a risk reduction understanding inclusive of all parts of society, it is required to strengthen existing partnerships and build innovative ones with universities, research institutions, private sector institutions, the Turkish Red Crescent (Kızılay), and NGOs. It is critical to ensure that universities and research institutions take a more active role in the adaptation cycle, by making use of their expertise and knowledge and incentivizing their research and development activities. Türkiye's Voluntary National Report for the Midterm Review of the Implementation of the Sendai Framework for Disaster Risk Reduction points out the need to develop research projects to formulate scenarios and simulations demonstrating the benefits that could be achieved through reducing the disaster risks that will emerge if ignored and mitigating their losses and damages. A collaborative approach will bring along a continuity in executing adaptation actions that aim to build a knowledge infrastructure and provide the private sector with technical support in climate and disaster risk reduction. AFAD, Kızılay, NGOs and associations play a critical role in enhancing climate and disaster resilience and reaching all community members.

In this context, the starting point in building critical infrastructure resilience is the recently published Guidance Notes on Building Critical Infrastructure Resilience in Europe and Central Asia which aim to support the authorities and practitioners, in cooperation with other institutions, business owners and/or servicer institutions, in implementing the adequate actions when designing the relevant resilience building

STRATEGIC GOAL 2

To ensure transformative risk governance to strengthen climate and disaster resilience.

policies before, during and after disasters (UNDP, 2022). As a result of this, the roadmap on critical infrastructure will be revised, followed by the updating of policy and normative frameworks. As part of the practical side of adaptation, the works towards protection against climate and disasters will be supported by ensuring the robustness and resilience of technical guidelines and infrastructure investments.

The final action under this strategic goal is to contribute to improving the process of assessing the losses and damages caused by climate change impacts. The insurance system in Türkiye has been improving and making it a priority to build a detailed system for earthquake-related disasters. Significant steps were taken in terms of agricultural insurance with the establishment of TARSIM. However, when the Turkish insurance system is evaluated as a whole, it is difficult to say that the principle of pre-disaster protection has been fully implemented as of yet. Participation in the insurance system is still below developed economies, depending on the variety of disaster risks. In this regard, insurance mechanisms need to be developed. The Turkish Losses and Damages Platform will serve as a central data and information repository regarding relevant losses and damages.

DRR3. Ensuring the systematic integration of climate change adaptation and disaster risk reduction in national and local sustainable and resilient development planning.
DRR4. Revising the legislation, including policies and sectors, by taking climate change into consideration to enhance the disaster resilience of critical infrastructure, and formulating practical guidelines in this regard.
DRR5. As part of compensating for losses and damages caused by climate-related disasters, enhancing the insurance mechanism, improving the loss and damage identification process, and creating the Turkish Losses and Damages Platform.

STRATEGIC GOAL 3

To build institutional capacity and raise awareness to achieve inclusive and sensitive climate and disaster resilience.

Building resilience to climate and disaster risks and strengthening climate change adaptation requires the authorities at all levels to understand and engaged in the matter in the framework of good governance principles, with the ultimate aim of achieving permanent long-term behavioural change. Awareness raising deals with the knowledge of individuals and institutions, aiming to ensure that relevant regional and urban authorities understand and take action to respond to certain climate impacts.

In this context, key policy-makers enable raising the awareness and improving the capacities of decision-makers and the government, as well as formulating, adopting and implementing policies and regulations focusing on climate change and disaster risk reduction. One of the prerequisites of successful adaptation actions is to sensitize administrators in ensuring the integration of adaptation in national policies and sectors and provide sustainable and consistent financing. In this direction, the key personnel and technical experts in competent ministries and institutions serve as key in implementing practical adaptation measures and activities while ensuring effective and efficient intersectoral cooperation, coordination and communication. Comprehensive and systematic training must be delivered through training-of-trainers, ensuring the sustainability of response, and every institution's adaptation capacity must be increased, made resilient, and improved.

Furthermore, no one must be left behind during the design and implementation of awareness-raising and capacity building activities, and the needs capacities of vulnerable groups, in particular, must be placed at the center of the issue. The capacities and potentials of target groups can contribute to enhancing the resilience of social groups and communities. In line with the recommendations under Türkiye's Voluntary National Report for the Midterm Review of the Implementation of the Sendai Framework for Disaster Risk Reduction to engage the business and industry sectors (AFAD, 2022) in professional risk reduction training, key business sectors, industrial representatives and practitioners must also be targeted to ensure the continuous preparedness of business community in terms of severe climate conditions and new increasing risks. Finally, disaster and emergency responders must acquire an adequate professional training on mitigating, being prepared for and responding to the severe and increasing impacts of climate and disaster risks. Additionally, as a resilience building tool, it is planned to provide disaster-affected professionals and populations with guidance on the delivery of psychological support after climate-related disasters.

The latest academic studies and scientific projections consider the impacts of climate change and climate-related disasters as factors that gradually increase human mobility and include more findings in this regard. In 2020 alone, more than 30

STRATEGIC GOAL 3

To build institutional capacity and raise awareness to achieve inclusive and sensitive climate and disaster resilience.

million people were displaced in their own countries due to disasters (Gemenne, Zickgraf, Hut, & Betancourt Castillo, 2021). In this context, owing to its geographic location, Türkiye has been receiving mass migrations of people who were forced to migrate due to humanitarian crises, climate change, and other various factors. The volume of mass migration, the duration of stay of migrants, and the transformation of the concept of migration from a temporary phenomenon to a permanent one requires Türkiye to be prepared for mass migration at all times, resulting in the need to develop policies, targets and implementation strategies to reduce mass migration risks (AFAD, 2022). This is supported by current figures; for example, according to TURKSTAT statistics, 2,777,797 persons, consisting of 47.5% men and 52.5% women (TURKSTAT, 2023), or 3.28% of the Turkish public migrated from one province to another in 2021. Furthermore, there are 3,279,152 Syrians under Temporary Protection living in the country as of 28.09.2023 (Presidency of Migration Management of the Ministry of Interior, 2023). Thus, the connection between human mobility and climate-related hazards in the country must be better comprehended to be integrated into the National Migration Policy and action plans at a sufficient degree. The starting point of this new approach is to better understand the impacts of climate-related adversities on human mobility and deal with migration policies in this direction.

DRR6. Building institutional and technical capacity to enhance disaster resilience.

DRR7. Taking into account the potential displacements caused by climate-related risks in the National Migration Policy and action plans and including climate change adaptation in the migration management process.

STRATEGIC GOAL 4

To make consistent and sustainable investments in the context of climate and disaster resilience.

The adaptation actions in this group include actions that shape feasible and inclusive adaptation actions and refer to a disaster risk reduction approach that is holistic with climate change. This action set covers various structural and non-structural measures and actions, implemented at various levels, for protection against prominent climate hazards such as floods, storms, drought, landslides, avalanches and forest fires. It also involves the design and implementation of adaptation actions that aim to enhance the resilience of energy and industry sectors, international and local airports, tourism and cultural heritage areas, and environmental management facilities.

The adaptation approach to enhance resilience must allow for measures that will strengthen the "Build Back Better" and "Leave No One Behind (LNOB)" principles regarding climate change adaptation and climate change impact mitigation, as well as guide climate change adaptation. Such an approach will be implemented by carrying out resilient recovery practices that integrates climate change impacts, regulation of ecosystem-based disaster risk reduction and disaster waste management, and population services.

DRR8. Carrying out the post-disaster restructuring and reconstruction process by taking into account the issues of climate change impacts and ecosystem-based disaster risk reduction.

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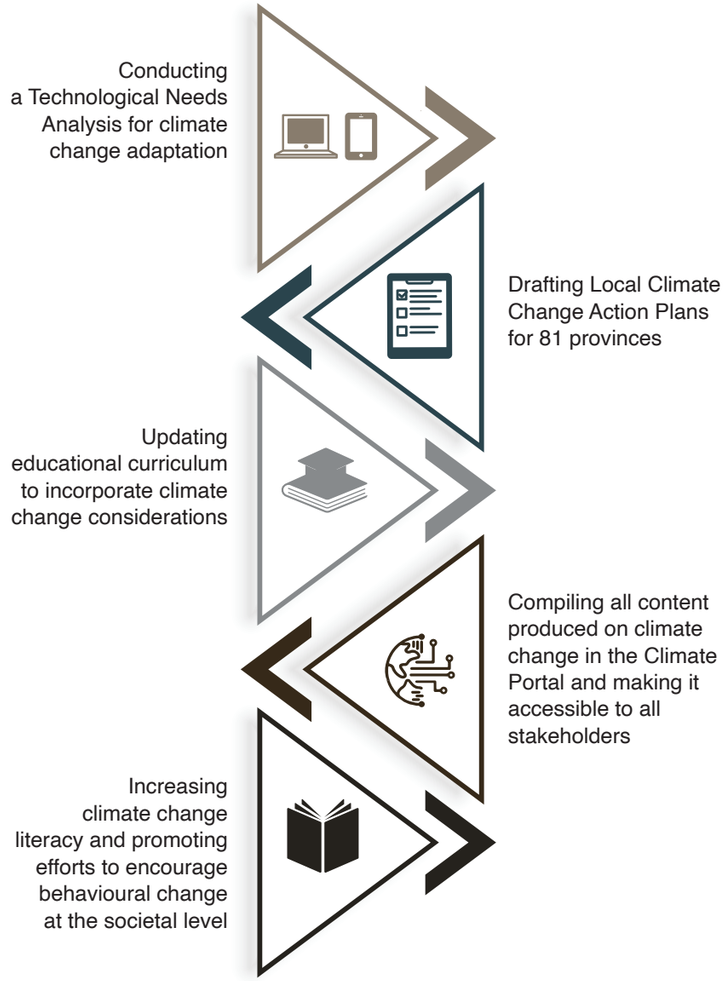
CROSS-CUTTING ISSUES

climate adaptation


Conducting a Technological Needs Analysis for climate change adaptation
Drafting Local Climate Change Action Plans for 81 provinces
Updating educational curriculum to incorporate climate change considerations
Compiling all content produced on climate change in the Climate Portal and making it accessible to all stakeholders
Increasing climate change literacy and promoting efforts to encourage behavioural change at the societal level

13.1. COMMONALITIES, TRADEOFFS AND SYNERGIES RELATING TO SECTORS

The climate change adaptation process cannot be dealt single-handedly, as many sectors are strongly interconnected. Therefore, the impact an adaptation action in one sector has on other sector(s) must be taken into account.

There is a significant link between climate change adaptation and Sustainable Development Goals (SDGs). Climate change adaptation is particularly associated with SDG 13 which aims to "Take urgent action to combat climate change and its impacts" and involves the targets of strengthening resilience and adaptive capacity to climate-related hazards and natural disasters; integrating climate change measures into national policies, strategies and planning; and improving education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning. The topic of adaptation has significant connections with other SDGs, as well. Progress towards increased resilience to climate change, for example, is closely associated with and is likely to contribute to Good Health and Well-Being (SDG 3), Quality Education (SDG 4), Clean Water and Sanitation (SDG 6), Affordable and Clean Energy (SDG 7), Decent Work and Economic Growth (SDG 8), Industry, Innovation and Infrastructure (SDG 9), Sustainable Cities and Communities (SDG 11), Life Below Water (SDG 14), Life on Land (SDG 15), and even Partnerships for the Goals (SDG 17).

As stated in numerous consultation meetings held throughout the process, dealing with cross-sectoral climate change adaptation topics requires interinstitutional coordination. This, in turn, requires building coordination mechanisms for the ministries with climate change adaptation responsibilities, universities and NGOs, municipalities, and the private sector.

The critical cross-cutting issues regarding sectors are summarized below:

Macroeconomic and social situations are two factors that significantly affect climate change adaptation capacity. According to the results of the vulnerability and risk assessments conducted before,

the adaptation capacity component, which plays a significant role in determining risk in almost all sectors, largely comprises socio-economic indicators. When assessing climate change projections on a sectoral basis, taking into consideration demographic and social changes and expectations is critical for resource management planning as well as enhancing climate resilience.

The adaptation actions implemented in one sector can affect one or more sectors. For this reason, it is critical to deal with sectoral analyses in a holistic manner. For example, building green belts between crop fields and roads can be considered as an agricultural adaptation activity, but the water filtering potential, micro-climate adjustment functions, pollination benefits, and its potential to protect the transport infrastructure from wind and snow could be considered as other adaptation benefits.

Potential measures to ensure the climate change adaptation of a sector can be out of that sector's direct control. This applies to the health sector where the main actions affecting human health, in particular, rely on various fields such as sanitation and water supply, education, agriculture, trade, tourism, transport, development, shelter, etc., and emphasizes that adaptation actions that potentially affect human health need to be understood by other sectors, as well.

Many actions related to enhancing the resilience of the agriculture sector also contribute to mitigation whereas increasing energy demand efficiency and reduced demand can also be interpreted as an adaptation action. The fact that the energy infrastructure need does not increase at the same rate as a result of increased population and consumption habits boosts the sector's climate resilience.

Sectoral interdependence can be positive or negative. For example, an increase in sustainable agricultural practices can boost the resilience of the agricultural ecosystem and therefore crop yield, yet the increase and concentration of agricultural areas can harm biodiversity through increased pollution, land transformation and irrigation needs and poor irrigation practices. Adaptation activities in various sectors (forestry, urban environment, biodiversity and ecosystem services, health and agriculture) have positive impacts on the tourism sector. In this context, it can be stated that there is a symbiotic relationship between many sectors.

There are strong sectoral relationships in terms of infrastructure services. All sectors depend on the efficient operation of infrastructure for energy, transport, water, information and communication technology networks. For this reason, any climate-related impact that affects such infrastructure will bear exhaustive consequences for other sectors. Additionally, infrastructure are interdependent; the efficient operation of the urban environment, for example, is related to urban infrastructure.

In the context of risk reduction, the disaster risk reduction sector was addressed separately in the CCASAP which contains actions planned for a relevant disaster in almost all sectors. For example, water resources management and urban likely include actions on flood prevention.

We must take advantage of the synergy between adaptation and mitigation. The subject of climate change adaptation has been recently introduced in the agenda of many sectors, especially economic ones. Until recently, topics related to GHG emissions largely occupied the agenda. However, as a result of the studies and the developing literature, it is recognized that many climate change adaptation efforts have positive impacts on mitigation activities which, in turn, have positive impacts on adaptation actions. Many actions related to enhancing agricultural resilience also contribute to mitigation, and boosting energy efficiency and reducing energy demand can also be interpreted as an adaptation action.

13.2. INTER-SECTORAL INTERACTIONS IN LIGHT OF CLIMATE CHANGE IMPACTS AND RISKS

The main inter-relationships (rather than sectoral connections in the context of adaptation options) of climate change risks and cross-sectoral vulnerabilities are summarized below. They include the vulnerability and risk of a given sector and their potential consequences and impacts on other sectors, as well as the impacts of other sectors on that given sector. For example, a serious flood causes direct damage on agricultural products, transport, energy and other infrastructure as well as affecting other sectors such as tourism; it can also trigger an increase in food and transport prices, resulting in challenges in accessing food. Disadvantaged groups, in particular, can experience problems in accessing water. Disasters such as floods affect the transport infrastructure as well as the populations that live in watersheds and coastal areas.

Water resources management is an extremely important sector that affects, either directly or indirectly, almost all economic sectors and systems with immeasurable monetary value. As often repeated in the regional climate projections for Türkiye, decreases in total precipitation and changes in the precipitation regime are expected. Based on the requirement to make separate assessments on a basin basis, no significant change in water potential is expected for some basins whereas water scarcity is projected for some others. This situation will create a seriously competitive environment for existing water resources in the areas of agriculture, drinking and utility water, energy, industry, tourism, and biodiversity and ecosystem services.

As decreasing water resources will trigger pollution, the contamination of irrigated crops can lead to

the degradation of food water and quality and public health issues. Polluted waters will also cause ecosystems to degrade which, in turn, further degrade water quality. Habitat loss and decreased wetlands that also serve as carbon sinks, caused by the degradation and destruction of water resources, will result in serious problems.

In the context of management of marine spaces; climate change is a significant problem that affects marine ecosystems and communities across the world adversely. Rising sea levels, extreme weather events and acidification of oceans make marine spaces even more vulnerable. Such changes also threaten the sustainable use of marine resources and services.

In cross-sectoral relationships, management of marine spaces is important for the following reasons:
i) Understanding the relevant stakeholders and their priorities.
ii) Developing a common vision for sustainable marine spaces management.
iii) Establishing strong cooperation mechanisms.

Agriculture, while varying from year to year, is the most water-consuming sector in Türkiye, with a consumption rate of approximately 80%. The significance of reducing agricultural water consumption is better understood considering the climate change projections which expect increased drought frequency. Increased water use in agriculture will affect all sectors that compete for water resources. Biodiversity and ecosystem services will be affected adversely by decreasing water levels especially in wetlands. Gradually increasing use of pesticides cause water pollution. Other significant causes of biodiversity loss include the use of agricultural pesticides and increased agricultural lands. However, controlled and proper agricultural practices can have positive impacts, providing advantages such as sustainable agricultural methods, biodiversity protection, rehabilitation of soil health, and more efficient use of water resources. For this reason, it is important that sustainable agricultural practices are encouraged to mitigate the environmental impacts of agriculture.

Decreased agriculture and food production will result in increased prices, in addition to risking food security. This situation can cause malnutrition for low-income groups, especially those living in urban. It also emphasizes the importance of climate response and sustainable agricultural practices. Sustainability-driven agricultural methods can protect ecosystems and create agricultural systems that are more resilient to climate change. This can contribute to maintaining food security as well as supporting environmental and social sustainability. Changes in food quality can lead to public health issues such as development of resistance to biocidal products, and malnutrition caused by inadequate and unhealthy food products.

The impacts of climate change on agricultural production will affect the industry related to agricultural products, as well. The number of farmers who make direct income from agriculture (including livestock breeding, fisheries, apiculture, etc.) as well as employment opportunities can decrease due to agro-based industries.

Impacts such as drought and increased temperatures will increase the need for irrigation water and consequently electricity consumption, as well as creating an increased need for cooling and therefore resulting in additional investment requirements in this regard and increased energy costs.

Water pollution increases as a result of the degradation of ***biodiversity and ecosystems*** due to the loss of their properties as a natural filter. Decreased water retention capacity of ecosystems is also a significant threat against water assets. Additionally, the carbon sequestration capacity of coastal and marine ecosystems (blue carbon) is directly linked to marine biodiversity and ecosystem degradation.

While the unsustainable increase in agricultural activities and lands affect biodiversity adversely; decreased pollination, increased difficulty to control pests and diseases, reduced soil formation, and loss of genetic diversity and regulatory ecosystem services can decrease the productivity of agricultural production and increase invasive species. Degradation of grasslands and steppes affect livestock breeding adversely, as well as those who make a living from ecosystem services (foresters, fishers, apiculturists, etc.).

Such adverse impacts on water and agriculture can cause changes in air, water, soil and food quality and health problems associated therewith. Vectoral and zoonotic diseases are also expected to increase with climate change. With changing and newly emerging disease patterns, it would be beneficial to begin studies on all such topics quickly.

Damage to biodiversity and ecosystem services as a result of climate change can affect many types of tourism including outdoor, forest sports, sea-sand-sun tourism, and ecotourism in particular. From a social dimension, those that could suffer the most will be the citizens who earn their incomes from ecosystem services.

The exposure of ecosystems and green areas that function as microclimate can block protection from urban heat islands/extreme cold temperatures. Ecosystems have some characteristics that prevent disasters such as floods, erosion, landslide, etc. With increasing disasters, ecosystem degradations can directly harm the public as well as affect energy, transport, communication infrastructure, etc., adversely.

From a ***public health*** perspective, connections related to biodiversity, water and agriculture have been established above. Yet it must be emphasized that outdoor workers can be directly affected by climate hazards, with agriculture and construction, tourism, transport and logistics workers being the first groups that come to mind in this regard. Furthermore, workers' productivity is expected to decrease in general due to extremely hot temperatures. Women, children, pregnant or breastfeeding women and elderly people, who stand out as vulnerable groups, are expected to be affected by different hazards in different ways. In the case of inadequate organization by the health sector, delays are likely to occur in emergency responses to climate hazards, epidemics and resulting disasters, all of which are expected to increase. The resilience of the health infrastructure must be enhanced in

order for the necessary responses to be carried out. Additionally, climate change also carries the risk of increasing communicable diseases and resulting epidemics and pandemics. Temperature changes, on the other hand, can cause biological species to alter their current habitats which will likely affect not only the sectors that are associated with agriculture and tourism but all sectors. Therefore, placing human beings at the focus of the solution through a holistic One Health approach, without distinguishing them from animal, plant and ecosystem health, will provide a unique opportunity to successfully achieve Sustainable Development Goals.

While ***energy*** demand is expected to increase during summer due to increased temperatures, heating needs are projected to decrease to some extent in many regions during winter. Prolonged summer season due to increased temperatures can further boost tourism and cause larger increase in energy needs.

If the demand for wood for energy purposes is not controlled to an adequate extent, inspections may need to be increased as this will affect forest assets adversely. This can also create a pressure on forests for extra wood production.

Increased demand for energy and the resulting increase in energy prices can increase energy poverty especially in cities, leading to health problems and increased expenses.

Increased ***touristic*** activity due to potentially prolonged summer seasons can create pressure on ecosystem services as well as on such sectors as agriculture, water, transport, etc. Increased demand for urban services can challenge local governments especially in terms of waste and wastewater.

In the ***industry*** sector, any changes in the location of industrial facilities due to the physical impacts of climate change can create pressure on natural values that are significant for ecosystems and tourism. As indicated in previous chapters, the industry sector is expected to engage in serious competition with many sectors for water resources. It is highly likely that occupational health and safety issues will increase due to climate sensitivity.

The problems that will occur due to climate change in ***transport and communications*** sector's infrastructure will affect many areas, mainly quality of living in urban. Such impacts will be felt in the context of agriculture, industrial raw materials and product logistics, workers' transport, and decreased tourist satisfaction. As the communication infrastructure can be damaged in the event of climate-related disasters, the operations of many sectors, and especially the services sector, can be affected adversely.

From the ***social development*** perspective, there are many cross-cutting issues in terms of the relationship of climate change adaptation with other sectors. Most of these issues were addressed in other sectors. Potential increases in water, food and energy prices aggravates socio-economic and socio-spatial injustices and in cases where social vulnerability is insufficiently dealt with in spatial planning processes and site selection decisions, the vulnerable population can become further exposed to climate hazards.

Changes in the income earned by agricultural sector employees affects the rural population structure due to reasons such as increased migration to cities. Women stand out as the group that is more affected by climate change in the agriculture sector.

From the ***disaster risk reduction*** perspective, efforts related to risk reduction affect many areas from infrastructure investments and economic sectors to public and environmental health. Furthermore, the vulnerability of rescue services which become challenging due to communication and transport issues during disasters can cause services to fail to be delivered or delivered late to disadvantaged groups. Socio-economic impacts are observed due to the facts that people with disabilities and other vulnerable groups are affected to a greater extent by disasters and afterwards, social services cannot be delivered to disadvantaged groups at an adequate level.

13.3. CHALLENGES TO CLIMATE CHANGE ADAPTATION

The sectoral vulnerability and risk assessment reports contain the main obstacles and gaps in climate change adaptation efforts. Common and inter-connected issues are summarized below. The categories of gaps and obstacles addressed herein are associated with adaptation capacity which was addressed in Türkiye's National Climate Change Vulnerability and Risk Assessment to reduce vulnerability to climate change.

Institutional capacity gap

This obstacle refers to the institutional/ administrative and expert capacities of institutions responsible for climate change adaptation policies and actions. Some institutions have reached a certain level of knowledge and capacity as they have been working on climate change adaptation for many years. The need to develop a culture of interinstitutional cooperation and collaboration and the gaps in interinstitutional levels of knowledge emerge as a problem, especially for sectors/areas that are closely linked to one another.

Additionally, unequal capacity and engagement among central, regional and local governments can potentially cause some institutions to be excluded from or show insufficient interest in determining climate change policies and adaptation priorities at the local and regional levels.

There may be gaps in the level of awareness of decision-makers. Special capacity building programmes should be established, and the abilities to use informed decision-making skills and instruments should be enhanced to ensure that the personnel integrate knowledge into the planning and management process.

Knowledge and data gaps

This topic refers to the imperfect knowledge in the adaptation policy making process and the

uncertainties and gaps in private studies. Such knowledge gaps include the uncertainties regarding climate projections and relevant risks, the monetary value of the costs and benefits of adaptation, local vulnerabilities, and the availability of data for the monitoring and evaluation phases. These knowledge and data gaps are also associated with the institutional capacity and policy and legal framework topics described above. Additionally, they can prevent some sectoral stakeholders from taking action. A major obstacle preventing energy companies to take action on the risks of extreme weather events, for example, possibly involves uncertainty and the lack of instruments to include such risks in institutional decision-making processes.

Financial and human resources

Financial resources is one of the most significant gaps in climate change adaptation that stands out in almost every sector. Financial resources for climate change adaptation largely depends on European Union funds. Projects with high returns that serve other short-term purposes are prioritized in many sectors. Short-term returns are favoured because the impacts of many adaptation actions emerge in the long term.

Furthermore, as there are limited financial studies on the costs and benefits of climate change adaptation actions, there is no sufficient information on financial return. However, the disasters that have occurred prove that the cost of nonaction increases day by day.

Qualified human resource is another significant gap. Lack of adequate knowledge of institutional workers, and particularly decision-makers, cause the disruption of adaptation activities and inability to develop adequate interinstitutional cooperation. All stakeholders require capacity building on climate change adaptation.

13.4. STAKEHOLDERS IN CROSS-CUTTING ISSUES

When considering the actions targeted to be implemented in the context of cross-cutting issues, the MoEUCC and its DCC play a significant role, in that, the MoEUCC is the national focal point for climate change. The main responsibilities of the DCC, on the other hand, include "Determining national and international policies, strategies and actions, executing negotiation processes, and ensuring coordination with institutions and organizations in the context of Türkiye's climate response and adaptation efforts".

Cross-cutting actions inherently require intense cooperation and coordination among different departments, institutions and stakeholders.

The CCACB mentioned in action tables and that covers member Ministries and other institutions comprises not only the CCACB secretariat but all departments in such institutions that work on this topic.

As emphasized in the introduction section, collaborations with the local governments (as emphasized in the urban and other sectors) and their representatives that are direct parties to many actions, in addition to the abovementioned institutions, are critical as the topic of climate change adaptation cannot be considered separately from the development policies of countries.

It should be considered that significant contributions to climate change adaptation may be provided by academia and research centers in conducting R&D studies much needed to close information gaps required to conduct cost-benefit analyses both for risk and vulnerability analyses and decision-making processes, as well as by NGOs which provide qualitative information in addition to quantitative data, and the private sector much enthusiastic for mitigating risks.

Furthermore, in order for all segments of the society, who are at the center of all actions, to take ownership of the actions and ensure that they consider themselves as part of the solution, inclusive platforms that encourage social sustainability must be established, without ignoring the needs of segments with different sensitivities such as people with disabilities, elderly people and children.

13.5. CROSS-CUTTING ACTIONS FOR CLIMATE CHANGE ADAPTATION

The CCASAP which covers 2024-2030 involves the following sectors.

- Urban
- Water resources management
- Agriculture and food security
- Biodiversity and ecosystem services
- Public health
- Energy
- Industry
- Tourism and cultural heritage
- Transport and communications
- Social development
- Disaster risk reduction.

As addressed in the sections above, many sectors are tightly connected to one another, with the actions of one affecting the other(s). There are many topics raised in national/international literature reviews and by institutions in consultation meetings, in order for the efficient performance of climate change adaptation efforts. Some of these topics are addressed in the section titled "Barriers to Climate Change Adaptation".

Most actions listed under different strategic goals below are closely related to one another and one action will eventually support the development of another.

STRATEGIC GOAL 1

To integrate climate change adaptation in all policies and strategies.

As often emphasized in the Vulnerability and Risk Assessment report, adaptation policies are in fact closely related to development policies. When examining national development plans, programmes and policies, many sectors and institutions directly included climate change adaptation in their strategies whereas other institutional strategies included indirect objectives. The Ministry of National Education has recently completed its Climate Change Adaptation Plan studies and the Ministry of Health has begun efforts to update its strategy. Documents such as the Green Deal Action Plan, Biodiversity and Drought Management Plans, National Water Plan, Rural Development Plan, National Energy Efficiency Action Plan, Energy Efficiency Strategy Paper, Water Efficiency Strategy and Action Plan in the Framework of Adaptation to Changing Climate (2023-2033) include objectives on efficiency, water resources management, food security, etc., which can be described as adaptation actions.

It is critical to undertake integrated impact assessment studies that consider the interactions of the impacts of these actions, which are addressed separately by different sectors and institutions. Therefore, it is required to conduct studies in which climate change impacts are assessed on a sectoral basis as well as together. As a result of such analyses and assessments, the risks or opportunities associated with climate change can be integrated in sectoral policies and regional and national development plans. All of these studies require broad participation as well as making amendments in many legislations. In particular, a study must be conducted with broader participation, together with institutions with a certain level of knowledge on climate change as well as different public entities and relevant private sector representatives that will start new collaborations; additionally, in this context, the efforts to draw up national legislation in line with the relevant provisions of the United Nations Framework Convention on Climate Change and the Paris Agreement should be undertaken through a well-attended organization.

Another significant topic that perhaps must be prioritized in the hierarchy of actions is the requirement to conduct sectoral and regional impact analyses with higher resolution, that will help to draft holistic or sectoral strategies in a healthier manner. It is also an important step in prioritizing and implementing the actions that align with local needs. Studies that address the financial dimension of the topic in prioritizing the actions will guide decision-makers, as well.

While this action plan does not designate individual actions related to finance strategies, it emphasizes the need to create a finance strategy on the topic at hand.
All sectors will need to keep track of innovations and leverage advancing technologies in their climate change adaptation efforts. This action plan includes an action

STRATEGIC GOAL 1

To integrate climate change adaptation in all policies and strategies.

regarding R&D projects that particularly concern technology support institutions, universities and NGOs.

The climate change adaptation efforts of local governments, which are the management levels closest to the public, are significant Türkiye as with the rest of the world. Action plans should be drafted in an integrated manner with other action plans that produce solutions to the issue of climate change. For example, the National Smart Cities Strategy and Action Plan for 2020-2023 addresses how to utilize smart city applications in climate response under the Smart Environment, Smart Energy, Disaster and Emergency Management and Smart Space Management components. It is important to undertake studies within a certain standard to ensure that the sustainability efforts of different institutions and organizations are comparable to one another and understood by everyone. For this reason, ensuring a sustainability reporting that includes descriptions of climate-related risks and opportunities will be a critical step in achieving a common objective.

CCI1. Conducting climate change impact, vulnerability and risk assessments on a sectoral basis.
CCI2. Dealing with the topic of climate change adaptation in a holistic manner in development plans as well as other plans, programmes and policies currently enforced, by taking into consideration sectoral interactions.
CCI3. Conducting Technological Need Analysis (TNA) and drafting an R&D and Innovation Strategy and Roadmap for climate change adaptation, and increasing the number of studies and product projects undertaken for the use of new technologies in universities and technology development zones.
CCI4. Setting up a legislative infrastructure to prepare a Local Climate Change Action Plan (LCCAP) and drafting LCCAPs for all provinces.
CCI5. Ensuring sustainability reporting that includes descriptions of climate-related risks and opportunities, in line with Turkish Sustainability Reporting Standards (TSRS).

STRATEGIC GOAL 2

To increase the knowledge supporting decision-making processes and to build institutional capacity to increase climate change-related expertise, training, database creation, monitoring and R&D studies.

The availability of reliable and updated environmental knowledge in implementing sustainable development policies will facilitate the well-functioning of decision-making mechanisms and institutions, as well as accelerating the studies on climate response which is a multi-disciplinary area. The need for the private sector's and people's engagement due to limited public resources and to provide quicker response is often addressed. However, based on the fact that a society with high awareness and consciousness in this regard can become a part of the response efforts, it is critical that the results of the studies conducted are shared in a transparent manner.

There are many responsible institutions with regard to the adaptation actions. The fact that other institutions are often unaware of the many studies conducted leads to repetition and inefficiency.

Data needs to be monitored regularly to conduct healthier risk assessments and observe whether the objectives have been met. Another important issue is the requirement that such data and climate-related studies be available. Experts and institutions can conduct the necessary analyses and studies in a healthy manner only through knowledge exchange.

Ensuring proper data management requires high technical capacity and that decision-makers have the knowledge to understand the consequences of their decisions in the context of climate change. For this reason, the capacities of all relevant Ministries and their local organizations as well as relevant boards must be enhanced through basic in-service training sessions regarding adaptation to climate change impacts and the situation in Türkiye.

CCI6. Identifying the national and local data required to conduct climate change vulnerability and risk assessments and ensuring they are gathered at a single source.
CCI7. Gathering the climate change content created by relevant stakeholders at a single source and ensuring they are accessible to all stakeholders.

STRATEGIC GOAL 3

To increase knowledge, consciousness and awareness on climate change adaptation in a way to ensure that citizens are part of the solution, and to ensure engagement in decision-making mechanisms.

One of the most striking issues when examining vulnerability and risk assessments is how important socio-economic situation is in terms of climate change adaptation capacity. Many sectors are expected to undergo significant changes in achieving the long-term objectives. Many new lines of business that will emerge will require new capabilities and skills. In this context, works should begin for human resource planning.

As climate change adaptation entails serious costs and human resource, it requires contributions from the private sector and the people, in addition to public investments. Objectives and actions related to awareness raising were also included in TDRRP drafted at the national level and PDRRPs drafted at the local level in coordination with AFAD.

The "Climate Change Action Plan" which was recently published by the Ministry of National Education is a positive step.

CCI8. Undertaking efforts for just transition to protect employment during the climate change adaptation process.
CCI9. Identifying and updating national occupational standards and national competencies to determine the new qualification and skill requirements in employment that will be created by the climate change adaptation process; conducting and scaling up examination and certification activities based on the designated national competences.
CCI10. Starting from pre-school until the final step of postgraduate training, reviewing and updating the outcomes in the curriculum from the perspective of Sustainable Development Goals and climate change; delivering training of trainers; increasing the number of graduate, post-graduate and doctoral education on climate change in different disciplines (law, education, social sciences, engineering, etc.).
CCI11. By using mass communication and media (social media, digital applications and games, TV series, films, etc.), undertaking efforts to ensure behavioural changes at the societal level to raise public awareness of climate change, such as increasing climate change literacy and getting the public to adopt environmentally sensitive consumption habits.

CLIMATE CHANGE
ADAPTATION STRATEGY AND ACTION PLAN


URBAN
climate adaptation

URB1. Identify Urban and buildings at flood risk; improve and transform these areas by addressing the needs of vulnerable groups. Develop evacuation and escape corridors, reopen blocked stream beds, and establish protection zones around streams.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities*	MoEUCC (PDs, GDIUTS, ILBANK), MoI (AFAD, SPA), MoAF (GDSW, DGSHW), MoTI (KGM), UMT	2024-2030	• Size of Urban transformed due to flood risk (ha) • Length of infrastructure renewed due to flood risk (km) • Size of area where flood evacuation corridor is built due to flood risk (ha)

URB2. Increase the resilience of building roofs and façades against severe weather events; scale up location-specific green roof, façade, and smart building applications.

Responsible Institution	Relevant Institutionsr	Implementing Periodi	Monitoring Indicators
Municipalities*	MoEUCC (GDVS, PDs, TOKI, GDIPME), UMT	2024-2030	• Number of buildings with green roof and/or green façade (count): • Ratio of number of buildings with green roof and/or green façade to total number of buildings (%) • Number of municipalities which amended legislation (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 1 To enhance the adaptation capacity and resilience of cities and urban dwellers.

URBAN climate adaptation

URB3. Improve urban infrastructure by enhancing capacity, restructuring drainage systems, separating consolidated (rainwater and wastewater) systems, and utilizing smart systems with sensory monitoring.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities*	MoEUCC, (Bank of Provinces Inc., GDG-IS), MoAF (GDWM), MoTI, (GDoH), UMT	2024-2030	• Increased capacity (renewed) infrastructure length (m or km); • Separated sewer infrastructure length (km); • Renewed drainage line length (km); • Created permeable surface/area size (ha)

URB4. Consider installing urban climate monitoring stations.

Responsible Institution	Relevant Institutions	Implementing Periodi	Monitoring Indicators
Municipalities* (DCCZW)	MoEUCC (TSMS), Universities, UMT	2024-2028	• Number of urban climate observation stations (count)

* UMT will monitor the actions for which municipalities are responsible.

URB5. Conduct studies to review and revise urban development legislation with a climate change perspective.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoEUCC (GDVS, GDSP)	MoEUCC (DCC)	2024-2030	• Draft legislative amendments prepared (exists/ not)

URB6. Develop guidelines for climate change adaptation, covering topics such as site selection, spatial planning, urban design, wind direction, passive ventilation, insulation, construction, and implementation, using climate data.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoEUCC (GDSP, GDVS), Municipalities*	MoEUCC (DCC), Universities, MoFSS (GDSPDE), UMT	2024-2030	• Local climate-sensitive urban design guides (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2 To revise legislation and plans to enhance climate change adaptation capacity

URBAN climate adaptation

URB7. Formulate risk maps for Urban based on spatial data.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities, MoI (AFAD)	GDGIS, GDCDE, DCC), MoAF (GDSW, DGSHW), MoH (GDPH) Governorates, District-Governorates, Universities, NGOs, UMT	2024-2030	• Risk assessment maps prepared (count)

URB8. Review and update spatial plans and planning processes at all levels, aligning them with local climate action plans and analyses.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities*, MoIT (GDIZ), MoEUCC (GDSP), MoCT (GDIE), MoI (SPA), MoTF (PA)	MoEUCC (GDLA, DCC), UMT, DAs, Universities	2025-2030	• Number of plans revised in line with local climate change action plan (count)

* UMT will monitor the actions for which municipalities are responsible.

URB9. Create new parks, forests, vegetated gardens, and ecological corridors. Convert unused (brown) areas or buildings into green spaces or emergency shelters. Build green corridors in urban peripheries and between industrial areas and settlements.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities, MoI (AFAD)	MoEUCC (ILBANK), MoAF (GDF), Governorates, MoFSS (GDSPDE), Universities, TUBITAK, UMT	2024-2030	• Size of newly-built green spaces (ha) • New trees planted in urban (count) • Size of green corridor created in urban periphery (ha) • Size of green corridor created near industrial region (ha) • Size (h) and number (count) of area transformed into green space out of no use

URB10. Protect existing water bodies. Create rainwater ditches and natural water surfaces in Urban and peripheries. Design public spaces to accumulate and channel rainwater into storage systems during heavy precipitation

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities*	MoEUCC (ILBANK), MoAF (GDSW, DGSHW), UMT	2024-2030	• Size of protected water surface (ha) • Size (h) and number (count) of water surface created • Size of squares renewed in this context (m2) • Number of rainwater ditches/gardens created (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 3 To ensure environmentally balanced, climate-resilient, sustainable urbanization

URBAN climate adaptation

URB11. Promote sustainable urban transport through a pedestrian-focused approach by developing sub-centers and pedestrian zones. Ensure pedestrianization projects account for climate impacts, such as extreme heat.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities*	MoEUCC (GDEM, GDLA), MoFSS (GDSPDE), MoTI (KGM, GDC), UMT	2024-2030	• Size of pedestrian area created (ha) • Number of sub-centers created in new plans (count) • Number of pedestrianization projects (count)

URB12. Implement urban agriculture initiatives and establish urban gardens on productive agricultural land within urban.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities*, MoAF (GDAR)	MoAF (TAGEM, GDF)	2024-2030	• Size of urban farming areas (ha) • Size and number of urban gardens (count, ha or m2)

* UMT will monitor the actions for which municipalities are responsible.

climate adaptation

WATER RESOURCES MANAGEMENT

WRM1. Formulate and implement river basin management plans by following up on the measures, precautions, and actions outlined in existing management plans.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDSW, GDAR)	MoEUCC (GDEM, TSMS, ILBANK), MoIT (GDI, GDIZ), MoFA (GDEE), MoI (GDPA, AFAD), MoCT (GDIE), MoH (GDPH), MoTI (GDEUFR), MoAF (GDNCNP, TAGEM, GDFA, TWI, DGSHW), Governorates, Municipalities*	2024-2030	• Number of basins for which basin-wide management plans have been prepared (basin protection action plan, basin water allocation plan, basin management plan, basin flood management plan, basin drought management plan) (count) • Ratio of measures, precautions and actions for these basins (%) • Number of Source-to-Tap Drinking and Utility Water Safety Plans (count) • Number of basin-based Water Efficiency Action Plans (count) • Number of basins/provinces where works have been undertaken for water footprinting (count)

WRM2. Develop monitoring and information systems to improve water and wastewater management, enabling the effective monitoring of the quantity and quality of surface and groundwater resources and sectoral water consumption.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDSW, DGSHW), MoEUCC (GDEM, GDEI-API)	MoEUCC (GDPNA, TSMS, ILBANK), MoIT (GDI, GDIZ), MoFA (GDEE), MoI (GDPA, AFAD), MoCT (GDIE), MoH (GDPH), MoTI (GDEUFR), MoAF (GDNCNP, GDAR, TAGEM, GDFA, TWI), TURKSTAT, Governorates, Municipalities*	2024-2030	• Number of users of National Water Information System (count) • Number of users of National Wastewater Information System at basin/province level (count) • Number of plants having Permanent Wastewater Monitoring System at basin/province level (count) • Number of active ground- and surface water stations that monitors water level (count) • Number of active ground- and surface water stations that monitors water quality (count) • Number of enterprises monitored by a measurement system for ground- and surface water at basin/province level (count) • Data on basin-based sectoral groundwater allocation (number of certificates, amount of allocation)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 1 To develop policy and legal frameworks on water resources management, to increase the production and sharing of data and information.

WATER RESOURCES MANAGEMENT
climate adaptation

WRM3. Strengthen and update legislation on water resources management to align with emerging needs and challenges.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDSW)	MoAF (DGSHW, GDNCNP)	2024-2030	• Water Law promulgated (exists/not) • Flood Law promulgated (exists/not)

WRM4. Assess the impacts of climate change on water resources, including lakes, wetlands, and coastal areas, to support informed policy development and management.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDSW)	MoAF (DGSHW, GDNCNP, TAGEM), DCC	2024-2030	• Türkiye climate projections relying on current datasets and scenarios (exists/not) • Number of basins on which climate change effects have been identified (count) • Number of lakes/wetlands on which climate change effects have been identified (count) • Ratio of coastal regions for which sea-level-rise has been studied (%)

WRM5. Monitor the implementation of the Water Efficiency Strategy and Action Plan within the Climate Change Adaptation Framework (2023-2033).

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDSW)	Public Institutions/ Organizations, NGOs, Universities, Private Sector	2024-2033	• Ratio of water loss in drinking water systems (%) • Rate of water recovery at tourism facilities (%) • Daily water consumption at households per capita and per household (liter/person*day) • Rate of agricultural irrigation efficiency (%) • Rate of water recovery in industry (%)

* UMT will monitor the actions for which municipalities are responsible.

WRM6. Continue efforts to protect surface and groundwater basins used or planned to be used, for drinking and utility water supplies.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDSW), MMs, CCBM	MoEUCC (GDEM, GDCDE, TSMS, ILBANK), MoIT (GDI, GDIZ), MoFA (GDEE), MoI (GDPA, AFAD), MoCT (GDIE), MoH (GDPH), MoTI (GDEUFR), MoAF (DGSHW, GDNCNP, GDAR, TAGEM, GDFA, TWI), Governorates	2024-2030	• Number of basin protection plans prepared for water resources from which drinking and utility water is supplied or planned to be supplied (count) • Ratio of implementation of actions in protection plans (%)

WRM7. Update and enforce discharge standards and parameters to protect water quality across all basins, with the goal of increasing the amount of treated wastewater and achieving a 15% reuse rate for treated wastewater by 2030.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoEUCC (GDEM), MoAF (GDSW)	MoIT (GDI, GDIZ), MoAF (DGSHW), MoEUCC (ILBANK), MoCT (GDIE), MoI (SPA), Municipalities*, OIZs	2024-2030	• Updating of the standard (exists/not) • Number of existing wastewater treatment plants at basin/province level (count) • Ratio of wastewater treated and discharged at basin/province level (%) • Ratio of reuse of treated wastewater at basin/province level (%) • Budget for support programmes (TRY)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2 To ensure the protection, improvement and efficient use of water resources

WATER RESOURCES MANAGEMENT
climate adaptation

WRM8. Monitor water quality and water levels in aquatic ecosystems to assess the effects of climate change. Develop water budgets for natural lakes, particularly those from which water is withdrawn for sectoral uses, and prepare or revise management plans for protected areas and wetlands. Identify, rehabilitate, and restore degraded wetlands while promoting the creation of artificial lakes, ponds, and wetlands using natural resources.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDNCNP, DGSHW, GDSW), MoEUCC (GDP-NA), CCBM	MoEUCC (GDEM, GDCDE, TSMS), MoIT (GDI, GDIZ), MoFA (GDEE), MoI (GDPA, AFAD), MoCT (GDIE), MoH (GDPH), MoTI (GDEUFR), MoAF (GDAR, TAGEM, GDFA, TWI), Governorates, Municipalities*, Universities	2024-2030	• Number of aquatic ecosystems for which monitoring is performed at basin level (count) • Number of lakes for which water budget has been prepared at basin level (count) • Number of management plans prepared at basin level (count) • Ratio of implementation of actions set out in management plans at basin level (count) • Number of rehabilitated and repaired wetlands at basin level (count) • Number of artificial lakes, ponds and wetlands at basin level (count)

WRM9. Establish a legal framework for stormwater management, and prepare or update inventories of rainwater infrastructure and contaminant sources.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities*, MoAF (GDSW)	MoEUCC (GDEM, GDIUTS, DCC, ILBANK)	2024-2030	• Number of legislative pieces prepared (count) • Number of inventories prepared (count) • Number of inventories updated (count)

* UMT will monitor the actions for which municipalities are responsible.

WRM10. Work towards reducing water losses in municipalities in accordance with applicable legislation and Water Efficiency Strategy targets. Increase the use of alternative water sources, such as rainwater harvesting and greywater reuse in urban and expand access to safe drinking water networks.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities*, MoAF (GDSW)	MoAF (TWI), MoI (SPA), MoNE (GDPE), MoEUCC (ILBANK), Unions of Village Services, UMT	2024-2030	• Ratio of municipalities which comply with the "Regulation Amending the Regulation on Control of Water Losses at Drinking Water Supply and Distribution Systems" to total number of municipalities (%) • Number of landlots to which the Regulation on Rainwater Collecting, Storing and Discharging Systems and Regulation Amending the Regulation on Land Development Planning of Planned Areas have been applied at province level (count) • Legislation on using grey water (exists/not) • Ratio of municipal population served by drinking and utility water system (piped) at province level (%)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2 To ensure the protection, improvement and efficient use of water resources

WATER RESOURCES MANAGEMENT
climate adaptation

WRM11. Promote efficiency-enhancing practices in agricultural irrigation in line with the Water Efficiency Strategy objectives within the climate change adaptation framework.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDAR, DGSHW, GDSW)	MoAF (PDs, GDAE), MoI (SPA), Municipalities*, Irrigation Unions, Irrigation Cooperatives	2024-2030	• Ratio of irrigated areas which use modern irrigation systems at basin/province level (%) • Ratio of irrigated areas with efficiency of 60% or more to total irrigated area at basin/province level (%) • Ratio of rehabilitated irrigated areas at basin/province level (%) • Ratio of areas irrigated by treated wastewater or drainage water to total irrigated area at basin/province level (%) • Ratio of irrigated areas which switched to night irrigation at basin/province level (%) • Ratio of irrigated areas which switched automation at basin/province level (%) • Number of water meters installed in the piped irrigation system at basin/province level (%) • Ratio of irrigated areas for which projects have been prepared for land aggregation and in-field development services (%)

* UMT will monitor the actions for which municipalities are responsible.

WRM12. Identify groundwater protection areas designated for drinking purposes and conduct groundwater body assessments. Prepare annual reports on groundwater withdrawal monitoring and control, install water meters on operational groundwater wells, and expand the use of underground dams and artificial groundwater recharge structures.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (DGSHW, GDSW)	MoI (SPA), Municipalities*, Irrigation Unions, Irrigation Cooperatives	2024-2030	• Number of wells and springs in protected area from which drinking water is supplied at basin level (count) • Number of reports prepared at basin level (count) • Ratio of groundwater withdrawing well which is required by Law No. 167 to have water meter to total number of withdrawing wells (%) • Number of underground dams and artificial groundwater recharge structures at basin level (count) • Number of basins where quantity and quality of groundwater have been determined (count) • Number of basins for which protective programmes have been determined (count)

WRM13. Ensure monitoring and recording of surface and groundwater use in line with the forthcoming legislation and the Water Efficiency Strategy and Action Plan (2023-2033). Promote efficient water use and recycling of water in industrial enterprises, industrial zones, and sites, as well as in the energy and mining sectors.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (DGSHW, GDSW), MAPEG, MoEUCC (GDEM), OS-BUK, MoI (SPA), Municipalities*	MoIT (GDIZ, GDI), MoENR (DEEE), OIZs, TOBB, TURKSTAT	2024-2030	• Number of enterprises at which monitoring is performed for surface and groundwater use at basin/province level (count) • Ratio of implementation of actions in water efficiency action plans (%) • Ratio of reused water to total water consumption at basin/province level (%)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2 To ensure the protection, improvement and efficient use of water resources

WATER RESOURCES MANAGEMENT
climate adaptation

WRM14. Implement structural measures for flood protection with a focus on nature-based solutions. Expand flood forecasting and early warning systems and continue the rehabilitation of flood protection facilities. Accelerate soil conservation efforts in flood-prone and high-risk areas and promote upstream flood protection measures. Develop and expand drought forecasting and early warning systems to enhance resilience to extreme weather events.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (DGSHW, GDSW, GDF, TAGEM)	MoEUCC (GDCDE), MoI (SPA), Municipalities*	2024-2030	• Ratio of proposed nature-based solutions to total number of measures at basin level (%) • Number of established flood forecasting and early warning stations at basin level (count) • Ratio of facilities which have undergone capacity rehabilitation at basin level (%) • Soil conservation works in areas of flooding risk at basin level (count, %) • Number of upstream works that have been undertaken to control floods at basin level (count) • Ratio of upstream measures to total number of measures (%) • Number of established drought early warning systems at basin level (count)

* UMT will monitor the actions for which municipalities are responsible.

AGRICULTURE AND FOOD SECURITY

climate adaptation

STRATEGIC GOAL 1

To develop policy and legal frameworks for the climate change adaptation of the agriculture sector; to strengthen institutional capacity, cooperation and awareness.

AGRICULTURE AND FOOD SECURITY
climate adaptation

AGR1. Review and update agricultural policies and legislation to build a climate-resilient, sustainable, and competitive agriculture sector that leverages technology effectively and considers the crop pattern and water budget of basins.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDAR, GDSW)	MoAF (GDPP, GDL, GDFA, TAGEM, SDD, GDFC, GDEUFR, PDs), PSB, Universities	2024-2030	• Report on reviewing agricultural policies considering climate change adaptation (exists/not) • Number of legislative pieces amended (count)

AGR2. Plan agricultural production based on agricultural basins or farms and revise agricultural support mechanisms to align with the objectives outlined in these plans.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDAR, GDL, GDPP)	TURKSTAT, TUBITAK, PSB, MoTF, Municipalities*, UMT, Universities,	2024-2030	• Land Use Plans (count) • Animal Production Plan (exists/not) • Plant Production Plan (exists/not)

AGR3. Expand training, awareness-raising, and capacity-building activities for stakeholders in the agriculture sector to enhance adaptation to climate change impacts.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (DTP)	MoEUCC (GDCDE), MoAF (TWI, GDSW), Municipalities*, UMT, TOBB, MoNE (GDLL), MoAF (DTP), DAs, UNDP, FAO, IFAD, Universities, TRC, NGOs	2024-2030	• Number of training courses for farmers (count) • Number of training courses for technical personnel (count) • Number of training courses for managers (count) • Number of training courses for private sector and NGOs (count) • Number of training courses for women (count) • Number of training courses for vulnerable groups (poor, persons with disabilities, seasonal workers, children and youth etc.) (count) • Number of studies conducted on drought and effective use of water (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2

To ensure the protection, enhancement and sustainable use of ecosystems and natural resources in agricultural production.

AGRICULTURE AND FOOD SECURITY
climate adaptation

AGR4. Conduct studies to identify appropriate crop patterns and livestock systems that promote efficient use of soil and water resources and safeguard biodiversity at provincial and district levels, and prepare guidelines for farmers.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDPP, GDL, TAGEM)	MoAF (PDs), TUBITAK, MoAF (ARDSI), RDA, DAs, Municipalities*, UMT, Universities	2024-2030	• Number of guides for recommended production pattern for province (count) • Number of guides for recommended production pattern for district (count) • Number of guides for recommended livestock breeding system for province (count) • Number of guides for recommended livestock breeding system for district (count) • Number of farmers who have participated in irrigation training (count)

AGR5. Ensure the protection of cultivated agricultural land, grassland, and rural landscapes, monitor grassland capacity and productivity, and identify and implement strategies to maintain water balance and increase grassland productivity.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDAR, TAGEM)	MoAF (GDF, GDPP), Municipalities*, UMT	2024-2030	• Size of agricultural land cultivated in province (ha) • Size of pastures in settlements (ha) • Size of rehabilitated pastures in province (ha)

AGR6. Draft a nature-based solutions guideline for agricultural activities at the national level, develop an ecosystem-based food production model, and promote agroforestry practices in agricultural lands.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDAR, TAGEM)	MoAF (GDF), TUBITAK, MoEUCC (GDCDE), MoAF (ARDSI), RDA, DAs, Municipalities*, UMT, Universities	2024-2030	• List of nature-based solutions in agricultural production (exists/not) • Ecosystem-centred food production model (exists/not) • Size of areas where agricultural forestry is practiced (ha)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2

To ensure the protection, enhancement and sustainable use of ecosystems and natural resources in agricultural production.

AGRICULTURE AND FOOD SECURITY
climate adaptation

AGR7. Promote sustainable aquaculture practices that align with climate change objectives, protect and enhance aquatic biodiversity, and establish plans to combat invasive species in fisheries.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDFA, TAGEM)	MoAF (ARDSI), TUBITAK, RDA, DAs, Municipalities*, UMT, Universities	2024-2030	• Ecosystem-aligned fisheries models (exists/not) • List of aquaculture practices adaptive and non-adaptive to climate change (exists/not) • Combat plan (exists/not)

AGR8. Improve support for households and businesses engaged in apiculture, taking into account their interconnection with other sectors, such as fruit production, tourism, and honey forests.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDL)	MoAF (GDF, ARDSI), RDA, TUBITAK, DAs, Municipalities*, UMT, Universities	2024-2030	• Research report on impact of climate change on apiculture and adaptation (exists/not)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 3

To increase R&D studies on climate change impacts and adaptation in agriculture; to develop databases, information technologies and innovation applications in agriculture and perform agricultural activities accordingly.

AGRICULTURE AND FOOD SECURITY
climate adaptation

AGR9. Support and enhance R&D studies on climate change impacts and adaptation in agriculture.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (TAGEM)	MoAF (GDFC, GDIT), PSB, TUBITAK, CHE, Universities, TUBITAK	2024-2030	• Number of supported research studies on impacts of climate change (count) • Number of supported research studies on plant diseases and pests (count) • Number of supported research studies on alternative feed sources (count) • Number of rehabilitation research studies (conventional, biotechnological and molecular genetics) (count)

AGR10. Identify and monitor socio-economic factors that influence vulnerability in the agriculture sector at provincial, district, and village levels.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDAR), TURKSTAT	MoAF (GDIT, TAGEM, PDs), Municipalities*, UMT	2024-2030	• List of identified socio-economic factors (exists/not) • Socio-economic data on rural population at province, district, village level (count)

* UMT will monitor the actions for which municipalities are responsible.

AGR11. Develop agricultural databases, information technologies, and innovation practices to guide agricultural activities and improve decision-making.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (TAGEM)	MoAF (GDPP, GDL, PDs, GDIT, GDAR), TUBITAK, Universities	2024-2030	• Number of lists of plant species/varieties compatible with anticipated conditions at province, district, village level (count) • Number of lists of animal species/varieties compatible with anticipated conditions at province, district, village level (count) • Number of agricultural calendars compatible with anticipated conditions at province, district, village level (count) • Number of lists of recommended cultivation processes at province, district, village level (count) • Agricultural data exchange portal (exists/not) • Digital monitoring system for agricultural drought (exists/not) • List of indicators for agriculture & environment (exists/not) • Forecasting and Warning Systems area (ha) • Number of crops covered by Forecasting and Warning Systems (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 3 To increase R&D studies on climate change impacts and adaptation in agriculture; to develop databases, information technologies and innovation applications in agriculture and perform agricultural activities accordingly.

AGRICULTURE AND FOOD SECURITY
climate adaptation

AGR12. Minimize losses and damages to critical infrastructure such as irrigation systems, cold chains, modern storage facilities, and transport infrastructure. Enhance the agricultural insurance system to incorporate the impacts of climate change.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDAR, TAGEM)	MoIT (GDIFC), MoTI (GDII), MoT (GDDT), MoEUCC (DCC), MoAF (ARDSI, DGSHW, GDSW), RDA, DAs, Municipalities*, UMT	2024-2030	• Inventory of water storage systems (exists/not) • Size of irrigated areas by irrigation method (ha) • Number of climate-related insurance programmes (products) (count) • Number of farmers who have purchased insurance (count) • Number of cold storage depots (count) • Report on current state and potential investments for provincial-district-village roads and railways (exists/not)

climate adaptation

BIODIVERSITY AND ECOSYSTEM SERVICES

STRATEGIC GOAL 1

To raise awareness and enhance capacity on biodiversity, ecosystem services, nature-based solutions, and ecosystem-based adaptation; to ensure data and information exchange, prevent confusion of power, and strengthen cooperation among all stakeholders.

BIODIVERSITY AND ECOSYSTEM SERVICES
climate adaptation

BIO1. Undertake climate and nature literacy programmes as part of climate change adaptation efforts; update school and university curricula to focus on the skills and qualifications required for the protection of biodiversity and ecosystems; develop nature conservation projects; and organize communication campaigns using diverse tools tailored for different target groups.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoNE (GDPE, GDLL, GDSE), MoEUCC (GDPNA), MoAF (GDNCNP, GDF)	MoEUCC (DCC, GDCDE), CHE, TUBITAK, TRT, MoCT (RTUK), MoYS, Universities, TRC, NGOs, Private Sector	2024-2030	• Number of programmes prepared (count) • Number of projects developed (count) • Number of campaigns launched (count) • Number of communications materials prepared (count) • Number of participants (count)

BIO2. Enhance institutional capacities related to biodiversity and ecosystems; ensure coordinated data and information exchange among all stakeholders to avoid power overlaps and strengthen cooperation.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDNCNP), MoEUCC (GDPNA)	MoAF (GDF, GDSW, DGSHW, GDFA, TAGEM, GDPP, GDAR), MoEUCC (GDCDE, GDEIAPI, GDSP, DCC), MoI (GGV), MoTI (GDMA), ARI, FRI, Universities, NGOs, Private Sector	2024-2030	• Number of inter-institutional protocols (count) • Number of in-service training courses (count) • Number of personnel participating in training (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2

To ease the pressures caused by various factors that threaten biodiversity and ecosystem services, such as habitat change and fragmentation, pollution, over-exploitation.

BIODIVERSITY AND ECOSYSTEM SERVICES
climate adaptation

BIO3. Update the legislation on biodiversity and ecosystem services with a focus on nature conservation; align protected area categories with international standards; and strengthen cooperation and coordination among relevant institutions to achieve effective management of these areas.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoEUCC (GDPNA, GDEIAPI), MoAF (GDNCNP, GDF)	CCACB, MoAF (TAGEM), Universities, NGOs	2024-2030	• Workshop for reviewing legislation (exists/not) • Number of amended/updated legislative pieces (count) • Amendments to Articles 16, 17 and 18 and Supplementary Article 16 of the Forest Law (exists/not) • Including EIA Regulation in impact mitigation hierarchy (Avoid>Mitigate>Compensate) (exists/not)

BIO4. Prevent, monitor, and inspect land and habitat changes and air, water, soil, plastic, and noise pollution that harm biodiversity.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoEUCC (GDEIAPI), MoAF (GDNCNP, GDF)	Municipalities*, UMT, MoAF (DGSHW), MoEUCC (GDEM, GDPNA)	2024-2030	• List of updated threshold values (exists/not) • Number of legislative pieces prepared (count) • Number of inspections (count) • Ratio of natural areas to country's surface area by international classification of plant cover (%) • Distribution of forest by piece size (count, %)

BIO5. Identify sustainability challenges and develop a roadmap to address them, ensuring the sustainable management and use of forest, agricultural, animal, and water resources.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDF, TAGEM, GDPP, GDFA, GDAR, GDL)	MoAF (DGSHW, GDNCNP, GDSW, TWI), MoEUCC (GDCDE, GDPNA), Universities, NGOs	2024-2030	• Number of workshops (count) • Roadmaps and guides prepared (count) • Monitoring and evaluation report prepared (exists/not)

* UMT will monitor the actions for which municipalities are responsible.

BIO6. Identify and catalogue all species across the classes of living creatures; explore the interactions between climate change, biodiversity, and ecosystem services; identify critical species and habitats, and implement projects to monitor their ecologies and populations; develop strategies and implement measures for the identification, monitoring (entry, early detection, spread), and control of invasive alien species.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDNCNP, GDFA, TAGEM), MoEUCC (GDPNA)	MoEUCC (TSMS), MoAF (GDPP, DGSHW, GDF, GDSW, TWI), MoT (GDC), TUBITAK, ARI, FRI, Universities, NGOs	2024-2030	• Extended National Biodiversity Inventory (exists/not) • Potential Natura2000 areas (count) • Number of species and habitats at risk (count) • Inventory species and habitats that will be primarily impacted by climate change (exists/not) • Guides for monitoring and evaluating species/habitats/ecosystem (count) • Number of monitored species/habitats/ecosystem (count) • Number of research studies on ecology of critical species considering also climate change (count) • Number of projects for monitoring invasive alien species (count) • Number of species and habitats placed under protection (count)

BIO7. Determine and map the contributions of ecosystems and nature to human well-being through their products and services, and integrate these contributions into administrative plans; conduct studies to compile traditional ecological knowledge.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoEUCC (GDCDE, GDPNA), MoAF (GDNCNP, GDF, GDPP, TAGEM, GDSW, GDFA)	TUBITAK, ARI, FRI, Universities, NGOs	2024-2030	• Number of projects for mapping ecosystem services (count) • Number of research studies on traditional ecological information (count) • Number of projects for those subsisting on ecosystem services (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 3 To explore, monitor and assess the impacts of climate change on biodiversity and ecosystem services.

BIODIVERSITY AND ECOSYSTEM SERVICES
climate adaptation

BIO8. Monitor biotic factors (e.g., insects and fungal pests) and abiotic factors (e.g., storms and snowfall) that harm forests due to climate change; build inventories of the affected areas and quantities of damaged wood; estimate long-term climate change impacts on forests and ensure the implementation of adaptation-based ecosystem management; prioritize preventive measures in forest fire management.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDF)	MoAF (GDNCNP), MoEUCC (GDPNA, GDCDE)	2024-2030	• Abiotic and biotic harm monitoring system (exists/not) • Forest areas and quantity of wood harmed by abiotic and biotic factors (ha, m3) • Number of action plans prioritizing fire prevention measures (count) • Number of adaptation-oriented forest arrangement plans (count) • Number of established (Integrated) Ecosystem Research and Monitoring Field (LTER) (count) • Ratio of afforestation in areas affected by fires (%)

* UMT will monitor the actions for which municipalities are responsible.

BIO9. Play an active role in contributing to global efforts to increase protected land and sea areas to 30%.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDNCNP), MoEUCC (GDP-NA)	MoAF (GDF, GDSW, DGSHW, GDFA, TAGEM, GDPP, GDAR), MoEUCC (GDCDE), MoTI (GDMA)	2024-2030	• Ratio of protected areas to country's total surface area (%)

BIO10. Integrate biodiversity conservation, support for ecosystem services, and climate change adaptation into the management and development plans for protected areas, as well as into species and habitat protection action plans.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDNCNP), MoEUCC (GDP-NA)	MoAF (GDF, DGSHW, GDSW), MoEUCC (GDCDE)	2024-2030	• Number of plans prepared (count)

BIO11. Create inventories of degraded and fragmented ecosystems to guide efforts to restore degraded ecosystems across the country and connect these ecosystems through the establishment of ecological corridors.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDNCNP, GDF, TAGEM, GDFA), MoEUCC (GDPNA, GDCDE)	MoAF (GDAR, GDSW, DGSHW, GDPP), TUBITAK, ARI, FRI, Universities, NGOs	2024-2030	• Inventory of degraded/fragmented ecosystems (exists/not) • Ecological restoration targets (for 2030 and 2040) (%) • Number of ecological corridors (count) • Number of pilot projects for ecological restoration (count) • Action Plan for Compensating Land Degradation (exists/not) • Number of pilot projects for balancing biodiversity (count) • Number of pilot projects for compensating land degradation (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 4 To increase the amount of protected areas for effective nature conservation, restore degraded ecosystems, and integrate climate change adaptation into management plans.

BIODIVERSITY AND ECOSYSTEM SERVICES
climate adaptation

BIO12. Identify national and international good practices on topics such as nature-based solutions and ecosystem-based adaptation and implement model application projects accordingly.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (GDNCNP, GDAR), MoEUCC (GDPNA)	MoAF (GDF, GDSW, DGSHW, GDFA, TAGEM, GDPP), MoEUCC (GDCDE), MoTI (GDMA), Municipalities*, Research Institutes, Universities, NGOs	2024-2030	• Number of good practices (count) • Number of pilot projects on nature-based solutions (count)

* UMT will monitor the actions for which municipalities are responsible.


PUBLIC
HEALTH
climate adaptation

PHE1. Develop a comprehensive list of indicators based on the Türkiye Climate and Health Profile and related health impact chains; establish a system to collect, maintain, and analyze data; and harmonize this system with existing applications such as reporting and early warning mechanisms.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoH (GDPH, GDHIS)	MoEUCC (DCC), TURKSTAT, Universities	2024-2025	• Number of indicators (count) • Number of health impact chains relating to climate hazards (count) • Number of TURKSTAT bulletins on climate and health (count) • Rates of climate-sensitive diseases (count/population*100)

PHE2. Increase epidemiological studies on the physical, mental, and social impacts of climate change; identify high-risk places and vulnerable populations at the regional and city levels; and plan health services based on climate determinants.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoH (GDPH)	MoEUCC (DCC), TUBITAK, CHE, TNA, DAs, Universities, MoH (GDHS, GDPH, GDEMS, GDHP, GDHIS, GDHI)	2024-2030	• Number of research studies (count) • Number of publications (count) • Number of plans prepared (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 1 Strengthening the infrastructure for evidence-based analysis, assessment and reporting on climate change in the field of health and increasing R&D studies.

PUBLIC HEALTH climate adaptation

PHE3. Prepare the legislative framework for Health Impact Assessments of the measures taken to address climate change.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoH (GDPH)	CCACB, Municipalities*	2024-2030	• Draft legislation (exists/not)

PHE4. Strengthen joint R&D efforts across sectors and disciplines to explore pathways for monitoring, protection, prevention, and early diagnosis of climate change-induced diseases, including those linked to extreme temperatures, ultraviolet radiation, water and air quality deterioration, animal- and vector-borne diseases, infectious diseases, and mental health impacts.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoH (GDPH)	TUBITAK, CHE, Universities	2024-2030	• Number of R&D studies (count)

* UMT will monitor the actions for which municipalities are responsible.

PHE5. Establish a high-level coordination unit responsible for activities such as monitoring, communication, working groups, and the development of climate and health ethics committees.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoH (GDPH)	MoEUCC (DCC), Universities, TOBB (SHM), Directorate of Communications	2024-2026	• Coordination unit (exists/not) • Number of working groups (count) • Number of ethics boards at national, regional and or provincial level (count) • Number of working group reports (count)

PHE6. Make climate change and health impacts a periodic agenda item for Public Health Boards in provinces to promote the protection of urban health from climate-related risks.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoH (GDPH)	Provincial Boards of Public Health	2024-2030	• Number of agenda items relating to climate change (count)

PHE7. Compile and use a list of climate-sensitive diseases; identify such diseases across the country; and develop a climate and health glossary for multidisciplinary and cross-sectoral use.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoH (GDPH)	MoEUCC (TSMS), Universities	2024-2025	• Number of disease codes (count) • Number and distribution of diseases coded at national and local level (count, %) • Dictionary prepared (exists/not)

PHE8. Initiate and promote climate and health literacy programs and provide specialized training for healthcare professionals to increase capacity in the health sector.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoH (GDPH)	MoEUCC (TSMS), MoNE, CHE, Universities	2024-2026	• Number of training courses (count) • Number of participants (count) (distribution by first, second and third tier)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2 To strengthen the capacity, cooperation and awareness across national and local institutions and organizations for a climate change and health perspective.

PUBLIC HEALTH climate adaptation

PHE9. Update curricula and application guidelines on the environment, urban, climate, and health, incorporating perspectives that link climate change to public health outcomes.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoNE (GDPE), CHE, MoH (GDPH), MoEUCC (DCC)	Universities	2024-2026	• Number of lessons addressing the relation of climate and health (count) • Number of learning objectives at F5s for climate and health (count)

PHE10. Seek accreditation for health facilities as climate-resilient institutions to ensure preparedness for climate-related challenges.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoH (GDPH, GDPH, GDHS, SDD)	TUSKA	2024-2026	• Number of accredited facilities (count)

PHE11. Expand the number of climate and health-related plans, programs, and projects developed through collaboration with national and local public entities and enhance public participation in climate adaptation efforts.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoH (GDPH)	MoEUCC (GDLA), NGOs, Municipalities*, MoI (SPA)	2024-2030	• Number of plans, programmes and projects completed (count) • Number of NGOs participating in climate and health work (count)

PHE12. Review and update Occupational Health and Safety (OHS) legislation in the context of climate change, focusing on occupational safety, public health risks, and occupational diseases to identify and address new or emerging risks.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoLSS (GDOHS)	MoEUCC (DCC), MoIT (GDI), MoAF (GDF), MoH (GDPH)	2024-2025	• Updated legislation (exists/not)

* UMT will monitor the actions for which municipalities are responsible.


ENERGY
climate adaptation

STRATEGIC GOAL 1

To develop policy and legal frameworks for the climate change adaptation of the energy sector; to strengthen institutional capacity and cooperation; to increase the production and sharing of data and information.

ENERGY
climate adaptation

ENR1. Provide necessary training and conduct awareness-raising activities for decision-makers in public institutions and the private sector in the energy sector to develop institutional capacity and information networks regarding climate change adaptation.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoENR	MoEUCC (DCC)	2024-2030	• Number of training courses (count) • Number of participants (count)

ENR2. Identify and assess needs for climate services and climate change-driven risks in the energy sector.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoENR	MoEUCC (TSMS, DCC), Municipalities*, international organizations working on climate change, MoAF (DGSHW, GDF), UMT	2024-2027	• Number of inter-institutional cooperation protocols (count) • Number of risk assessments (count)

ENR3. Incorporate climate risks and climate change adaptation into policy documents prepared in the area of energy and energy resources.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoENR	MoEUCC (DCC), TOBB, Private Sector	2024-2030	• Number of policy papers in which climate change adaptation has been incorporated (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2

To strengthen the production, transmission & distribution and storage infrastructure in energy resources, considering necessary designs and enhancing flexibility in power systems in order to achieve climate change adaptation.

ENERGY
climate adaptation

ENR4. Integrate climate change adaptation into water resources management and decisions that affect the operation of reservoir-storage HPPs; enhance their water holding capacity or prefer pumped-storage HPPs; improve the durability of reservoir embankments and power plant equipment and boost the productivity of turbines..

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoAF (DGSHW)	MoENR, Municipalities* (WSAs), UMT, Private Sector	2024-2030	• Number of reservoir water resources management plans considering climate change adaptation (count) • Number of pumped-storage HPPs (count) • Increased water-holding capacity (m3) • Number of power plant equipment pieces damaged (count)

ENR5. Take necessary precautions to protect open lignite mines and stocks from climate hazards such as floods and heatwaves.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoENR	Private Sector	2024-2030	• Number of water-blown cooling systems (count) • Number of improved drainage systems (count)

ENR6. Conduct vulnerability and risk assessments in the face of rising sea levels for energy facilities located by the coastline and take necessary precautions.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoENR	MoEUCC (DCC, TSMS, GDEM), Private Sector	2024-2030	• Number of vulnerability and risk assessments (count) • Number of equipment pieces for which precautions have been taken (count) • Number of improved drainage systems (count)

* UMT will monitor the actions for which municipalities are responsible.

ENR7. Take precautions to prevent damage to overhead electricity transmission and distribution infrastructure due to climate hazards.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoENR	MoAF, Private Sector	2024-2030	• Length of distribution lines built underground (km) • Length of overhead transmission lines with plant cover controlled (km) • Length of overhead distribution lines with plant cover controlled (km)

ENR8. Take precautions in petroleum and natural gas exploration and production platforms, transmission and distribution pipelines, and tank farms against the impacts of climate change.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoENR	TANAP, Private Sector	2024-2030	• Number of reinforced petroleum and natural gas facilities (count) • Length of flexible pipelines (km) • Number of drainage systems (count)

ENR9. Reduce damages and efficiency losses in wind power plants (WPPs).

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoENR	Municipalities*, Private Sector	2024-2030	• Number of blade heating systems (count) • Number of modules in use that clean dust, sand, snow and hail (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2 To strengthen the production, transmission & distribution and storage infrastructure in energy resources, considering necessary designs and enhancing flexibility in power systems in order to achieve climate change adaptation.

ENERGY climate adaptation

ENR10. Establish early warning and response systems for energy management to improve maintenance programmes and rapidly meet post-disaster recovery needs.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoENR	MoI (AFAD), Private Sector	2024-2030	• Improved maintenance programmes (count) • Early warning and response systems (count)

ENR11. Promote the use of new and efficient devices and district heating/cooling systems directly from building design to improve energy efficiency in buildings.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoENR	MoEUCC (GDVS, GDEM, TOKI), MoIT (GDI), TUBITAK, TSE, Private Sector	2024-2030	• Energy efficiency applications in buildings (count) • Number of district heating and cooling systems (count) • Number of energy performance standards applied (count)

* UMT will monitor the actions for which municipalities are responsible.


TOURISM
CULTURAL
HERITAGE
climate adaptation

STRATEGIC GOAL 1 To enhance the climate change adaptation capacity of tourism investments and enterprises in terms of infrastructure.

TOURISM CULTURAL HERITAGE climate adaptation

TUR1. Develop criteria for the construction of resilient tourism facilities against climate risks, rehabilitate existing ones, and increase their adaptive capacity.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoCT (GDIE, TGA)	MoEUCC (GDSP, GDIUTS, GDLA), MoAF (GDNCNP), Municipalities*, UMT, MoCT (TGA Field Offices)	2024-2026	• Number of projects prepared (count)

TUR2. Outline a legal and institutional framework to rehabilitate, construct, and supervise existing and new tourism facilities in accordance with the determined criteria, and provide financial support to enterprises for these purposes.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoCT (GDIE)	MoEUCC (GDLA), Municipalities*, UMT, MoFSS (GDSPDE)	2025-2030	• Number of regulations/ circulars/ principles/ criteria promulgated (count) • Number of units established (count) • Number of supported projects (count)

TUR3. Implement training programs and provide technical support for tourism enterprises and destinations to encourage sustainable tourism practices nationwide.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoCT (TGA)	PSB (GDSPI), NGOs, TOBB, MoFSS (GDSPDE)	2024-2027	• Number of training courses delivered (count) • Number of sustainability certificates (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2 To improve social infrastructure to develop adaptive capacity to climate change in the tourism and cultural heritage sector.

TOURISM CULTURAL HERITAGE climate adaptation

TUR4. Conduct training and awareness-raising programs on the impacts of climate change on tourism and cultural heritage along with adaptation actions, at official educational institutions, responsible authorities, and sector-related NGOs, to enhance their technical capacity.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoCT (GDRE, GDCAM, GDF)	MoNE (GDLL, GDPE), CHE, MoCT (DRGCCNA, PDs, RTUK), ISKUR, Municipalities*, NGOs, TOBB	2024-2030	• Number of training and awareness-raising campaigns (count) • Number of activities undertaken on cultural heritage and climate change (count)

TUR5. Establish destination management organizations/offices to ensure local ownership, common action, and cooperation among stakeholders, and boost climate change adaptation capacity at tourism destinations.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoCT (TGA)	MoIT (DAs), MoCT (Field Offices) Municipalities*, UMT, NGOs, TOBB	2024-2029	• Number of local destination management offices (count)

TUR6. Prepare guidelines to identify climate risks and requirements for movable and immovable cultural heritage elements and sites, and define priority responses.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoCT (GDCAM, GDF)	MoCT (DRGCCNA), MoEUCC (DCC, TSMS), MoTI	2024-2026	• Number of guides prepared (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2

To improve social infrastructure to develop adaptive capacity to climate change in the tourism and cultural heritage sector.

TOURISM CULTURAL HERITAGE climate adaptation

TUR7. Establish local, national, and international cooperation and collaboration, along with inter-institutional coordination, to determine and reduce climate vulnerability levels and conserve cultural heritage and assets.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoCT (GDCAM, GDF)	MoCT (GDIE), UNESCO TMK, Municipalities*, UMT, ICOM, ICOMOS, UNDP, MoTI, MoI (SGC), MoND (NFC), NGOs, TOBB, MoFSS	2024-2030	• Number of meetings organized (count) • Number of projects completed (count)

TUR8. Utilize specific materials aligned with changing tourist motivations and preferences, target market conditions, and sustainable and responsible tourism approaches, for country- and destination-specific promotional activities.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoCT (TGA)	MoCT (GDP), NGOs, TOBB	2024-2026	• Number of promotion materials prepared (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 3

To consider climate change adaptation as a topic in the decisions of strategic and spatial plans related to tourism and cultural heritage and establish of inter-institutional coordination.

TOURISM CULTURAL HERITAGE climate adaptation

TUR9. Update the strategic goals for the preservation and transmission of cultural heritage to future generations by integrating climate change adaptation actions into the preparation process of the new national tourism strategy.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoCT (GDIE)	MoCT (GDCAM, GDF), MoEUCC (GDSP), MoAF (GDNCNP)	2024-2025	• Updated National Tourism Strategy (exists/not)

TUR10. Incorporate climate change adaptation as a topic in spatial plans for potential tourism areas where suitability for certain tourism types may increase due to climate change and ensure sustainable land use practices.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoCT (GDIE)	MoEUCC (GDSP, MoAF (GDNCNP), MoCT (GDCAM), Municipalities*, MoI (SPA)	2024-2027	• Number of projects prepared (count) • Number of spatial plans prepared (count) • Number of regulations/ circulars/ principles/ criteria prepared (count)

TUR11. Identify focal points suitable for niche tourism types in specialized themes and fields, and develop sustainable tourism strategies to reduce the sector's climate vulnerability.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoCT (GDIE)	MoCT (TGA), TURSAB	2024-2030	• Number of strategies/principles/plans prepared (count) • Number of tourism operating certificates issued (camping, tent, tent vehicle, mobile home, motor mobile home, bungalow … etc.) (count)

* UMT will monitor the actions for which municipalities are responsible.

INDUSTRY

climate adaptation

STRATEGIC GOAL 1

To identify the facilities exposed to the technological risks triggered and major industrial accident risks.

INDUSTRY
climate adaptation

IND1. Re-evaluating facilities at risk of technological risks and/or major industrial accidents triggered by climate change-related disasters, based on climate projections and vulnerability and risk assessments.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoEUCC (GDEI-API), MoI (AFAD)	MoEUCC (DCC, GDEM), MoH (GDPH), MoIT (GDI), MoLSS (GDL), OSBUK	2024-2027	• Determination study (exists/not)

IND2. Reviewing the risk assessment and contingency plans of each facility in the context of climate change adaptation, completing the necessary updates, identifying priority adaptation actions and implementing the identified actions.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoEUCC (GDEI-API),	MoEUCC (GDEM), MoIT (GDI), MoI (AFAD), MoLSS (GDL), OSBUK	2025-2030	• Facility-based monitoring and reporting system (exists/not) • Number of adaptation actions implemented (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2

To evaluate and monitor the impacts of climate change on investment and that of investment on the climate prior to investment projects.

INDUSTRY
climate adaptation

IND3. Reviewing investment incentive legislation and practices (primarily allocation of investment sites) from a climate change adaptation perspective, taking into account vulnerability and risk assessments across the industry sector in decision-making and monitoring processes.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoIT (GDIFC)	MoEUCC (DCC, GDNP), KOSGEB, OSBUK	2025-2030	• Number of incentives for investment place where adaptation criteria have been considered (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 3

To make the necessary updates after reviewing the insurance legislation with to increase insurability against the impacts of climate change.

INDUSTRY
climate adaptation

IND4. Monitoring insured industrial assets at risk from climate change-related catastrophes and climate hazards.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
IPRSA, IIMC	IAT, MoEUCC (DCC), OSBUK, MoIT (GDI), MoI (AFAD)	2025-2030	• Number of insured facilities impacted by climate hazards (count) • Compensation paid for damages caused by climate hazards (TRY) • Ratio of damages compensated by insurance (%)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 4

To ensure quick and practical access to national projections and databases for the studies to be carried out by the industry sector.

INDUSTRY
climate adaptation

IND5. Identifying sub-sectors of industry most vulnerable to climate change and developing adaptation guidelines for these sectors.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
TOBB	KOSGEB, TURKSTAT, OSBUK, MoIT (GDI)	2024-2030	• Number of sectoral adaptation guides (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 5 To encourage cooperation within the sector (mentorship system and training of trainers).

INDUSTRY climate adaptation

IND6. Organizing a training programme for trainers through the sector.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
TOBB	MoEUCC (DCC), TUSIAD, MUSIAD, OSBUK, MoIT (GDIZ, GDI), KOSGEB, Chambers of Industry	2024-2026	• Number of programmes for training of trainers (count) • Number of participants (count)

IND7. Strengthening the capacity of industrial enterprises, in particular SMEs, concerning technical know-how for adaptation to the effects of climate change.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
TOBB	TUSIAD, MUSIAD, OSBUK, MoIT (GDI, GDIZ, GDDA), KOSGEB, Chambers of Industry	2026-2030	• Number of training courses (count) • Number of participants (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 6 To encourage the inclusion of climate change adaptation components in green procurement criteria.

INDUSTRY climate adaptation

IND8. Providing information on the inclusion of compliance elements in the updates to be made for voluntary green procurement in the industry sector.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
TOBB	TUSIAD, MUSIAD, OSBUK, MoIT (GDI, GDIZ), KOSGEB, Chambers of Industry	2024-2026	• Number of informative activities/workshops for green procurement incorporating aspects of adaptation (count)

* UMT will monitor the actions for which municipalities are responsible.

climate adaptation

TRNS1. Ensuring the resilience of critical routes and infrastructures in highways, railways (High-Speed Rail, Rapid Rail and conventional lines), ports and airports against the risks posed by climate change where needed in line with future climate projections.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoTI (GDII, KGM, TCDD, GD-SCS, DMPF, TDI, GDCA, DHMI)	MoTI (GDMA, SDD, TSIC), MoAF (DGSHW), MoI (AFAD), MoEUCC (TSMS, DCC), Universities, TOBB, TMMOB	2024-2030	• Situation evaluation and needs assessment work (exists/not) • Number of planning and project design works (count) • Length and number of infrastructure interventions (km, count)

TRNS2. Making vehicle roads, bike and pedestrian roads and all public transport (rail, bus, maritime) infrastructure in cities resilient to risks arising from climate change.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities*, MoTI (KGM, TCDD)	MoTI (GDII, GDC), MoI (AFAD), MoEUCC (GDVS, DCC), TOBB, Universities, TMMOB, UMT	2024-2030	• Length and number of infrastructure interventions (km, count) • Length and number of drainage system improvement works (km, count) • Length and number of barriers and set against storm and sea waves at coastal cities (km, count) • Length of protective shades and protected roads against heatwaves (vehicles, bicycles, pedestrians) (km) • Revision of Bike Paths Regulation (exists/not) • Legislation for technical equipment for mass transport and school/workplace shuttle vehicles (exists/not)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 1 To ensure the resilience of critical transport and communications infrastructure.

TRANSPORT COMMUNICATIONS climate adaptation

TRNS3. Making data centers, base stations and electronic communications infrastructure in the communications sector resilient to risks caused by climate change.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
ICTA	MoTI (GDC, GDII), TUBITAK, MoI (AFAD), MoEUCC (TSMS), Universities, TOBB, TMMOB	2024-2030	• Monitoring report on compliance with service quality requirements laid down by ICTA (exists/not)

* UMT will monitor the actions for which municipalities are responsible.

TRNS4. Using pavements with high permeability on the hard surfaces of roads, sidewalks, squares and car parks in urban.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities*, MoTI (KGM)	Universities, UMT, TMMOB	2024-2030	• Public meetings held in provinces (exists/not) • Number of provinces where public meetings have been held, and number of people participating (count) • Number of planning and project design works (count) • Size of infrastructural intervention (m2) and/or number of projects (count)

TRNS5. Planning and expanding green and blue infrastructures in urban with a view to increasing permeable surfaces and drainage opportunities as well as mitigating the impact of heatwaves.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities*	MoAF (DGSHW), UMT, Universities, TMMOB	2024-2028	• Increase in size of green spaces (m2) • Increase in size of per capita green spaces (m2) • Length of streams recovered for city (km)

TRNS6. Ensuring presence of air-conditioning and ventilation systems in public transport vehicles, school buses, and buses and minibuses used in intercity passenger transport, and renewing private and public transport vehicle fleets through the use of materials and vehicle roof top colours that do not transmit high levels of heat.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities*	MoTI (KGM), Companies Providing Transport Services, Universities, TOBB, TMMOB, TSE, MoIT, UMT	2024-2030	• Number of renewed vehicles (count) • Number of improved vehicles (count) • Ratio of vehicles with air-conditioning to total size of vehicle fleet (%)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2 To safeguard transport activity and passenger health by reducing the level of vulnerability.

TRANSPORT COMMUNICATIONS climate adaptation

TRNS7. Using materials that reduce surface temperature ("cooler pavements") in high temperature areas of highways and urban roads, constructing tree-lined and sheltered roads for vehicles, bikers and pedestrians, and replacing landscape elements that increase the risk of fire with appropriate alternatives.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoTI (KGM), Municipalities*	Universities, TMMOB, UMT	2024-2030	• Length of cool paved roads (km) • Length of protected roads and number of protected passes/waiting spaces (km, count) • Number of landscaping interventions against fire risk (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 3

To enhance the emergency management and response capacity by developing means of accessibility, communication and evacuation during climate-related disasters.

TRANSPORT COMMUNICATIONS climate adaptation

TRNS8. Creating a flexible transport infrastructure with a high level of modal diversity and intermodal integration, both across the country and in cities.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoTI (SDD), Municipalities*	MoTI (GDC, GDII, KGM, TCDD, GDSCS, GDMA, TDI, GDCA, DHMI), PSB, MoENR, Universities, TMMOB, UMT	2024-2030	• Investment made to expand railway network (TRY) • Investment in maritime transport (TRY) • Balanced distribution of urban passenger transport modes (% distribution of passengers) • Investment planning for mass transport, bike and pedestrian travel in urban plans and transport plans (exists/not) • Investment in rail systems and/or reserved bus roads (TRY) • Investment in bike paths (TRY)

TRNS9. Developing early warning for climate hazards and transport information systems by including smart and mobile applications.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities*	MoEUCC (DCC), Universities, TOBB, TMMOB, UMT	2024-2028	• Number of smart/mobile application for warning information purposes (count)

TRNS10. Providing infrastructural support for additional power supply to ensure uninterrupted operation of communications systems such as data centers, fixed/mobile base stations, internet, cameras, etc.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
ICTA	MoTI (GDC, GDII), Universities, TMMOB	2024-2030	• Monitoring report on compliance with service quality requirements laid down by ICTA (exists/not)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 4

To enhance planning capacity in the field of transport and communications in line with the climate change adaptation objective.

TRANSPORT COMMUNICATIONS climate adaptation

TRNS11. Implementing legislation that reinforces the resilience of transport and communications infrastructure and reduces the vulnerability of infrastructure and users to the hazards of climate change.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoTI (GDII), ICTA, MoEUCC (GDEIAPI)	MoEUCC (ILBANK), Municipalities*, UMT, Universities, TMMOB	2024-2030	• Legislation on including climate change adaptation and resilience in feasibility and EIA reports (exists/not)

TRNS12. Developing design guidelines to be used as resources in transport plans for the planning and expansion of green infrastructure and use of permeable pavement materials on streets and avenues and developing climate change adaptation strategies in the context of Urban Transport Master Plans, Sustainable Urban Mobility Plans (SUMPs) and Bike Transport Master Plans (BTMPs).

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Municipalities*, UMT, MoTI (GDII, SDD)	MoEUCC (DTP, DCC, GDSP, GDLA, ILBANK), MoAF (DTP), Universities, TMMOB	2024-2030	• Number of design guides (count) • Number of plans that include adaptation strategies (count)

* UMT will monitor the actions for which municipalities are responsible.

SOCIAL DEVELOPMENT

climate adaptation

STRATEGIC GOAL 1

To include the social life impacts of, and measures against, climate change in the socio-economic development and ecosystem protection strategies at all levels (national, regional, local) and to incorporate the social development component into the climate change adaptation policies, planning and implementation processes of all sectors.

SOCIAL DEVELOPMENT
climate adaptation

SDV1. Ensuring that the multi-faceted impacts of climate change on social development is taken into consideration in higher policy documents such as Long-Term Climate Strategy of Türkiye.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoEUCC (DCC)	PSB (GDSPI)	2024-2025	• Long-term climate change strategy incorporating social development aspects (exists/not)

SDV2. Producing statistics which will allow for demographic and socio-economic analyses on individuals employed in sectors vulnerable to climate change.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
TURKSTAT	MoLSS (DIA, ISKUR), MoFSS (DSS, GDSW), MoI (PMM)	2025-2026	• Data and information inventory statistically generated and classified (exists/not)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2

To develop social protection policies to strengthen public resilience and adaptation to existing/potential climate hazards.

SOCIAL DEVELOPMENT
climate adaptation

SDV3. Developing social assistance and social service programmes that are implemented within the frame of social protection policies, with a particular consideration of provinces with high social vulnerability so that the vulnerability of individuals/households to the impacts of climate change can be reduced and their resilience strengthened.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoFSS (GDSA, SDD)	MoEUCC (DCC), MoFSS (DSS, GDSPDE, GDCS, GDSW), MoNE (GDSS), MoLSS, (GDL), CHE, Governorates, District-Governorates, Municipalities*, UMT, Regional Unions of Municipalities, TRC, SASF	2025-2028	• Number of social service types developed (count) • Number of application projects designed in alignment with green social services (count)

SDV4. Promoting research efforts and implementing findings in practice in order to formulate climate friendly alternative social assistance policies in the framework of social protection policies.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoFSS (SDD, GDSA, GDCS, GDSPDE, GDSW)	Universities, CHE, TURKSTAT, MoNE, MoLSS (GDL), Governorates, District-Governorates, Municipalities*, UMT, SASF, Union of Bar Associations of Türkiye, NGOs, SSF	2025-2030	• Number of supported research studies (count) • Number of applications (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 3

To abandon the crisis management mindset and facilitate transition to the risk management model to ensure public adaptation to climate change and strengthen the legal, institutional, administrative, scientific, social and financial capacity required in this context.

SOCIAL DEVELOPMENT
climate adaptation

SDV5. Conducting analyses on how climate change affects all segments of society, particularly vulnerable groups (elderly, children and persons with disabilities) and introducing development programmes supported by local administrations considering various needs of such groups.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoFSS (DSS, GDSPDE, GDCS, GDSW, SDD)	MoEUCC (DCC, GDGIS), MoNE (GDSS), MoLSS (GDL), MoIT (GDDA), Universities, TUBITAK	2025-2030	• Number of analyses completed (count) • Number of local development programmes supported (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 4

To implement the national climate change adaptation policies by focusing on a rights- and benefits-based approach and equal opportunities to ensure the well-being of all segments of society.

SOCIAL DEVELOPMENT
climate adaptation

SDV6. Identifying the benefits of measuring women's different levels of vulnerability to climate change and of their climate change adaptation by taking into consideration the adaptation actions of related SDGs and sectors.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoFSS (DSS, GDCS, GDSPDE, GDSW, SDD)	MoNE (GDPE, SDD), MoJ (DHR), MoI (GDRCS), MoLSS (GDL), Universities, NGOs	2025-2030	• Report considering SDG5 targets (exists/not)

* UMT will monitor the actions for which municipalities are responsible.

DISASTER RISK REDUCTION

climate adaptation

STRATEGIC GOAL 1

To strengthen the understanding of and information infrastructure for climate change and disaster risks for sustainable and resilient development.

DISASTER RISK REDUCTION
climate adaptation

DRR1. Conducting comprehensive risk assessment and planning studies to establish climate change risks more clearly.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoI (AFAD), MoEUCC (DCC), MoAF (GDSW)	CCACB, MoYS (SDD), MoCT (SDD), Municipalities*, UMT, Universities	2024-2027	• Number of hazard-specific research studies and action plans by type (count) • National climate risk assessment report (exists/not) • Number of integrated risk and hazard maps published in various scales (printed/electronic) (count) • Number of basin flood risk management plans promulgated (count) • Number of river basin management plans (count)

DRR2. Developing a Multiple Hazard Early Warning System, including warning systems for fast- and slow-growing events, that aims to reach all segments of society and involves foresight and response actions.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoI (AFAD)	MoEUCC (TSMS, GDCDE), MoAF (DGSHW, GDF, TAGEM, GDAR, GDPP, GDSW), MoH (GDPH), MoENR (MTA), MoTI, Municipalities*, UMT, TRC, Mobile Telephone Operators, Media Organizations, NGOs	2024-2026	• Number of protocols for data and information sharing and Standard Operating Procedures (count) • Number and types of hydro-meteorological solutions and models (count) • Multiple Hazard Early Warning System (exists/not) • Communication system that reaches all segments and individuals of the society (exists/not)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2

To ensure transformative risk governance to strengthen climate and disaster resilience.

DISASTER RISK REDUCTION
climate adaptation

DRR3. Ensuring the systematic integration of climate change adaptation and disaster risk reduction in national and local sustainable and resilient development planning.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
CCACB	PSB, MoI (AFAD), MoEUCC (GDCDE, GDSP, DCC), MoFSS (SDD), MoLSS (GDL), MoYS (SDD), MoCT (SDD), Municipalities*, UMT, Universities	2024-2030	• Guide on incorporating disaster risk reduction in national development planning processes (exists/not) • Number of updated policy papers, laws and regulations (count) • Number of methodologies and technical guides prepared for climate- and disaster-sensitive spatial planning (count) • Number of updated spatial plans (count)

DRR4. Revising the legislation, including policies and sectors, by taking climate change into consideration to enhance the disaster resilience of critical infrastructure, and formulating practical guidelines in this regard.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
CCACB, MoI (AFAD)	MoFSS (SDD), MoEUCC (DCC), MoLSS (GDL), MoYS (SDD), MoCT (SDD), MoH (GDPH), MoENR, Municipalities*, UMT, Universities	2024-2030	• Guide on incorporating disaster risk reduction in nGuide on climate-resilient critical infrastructure (exists/not) • Number of legislative pieces updated (count)

DRR5. As part of compensating for losses and damages caused by climate-related disasters, enhancing the insurance mechanism, improving the loss and damage identification process, and creating the Turkish Losses and Damages Platform.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
IPRSA, MoI (AFAD), MoTF, MoAF (GDAR)	MoEUCC (DCC, TSMS), MoAF (GDF), TURKSTAT, DASK, IIMC, Insurance Companies, IAT, SRMC, TOBB (ECIA)	2024-2026	• Improving the insurance legislation to cover climate change impacts (exists/not) • Number of insurance policies issued (count) • Revision of existing loss and damage assessment process (exists/not)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 3

To build institutional capacity and raise awareness to achieve inclusive and sensitive climate and disaster resilience.

DISASTER RISK REDUCTION
climate adaptation

DRR6. Building institutional and technical capacity to enhance disaster resilience.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoI (AFAD)	MoEUCC (GDCDE), MoFSS (SDD), MoLSS (SDD), MoYS (SDD), MoCT (SDD, RTUK), MoNE (GDSS), MoH (GDPH), MoJ (SDD), TOBB, Governorates, Municipalities*, UMT, Universities, Private Sector, NGOs	2024-2030	• Number of awareness-raising and training activities (count) • Number of participants in training programmes for vulnerable groups (count, disaggregated by M/F) • Number of institutions participating in training programmes (count)

DRR7. Taking into account the potential displacements caused by climate-related risks in the National Migration Policy and action plans and including climate change adaptation in the migration management process.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoI (PMM)	MoI (AFAD), MoEUCC (DCC), MoH (GDPH), TRC, MoNE (GDSS), MoLSS (GDL, DGILF)	2024- 2030	• Report on systematic assessment of impacts of climate change on population movements and migrant populations (exists/not) • Analysis of population mobility by climate change risk scenarios (exists/not)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 4

To make consistent and sustainable investments in the context of climate and disaster resilience.

DISASTER RISK REDUCTION
climate adaptation

DRR8. Carrying out the post-disaster restructuring and reconstruction process by taking into account the issues of climate change impacts and ecosystem-based disaster risk reduction.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoEUCC (GDVS, GDEM, GDIPME, TOKI), MoI (AFAD),	MoEUCC (DCC, ILBANK, GDCDE, GDSP, GDIUTS), CCACB, MoFSS (SDD), MoLSS (SDD), MoYS (SDD), MoCT (SDD), MoH (GDPH), MoAF (GDSW), Municipalities*, UMT, Universities, Private Sector, TRC	2024-2030	• Number of applications considering climate change adaptation (count)

* UMT will monitor the actions for which municipalities are responsible.

CROSS-CUTTING ISSUES

climate adaptation

CCI1. Conducting climate change impact, vulnerability and risk assessments on a sectoral basis.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoEUCC (DCC)	CCACB, MoFSS (SDD), MoLSS (GDL), MoCT (SDD), MoJ (SDD), MoYS (SDD), MoND (SDD)	2024-2026	• Sectoral vulnerability and risk assessments (exists/not), number of sectors (count)

CCI2. Dealing with the topic of climate change adaptation in a holistic manner in development plans as well as other plans, programmes and policies currently enforced, by taking into consideration sectoral interactions.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
CCACB	MoFSS (SDD), MoLSS (GDL), MoCT (SDD), MoJ (SDD), MoYS (SDD), MoND (SDD), MoIT (GDDA), Universities	2024-2030	• Number of plans prepared/updated (count)

CCI3. Conducting Technological Need Analysis (TNA) and drafting an R&D and Innovation Strategy and Roadmap for climate change adaptation, and increasing the number of studies and product projects undertaken for the use of new technologies in universities and technology development zones.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
TUBITAK	CCACB, MoFSS (SDD), MoLSS (GDL), MoCT (SDD), MoJ (SDD), MoYS (SDD), MoND (SDD), KOSGEB, Universities, Private Sector, CHE, NGOs	2024-2030	• Technology needs assessment (exists/not) • Number of research and product projects (count) • Amount of support to R&D (TRY)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 1 To integrate climate change adaptation in all policies and strategies

CROSS-CUTTING ISSUES
climate adaptation

CCI4. Setting up a legislative infrastructure to prepare a Local Climate Change Action Plan (LCCAP) and drafting LCCAPs for all provinces.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
Governorates, Municipalities*, MoEUCC (DCC)	UMT	2024-2026	• Number of LCCAPs prepared (count) • Legislation prepared (exists/not)

CCI5. Ensuring sustainability reporting that includes descriptions of climate-related risks and opportunities, in line with Turkish Sustainability Reporting Standards (TSRS).

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
POA	MoLSS (GDL), Private Sector	2024-2026	• Number of reports prepared (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 2

To increase the knowledge supporting decision-making processes and to build institutional capacity to increase climate change-related expertise, training, database creation, monitoring and R&D studies.

CROSS-CUTTING ISSUES
climate adaptation

CCI6. Identifying the national and local data required to conduct climate change vulnerability and risk assessments and ensuring they are gathered at a single source.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoEUCC (DCC, GDGIS)	Municipalities*, UMT, Universities	2024-2030	• TNGIS climate change data layer (exists/not) • Number of entries into TNGIS (count)

CCI7. Gathering the climate change content created by relevant stakeholders at a single source and ensuring they are accessible to all stakeholders.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoEUCC (DCC)	CCACB, Municipalities*, Private Sector, Universities, NGOs	2024-2030	• Climate portal (exists/not) • Number of entries (count)

* UMT will monitor the actions for which municipalities are responsible.

STRATEGIC GOAL 3

To increase knowledge, consciousness and awareness on climate change adaptation in a way to ensure that citizens are part of the solution, and to ensure engagement in decision-making mechanisms.

CROSS-CUTTING ISSUES
climate adaptation

CCI8. Undertaking efforts for just transition to protect employment during the climate change adaptation process.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoLSS (GDL)	ISKUR, Universities, Trade Unions, NGOs, Municipalities*, UMT	2024-2030	• Number of training programmes on new employment areas (count) • Number of newly created vocational standards (count)

CCI9. Identifying and updating national occupational standards and national competencies to determine the new qualification and skill requirements in employment that will be created by the climate change adaptation process; conducting and scaling up examination and certification activities based on the designated national competences.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoLSS (GDL), VQA	ISKUR, Universities, Trade Unions, NGOs, TOBB, MoNE, Municipalities*, UMT	2024-2030	• Number of analyses and reports (count) • Number of national vocational standards published and/or updated (count) • Number of national qualification certificates published and/or updated (count) • Number of vocations for which certifications are issued (count) • Number of persons for whom certifications are issued (count)

* UMT will monitor the actions for which municipalities are responsible.

CCI10. Starting from pre-school until the final step of postgraduate training, reviewing and updating the outcomes in the curriculum from the perspective of Sustainable Development Goals and climate change; delivering training of trainers; increasing the number of graduate, post-graduate and doctoral education on climate change in different disciplines (law, education, social sciences, engineering, etc.).

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoNE (GDPE, GDSS), CHE	MoEUCC, MoLSS (GDL), ISKUR, VQA, Universities, TOBB, NGOs	2024-2030	• Number of programmes for training of trainers (count, M/F) • Number of in-service training courses/events for teachers (count) • Number of participants (count, M/F) • Number of programmes/lessons (count) • Number of students (count, M/F)

CCI11. By using mass communication and media (social media, digital applications and games, TV series, films, etc.), undertaking efforts to ensure behavioural changes at the societal level to raise public awareness of climate change, such as increasing climate change literacy and getting the public to adopt environmentally sensitive consumption habits.

Responsible Institution	Relevant Institutions	Implementing Period	Monitoring Indicators
MoNE (GDRI, GDLL, GDVTE, GDPEI, GDSE, GDSECS, BET, GDSS, GDIET, GDPE)	MoEUCC (DCC), Directorate of Communications, CHE, MoH (GDPH), TURKSTAT, MoCT (RTUK, GDST), MoYS (GDYS), TUBITAK	2024-2030	• Number of programmes implemented (count) • Number of views of communication means used (count) • Number of materials prepared on climate change literacy, climate- and environment-sensitive consumption habits, and nature protection (count) • Number of research studies at the societal level on particularly climate change literacy, climate- and environment-sensitive consumption habits, nature protection, and protecting health against climate change impacts (count) • Annual survey to measure the extent of behaviour changes (exists/not) • Number of theatrical pieces (count)

* UMT will monitor the actions for which municipalities are responsible.

ANNEX-1:
VULNERABILITY AND RISK ASSESSMENT

VULNERABILITY AND RISK ASSESSMENT METHODOLOGY

Vulnerability and risk are influenced by a wide range of factors, including anthropogenic climate change, natural climate variability, and socio-economic development (IPCC, 2012). Consequently, climate change impacts can disrupt the normal functioning of societies and cause significant damage or loss of function in sectors, depending on the severity of these changes.

Risk is defined as the potential for negative consequences when elements of value, such as human lives, ecosystems, cultural assets, and physical infrastructure, are exposed to harm. According to the IPCC Fifth Assessment Report (AR5), risk is conceptualized as a combination of vulnerability, exposure, and hazard (Figure 57). Climate risk, specifically, refers to the potential for adverse outcomes resulting from the exposure of these valued elements to climate hazards. Systems may be exposed to individual or multiple climate hazards simultaneously (IPCC, 2014).

A hazard refers to a human-induced or natural physical phenomenon that may cause loss of life, injury, health impacts, or damage to property, infrastructure, livelihoods, services, ecosystems, and environmental resources. It also encompasses trends or the potential for physical impacts in addition to specific events.

Exposure is the presence of species, ecosystems, social and natural resources, infrastructure, or economic, social or cultural assets that could be adversely affected by climate change. It can also be described as elements that are exposed, vulnerable or open to risk (IPCC, 2014).

Vulnerability is the predisposition of a system to be adversely affected, determined by factors such as sensitivity, susceptibility to damage, and the capacity to cope and adapt (IPCC, 2014). Sensitivity and capacity are the two key components of vulnerability. Sensitivity is shaped by factors that directly influence the outcomes of a hazard, including the physical, socio-economic, and cultural characteristics of a system. Capacity refers to the ability of societies to prepare for and respond to the current and future effects of climate change. Coping capacity is the ability of individuals, institutions, and systems to manage and overcome adverse circumstances in the

Figure 57. Risk components according to IPCC AR5 approach (IPCC, 2014)

short and medium term using available resources, skills, and opportunities. Adaptive capacity refers to the capability of these entities to adjust to potential damages, seize new opportunities, or respond effectively to consequences (IPCC, 2014).

Since risks cannot be entirely eliminated, they can be managed through various strategies such as reducing exposure and sensitivity, enhancing adaptive capacity, or distributing risk. Sector-specific action plans play a vital role in effective risk management, ensuring that responses are tailored to the specific needs and vulnerabilities of different sectors.

The vulnerability and risk assessment method was established in accordance with IPCC reports, following this conceptual framework. As outlined in the IPCC Fifth Assessment Report, risk is a function of hazard, exposure, and vulnerability (IPCC, 2014), represented in Equation 1:

R=f(T,M,E)

where R denotes risk, H represents hazard, E refers to exposure, and V is vulnerability. Vulnerability, in turn, comprises two key components: sensitivity (S) and adaptive capacity (AC). Groups identified as "potentially vulnerable" are those exposed and sensitive to climate change impacts. These groups are further divided into two subcategories: those with coping or adaptation capacity and those without it. The latter group—those without coping or adaptation capacity—are referred to as directly vulnerable groups, as they are unable to mitigate or adapt to climate change impacts (Nguyen, 2015 When a region's capacity is very low or absent, its vulnerability increases significantly. This condition is described in some studies as "lack of coping capacity (LCC)", which is expressed as 1 minus the adaptation capacity (AC) or (1- AC) [(Das et al., 2020a), (Johnson, Depietri, & Breil, 2016)].

Consequently, vulnerability (V) can be defined in terms of sensitivity and lack of adaptive capacity:

E=Dx(1-UK)

In the final form of the risk formula, hazard, exposure, sensitivity, and lack of adaptive capacity are multiplied, as shown below in Equation 3:

R=TxMxD(1-UK)

The methodology used to calculate climate-related risks is organized into **eight phases** (Figure 58). The first step involves **preliminary preparations** for each sector. This phase is essential for ensuring the accuracy of risk assessments, as it shapes all subsequent steps. The scope of the analysis is defined based on the outcomes identified and targeted during these initial preparations.

Following the preliminary phase, sectoral **impact chains** were developed. An impact chain serves to analytically determine the factors influencing the system and to identify the components required for risk calculations. After constructing the impact chain, **indicators** were selected to effectively represent climate risk across relevant components, ensuring the most accurate reflection of each sector's vulnerabilities and potential risks.

After determining the indicators for each component comprising the impact chain, **data** was requested and collected from various institutions and sources. The data obtained was initially **normalized** and then standardized to ensure comparability, as the data involved different units or were unitless. Following standardization, **weighting** was applied. The indicators designated for the risk components were weighted using Principal Components Analysis (PCA). The sector-specific risk indicators selected for the exposure, sensitivity, and adaptation capacity components were weighted by PCA, and the values were multiplied by their respective weights to calculate the component scores, as shown in Equation 4:

$$M, D, K = \sum_{i=1}^{n} X_i \times A_i \qquad [4]$$

where Ai represents the weight value of the ith indicator, and Xi the own value of the ith indicator. Before inputting the normalized values of the exposure, sensitivity, and capacity components

Figure 58. Steps followed in risk assessment

Table 9. Threshold values used in classification of risks and components based on quantiles and their classification equivalents

Lower Threshold (>)	Upper Threshold (<=)	Classification
0	0.2	Very Low
0.2	0.4	Low
0.4	0.6	Moderate
0.6	0.8	High
0.8	1	Very High

obtained through PCA, along with the hazard variables specific to each sector, into the risk formula (Das et al., 2020a), the data was **classified** on a scale from 1 to 5. The threshold values used for classification are provided in Table 9.

This **classification was based on quantiles**, dividing the data into class intervals of predetermined sizes. The division was made using distribution-based percentiles rather than the actual numerical values of the data. As a result, the values that fall on threshold limits could be adjusted to the upper or lower class, and not every class was assigned an equal number of values. This approach ensures greater alignment with data distribution patterns rather than rigid numerical intervals.

The data and risk components—exposure, sensitivity, and adaptation capacity—obtained for all 81 Turkish provinces were calculated at the national scale, with the sectoral risk calculation carried out as illustrated in Equation 3. Upon completion of the risk assessment, the results were normalized and reclassified to ensure consistency across all components.

The hazard component, the first element of the risk calculation, was defined as climate hazards. These hazards, selected on a sectoral basis, were analyzed for both the current period (1990-2019) and the future period (2021-2100). For future projections, RCP4.5 (optimistic scenario) and RCP8.5 (pessimistic scenario) were employed. The future periods were divided into four 20-year intervals: 2021-2040, 2041-2060, 2061-2080, and 2081-2100 to allow for detailed analysis over time.

A total of six climate hazards were identified for assessment: heatwaves, drought, heavy precipitation, forest fire, cold wave, and extreme wind. For the analysis, extreme climate indices were designated for each hazard and calculated for both the current and future periods. The future risk assessments incorporated these climate hazard projections alongside the sectoral indicators, which were based on current period conditions. In this way, the future risks of sectors were evaluated for both the optimistic RCP4.5 and pessimistic RCP8.5 scenarios. Further details and in-depth analyses of these assessments are provided in the National Vulnerability and Risk Assessment Report.

The climate hazards most affecting sectors were identified through national stakeholder meetings conducted as part of the study, and the selected hazards were incorporated into the risk assessments for each sector. Once the relevant climate hazard was designated for each sector, sectoral indicators were defined, and risk assessments were performed and mapped based on the available data. The primary climate hazards for Türkiye were identified as heavy precipitation, drought, and heatwaves. Sectoral vulnerability and risk assessments were conducted using one or multiple hazards, depending on the sector's specific context. Accordingly, heavy precipitation was analyzed for the Urban, transport and communication, water resources, and industry sectors. Drought was examined in relation to water resources, agriculture, ecosystems, energy, and industry sectors. Heatwaves were assessed for their impacts on transport and communication, urban, health, energy, and tourism sectors. The sector-specific chapters of the report present the detailed results and findings from these assessments.

CLIMATE CHANGE IMPACTS IN TÜRKİYE AND MULTI-HAZARD ANALYSIS RESULTS

Türkiye, located between warm and subtropical climatic zones, exhibits diverse climatic types due to its geography and the fact that it is surrounded by seas on three sides. While the coastal regions experience warmer climatic characteristics, Northern Anatolia and the inland areas display features of a continental climate due to the influence of the Taurus Mountains. Under the effect of these varied climatic zones, the average temperature in Türkiye was recorded at 13.9°C over the last 30 years (1991-2020) and slightly higher at 14.1°C during the last 11-year period (2012-2022).

When examining the average temperature values over the 1990-2019 period, the highest temperatures were observed in the Southeastern Anatolia, Aegean, and Mediterranean Regions. Average temperatures reach 18°C in locations such as Şanlıurfa in Southeastern Anatolia, Adana and Antalya in the Mediterranean, and Muğla and Aydın in the Aegean. In the Marmara and Central Anatolia Regions, average temperatures range between 12-13°C. Moving eastward, the values decline significantly, with averages approaching 0°C in the Eastern Anatolia Region.

According to measurements by TSMS, the total average precipitation in Türkiye over the last 30 years is approximately 573.4 mm (TSMS, 2022). Precipitation levels are highest in the northeast of the country and lowest in Central Anatolia. Total precipitation exceeds 1,800 mm in the Eastern Black Sea Region, particularly around the provinces of Artvin, Rize, and Trabzon. In the Western and Central Black Sea, the southern parts of the Aegean Region, and the highest sections of the Taurus Mountains, precipitation levels reach up to 1,000 mm. The Aegean Region recorded its highest precipitation, approximately 1,000 mm, over Muğla province. In contrast, the lowest total precipitation,

approximately 300 mm, was measured in Konya, Aksaray, and Karaman.

Looking at future temperature projections, both the RCP4.5 and RCP8.5 scenarios indicate a rise in average temperature toward the end of the century, although the degree of increase differs between the scenarios. Both scenarios project an increase of around 1.5°C for Türkiye during the 2021-2040 period. By the end of the century (2081-2100), the RCP4.5 scenario forecasts an average temperature increase of 3°C, while the RCP8.5 scenario projects a more significant rise, reaching 6°C. The highest temperature increases are expected in the Eastern and Southeastern Anatolia Regions. Both scenarios suggest that the most pronounced temperature changes will occur in the Eastern Anatolia Region, while the Thrace region of Marmara and Northern Aegean are projected to experience the least change.

When examining future changes in annual total precipitation, a general increase is projected in the northern regions and a decrease in the southern regions of Türkiye. The RCP8.5 scenario indicates a more pronounced change in precipitation patterns. Until the 2060s, both scenarios estimate variations in total precipitation between -20% and +20%. However, beyond the 2060s, projections suggest a decline of more than 20% in the southern regions and increases of up to 30% in the northern regions. Under the RCP4.5 scenario, the most significant decreases in annual precipitation are expected in the Mediterranean Region during the 2061-2080 period, while the Marmara Region is anticipated to experience the largest increase starting from the 2040s. The RCP8.5 scenario projects that the Eastern Black Sea Region will see the highest precipitation increase during 2081-2100, while the Teke Plateau in the Mediterranean Region is expected to experience a 50% decrease in precipitation. Additionally, the study evaluated the return periods of extreme weather events, which are currently observed in 2-, 10-, 20-, 50-, and 100-year cycles. Future projections assessed how the frequency of extreme events will change across Türkiye compared to the reference period (Figure 59).

According to the results, the frequency of **heatwaves** is expected to increase across Türkiye in future projections. Heatwaves that occurred once every two years during the reference period are projected to occur annually under both scenarios in the future. The most significant increase is anticipated during the 2090s under the RCP8.5 scenario, where heatwaves with a 10-year return period in the reference period are expected to occur every year by the end of the century. Similarly, heatwaves with a 100-year return period are estimated to occur two to three times by the 2050s and annually by 2100. These projections suggest that heatwaves will become an almost annual occurrence by the end of the century. In contrast to heatwaves, **cold wave** frequencies are projected to decline throughout the country in all future periods. Cold waves, which occurred once every two years in the reference period, are expected to occur once every 12 years under the RCP4.5 scenario and once every 20 to 21 years under the RCP8.5 scenario by the 2070s. Additionally, the occurrence of 100-year cold waves is expected to decrease significantly and nearly disappear entirely by the end of the century.

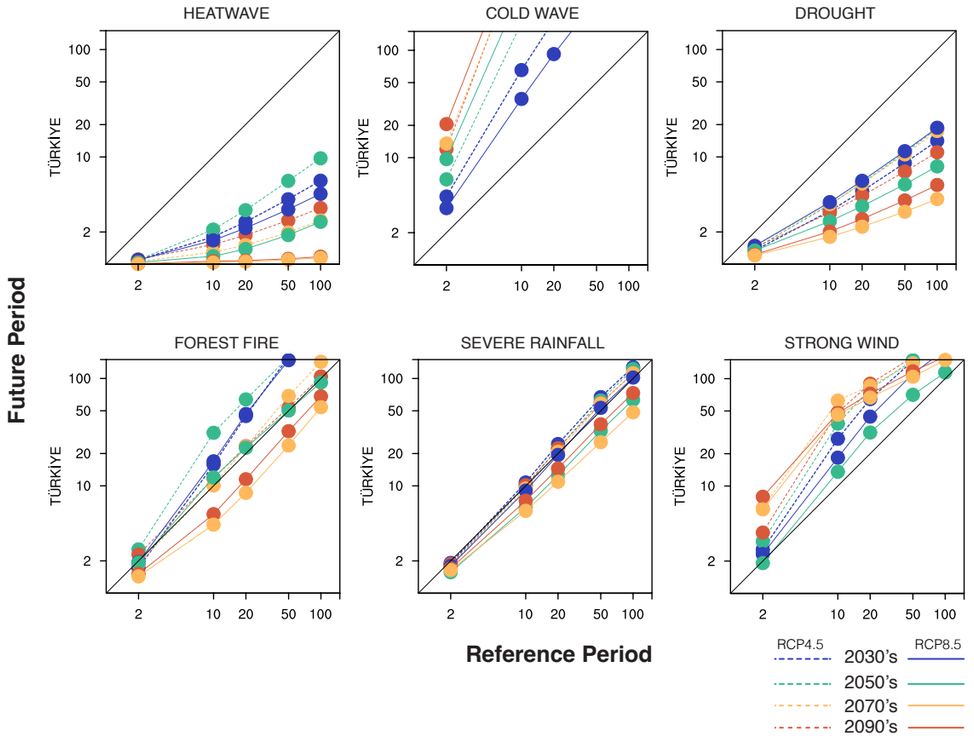


Figure 59. Changes in frequency of extreme climate hazards in Türkiye

The increase in frequency projected for heatwaves is even more pronounced for **droughts**, leading to alarming outcomes under both emission scenarios. Drought events with a 2-year return period in the reference scenario are expected to occur nearly every year in the future across both scenarios. Similarly, droughts with a 10-year return period in the reference scenario are projected to take place every 2 to 3 years, while those with a 50-year return period are expected to recur every 8 to 10 years. These findings indicate that drought conditions will become nearly permanent, posing significant challenges for water resources and agriculture under both scenarios.

According to the analysis of the Fire Weather Index (FWI), which captures forest fire-prone atmospheric conditions based on factors such as temperature, wind, and relative humidity, the future incidence of **forest fires** in Türkiye varies under both climate

scenarios. The RCP4.5 scenario projects an increase in fire frequency across all return periods. However, under the RCP8.5 scenario, the frequency of forest fires is expected to decrease until the 2050s but increase steadily from that point onward. Fires with a 10-year return period in the reference scenario are anticipated to occur once every 17 years until the 2050s and once every 4 years from the 2050s until the end of the century. Similarly, 20-year return period fires are projected to occur once every 9 years, while 100-year return period fires are expected to take place once every 54 years by the end of the century.

The incidence of the **heavy precipitation** hazard shows opposing trends across different periods under both scenarios. While heavy precipitation follows a decreasing trend under the RCP4.5 scenario, it is expected to increase under the RCP8.5 scenario. Under the pessimistic RCP8.5 scenario, heavy precipitation events with a 10-year return period in the reference scenario are projected to occur once every 6 years, those with a 20-year return period once every 11 years, and those with a 100-year return period once every 49 years nationwide by the end of the century. However, regional variability in precipitation distribution will lead to differences in the frequency of heavy precipitation across various regions of the country.

In contrast, both scenarios project a decrease in the frequency of **extreme wind** events compared to the reference period. Extreme wind events with a 10-year return period in the reference scenario are expected to occur once every 63 years under the RCP4.5 scenario and once every 46 years under the RCP8.5 scenario by the end of the century.

ANNEX-2:
INSTITUTIONS PARTICIPATING IN CCASAP PREPARATIONS

- Presidency of Strategy and Budget (PSB)
  - General Directorate of Sectors and Public Investments
- Ministry of Environment, Urbanization and Climate Change (MoEUCC)
  - General Directorate of Local Authorities
  - General Directorate of European Union and Foreign Relations
  - General Directorate of Geographic Information System
  - General Directorate of Environmental Impact Assessment, Permit and Inspection
  - Bank of Provinces Inc. (ILBANK)
  - Turkish State Meteorological Service (TSMS)
  - General Directorate of Spatial Planning
  - General Directorate of Infrastructure and Urban Regeneration
  - General Directorate of Vocational Services
  - Housing Development Administration (TOKI)
  - General Directorate of
  - General Directorate of Construction Works
  - Directorate of Climate Change
  - General Directorate of Environmental Management
  - General Directorate of Infrastructure and Urban Transformation Services
  - General Directorate for Protection of Natural Assets
  - General Directorate of National Property
  - Turkish Environment Agency (TEA)
- Ministry of Justice
  - Department of Human Rights
- Ministry of Family and Social Services (MoFSS)
  - General Directorate of Family and Community Services
  - General Directorate of Child Services
  - General Directorate of Status of Women
  - General Directorate of Services for Persons with Disabilities and the Elderly
  - General Directorate of Social Assistance
  - Department of Support Services
  - Strategy Development Department
- Ministry of Labour and Social Security (MoLSS)
  - Turkish Employment Agency
  - General Directorate of Occupational Health and Safety
  - General Directorate of Labour
  - Department of Internal Audit
  - General Directorate of International Labour Force
  - Strategy Development Department
- Ministry of Foreign Affairs (MoFA)
  - Directorate of European Union Affairs, General Directorate of EU Relations
  - General Directorate of Energy and Environment
  - Turkish National Agency
- Ministry of Energy and Natural Resources (MoENR)
  - Department of Energy Efficiency and Environment
  - Energy Market Regulatory Authority
  - Electricity Generation Corp.
  - Turkish Electricity Transmission Corp.
  - General Directorate of Mineral Research and Exploration
- Ministry of Youth and Sports (MoYS)
  - General Directorate of Youth Services
  - Strategy Development Department
- Ministry of Treasury and Finance (MoTF)
  - Turkish Statistical Institute (TURKSTAT)
  - Turkish Natural Catastrophe Insurance Pool
  - General Directorate of Foreign Economic Relations
  - General Directorate of Debt Office
  - Public Procurement Authority
  - Insurance and Private Pension Regulation and Supervision Agency
- Ministry of Interior (MoI)
  - Strategy Development Department
  - Department of European Union and Foreign Relations
  - Disaster and Emergency Management Presidency
  - General Directorate for Provincial Administrations
  - Gendarmerie General Command
  - Presidency of Migration Management
  - General Directorate of Relations with Civil Society
- Ministry of Culture and Tourism (MoCT)
  - General Directorate of Cultural Assets and Museums
  - General Directorate of Research and Education
  - General Directorate of Foundations
  - General Directorate of Investments and Enterprises
  - Radio and Television Supreme Council
  - Türkiye Tourism Promotion and Development Agency
  - Directorates of Regional Board for Conservation of Cultural Assets
  - Provincial Directorates
  - Area Directorates of Türkiye Tourism Promotion and Development Agency
- Ministry of National Education (MoNE)
  - General Directorate of Primary Education
  - General Directorate of Lifelong Learning
  - General Directorate of Secondary Education
  - General Directorate of Support Services
  - General Directorate of Innovation and Educational Technologies
- Ministry of National Defence (MoND)
  - General Directorate of Mapping
  - Naval Forces Command
  - Strategy Development Department
- Ministry of Health (MoH)
  - General Directorate of Public Health
  - General Directorate of Health Information Systems
  - General Directorate of Health Services
  - General Directorate of Public Hospitals
  - General Directorate of Emergency Health Services
  - General Directorate of Health Promotion
  - General Directorate of Health Investments
  - Strategy Development Department
- Ministry of Industry and Technology (MoIT)
  - General Directorate of Development Agencies
  - General Directorate of Industrial Zones
  - General Directorate of Industry
  - General Directorate of Incentives and Foreign Capital
  - Scientific and Technological Research Council of Türkiye (TUBITAK)
- Ministry of Agriculture and Forestry (MoAF)
  - General Directorate of State Hydraulic Works
  - General Directorate of Forestry
  - General Directorate of Agricultural Research and Policies
  - General Directorate for Nature Conservation and National Parks

    - General Directorate of Fisheries and Aquaculture
    - Turkish Water Institute
    - General Directorate of Agricultural Reform
    - General Directorate of Livestock
    - General Directorate of Plant Production
    - Strategy Development Department
    - General Directorate of Food and Control
    - General Directorate of Water Management
    - Agriculture and Rural Development Support Institution
    - General Directorate of Information Technologies
- Ministry of Trade
    - General Directorate of International Treaties and European Union
    - General Directorate of Domestic Trade
    - General Directorate of Customs
- Ministry of Transport and Infrastructure (MoTI)
    - General Directorate of Highways
    - General Directorate of State Airports Authority
    - General Directorate of Maritime Affairs
    - General Directorate of Infrastructure Investments
    - General Directorate of Communications
    - General Directorate of Civil Aviation
    - General Directorate of European Union and Foreign Relations
    - General Directorate of State Railways (TCDD)
    - General Directorate of Shipyards and Coastal Structures
    - Department of Management of Ports and Ferries
    - Turkish Maritime Enterprises Corp.
    - Strategy Development Department
    - General Directorate of Transport Services Regulation
- Information Technologies and Telecommunication Authority
- Organized Industrial Zones Senior Organization (OSBUK)
- Turkish Red Crescent
- Union of Municipalities of Türkiye
- Irrigation Unions
- Irrigation Cooperatives
- Development Agencies
- United Nations Development Programme
- International Fund for Agricultural Development
- Food and Agriculture Organization of the United Nations
- Regional Development Administrations
- Council of Higher Education
- Turkish Radio and Television Corporation (TRT)
- Agricultural Research Institutes
- Forestry Research Institutes
- Public Health Board
- Turkish Health Services Quality and Accreditation Institute
- Trans-Anatolian Natural Gas Pipeline Project
- Turkish Standards Institute
- UNESCO Turkish National Commission
- International Council on Monuments and Sites
- International Council of Museums
- Association of Turkish Travel Agencies (TURSAB)
- Small and Medium Enterprises Development Organization (KOSGEB)
- Insurance Information and Monitoring Center

- Insurance and Private Pension Regulation and Supervision Agency
- Turkish Industry and Business Association (TUSIAD)
- Independent Industrialists' and Businessmen's Association (MUSIAD)
- Chambers of Industry
- Turkish Union of Chambers of Engineers and Architects (TMMOB)
- Social Assistance and Solidarity Foundation
- Union of Bar Associations of Türkiye (UTBA)
- Social Service Federation
- Mobile Telephone Operators
- Media Organizations
- Insurance Association of Türkiye
- Special Risks Management Centre
- Public Oversight Authority
- Vocational Qualifications Authority
- Special Provincial Administration
- Municipalities
- Universities