Climate Change Adaptation and Implementation Actions Plan for the Aegean Region, Türkiye

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Abbreviation	Full Form
AFAD	Disaster and Emergency Management Authority *(Afet ve Acil Durum Yönetimi Başkanlığı)*
DSİ	State Hydraulic Works *(Devlet Su İşleri Genel Müdürlüğü)*
ICZM	Integrated Coastal Zone Management
MGM	Turkish State Meteorological Service *(Meteoroloji Genel Müdürlüğü)*
MoEUCC	Ministry of Environment, Urbanization and Climate Change *(Çevre, Şehircilik ve İklim Değişikliği Bakanlığı)*
MoH	Ministry of Health *(Sağlık Bakanlığı)*
MoAF	Ministry of Agriculture and Forestry *(Tarım ve Orman Bakanlığı)*
MoCT	Ministry of Culture and Tourism *(Kültür ve Turizm Bakanlığı)*
NGO	Non-Governmental Organization
R&D	Research and Development
SME	Small and Medium-sized Enterprise
TARSİM	Agricultural Insurance Pool of Türkiye *(Tarım Sigortaları Havuzu)*
TEİAŞ	Turkish Electricity Transmission Corporation *(Türkiye Elektrik İletim A.Ş.)*
TÜBİTAK	Scientific and Technological Research Council of Türkiye *(Türkiye Bilimsel ve Teknolojik Araştırma Kurumu)*
UHI	Urban Heat Island
WWF-Türkiye	World Wide Fund for Nature – Türkiye

1. Introduction: Climate Challenges in the Aegean Region

The Aegean Region of Türkiye is increasingly affected by climate change, experiencing **rising temperatures, frequent heatwaves, prolonged droughts**, and **intense rainfall events** that lead to flash floods. **Wildfire risk** has grown significantly, as seen in the devastating fires of 2021, while **coastal areas face erosion and flooding** from sea level rise and storm surges.

These interconnected hazards threaten the region's **environment, economy, and society**. Compound events—like heatwaves followed by wildfires or storms amplified by coastal flooding—intensify vulnerability across sectors. Projections indicate hotter, drier summers and more extreme weather in the coming decades, with serious implications for **agriculture, water supply, ecosystems, public health, tourism, and infrastructure**.

This Adaptation and Implementation Plan outlines both **short- and long-term strategies** to address these risks. It prioritizes **nature-based solutions**, **resilient infrastructure**, **data-driven decision-making**, **community awareness**, and **institutional coordination** to build regional climate resilience.

2. Priority Vulnerable Sectors

The plan first addresses the most climate-sensitive sectors:

- Urban Areas
- Agriculture
- Water Resources
- Coastal Zones

These are followed by:

- Biodiversity & Ecosystem Services
- Public Health
- Tourism
- Energy

Each section identifies climate risks, outlines specific adaptation actions, and recommends implementation methodologies and institutional responsibilities to support effective and coordinated adaptation across the Aegean Region.

3. Urban Settlements and Infrastructure

The Aegean Region's urban areas face increasing vulnerability to climate change due to rising temperatures, more frequent heatwaves, heavier precipitation events, and the accelerating threat of sea-level rise. These hazards jeopardize urban infrastructure, critical services, economic stability, and public health, particularly in densely populated coastal cities such as Izmir, Aydın, and Manisa. Integrated adaptation strategies are essential to safeguard urban livability and resilience. This section outlines priority adaptation and implementation actions to address the urban heat island (UHI) effect, urban flooding, and sea-level rise.

3.1. Adaptation and Mitigation Actions for Urban Heat Island (UHI)

Urban centers in the Aegean experience intensified heat due to dense construction, limited green spaces, and excessive paved surfaces, which amplify the Urban Heat Island (UHI) effect. Rising night-time temperatures, deteriorating air quality, and health risks for vulnerable groups make adaptation urgent.A combination of nature-based solutions, resilient urban design, and planning reforms can mitigate the UHI effect and help cities adapt to future climate conditions.

- **Expanding Urban Green Spaces:**
  Creating and maintaining urban parks, green belts, street trees, and green roofs reduces surface and air temperatures, improves air quality, and enhances water retention in cities.
- **Implementing Cool Roofs and Pavements:**
  Switching to light-colored, reflective roofing materials and pavements can reduce surface heat absorption, lowering surrounding air temperatures and cooling indoor environments.
- **Establishing Urban Forests and Shaded Streets:**
  Planting shade-providing, drought-tolerant trees along streets and in urban squares can significantly lower local temperatures and reduce heat stress for pedestrians.

- **Introducing Urban Water Features and Blue Infrastructure:**
  Integrating water elements such as ponds, fountains, rain gardens, and constructed wetlands can help absorb heat, regulate humidity, and reduce surface temperatures.
- **Smart Urban Planning:**
  Urban zoning must consider wind corridors, building orientation, density limits, and green infrastructure integration to prevent heat traps and allow natural cooling airflow.
- **Promoting Heat-Resilient Building Design:**
  Passive cooling elements, proper insulation, natural ventilation, and sun-shading systems should be standard in both new constructions and retrofits.
- **Heatwave Early Warning Systems:**
  Strengthening meteorological monitoring and establishing SMS and app-based alert systems can help residents prepare for extreme heat in advance.
- **Establishing Community Cooling Centers:**
  Municipalities can designate and retrofit public spaces as cooling shelters during heatwaves, targeting vulnerable populations such as the elderly and children.
- **Supporting Urban Agriculture and Rooftop Gardens:**
  Green roofs and community urban farms improve insulation, reduce surface temperatures, and create co-benefits like food security and biodiversity.
- **Integrating Climate Resilience into Urban Master Plans:**
  All future urban planning and development strategies should incorporate projected climate data to ensure long-term resilience, prioritizing both mitigation and adaptation measures.

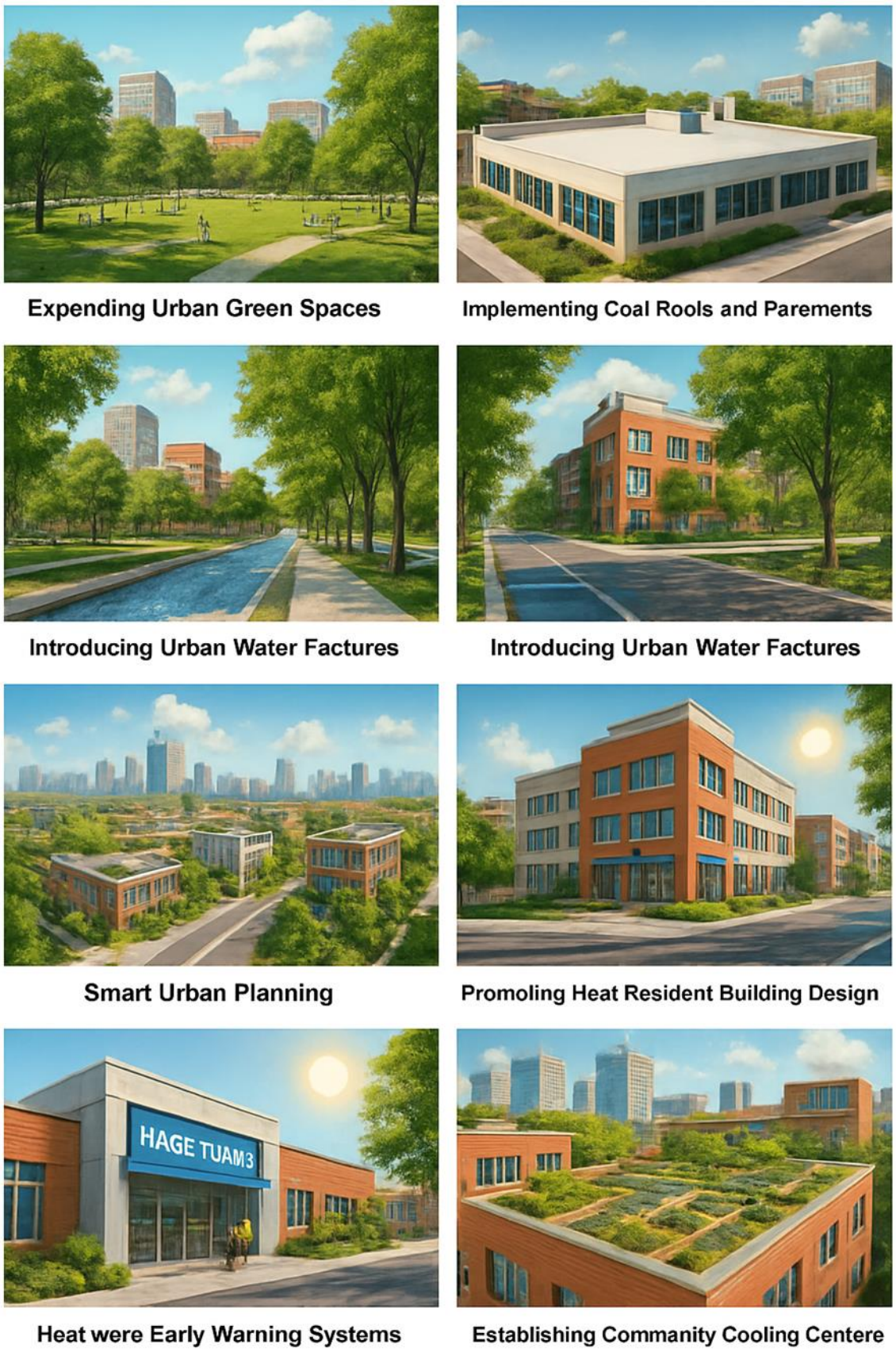

Figure 1. Visual Guide to Adaptation and Mitigation Actions for Urban Heat Island (UHI)

Table 1. Urban Heat Island Adaptation Actions and Implementation Measures

Adaptation Actions	Implementation Actions	Key Institutions Involved
Expanding Urban Green Spaces	Establish new parks, green corridors, green roofs, and enforce minimum green space quotas in zoning plans.	Municipalities, Ministry of Environment, NGOs
Cool Roofs and Cool Pavements	Require light-colored or reflective surfaces for roofs and pavements via building codes and incentive schemes.	Municipalities, Ministry of Urbanisation, Private Sector
Urban Forests and Tree-Lined Streets	Launch tree planting programs focusing on drought-tolerant, native species to create shaded microclimates.	Municipalities, Provincial Forestry Directorates, NGOs
Urban Water Features & Blue Infrastructure	Integrate fountains, rain gardens, stormwater ponds, and constructed wetlands into urban public spaces.	Municipalities, DSİ (State Hydraulic Works)
Smart Urban Planning	Revise zoning and master plans to incorporate ventilation corridors, green spaces, and shading design.	Municipalities, Ministry of Urbanisation, Universities
Heat-Resilient Building Design	Update construction standards to include passive cooling, shading, ventilation, and insulation systems.	Ministry of Urbanisation, Chamber of Architects
Heatwave Early Warning Systems	Expand meteorological data collection and develop public alert systems for extreme heat events.	Meteorological Service, Municipalities, Health Institutions
Community Cooling Centers	Retrofit public buildings as heat shelters and set up local communication plans for at-risk groups.	Municipalities, Ministry of Health, NGOs
Urban Agriculture and Rooftop Gardens	Encourage rooftop gardening, vertical gardens, and community farming to enhance local cooling.	Municipalities, Agricultural Chambers, NGOs
Climate-Integrated Urban Master Planning	Integrate climate projections and heat risk assessments into future city planning processes.	Ministry of Environment & Urbanisation, Municipalities, Universities

3.2. Urban Settlements and Infrastructure — Focus on Urban Flooding

The Aegean Region's cities are not only facing rising heat but also increased risks from extreme rainfall and flash floods, especially during the autumn and winter months. Urbanisation has expanded onto floodplains and paved over natural water-absorbing landscapes, which leads to rapid surface runoff and sewer overflows during heavy rainfall events.

In coastal cities such as İzmir, Kuşadası, and Çeşme, this risk is compounded by outdated drainage systems, shrinking green space, and climate-driven changes in precipitation patterns — increasing both the frequency and intensity of urban flooding.

3.3. Adaptation and Mitigation Actions for Urban Flooding

- **Green and Permeable Infrastructure:**
  Promote permeable surfaces (porous pavements, green roofs, rain gardens) to allow water infiltration, reducing surface runoff.
- **Upgrading Stormwater Drainage Systems:**
  Expand the capacity of urban drainage, modernize pumping stations, and build separate rainwater and sewage channels to prevent overflows.
- **Floodplain Zoning and Restriction Policies:**
  Ban construction in flood-prone areas and update urban zoning to leave room for natural water retention and flood buffers.
- **Early Warning Systems for Flood Events:**
  Develop real-time rainfall and flood alert systems, especially for urban neighborhoods with known drainage limitations.
- **Urban Wetlands Restoration:**
  Restore or create wetlands in peri-urban areas to act as natural sponges during storm events.
- **Water Retention Basins and Underground Tanks:**
  Construct retention ponds, underground tanks, and dry basins in urban parks to temporarily store excess stormwater.
- **River Channel Maintenance and Green Restoration:**
  Regularly clear obstructions, re-naturalize riverbanks, and reduce concrete channelization to slow water flow and prevent urban flash floods.
- **Community Emergency Preparedness Training:**
  Educate citizens on evacuation routes, flood safety practices, and neighborhood-based alert networks.
- **Integrating Climate Models into Urban Planning:**
  Use flood risk maps informed by climate change projections for future zoning and infrastructure development.
- **Municipal Climate-Resilient Investment Strategies:**
  Secure long-term financing to modernize urban water management and resilience infrastructure.
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- **Key Institutions**: Municipalities, General Directorate of State Hydraulic Works (DSI), AFAD, Ministry of Urbanisation, Provincial Environmental Authorities.

Figure 2. Coastal Resilience in Action: Visual Guide to Adaptation and Implementation Strategies

Table 2. Urban Flooding Adaptation Actions & Implementation Measures

Adaptation Actions	Implementation Actions	Key Institutions Involved
Green and Permeable Infrastructure	Mandate permeable pavements, green roofs, and rain gardens in urban design codes.	Municipalities, Ministry of Environment, Private Sector
Upgrading Drainage Systems	Expand drainage capacity, separate rainwater and sewage systems, and modernize pump stations.	Municipalities, Water and Sewerage Authorities
Floodplain Zoning & Restriction Policies	Update zoning laws to prevent construction on floodplains and preserve buffer zones.	Municipalities, Ministry of Urbanisation
Flood Early Warning Systems	Deploy real-time monitoring sensors and public alert systems for heavy rainfall and flood events.	Meteorology Service, Municipalities, AFAD
Urban Wetlands Restoration	Protect existing wetlands and recreate flood-buffering wetland areas near urban zones.	Ministry of Environment, DSİ, Municipalities
Water Retention Basins & Tanks	Integrate retention ponds and underground stormwater tanks into urban planning.	Municipalities, DSİ
River Channel Maintenance & Restoration	Clear blockages, green riverbanks, reduce artificial channelization.	Municipalities, Provincial Directorates of Environment
Community Emergency Preparedness	Train communities in flood response and evacuation drills.	Municipalities, AFAD, NGOs
Climate-Proof Urban Planning	Use climate projections to inform future infrastructure placement and sizing.	Municipalities, Ministry of Urbanisation, Universities
Climate-Resilient Investment Strategies	Allocate budget lines for flood mitigation in municipal investment programs.	Municipalities, Ministry of Treasury & Finance

3.4. Sea-Level Rise Preparedness

Coastal cities in the Aegean are increasingly exposed to sea-level rise and coastal erosion, threatening infrastructure, fresh water resources, and livelihoods.

3.4.1. Adaptation and Implementation Actions

- Update development regulations to enforce coastal buffer zones.
- Restore natural coastal defenses such as dunes and wetlands.

- Combine hard engineering solutions (sea walls) with nature-based protection.
- Elevate critical infrastructure above projected sea-level thresholds.
- Monitor groundwater salinity to prevent saltwater intrusion.
- Run public awareness campaigns for coastal communities.
- Establish Integrated Coastal Zone Management (ICZM) plans.
- Retrofit coastal facilities to withstand storm surges.
- Develop socially equitable relocation plans for highly exposed areas.
- Strengthen international collaboration and knowledge exchange on coastal adaptation.

Key Institutions: Ministry of Environment and Urbanisation, DSI, Municipalities, Ministry of Transport, Coastal Councils, NGOs, Universities.

Figure 3 Coastal Climate Resilience: Illustrated Strategies for Adaptation and Implementation

Table 3. Sea-Level Rise Adaptation Actions & Implementation Measures

Adaptation Actions	Implementation Actions	Key Institutions Involved
Coastal Zone Setback Policies	Update urban development laws to limit coastal construction.	Municipalities, Ministry of Urbanisation, Coastal Councils
Nature-Based Coastal Protection	Restore sand dunes, salt marshes, and coastal vegetation.	Ministry of Environment, NGOs, Municipalities
Hybrid Coastal Defenses	Combine sea walls with wetland and reef restoration.	DSİ, Ministry of Transport, Coastal Authorities
Elevating Critical Infrastructure	Build infrastructure above sea-level rise projections.	Municipalities, Infrastructure Ministries
Saline Intrusion Monitoring	Monitor aquifer salinity and manage groundwater extraction rates.	Provincial Water Authorities, DSİ
Coastal Community Risk Awareness	Launch public awareness campaigns on coastal risk and response.	Municipalities, NGOs
Integrated Coastal Zone Management (ICZM)	Develop regional coastal adaptation plans involving multiple sectors.	Ministry of Environment, Coastal Authorities, Universities
Retrofitting Coastal Facilities	Flood-proof ports, sewage outlets, and coastal buildings.	Municipalities, Ministry of Transport, Private Sector
Relocation Planning for Risk Zones	Develop social support plans for managed retreat where needed.	Ministry of Urbanisation, Municipalities, AFAD
International Best Practices Sharing	Join Mediterranean climate adaptation platforms and working groups.	Ministry of Environment, EU Delegation to Türkiye

4. Agriculture and Food Security

Agriculture in the Aegean Region faces growing risks from climate change, including rising temperatures, irregular rainfall, and worsening water scarcity. Key crops such as olives, grapes, cotton, and cereals are increasingly impacted by drought, heat stress, and shifting seasonal patterns. Water shortages in basins like Gediz and Büyük Menderes are reducing irrigation, while warmer winters disrupt fruit production cycles. Without timely adaptation, these challenges threaten both farmer livelihoods and regional food security.

4.1. Combined Adaptation and Implementation Actions for Agriculture and Food Systems

- **Efficient Irrigation and Water-Saving Farming**
  – Expand use of drip and sprinkler irrigation systems.
  – Train farmers in optimal irrigation scheduling.
  – Encourage rainwater harvesting and on-farm water storage (ponds).
- **Drought-Resistant Crops and Crop Diversification**
  – Distribute and subsidize high-yielding, drought-tolerant seed varieties.
  – Promote crop shifts from water-intensive plants to drought-hardy options such as barley, chickpeas, and lentils.
- **Agro-Meteorological Early Warning Systems**
  – Establish localized weather forecasting and drought alert systems.
  – Deploy SMS/app-based advisories for extreme weather (heatwaves, frost, heavy rain).
- **Climate-Smart Farming Extension Services**
  – Scale up training in conservation agriculture, mulching, integrated pest management, and agroforestry techniques.
  – Develop model demonstration farms to spread best practices.
- **Crop Insurance and Financial Safety Nets**
  – Expand participation in TARSİM (Türkiye's national agricultural insurance scheme).
  – Provide rapid post-disaster financial relief and access to subsidized recovery loans.
- **Integrated Water Resource Management**
  – Develop basin-level water allocation plans and invest in new reservoirs.
  – Promote the use of recycled wastewater and prioritize drought-year water sharing strategies.
- **Climate-Resilient Crop Research and Development**
  – Establish breeding programs for heat-, drought-, and salt-tolerant crop varieties.
  – Support long-term agricultural innovation through universities and international collaborations.
- **Agroforestry and Ecosystem-Based Farming**
  – Promote integration of trees into farming systems (windbreaks, intercropping, shelterbelts).
  – Support biodiversity-friendly practices that enhance soil fertility, shade, and water retention.
- **Soil and Land Conservation Measures**
  – Expand terracing, soil erosion prevention structures, and soil restoration projects.
  – Grow incentive-based conservation programs like CATAK for sustainable land stewardship.
- **Strengthening Farmer Institutions and Networks**
  – Build the capacity of cooperatives and water user associations for adaptive planning.
  – Promote participatory approaches and farmer-led climate adaptation learning networks.

4.2. Key Institutions Involved in Implementation

- **Ministry of Agriculture and Forestry (Tarım ve Orman Bakanlığı)**
  – National leadership on agricultural policy, irrigation, water resource management,

and R&D for climate-smart agriculture.
– Oversight of drought-resistant seed distribution, insurance programs (TARSİM), agroforestry, and land conservation.

- **General Directorate of State Hydraulic Works (DSİ)**
  – Planning and execution of basin-level water allocation strategies, reservoir construction, and irrigation infrastructure upgrades.
- **Provincial Directorates of Agriculture and Forestry**
  – Local coordination of farmer training, subsidy distribution, agro-meteorological services, and drought monitoring.
- **TARSİM (Agricultural Insurance Pool)**
  – Expansion and management of agricultural insurance schemes against climate-induced losses.
- **Turkish State Meteorological Service (MGM)**
  – Development and dissemination of localized agro-meteorological early warnings, weather forecasts, and seasonal climate outlooks.
- **Universities and Agricultural Research Institutes**
  – Conduct crop breeding programs for drought- and heat-resilient varieties, soil conservation research, and climate impact modeling.
- **Ministry of Environment, Urbanization and Climate Change**
  – Integration of adaptation measures into national climate policies, soil protection regulations, and ecosystem services planning.
- **Farmer Cooperatives and Unions (e.g., TARIM-KOOP, Ziraat Odaları)**
  – Facilitate farmer engagement, training, information exchange, and collective action for climate adaptation practices.
- **Water User Associations (Sulama Birlikleri)**
  – Coordinate local irrigation management and implementation of water-saving technologies and schedules.
- **Non-Governmental Organizations (NGOs) and International Organizations**
  – Support awareness campaigns, technical assistance, and ecosystem-based adaptation projects (e.g., WWF-Türkiye, FAO, UNDP).

Figure 4. Climate-Resilient Agriculture: Key Adaptation and Implementation Strategies for Food System Sustainability

Table 4. Adaptation Actions and Implementation Measures for Agriculture and Food Systems — Aegean Region

Adaptation Actions	Implementation Actions	Key Institutions Involved
Efficient Irrigation and Water-Saving Farming	Expand drip and sprinkler systems; train farmers on irrigation timing; promote rainwater harvesting.	Ministry of Agriculture and Forestry, DSİ, Agricultural Chambers
Drought-Resistant Crops and Crop Diversification	Distribute drought-tolerant seeds; promote low-water crops like chickpeas and barley.	Ministry of Agriculture and Forestry, Seed Growers' Association
Agro-Meteorological Early Warning Systems	Establish local weather alerts; deploy SMS and app-based advisory systems for extreme events.	Turkish State Meteorological Service, AFAD, Agricultural Chambers
Climate-Smart Farming Extension Services	Expand farmer training on conservation agriculture, IPM, mulching, agroforestry; create demonstration farms.	Ministry of Agriculture and Forestry, Universities, Local NGOs
Crop Insurance and Financial Safety Nets	Increase TARSİM participation; offer post-disaster loans and subsidies.	Ministry of Agriculture and Forestry, Treasury and Finance, Banks
Integrated Water Resource Management	Develop basin-level water strategies; invest in reservoirs, recycled water and prioritization frameworks.	DSİ, Basin Management Authorities, Municipalities
Climate-Resilient Crop R&D	Establish breeding programs for climate-tolerant varieties; promote research partnerships.	Universities, TÜBİTAK, Agricultural Research Institutes
Agroforestry and Ecosystem-Based Farming	Promote tree integration (windbreaks, intercropping); support biodiversity-friendly farming techniques.	Ministry of Agriculture and Forestry, Local NGOs, Farmer Cooperatives
Soil and Land Conservation	Expand terracing, reforestation, anti-erosion works, and financial incentives under the ÇATAK program.	Ministry of Agriculture and Forestry, Ministry of Environment, Municipalities
Strengthening Farmer Institutions	Build cooperative capacities; promote farmer-led planning and climate adaptation networks.	Agricultural Chambers, Farmer Cooperatives, Development Agencies

5. Water Resources

Introduction

The Aegean Region’s water security is under growing threat due to climate change. The region’s hydrological system is heavily dependent on winter rainfall, but projections indicate a

significant reduction in both rainfall and river flows — especially in critical basins like Gediz and Büyük Menderes. Rising temperatures will also accelerate evaporation, further limiting available surface and groundwater. Water scarcity will affect drinking water supply, agriculture, energy production, ecosystems, and industry. At the same time, extreme rainfall events will strain existing water infrastructure, increasing flood and pollution risks.

This adaptation plan focuses on reducing vulnerability to long-term drought, building more resilient water supply systems, and ensuring sustainable water allocation in the face of an increasingly unpredictable climate.

5.1. Adaptation and Implementation Actions

- **Urban and Agricultural Water Efficiency**
  Launch large-scale programs to reduce water loss in municipal networks, modernize irrigation systems (e.g., shift to drip irrigation), and encourage water-saving appliances in homes and businesses.
- **Wastewater Reuse and Alternative Sources**
  Expand the treatment and reuse of wastewater, especially for irrigation, industrial cooling, and park maintenance; explore desalination for coastal urban areas and mobile systems for drought emergencies.
- **Groundwater Recharge and Rainwater Harvesting**
  Build recharge basins and check dams to retain stormwater and enhance aquifer recharge; mandate rainwater collection systems in new developments and farms.
- **Reservoir and Storage Optimization**
  Upgrade existing reservoirs to improve storage and distribution efficiency, and construct small-scale storage structures (e.g., farm ponds, village cisterns) to buffer against dry seasons.
- **Nature-Based Water Retention Measures**
  Restore degraded wetlands and upper watershed forests to improve water retention, reduce surface runoff, and maintain river flows during drought.
- **Early Warning Systems for Drought and Floods**
  Expand monitoring networks and create an integrated early warning system that uses real-time data and seasonal forecasts to alert communities and farmers in advance.
- **Integrated River Basin Management (IRBM)**
  Strengthen multi-stakeholder basin committees to develop annual drought plans, manage reservoirs cooperatively, and prioritize critical water uses during shortages.
- **Policy and Regulatory Reform**
  Update water allocation laws to reflect climate-induced scarcity, introduce water quotas for drought years, and implement progressive tariffs that promote conservation across sectors.
- **Infrastructure Climate Proofing**
  Retrofit dams, pipelines, and urban drainage to withstand extreme events such as flash floods and prolonged droughts; embed climate modeling in design and maintenance processes.
- **Public Awareness and Stakeholder Participation**
  Launch educational campaigns, promote water-saving behaviors, and ensure farmers, industries, and local governments are fully engaged in regional water governance.

5.2. Key Institutions for Cooperation

- State Hydraulic Works (DSİ)
- Ministry of Agriculture and Forestry
- Ministry of Environment, Urbanization, and Climate Change
- Provincial Governorates and Metropolitan Municipalities
- State Meteorological Service (MGM)
- Disaster and Emergency Management Authority (AFAD)
- Universities and Research Institutions
- NGOs (e.g., TEMA, Doğa Derneği, WWF- Türkiye)
- River Basin Management Committees
- Private sector stakeholders (agriculture, industry)

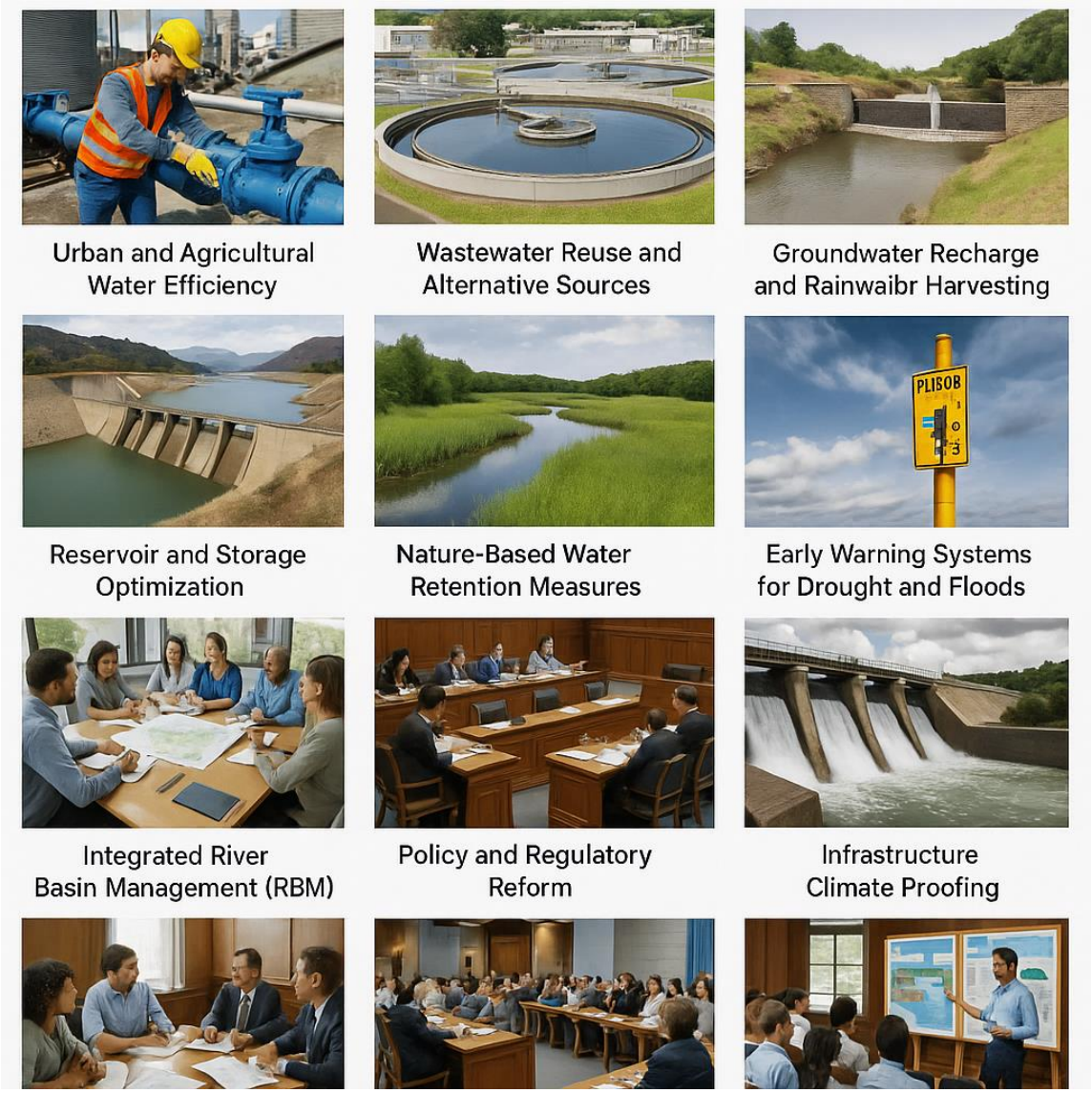

Figure 5. Water Security Under Climate Change: Adaptation and Implementation Strategies for Resilient Management

Table 5. Water Resources Adaptation Actions Implementation Measures

Adaptation Action	Implementation Focus	Cooperating Institutions
Urban & Agri Water Efficiency	Leak control, efficient irrigation, water-saving tools	DSİ, Municipalities, Ministry of Agriculture
Wastewater Reuse & Alternative Sources	Treated reuse, desalination, emergency supply systems	Municipalities, DSİ, Environment Ministry
Groundwater Recharge & Rain Harvesting	Check dams, recharge basins, rainwater systems	DSİ, Municipalities, Ministry of Agriculture
Reservoir & Storage Optimization	Increase storage, build small-scale retention systems	DSİ, Local Gov, Regional Dev. Agencies
Nature-Based Water Retention	Wetland restoration, reforestation, soil protection	Forestry Directorate, NGOs, DSİ
Drought & Flood Early Warning	Monitoring, forecasts, community alert systems	MGM, AFAD, DSİ, Municipalities
Integrated Basin Governance	Strengthen committees, drought plans, fair allocation	DSİ, Basin Committees, Municipalities
Policy & Regulation Reform	Water rights, drought quotas, adaptive tariffs	Ministries, Basin Committees, Parliament
Climate-Proofing Infrastructure	Retrofits, design for extremes, climate scenario tests	DSİ, Municipalities, Infrastructure Ministry
Awareness & Stakeholder Participation	Education campaigns, collaborative planning	Municipalities, NGOs, Basin Committees

6. Coastal Zones and Marine Areas

Introduction:
The Aegean coastline — home to thriving tourism, historic settlements, rich biodiversity, and vital marine industries — faces growing risks from climate change. Rising sea levels, stronger coastal storms, saltwater intrusion, habitat loss, and ecosystem shifts are already reshaping the natural and economic landscape of the region. Without timely action, these pressures will erode coastal resilience, threaten infrastructure, disrupt tourism and fisheries, and reduce the safety and quality of life in coastal communities.

This adaptation plan proposes an integrated set of **engineering, ecological, regulatory, and community-based actions** designed to secure the Aegean's coastal zones against the long-term impacts of climate change while promoting sustainable development.

6.1. Adaptation and Implementation Actions

- **Integrated Coastal Zone Management and Setback Zones**
  Establish legally enforced coastal management plans across Aegean provinces, including dynamic "setback" buffer zones to prevent new construction in erosion and flood-prone areas.

- **Nature-Based Erosion Control & Habitat Restoration**
  Deploy beach nourishment, dune stabilization, wetland conservation, and living shoreline techniques to protect and restore coastal ecosystems while reducing wave and flood impact.
- **Coastal Flood Early Warning Systems**
  Develop and implement advanced real-time monitoring and alert systems for storm surges, high waves, and flooding, paired with community evacuation protocols.
- **Marine Ecosystem Resilience Programs**
  Establish and expand Marine Protected Areas (MPAs), implement fisheries management measures, and restore seagrass beds and other natural habitats to buffer against warming and acidification.
- **Hard Coastal Defenses at Critical Locations**
  Design and build engineered structures (seawalls, storm surge barriers, breakwaters) selectively for irreplaceable urban areas, ports, and heritage sites exposed to rising seas and extreme weather.
- **Managed Retreat and Strategic Land Use Adjustment**
  Identify unsustainable coastal settlements and plan proactive relocation, transforming vacated areas into ecological buffer zones or open space over time.
- **Infrastructure Climate-Proofing**
  Redesign and retrofit transport, utility, port, and tourism-related infrastructure in coastal areas to withstand sea-level rise and intensified storm events.
- **Adaptive Fisheries & Marine Livelihoods Support**
  Support fishing communities in adjusting to shifting fish distributions and invasive species, while encouraging sustainable alternatives and early-warning for harmful marine phenomena.
- **Sustainable Coastal Tourism Transition**
  Diversify the tourism economy by promoting inland and climate-resilient alternatives (ecotourism, heritage tourism) and guiding future developments away from high-risk shorelines.
- **Multi-Stakeholder Coastal Resilience Coordination**
  Establish a permanent regional coordination mechanism to align municipalities, ministries, NGOs, and researchers around integrated coastal adaptation, ecosystem management, and monitoring.

6.2. Key Institutions to Be Involved

- **Ministry of Environment, Urbanization and Climate Change**
  (Spatial planning, coastal policy, managed retreat regulation, ecosystem conservation)
- **Ministry of Transport and Infrastructure**
  (Coastal structures, port resilience, engineering solutions)
- **Ministry of Agriculture and Forestry**
  (Fisheries management, ecosystem resilience, aquaculture, invasive species control)
- **AFAD — Disaster and Emergency Management Authority**
  (Emergency planning, evacuation systems, coastal flood response)
- **Turkish State Meteorological Service**
  (Storm surge and extreme weather monitoring, forecasting)
- **Local Municipalities & Metropolitan Municipalities**
  (Urban planning, enforcement of setback zones, coastal restoration, public awareness)

- **Development Agencies (İZKA, GEKA)**
  (Financial support for sustainable coastal projects and tourism diversification)
- **NGOs and Environmental Foundations**
  (WWF- Türkiye, Doğa Koruma Merkezi, TEMA) — (Nature-based solutions, restoration projects)
- **Universities & Research Institutions**
  (Monitoring, climate projections, coastal ecosystem studies)
- **Fisheries Cooperatives & Local Communities**
  (Local adaptation actions, marine stewardship, sustainable livelihoods)

Figure 6. Building Coastal Resilience: Integrated Adaptation and Protection Strategies for Shoreline Sustainability

Table 6. Aegean Region Coastal Adaptation Actions and Implementation Measures

Adaptation Actions	Implementation Actions	Key Institutions
Coastal Zone Management and Setback Regulations	-Develop dynamic coastal planning frameworks that map flood- and erosion-prone areas, -set clear no-construction buffer zones, and embed risk scenarios in local land use plans.	Ministry of Environment, Urbanization and Climate Change; Provincial Governorates; Municipalities; General Directorate of Spatial Planning
Beach Stabilization and Soft Shoreline Reinforcement	Execute beach nourishment projects by adding compatible sediment to eroded beaches and strengthen dunes with native vegetation to enhance natural shoreline resilience.	Municipalities; Ministry of Transport and Infrastructure; Environmental NGOs; University Marine Science Departments
Ecosystem-Based Coastal Defense	Restore wetlands, underwater meadows, and natural habitats that reduce wave force, enhance sediment capture, and serve as biodiversity strongholds for climate adaptation.	Ministry of Environment; WWF-Türkiye; Doğa Koruma Merkezi; Universities; Fisheries Cooperatives
Coastal Flood Early Warning and Evacuation Preparedness	Install real-time coastal monitoring networks, establish multi-channel alert systems for extreme wave and storm events, and hold regular public evacuation drills in coastal settlements.	AFAD; Turkish State Meteorological Service; Naval Forces; Municipalities; Coast Guard Units
Adaptive Fisheries and Marine Resource Management	Revise fishing rules and quotas based on climate-driven species migration, train fishers in invasive species control, and launch marine health bulletins for aquaculture and tourism.	Ministry of Agriculture and Forestry; Fishery Cooperatives; Marine Research Institutes
Coastal Defense Structures in High-Value Areas	Design future-proof hard barriers — such as seawalls, dikes, and breakwaters — to protect vital urban waterfronts, ports, and heritage sites against sea-level rise and storm surge.	Ministry of Transport and Infrastructure; Ministry of Environment; Metropolitan Municipalities; Engineering Firms
Strategic Managed Retreat and Risk-Zone Conversion	Identify communities and assets located in unsustainable coastal zones and prepare incentive-based relocation schemes while converting vacated areas into ecological buffer parks.	Ministry of Environment and Urbanization; Local Authorities; Disaster Funds; Social Services; Urban Planning Units
Resilient Infrastructure Development in Coastal Areas	Retrofit and redesign roads, railways, utilities, and public facilities in coastal regions to resist flooding, salinity, and extreme weather events, using climate risk-based design standards.	General Directorate of Highways; TCDD; Local Utility Providers; Municipalities

Adaptation Actions	Implementation Actions	Key Institutions
Climate-Resilient Coastal Economy and Tourism Model	Shift tourism investments from high-exposure coastal areas to safer inland locations and promote year-round sustainable tourism formats such as cultural, ecological, and rural experiences.	Ministry of Culture and Tourism; Local Tourism Boards; Development Agencies; Municipal Planning Units
Long-Term Marine Ecosystem Strengthening	Expand marine protected zones, restrict overfishing, implement restoration programs for keystone species, and enhance water quality monitoring to build ecosystem adaptability.	Ministry of Agriculture and Forestry; Ministry of Environment; Universities; Barcelona Convention Collaboration Bodies

7. Biodiversity and Ecosystem Services

7.1. Climate Adaptation Plan

Introduction

The Aegean Region stands out as one of Türkiye's most biologically diverse landscapes, hosting a variety of ecosystems including pine forests, shrublands, grasslands, wetlands, and rich marine habitats. This natural heritage not only defines the region's identity but also supports vital ecosystem services that directly sustain human well-being, from freshwater supply and soil protection to pollination and fisheries productivity.

Yet climate change has emerged as a serious disruptor of this balance. Rising temperatures, erratic rainfall, extended droughts, and intensified wildfires are already reshaping ecosystems, pushing many species beyond their adaptive limits. The compounded pressure of habitat fragmentation, invasive species, and overexploitation further accelerates biodiversity loss.

A future-proof strategy for the Aegean Region requires an integrated and adaptive approach — one that not only safeguards species and habitats but also reinforces the natural systems' role in supporting human climate resilience. Below is a targeted set of 10 adaptation actions designed to secure this outcome.

7.2. Adaptation Actions for Biodiversity and Ecosystem Services

- **Expansion and Dynamic Management of Protected Areas**
  Strengthen and expand protected area networks, especially in locations expected to serve as climate refugia. Protected area management plans should integrate updated climate vulnerability assessments, fire prevention strategies, and invasive species monitoring protocols.
- **Proactive Wildfire Risk Reduction**
  Implement integrated fire risk management including preventive fuel load reduction,

establishing buffer zones, improving early detection systems, and reinforcing the capacity of both professional and community-based firefighting units.

- **Restoration of Degraded Ecosystems**
  Rehabilitate degraded forests, rangelands, and wetlands to strengthen ecological resilience and ecosystem service delivery. Restoration efforts should prioritize native species suited to future climate conditions and be closely aligned with local hydrological and soil patterns.
- **Facilitating Species Migration and Conservation Breeding**
  Support species under severe climate stress through targeted translocation, seed banking, and conservation breeding. This includes relocating vulnerable fauna and flora to more stable microhabitats or controlled environments for future reintroduction.
- **Strengthening Control of Invasive Species and Pests**
  Develop a coordinated monitoring and rapid response framework to manage climate-driven invasive species expansion and pest outbreaks, minimizing ecological damage through environmentally responsible interventions.
- **Ecological Connectivity Planning**
  Establish ecological corridors to enable species migration across fragmented landscapes in response to shifting climate zones. Connectivity planning should be embedded in land-use policy and regional development strategies.
- **Climate-Smart Forest Management**
  Revise forestry practices to promote structural diversity, resilience, and species mix suitable for emerging climate scenarios. Assisted migration of tree species and ongoing updates to forest management models should be institutionalized.
- **Protection of Freshwater Ecosystems**
  Implement environmental flow regulations, improve aquatic habitat restoration, and modernize dam operation models to sustain biodiversity and ecosystem functions in the face of changing hydrological regimes.
- **Strengthening Long-Term Monitoring and Research**
  Establish an integrated biodiversity monitoring network to continuously assess ecosystem health, detect climate-driven changes, and feed evidence-based data into adaptive conservation strategies.

7.3. Key Institutions Responsible for Implementation

- **Ministry of Agriculture and Forestry**
  (General Directorate of Nature Conservation and National Parks, General Directorate of Forestry, Fisheries and Wildlife Units)
- **Ministry of Environment, Urbanization and Climate Change**
  (Environmental Impact and Adaptation Units)
- **State Hydraulic Works (DSİ)**
- **Universities**
  (Ege, Dokuz Eylül, Muğla Sıtkı Koçman — Ecology, Biology, Forest Engineering departments)
- **NGOs**
  (WWF-Türkiye, Doğa Derneği, Nature Conservation Centre)
- **Local Governments**
  (Municipalities and Provincial Directorates of Environment and Forestry)
- **Community-based Organizations and Volunteer Networks**
- **International Organizations**
  (IUCN, MedECC, GEF Small Grants Programme)

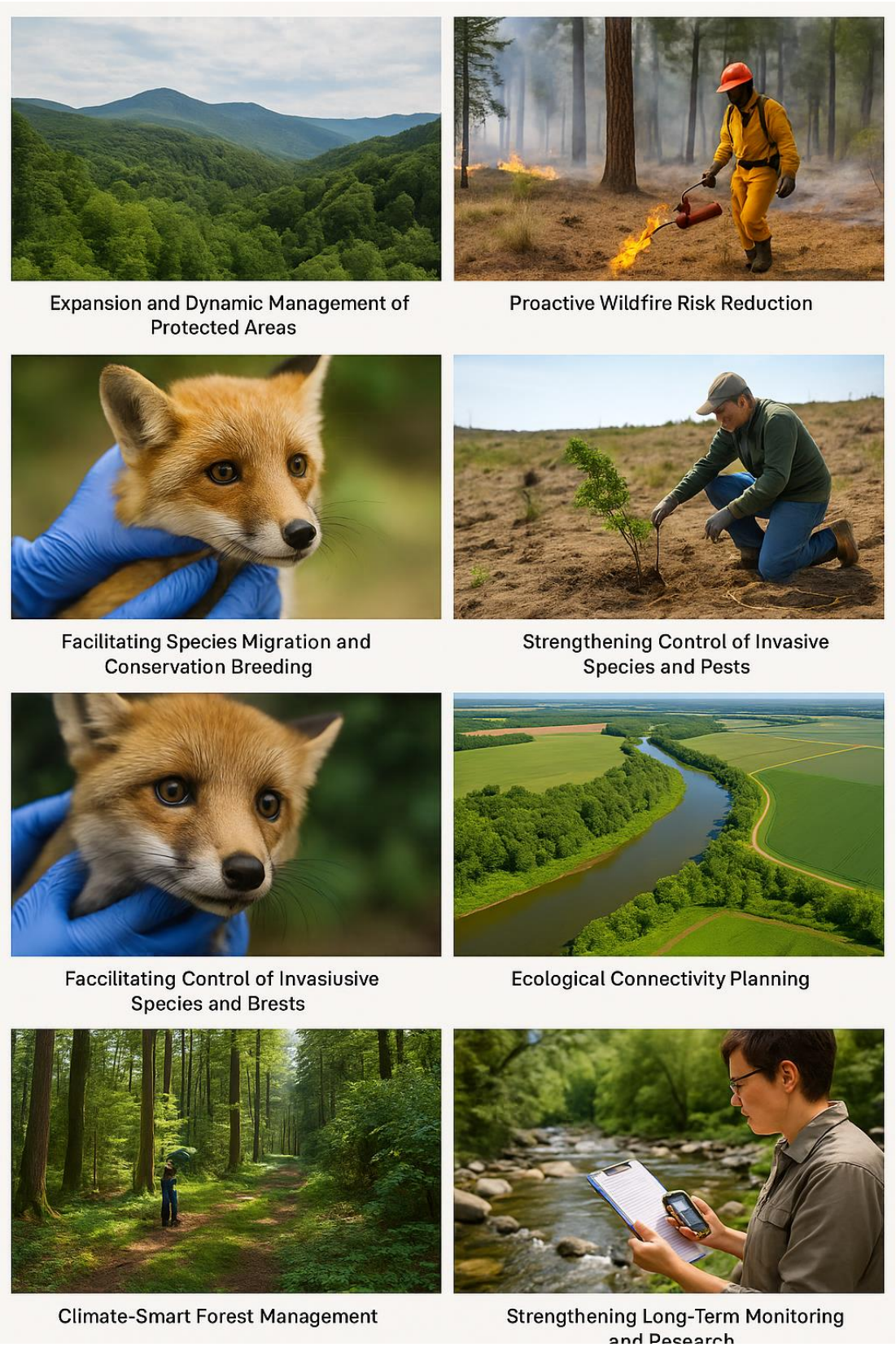

Figure 7. Biodiversity in a Changing Climate: Adaptive Strategies for Ecosystem Resilience and Conservation

Table 7. Biodiversity and Ecosystem Services Climate Adaptation Actions and Implementation Measures

Adaptation Action	Implementation Actions	Key Institutions Involved
Expansion and Dynamic Management of Protected Areas	Identify and designate new protected areas with climate refugia potential; integrate adaptive management plans addressing fire, drought, and invasive species into existing reserves.	Ministry of Agriculture and Forestry, Local Governments, NGOs
Proactive Wildfire Risk Reduction	Develop firebreak networks, conduct controlled burns, modernize detection systems, and organize community-based firefighting teams.	General Directorate of Forestry, AFAD, Local Municipalities
Restoration of Degraded Ecosystems	Execute large-scale native species reforestation, wetland restoration, and erosion control measures aligned with hydrological dynamics.	Ministry of Agriculture and Forestry, Universities, NGOs
Facilitating Species Migration and Conservation Breeding	Launch seed banking, wildlife relocation programs, and captive breeding for climate-vulnerable species; support post-event reintroduction.	Ministry of Agriculture and Forestry, Universities, Botanical Gardens
Strengthening Control of Invasive Species and Pests	Monitor invasive species range expansion, apply biological control where feasible, and coordinate rapid removal campaigns involving local communities.	Ministry of Agriculture and Forestry, Universities, Local NGOs
Ecological Connectivity Planning	Map habitat corridors, integrate connectivity zones into land-use plans, and incentivize private land conservation.	Ministry of Environment, Land-Use Planners, NGOs
Climate-Smart Forest Management	Adjust reforestation programs to include drought-tolerant species, promote mixed-age stands, and initiate assisted migration trials.	General Directorate of Forestry, Universities, TÜBİTAK
Protection of Freshwater Ecosystems	Implement environmental flow standards, redesign dam management to support biodiversity, and restore riparian vegetation buffers.	DSİ, Ministry of Agriculture and Forestry, Local Water Committees
Strengthening Long-Term Monitoring and Research	Establish monitoring plots, climate-ecology research stations, and predictive modeling for future biodiversity shifts.	Universities, TÜBİTAK, Ministry of Environment, International Research Networks
Community Engagement and Nature-Based Solutions Promotion	Develop eco-tourism, conservation education, and local stewardship programs to foster long-term public support for biodiversity adaptation actions.	NGOs, Local Governments, Ministry of Environment, Ministry of Education

8. Public Health and Social Welfare

8.1. Climate Adaptation Plan

Introduction

The Aegean Region is increasingly exposed to climate-induced health risks due to rising temperatures, extreme weather events, shifting disease patterns, and social vulnerabilities. The region's dense urban centers, rural agricultural communities, and coastal settlements each face unique public health challenges linked to climate change. Beyond direct effects such as heat-related illnesses and vector-borne diseases, climate change exacerbates mental health stress, strains healthcare systems, and deepens social inequalities. To safeguard public health and social welfare, proactive adaptation measures are essential. This plan outlines targeted actions designed to reduce vulnerability, strengthen resilience, and ensure that health systems are equipped to manage the evolving risks of a changing climate.

8.2. Adaptation Actions

- **Heatwave Preparedness and Early Warning Systems**
  Establish a region-wide heat health early warning system. Integrate forecast data with public alerts and structured community responses including opening cooling centers, prioritizing care for vulnerable groups, and training emergency services for heat-related health surges.
- **Strengthened Vector-Borne Disease Surveillance and Control**
  Expand monitoring for climate-sensitive diseases such as West Nile virus, leishmaniasis, and malaria. Deploy targeted vector control programs and launch public education campaigns on personal protection and habitat management.
- **Safe Water and Sanitation Assurance During Climate Extremes**
  Enhance flood and drought contingency planning for water systems. Stockpile water treatment resources, strengthen water quality surveillance, and ensure infrastructure resilience to prevent contamination during extreme events.
- **Healthcare System Climate Preparedness**
  Equip hospitals and health facilities to maintain service continuity during heatwaves, wildfires, and floods. Update emergency protocols, secure backup energy and water systems, and train medical personnel in climate-related health risks.
- **Community Outreach and Health Risk Education**
  Implement sustained education campaigns on climate-related health risks. Engage schools, media, NGOs, and local leaders to deliver messages on heat safety, disease prevention, and hygiene during climate extremes.
- **Climate-Resilient Urban Planning for Health Protection**
  Integrate public health into urban design. Promote green infrastructure, heat-mitigating

building materials, and zoning reforms to reduce heat islands and improve air quality, especially in vulnerable neighborhoods.

- **Strengthening Social Safety Nets and Mental Health Services**
  Expand climate-adaptive social assistance programs for disaster-affected populations. Integrate mental health care into disaster recovery and establish community peer-support systems to strengthen social resilience.

- **Research and Development on Climate-Sensitive Diseases**
  Invest in scientific research on shifting disease patterns and vector ecology. Support early vaccine planning and partnerships with international health bodies for emerging infectious disease preparedness.

- **Institutional Capacity Building and Intersectoral Coordination**
  Establish dedicated climate-health units at national and provincial levels. Ensure cross-sectoral collaboration with urban planning, water management, agriculture, and disaster response for integrated adaptation actions.

- **Policy Integration and Long-Term Strategic Planning**
  Embed climate considerations into all public health planning processes. Strengthen Türkiye's participation in international climate-health networks and ensure that national health policy reflects evolving climate risk scenarios.

8.3. Key Institutions for Collaboration

- Ministry of Health
- Provincial Health Directorates
- Ministry of Environment, Urbanization and Climate Change
- State Meteorological Service
- Disaster and Emergency Management Authority (AFAD)
- Municipal Governments (Metropolitan and District)
- Ministry of Family and Social Services
- Ministry of Agriculture and Forestry
- Turkish Red Crescent and NGOs
- Universities and Research Institutes (e.g., Ege University, TÜBİTAK)
- International Organizations (WHO, ECDC)

Figure 8. Adaptation Actions for Climate Change and Publich Health

Table 8. Climate Adaptation Actions and Implementation Measures Public Health and Social Welfare

Adaptation Action	Objective	Lead Agencies	Supporting Partners
Heatwave Preparedness and Early Warning	Reduce heat-related health risks	MoH, Provincial Health, Municipalities	Meteorological Service, NGOs
Vector-Borne Disease Surveillance & Control	Early detection & control of vector-borne diseases	MoH, Provincial Health	Ministry of Agriculture, NGOs
Safe Water and Sanitation Resilience	Protect public health during floods & droughts	MoH, Municipal Water Authorities	AFAD, Community Organizations
Healthcare System Climate Preparedness	Ensure health service continuity during climate events	MoH, Hospital Administrations	AFAD, Municipalities, Energy Ministry
Community Outreach and Health Education	Raise climate-health risk awareness	MoH, Municipalities	NGOs, Schools, Local Media
Climate-Resilient Urban Planning	Reduce urban heat and improve living conditions	Municipalities, MoEUCC	Developers, Architects, NGOs
Social Safety Nets & Mental Health Services	Mitigate socioeconomic and mental health stress	MoFSS, MoH	NGOs, Community Centers
Climate-Sensitive Disease Research	Anticipate future health threats	MoH, Universities, TÜBİTAK	WHO, ECDC
Institutional Capacity & Cross-Sectoral Coordination	Strengthen planning & governance for health adaptation	MoH, MoEUCC	AFAD, Local Governments
Policy Integration & Strategic Planning	Mainstream health adaptation in all public health policy	MoH	International Networks, Ministries

9. Tourism & Cultural Heritage

Introduction

The Aegean's tourism—anchored by sun-splashed beaches, ancient ruins, and vibrant cultural experiences—faces heightened heat, coastal risks, and seasonal shifts under climate change. To safeguard visitor appeal, protect heritage, and maintain economic vitality, this plan pairs each adaptation objective with its implementation steps and identifies the institutions responsible for delivery.

9.1. Adaptation Actions & Implementation

- **Seasonal Diversification & Alternative Offerings**
  Develop and market spring/autumn festivals, cultural tours, wellness retreats, agro- and eco-tourism packages to spread arrivals beyond peak summer.
- **Resource-Efficient Facilities**
  Roll out grants and certification for hotels to install low-flow fixtures, solar water heaters, high-efficiency HVAC, and smart energy controls; conduct on-site efficiency audits.
- **Climate Vulnerability Audits**
  Deploy expert teams to assess heat, flood, fire, and erosion exposure at beaches, marinas, and archaeological sites; prioritize protective upgrades.
- **Visitor Safety & Communication**
  Integrate multi-lingual weather alerts and safety protocols into booking and guide systems; install shade structures, hydration stations, and train staff in first aid for heat or flood incidents.
- **Climate Risk Insurance**
  Design subsidized insurance products covering storm, flood, and fire damage for tourism SMEs; establish a rapid-response relief fund for post-disaster recovery.
- **Resilient Infrastructure Design**
  Update building codes and permitting to require elevated, flood-resistant, and passively cooled designs in new developments; retrofit critical facilities accordingly.
- **Heritage Asset Protection**
  Install protective canopies and improved drainage around vulnerable monuments; apply UV-resistant conservation treatments and digitally document sites for archival.
- **Inland & Mountain Tourism Development**
  Invest in visitor centers, access roads, and shuttle services to cooler upland and rural destinations; promote eco-lodges and guided nature experiences.
- **Data Monitoring & Adaptive Management**
  Establish a tourism observatory to collect visitor feedback, climate-impact data, and market trends; adjust offerings and capacity planning in real time.

9.2. Key Institutions

- Ministry of Culture & Tourism (MoCT)
- Regional Tourism Boards & Development Agencies
- Metropolitan & District Municipalities
- Ministry of Environment, Urbanization & Climate Change (MoEUCC)
- Disaster & Emergency Management Authority (AFAD)
- Turkish State Meteorological Service (TSMS)
- Insurance Regulatory & Development Authority
- Heritage Protection Directorate (MoCT)
- Hotel & Restaurant Associations
- Turkish Travel Agencies Association (TURSAB)
- Vocational & Higher Education Institutions

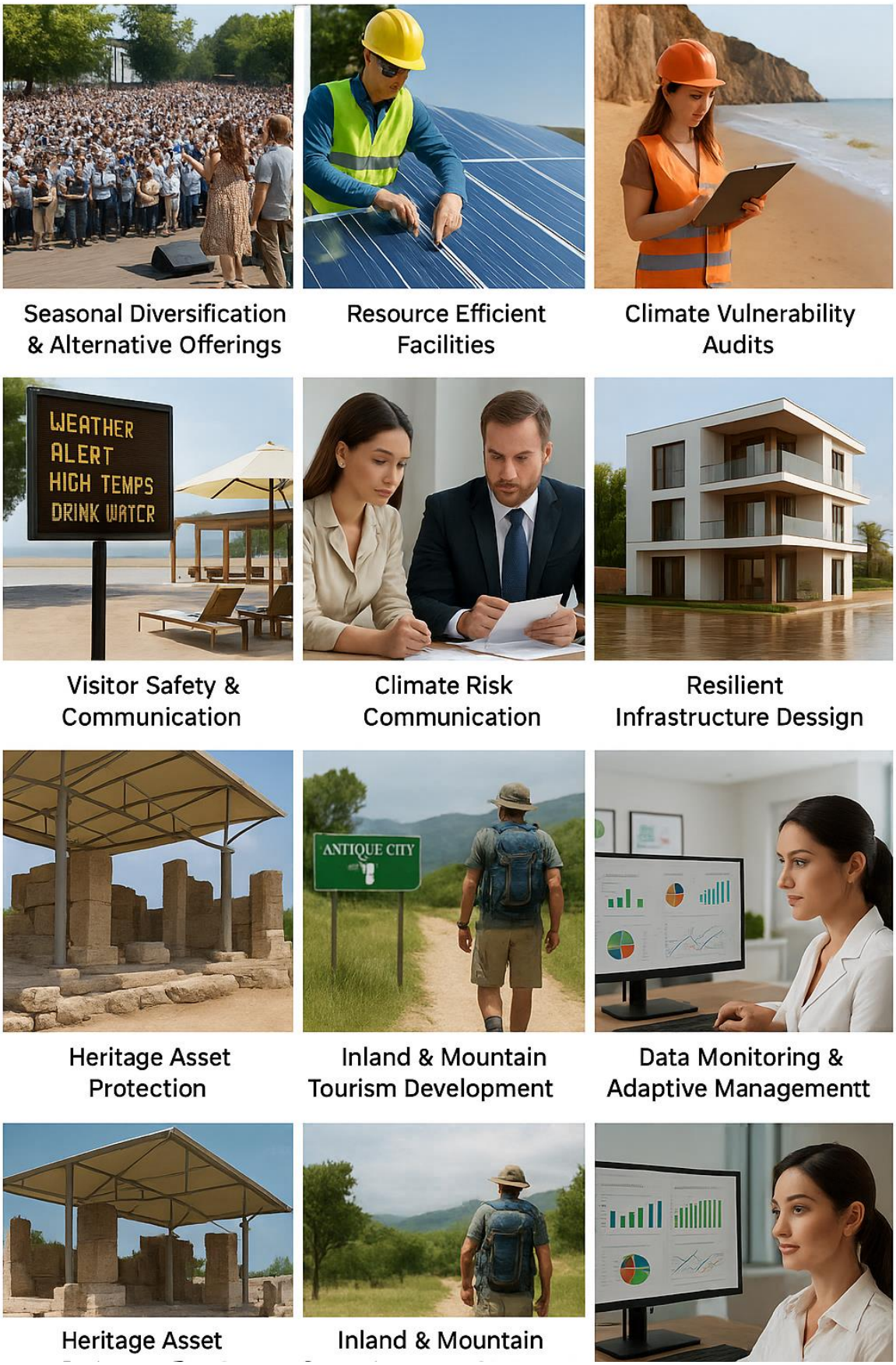

Figure 9. Tourism Sector Climate Adaptation: Strategies for Resilient, Safe, and Sustainable Tourism

Table 9. Climate Change Adaptation Actions and Implementation Measures for Tourism & Cultural Heritage

Adaptation Action	Implementation Action	Key Institutions
Seasonal Diversification & Alternative Offerings	Roll out spring/autumn festivals, cultural tours, wellness retreats, agro- and eco-tourism packages to disperse visitor demand.	MoCT; Regional Tourism Boards; TURSAB
Resource-Efficient Facilities	Provide grants and "Climate Friendly" certification; conduct on-site water/energy audits; upgrade fixtures and HVAC systems.	Municipalities; Utility Companies; MoCT
Climate Vulnerability Audits	Perform heat, flood, fire, and erosion risk assessments at beaches, marinas, and heritage sites; prioritize protective works.	MoEUCC; MoCT Heritage; Universities
Visitor Safety & Communication	Integrate multi-lingual weather alerts into booking systems; install shade structures, hydration stations; train staff in first aid.	AFAD; TSMS; Municipalities; Hotel Associations
Climate Risk Insurance	Design subsidized hazard-insurance packages for tourism SMEs and establish a rapid-response relief fund for post-disaster recovery.	MoCT; Finance Ministry; Insurance Regulator
Resilient Infrastructure Design	Update building codes to require elevated, flood-resistant, and passively cooled designs; retrofit existing resorts and facilities.	MoEUCC; Municipal Planning Departments
Heritage Asset Protection	Install protective canopies, improve drainage, apply UV-resistant treatments, and digitally 3D-scan vulnerable monuments.	MoCT Heritage; UNESCO; Conservation NGOs
Inland & Mountain Tourism Development	Invest in inland visitor centers, access roads, shuttle services, and eco-lodges to offer cooler alternatives to the coast.	Regional Development Agencies; MoCT; Transport Ministry
Workforce Training & Community Engagement	Conduct regular sustainability and emergency-response workshops for tourism staff; involve locals in adaptation planning.	Vocational Institutes; Hotel & Restaurant Assns.; NGOs
Data Monitoring & Adaptive Management	Establish a Tourism Observatory to track climate impacts and visitor trends; iteratively refine offerings and capacity plans.	Tourism Promotion Agency; Universities; Municipal Tourism Offices

Legend — Key Institutions:

- **MoCT**: Ministry of Culture & Tourism

- **MoEUCC**: Ministry of Environment, Urbanization & Climate Change
- **TSMS**: Turkish State Meteorological Service
- **AFAD**: Disaster & Emergency Management Authority

10. Energy and Infrastructure

10.1. Adaptation Actions and Implementation Steps

- **Reinforce electrical grid and manage peak demand**
  - Upgrade transformers and transmission lines, especially in areas where heatwaves increase energy demand.
  - Implement demand-side management strategies, such as smart metering, consumer incentive programs, and awareness campaigns to reduce peak hour usage.
  - Establish temporary backup energy systems for critical facilities like hospitals, water supply stations, and emergency services during extreme weather.
- **Adapt public infrastructure to heatwaves and extreme rainfall**
  - Design public buildings with passive cooling strategies and install high-efficiency cooling systems in health and social care buildings.
  - Retrofit and expand urban stormwater drainage systems to handle intense and short-duration rainfall linked to climate change.
  - Apply heat-reflective coatings to surfaces and prioritize shading solutions (trees, canopies, solar pergolas) for streets, public squares, and bus stops.
- **Protect energy infrastructure from wildfires and floods**
  - Regularly clear and maintain vegetation in the proximity of energy transmission corridors to reduce wildfire risk.
  - Build flood-protection measures such as elevated installations and water-resistant equipment in flood-prone substations.
  - Strengthen coordination between energy providers and disaster risk management agencies for early warning and rapid response.
- **Promote decentralized renewable energy systems**
  - Encourage installation of rooftop solar panels, solar water heaters, and small-scale wind turbines in residential, commercial, and public buildings.
  - Simplify permitting and net-metering regulations to accelerate local renewable energy adoption.
  - Support the development of community-based microgrids that improve resilience against grid disruptions.
- **Improve energy efficiency of infrastructure and services**
  - Conduct systematic energy audits in public and private buildings to identify inefficiencies.
  - Incentivize energy-saving retrofits, including high-performance insulation, energy-efficient HVAC systems, and LED lighting.
  - Support public campaigns on reducing energy consumption in households and businesses, particularly during extreme weather events.
- **Integrate climate resilience into energy infrastructure planning**
  - Require climate risk assessments for all new energy generation, transmission, and distribution projects.

  - Locate energy-critical facilities away from known flood zones, wildfire-prone areas, and unstable slopes.
  - Incorporate future temperature extremes into the design of transmission systems (e.g., choosing materials and components that tolerate higher operating temperatures).
- **Diversify the energy mix with climate-resilient sources**
  - Expand the share of geothermal, solar, and wind energy in the Aegean Region's energy portfolio to reduce dependence on vulnerable hydropower sources.
  - Promote hybrid energy systems that integrate storage solutions with renewable production.
  - Accelerate adoption of geothermal-based heating and cooling for industrial and urban facilities, especially in geothermal resource-rich areas like Denizli and Aydın.
- **Invest in smart grids and large-scale energy storage**
  - Deploy smart grid solutions for real-time load balancing, predictive maintenance, and outage management.
  - Develop grid-scale battery storage facilities to handle renewable energy fluctuations and ensure energy availability during extreme weather.
  - Establish microgrid solutions to ensure critical facilities remain operational even in the event of widespread power grid failure.

10.2. Key Institutions Involved

- **Ministry of Energy and Natural Resources** — Coordination of national energy security policies, grid infrastructure upgrades, and renewable energy strategy.
- **EPDK (Energy Market Regulatory Authority)** — Regulation of grid and distribution company practices, pricing, incentives for renewable energy, and grid access.
- **TEİAŞ (Turkish Electricity Transmission Corporation)** — Operation and planning of the transmission network, system-wide balancing and adaptation investments.
- **Distribution Companies (GEDİZ EDAŞ, AYDEM, etc.)** — Regional grid maintenance, local power distribution network improvements, and customer-oriented adaptation measures.
- **AFAD (Disaster and Emergency Management Authority)** — Risk assessment, early warning, and rapid response planning in climate-induced emergencies.
- **General Directorate of Meteorology** — Weather and climate projections, early warning systems.
- **Municipalities** — Local adaptation planning, enforcement of construction standards, promotion of decentralized renewables, and urban drainage improvements.
- **Private Sector** — Investment and innovation in renewable energy, smart grids, and energy efficiency technologies.
- **Universities and Research Institutions** — Development of climate risk assessment tools, innovative technologies, and technical support for energy resilience projects.
- **Regional Development Agencies** — Project funding, technical support, and regional coordination of adaptation efforts.

Figure 10. Climate-Resilient Energy and Infrastructure: Adaptation Strategies for a Sustainable Future

Table 10. —Climate Adaptation Actions and Implementation Measures for Energy and Infrastructure.

Adaptation Actions	Implementation Actions	Key Institutions Involved
Reinforce electrical grid and manage peak demand	Upgrade infrastructure, promote demand-side management, ensure backup systems for critical services.	TEİAŞ, GEDİZ EDAŞ, AYDEM, Ministry of Energy, EPDK, Municipalities.
Adapt public infrastructure to heatwaves and extreme rainfall	Design for heat resilience, upgrade drainage systems, apply reflective coatings and shading in cities.	Municipalities, Ministry of Environment, Ministry of Interior, Ministry of Health, AFAD.
Protect energy infrastructure from wildfires and floods	Vegetation management, flood-proofing of substations, strengthen early warning and response systems.	TEİAŞ, Distribution Companies, AFAD, Ministry of Forestry, General Directorate of Meteorology.
Promote decentralized renewable energy systems	Incentivize rooftop solar, simplify permits, support microgrids and community energy models.	Ministry of Energy, EPDK, Municipalities, Private Sector, Regional Development Agencies.
Improve energy efficiency of infrastructure and services	Conduct energy audits, retrofit public and private buildings, launch energy-saving campaigns.	Ministry of Energy, Municipalities, Universities, Private Sector, ESCOs.
Integrate climate resilience into energy infrastructure planning	Climate risk assessment for all new projects, locate facilities away from hazards, future-proof designs.	Ministry of Energy, TEİAŞ, EPDK, Climate Experts, Universities.
Diversify the energy mix with climate-resilient sources	Expand geothermal, wind, solar, and hybrid systems with storage integration.	Ministry of Energy, Private Sector, TUBITAK, Regional Development Agencies, Municipalities.
Invest in smart grids and large-scale energy storage	Implement smart grids, develop storage facilities, enable microgrid resilience for critical facilities.	TEİAŞ, Energy Distribution Companies, TUBITAK, Private Technology Firms, Ministry of Energy.

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