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Tirebolu Climate Change Adaptation & Mitigation Plan (CCAMP)





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INTRODUCTION

Climate change has emerged as one of the most pressing global challenges, with local and regional impacts increasingly threatening communities, economies, and ecosystems. As a coastal municipality in the Black Sea region of Türkiye, Tirebolu faces unique vulnerabilities to climate-related risks such as flooding, coastal erosion, heatwaves, agricultural disruptions, and water scarcity. These risks are compounded by the municipality's geographic, socio-economic, and infrastructural characteristics, demanding a proactive and comprehensive response.

The Climate Adaptation and Mitigation Plan for Tirebolu serves as a strategic roadmap to address these challenges while fostering a sustainable, resilient, and low-carbon future. The plan outlines targeted objectives and actionable strategies aimed at safeguarding public safety, infrastructure, and natural resources. Furthermore, it emphasizes the critical role of community engagement, regional collaboration, and policy alignment in ensuring effective implementation and long-term success.

This document is structured into key sections that address adaptation and mitigation priorities, as well as frameworks for community participation and regional replication. It draws on the findings of comprehensive research, including the Carbon Footprint Report, the Rainwater Harvesting and Greywater Management Report, and the Climate Change Awareness Survey, to ensure data-driven and context-specific approaches. The plan also aligns with Türkiye's National Climate Change Action Plan, the Sustainable Development Goals (SDGs), and the responsibilities outlined in the Türkiye Belediyeler Kanunu, providing a cohesive and legally grounded framework for action.

While the challenges posed by climate change are substantial, they also present opportunities for innovation, collaboration, and progress. By implementing this plan, Tirebolu not only aims to safeguard its own future but also seeks to serve as a model for neighboring municipalities in the Black Sea region, creating a ripple effect of sustainable and climate-resilient development.

The following sections of this document provide a detailed overview of Tirebolu's climate risks, the gaps and challenges hindering progress, and the strategies to address them. An Executive Summary follows this introduction, offering a concise overview of the plan's objectives and key strategies.


EXECUTIVE SUMMARY

Tirebolu, a coastal municipality in the Black Sea region of Türkiye, faces escalating risks from climate change, including flooding, coastal erosion, heatwaves, agricultural disruptions, and water scarcity. These vulnerabilities, driven by the municipality's unique geographical and socio-economic profile, threaten its infrastructure, natural resources, and public well-being. The Climate Adaptation and Mitigation Plan provides a comprehensive roadmap to address these challenges, build resilience, and foster sustainable development for Tirebolu and its neighboring municipalities.

The plan is structured around two main pillars: Adaptation and Mitigation, supported by Community Engagement and a Cross-Municipality Application Framework. These components are aligned with Türkiye's National Climate Change Action Plan, the Sustainable Development Goals (SDGs), and regional policies, ensuring consistency with national and global priorities while addressing local needs.

In the Adaptation pillar, the plan focuses on enhancing resilience to climate risks through strategic measures. Infrastructure resilience is a key priority, with proposed actions to modernize rainwater harvesting systems, upgrade urban drainage networks, and integrate nature-based solutions like reforestation and wetland restoration. Regional collaboration is emphasized through watershed management and data-sharing partnerships with neighboring municipalities, including Eynesil, Güce, and Çanakçı. The plan also prioritizes agricultural resilience by promoting sustainable farming practices, modernizing irrigation systems, and supporting farmers with training and financial incentives. Additionally, the adaptation strategy addresses coastal protection, proposing measures to reinforce coastal infrastructure and restore vegetation buffers.

The Mitigation pillar aims to reduce greenhouse gas (GHG) emissions and transition Tirebolu to a low-carbon economy. Renewable energy expansion is central to this effort, with plans to install solar panels on municipal buildings, promote community solar initiatives, and explore wind and hydroelectric energy projects. Sustainable transportation initiatives include electrifying municipal fleets, developing charging infrastructure, and creating bike lanes and pedestrian-friendly pathways.




The plan also outlines strategies for efficient waste management, such as expanding recycling infrastructure, introducing municipal composting programs, and implementing methane capture systems at landfills. Additionally, green urban spaces are prioritized through urban forests, green roofs, and the protection of natural carbon sinks like wetlands.

Recognizing the importance of public participation, the Community Engagement component fosters a culture of environmental responsibility and empowers residents to take an active role in climate action. The plan includes multimedia awareness campaigns, workshops on sustainable practices, and community-led environmental initiatives such as tree planting and recycling programs. Local climate action committees and public consultations will ensure that community input is integrated into decision-making processes.

The Cross-Municipality Application Framework extends the impact of Tirebolu's efforts across the region by fostering collaboration with neighboring municipalities. A replication framework provides templates and monitoring systems to adapt the plan's strategies to different contexts. Knowledge-sharing platforms, including a regional hub and forums, will disseminate best practices, while joint projects and a regional climate action fund will enable cooperative solutions for shared challenges.

The plan also aligns with Türkiye's National Climate Change Action Plan, SDGs, and the Türkiye Belediyeler Kanunu (Law No. 5393), ensuring compliance with national mandates and leveraging findings from key research reports, such as the Carbon Footprint Report and Rainwater Harvesting and Greywater Management Report. By integrating local policies and aligning with broader frameworks, Tirebolu's approach demonstrates a commitment to effective, scalable climate action.

This plan positions Tirebolu as a leader in climate-resilient development in the Black Sea region. Through its robust adaptation and mitigation strategies, community-driven initiatives, and regional partnerships, Tirebolu aims to safeguard its future while creating a replicable framework for neighboring municipalities. The implementation of this plan marks a critical step toward a sustainable, resilient, and low-carbon future for Tirebolu and its surrounding communities.



1. SITUATIONAL ANALYSIS: CLIMATE RISKS FOR TIREBOLU

Tirebolu, located in the Black Sea region of Türkiye, faces a range of climate-related risks due to its geographic and socio-economic profile. Flooding and extreme rainfall events are among the most immediate threats to the municipality. Its steep terrain and proximity to the Black Sea make it highly vulnerable to flash floods, which have historically caused severe damage to infrastructure and disrupted critical services. These risks are expected to intensify as climate change exacerbates rainfall patterns, making robust flood management a top priority (Zaimes & Kiosses, 2021).

Coastal erosion and rising sea levels also pose significant challenges. Erosion driven by stronger storm surges and rising sea levels threatens local ecosystems and economic activities such as tourism and fisheries. Infrastructure along the coast, including ports and small-scale fisheries, is increasingly at risk, necessitating integrated coastal management strategies to mitigate these impacts (Kostianaia & Kostianoy, 2021).

Rising temperatures and heatwaves are becoming more frequent, increasing energy demands for cooling and imposing health risks, especially for vulnerable populations like the elderly and children. Higher temperatures further aggravate agricultural challenges, creating stress on water resources and reducing crop yields (Hadri et al., 2021).

Agricultural disruptions due to irregular rainfall and prolonged dry spells are another critical issue. Hazelnut production, a cornerstone of Tirebolu's local economy, is increasingly affected by changing climatic conditions, including pest outbreaks exacerbated by warming temperatures. Safeguarding agriculture through sustainable practices is essential to ensuring economic stability (Bär et al., 2015; Gumus et al., 2023).

Despite abundant rainfall historically, Tirebolu is not immune to water scarcity. Prolonged dry spells and increased demand for agricultural and domestic water use are straining existing water supplies.

Landslides, often triggered by heavy rainfall and deforestation, compound these risks, damaging infrastructure and displacing communities (Çelebioğlu & Tayanç, 2024).

In summary, these risks require a multi-dimensional response that includes infrastructure upgrades, sustainable resource management, and enhanced community resilience. Tirebolu's adaptation and mitigation efforts will also serve as a model for neighboring municipalities.

2. GAPS IN KNOWLEDGE, INFRASTRUCTURE, AND COMMUNITY BEHAVIOR

Despite the evident risks associated with climate change, Tirebolu faces critical gaps that hinder the implementation of effective adaptation and mitigation strategies. Addressing these gaps is crucial to building resilience and ensuring long-term sustainability.

Knowledge Gaps:

Tirebolu lacks localized climate data that could inform targeted adaptation measures. For example, detailed projections on landslide risks and coastal erosion would allow for better planning and zoning. Public awareness of climate risks and the benefits of sustainable practices is also limited. Residents often underestimate the long-term impacts of flooding, landslides, and other hazards, making it difficult to mobilize collective action (Zaimes & Kiosses, 2021; Hadri et al., 2021).

Infrastructure Deficiencies:

The municipality's existing infrastructure is outdated and insufficient to cope with extreme weather events. Flood management systems, such as drainage networks and rainwater harvesting mechanisms, require modernization. Coastal protection infrastructure is poorly maintained, leaving critical assets vulnerable to rising sea levels and erosion. Public transportation systems, heavily reliant on fossil fuels, contribute significantly to emissions and fail to offer sustainable alternatives (Bär et al., 2015; Kostianaia & Kostianoy, 2021).

Community Behavioral Challenges:

Resistance to adopting sustainable practices, such as waste segregation and water conservation, remains a barrier to climate action. This resistance is often linked to economic constraints and a lack of financial incentives. Additionally, low levels of public participation in climate-related programs highlight the need for more inclusive and community-driven initiatives (Zaimes & Kiosses, 2021).

Collaborative Regional Efforts:

Collaboration with neighboring municipalities could improve resource pooling and information sharing, addressing shared risks like coastal erosion and regional water scarcity more effectively. Tirebolu must actively engage in regional partnerships to strengthen resilience at a broader scale.

In conclusion, addressing these gaps will require a multi-stakeholder approach integrating education, infrastructure development, and community-driven solutions. Bridging these gaps holistically will enable Tirebolu to better anticipate climate risks and build a sustainable future.

3. EMISSIONS PROFILE: TIREBOLU'S CARBON FOOTPRINT

Tirebolu's carbon footprint, as detailed in the Carbon Footprint Report (CIRIS 2024) prepared by the project, highlights key sources of greenhouse gas (GHG) emissions, including energy consumption, transportation, and waste management. Understanding these sources is critical for designing effective mitigation strategies.

Energy Consumption:

The energy sector accounts for approximately 45% of Tirebolu's total emissions, primarily from municipal buildings, public lighting, and residential energy use. Inefficient heating systems and reliance on fossil fuels amplify these emissions. Transitioning to renewable energy and modernizing energy systems are critical opportunities for reducing emissions (Bär et al., 2015).

Transportation:

Transportation contributes nearly 30% of emissions. Municipal fleets and privately owned vehicles rely heavily on fossil fuels, and the lack of public transportation options exacerbates this dependency. Expanding public transportation and transitioning to electric vehicles will address these challenges (Gumus et al., 2023).

Waste Management:

The waste sector accounts for approximately 20% of emissions, primarily from unmanaged landfills emitting methane. Expanding recycling programs and implementing methane capture systems can significantly reduce emissions while promoting sustainable waste practices (Zaimes & Kiosses, 2021).

Minor Emission Sources:

Remaining emissions stem from water treatment facilities, agricultural activities, and industrial processes. While relatively small, these emissions require targeted interventions to prevent future growth (CIRIS 2023).

In conclusion, addressing these emissions requires targeted interventions across energy, transportation, and waste management sectors. These efforts will position Tirebolu as a leader in sustainability within the Black Sea region.

4. POLICY FRAMEWORK

Alignment with National and Regional Goals:

Tirebolu's climate strategy is designed to align with Türkiye's National Climate Change Action Plan, the Sustainable Development Goals (SDGs), and regional policies at the provincial level. This alignment ensures that the municipality's actions contribute to broader national and international climate objectives while addressing local priorities and challenges.

National Climate Change Action Plan:

Türkiye's National Climate Change Action Plan provides a comprehensive framework for reducing greenhouse gas emissions, enhancing climate resilience, and transitioning to a sustainable economy. Tirebolu's initiatives—such as increasing energy efficiency, expanding renewable energy capacity, and improving waste management practices—directly support the goals outlined in this plan. However, challenges remain in implementing these initiatives, particularly for smaller municipalities, due to financial and institutional capacity limitations (Peker & Ataöv, 2021). To overcome these challenges, Tirebolu must focus on building institutional capacity and securing funding from national programs.

The emphasis on integrating proactive measures, as recommended in Türkiye's climate strategies, is critical for ensuring resilience to future climate risks (Babaoğlu et al., 2023). For Tirebolu, aligning with these national objectives not only ensures consistency but also enhances the potential to attract technical and financial support for local initiatives.

Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) provide a global framework for achieving sustainability and equity. Tirebolu's climate initiatives align particularly with:

- **Goal 7 (Affordable and Clean Energy):** Expanding renewable energy infrastructure and promoting energy efficiency.
- **Goal 11 (Sustainable Cities and Communities):** Developing resilient infrastructure to mitigate risks from floods and coastal erosion.
- **Goal 13 (Climate Action):** Implementing targeted mitigation and adaptation actions to enhance resilience.

While these initiatives align well with SDG objectives, the effective implementation of these measures requires addressing gaps in financial resources and technical expertise. Studies highlight that Türkiye's progress on SDGs has been uneven, with rural municipalities often lagging behind urban centers in achieving these goals (Atvur & Vural, 2022). Tirebolu must ensure its strategies are tailored to local conditions and actively seek collaborations to bridge these gaps.

Regional Policies and Collaboration:

At the regional level, Tirebolu's strategy is designed to complement provincial initiatives and foster collaboration with neighboring municipalities. Participating in regional programs for flood management, coastal protection, and sustainable agriculture ensures that the municipality's actions are integrated into broader efforts to combat climate change across the Black Sea region. However, fragmented coordination and uneven resource distribution often undermine such efforts, as seen in similar regions across Türkiye (Tuğaç, 2022).

Tirebolu's goal to share experiences and best practices with neighboring municipalities is an important step toward fostering a collaborative approach to climate action. Establishing joint initiatives, such as shared coastal defense projects or inter-municipal knowledge exchange platforms, could amplify the impact of its efforts and ensure more cohesive regional strategies.

Securing Funding and Technical Support:

Aligning with national and international frameworks strengthens Tirebolu's ability to secure funding and technical assistance. National programs, such as Türkiye's adaptation and resilience funds, and international mechanisms, including the Green Climate Fund and European Union grants, offer opportunities to support these initiatives. However, accessing these resources requires the development of institutional capacity and improvements in project preparation processes. To maximize funding opportunities, Tirebolu could enhance the competencies of municipal staff through training programs, collaborate with institutions that provide technical support, and coordinate efforts with regional development agencies.

Moreover, involving local stakeholders is a crucial factor in ensuring the sustainability of projects. Establishing partnerships with universities, civil society organizations, and the private sector can facilitate access to technical expertise and support capacity-building activities. Such collaborations not only enhance the effectiveness of ongoing projects but also position Tirebolu as a leader in climate change mitigation and water management in the long run.

5. CLIMATE ADAPTATION AND MITIGATION PLAN FOR TIREBOLU

a. Climate Adaptation Section of the Plan

Climate change poses significant risks to Tirebolu, requiring a comprehensive adaptation plan to safeguard infrastructure, agriculture, and public well-being. This section outlines targeted objectives and strategies aimed at enhancing resilience to climate impacts, leveraging regional collaboration, and fostering community engagement.

Objective 1: Strengthen Infrastructure to Mitigate Flood Risks

Flood risks, exacerbated by increased rainfall intensity, present one of the most immediate threats to Tirebolu. Strengthening flood mitigation infrastructure will protect public safety, reduce economic losses, and improve water resource management.

- **Strategy 1.1:** Modernize rainwater harvesting systems in public buildings and high-risk residential areas, integrating with the regional early warning system.
- **Strategy 1.2:** Upgrade urban drainage systems with permeable pavements, bio-swales, and stormwater retention basins.
- **Strategy 1.3:** Implement nature-based solutions such as reforestation in upstream areas and wetland restoration to enhance flood mitigation capacity.

Objective 2: Regional Collaboration and Data-Driven Decision-Making

Given the interconnected nature of watersheds and climate risks, collaborative and data-driven solutions are critical.

- **Strategy 2.1:** Develop an integrated watershed management strategy with Eynesil, Güce, and Çanakçı to regulate water flow and minimize regional flood risks.
- **Strategy 2.2:** Use GIS tools to monitor water levels, land-use changes, and high-risk zones.
- **Strategy 2.3:** Facilitate inter-municipal knowledge sharing and training programs for flood mitigation and response.

Objective 3: Strengthen Community Engagement and Preparedness

Engaging the community in adaptation efforts ensures sustainable outcomes and builds collective resilience.

- **Strategy 3.1:** Conduct community training programs on flood preparedness, including response drills and flood-proofing techniques.
- **Strategy 3.2:** Develop mobile applications to provide real-time alerts, preparedness guidelines, and emergency contact information.
- **Strategy 3.3:** Support neighborhood-led initiatives like tree planting campaigns and community drainage maintenance.

Objective 4: Address Coastal Erosion and Rising Sea Levels

Coastal erosion and rising sea levels pose significant risks to Tirebolu's coastline, impacting infrastructure, ecosystems, and local livelihoods.

- **Strategy 4.1:** Reinforce vulnerable coastal infrastructure, such as seawalls and jetties, to withstand storm surges and erosion.
- **Strategy 4.2:** Develop and restore coastal vegetation buffers to stabilize shorelines and provide natural protection against erosion.
- **Strategy 4.3:** Collaborate with regional authorities and environmental organizations to integrate coastal protection measures into watershed management strategies.

Objective 5: Build Emergency Response and Recovery Capacity

Timely and effective emergency response minimizes the impacts of extreme weather events.

- **Strategy 5.1:** Equip municipal disaster response teams with advanced tools (portable pumps, sandbags, rapid deployment barriers).
- **Strategy 5.2:** Develop a recovery framework for efficient rehabilitation of infrastructure and financial support for affected households.
- **Strategy 5.3:** Conduct post-flood assessments to refine adaptation strategies.

Objective 6: Strengthen Agricultural Resilience

Agriculture remains a vital economic pillar but is vulnerable to climate variability.

- **Strategy 6.1:** Promote sustainable farming practices, such as crop diversification, soil conservation, and organic farming.
- **Strategy 6.2:** Modernize irrigation systems with drip and sprinkler technologies to optimize water use.
- **Strategy 6.3:** Provide financial incentives and training for farmers to adopt climate-resilient techniques.

b. Mitigation Section of the Plan

Mitigation efforts aim to reduce greenhouse gas (GHG) emissions through energy transition, sustainable transportation, and waste management. These strategies align with global and regional climate goals while fostering economic innovation.

Objective 1: Transition to Renewable Energy Sources

Expanding renewable energy is central to reducing emissions and ensuring energy security.

- **Strategy 1.1:** Install solar panels on municipal buildings and develop community solar initiatives for households and small businesses.
- **Strategy 1.2:** Diversify renewable energy sources, such as small-scale wind and hydroelectric projects.
- **Strategy 1.3:** Provide incentives for businesses adopting renewable energy systems.

Objective 2: Promote Sustainable Transport

Low-carbon transportation reduces emissions and improves mobility.

- **Strategy 2.1:** Electrify municipal fleets and install charging stations at strategic locations.
- **Strategy 2.2:** Develop bike lanes and pedestrian-friendly infrastructure to encourage active transportation.
- **Strategy 2.3:** Partner with neighboring municipalities to create inter-city electric bus routes.

Objective 3: Implement Efficient Waste Management

Managing waste sustainably reduces emissions and environmental impacts.

- **Strategy 3.1:** Expand recycling infrastructure with neighborhood collection points and educational campaigns.
- **Strategy 3.2:** Introduce municipal composting programs for organic waste, linking this with sustainable agricultural practices.
- **Strategy 3.3:** Equip landfills with methane capture systems and explore waste-to-energy technologies.

Objective 4: Enhance Carbon Sequestration and Green Urban Spaces

Expanding green spaces improves air quality and absorbs emissions.

- **Strategy 4.1:** Develop urban forests and green corridors while engaging communities in tree-planting campaigns.
- **Strategy 4.2:** Incentivize green roofs and walls on public and private buildings to mitigate urban heat islands.
- **Strategy 4.3:** Protect and restore natural carbon sinks, such as coastal wetlands and forests.

c. Community Engagement and Education Section of the Plan

Objective: Foster a Culture of Environmental Responsibility

Community involvement and education are essential for long-term climate action.

- **Strategy 1.1:** Organize multimedia awareness campaigns on sustainable behaviors and climate change impacts.
- **Strategy 1.2:** Conduct workshops on energy-saving techniques, waste reduction, and water efficiency.
- **Strategy 1.3:** Provide financial incentives to encourage household-level adoption of sustainable technologies, such as solar panels or water-saving devices.

d. Cross-Municipality Application Section

Climate challenges often transcend municipal boundaries, requiring regional collaboration and shared strategies for effective mitigation and adaptation. This section outlines Tirebolu's framework for enabling neighboring municipalities, such as Eynesil, Güce, and Çanakçı, to replicate successful initiatives, share best practices, and cooperate on joint climate action projects.

Objective 1: Develop a Replication Framework

- **Strategy 1.1:** Conduct Regional Needs Assessments to identify shared risks and capacity gaps.
- **Strategy 1.2:** Provide Adaptation and Mitigation Templates with clear implementation guidelines.
- **Strategy 1.3:** Integrate Municipalities into Existing Monitoring Systems for consistency in data collection and decision-making.

Objective 2: Establish a Best Practices Sharing Platform

- **Strategy 2.1:** Create a Regional Knowledge Hub for sharing reports, tools, and success stories.
- **Strategy 2.2:** Organize Regional Forums and Thematic Workshops on key topics like renewable energy and flood management.
- **Strategy 2.3:** Implement Peer-to-Peer Learning Programs with mentorships and site visits.

Objective 3: Foster Inter-Municipal Cooperation

- **Strategy 3.1:** Develop Joint Projects for regional priorities like transportation and renewable energy systems.
- **Strategy 3.2:** Establish a Regional Climate Action Fund for financing inter-municipal projects.
- **Strategy 3.3:** Advocate for National and International Support to secure grants and policy backing.

CONCLUSION

The Climate Adaptation and Mitigation Plan represents a critical step in safeguarding Tirebolu's future against the escalating risks of climate change. By addressing vulnerabilities such as flooding, coastal erosion, agricultural disruptions, and water scarcity, the plan provides a comprehensive framework for building resilience and fostering sustainability. Through a combination of strategic adaptation measures, targeted mitigation actions, robust community engagement, and regional collaboration, Tirebolu is positioned as a leader in sustainable development within the Black Sea region.

This plan aligns with Türkiye's National Climate Change Action Plan, the Sustainable Development Goals, and the mandates outlined in the Türkiye Belediyeler Kanunu, ensuring coherence with national and international priorities while addressing the unique needs of the municipality. By leveraging findings from key research reports, the plan integrates evidence-based strategies to optimize outcomes and guide effective implementation.

The initiatives outlined in this document extend beyond the borders of Tirebolu, fostering collaboration with neighboring municipalities such as Eynesil, Güce, and Çanakçı. The Cross-Municipality Application Framework enables these communities to replicate Tirebolu's strategies, share knowledge, and pool resources to address shared climate challenges. This regional approach amplifies the plan's impact, ensuring that its benefits are realized across the broader Black Sea region.

Through the combined efforts of local government, community members, and regional partners, this plan sets a pathway toward a sustainable, low-carbon, and climate-resilient future. Tirebolu's commitment to proactive climate action not only safeguards its infrastructure, natural resources, and livelihoods but also serves as a model for other municipalities facing similar challenges. By implementing this plan, Tirebolu takes a decisive step toward ensuring a thriving and resilient community for generations to come.



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