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OPEN GREEN AREA STRATEGIES AND ACTION PLANNING IN RESILIENT COASTAL CITIES

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Abstract: Cities, as complex entities composed of interdependent and multi-layered systems, are inherently vulnerable to both natural disasters and human-induced threats. Nevertheless, they are not only spaces exposed to adverse impacts but also strategic hubs for infrastructure, sustainability, technology, and investment. In the face of evolving economic, social, cultural, and environmental dynamics, ensuring urban resilience against sudden shocks and long-term stresses has become a critical priority. This study, conducted specifically for the province of Rize, focuses on the development of green area action plans aimed at enhancing the resilience of coastal cities. The primary objective is to contribute to the creation of greener and more inclusive urban environments that can sustain their functionality during crises, resist various shock and stress factors, and play a risk-mitigating role. Within this framework, living spaces were evaluated with respect to climate change, urban infrastructure, transportation models, and open-green areas. Urban resilience was analyzed through key parameters including population, climate, residential patterns, open-green spaces, transportation systems, land use, accessibility, and walkable access distances. Based on the findings, strategic recommendations for open-green space planning and the formulation of green area action plans were developed to strengthen the adaptive capacity and sustainability of coastal urban environments.

Keywords: Resilient city, Coastal urban planning, Sustainability

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1. Introduction

Cities, as dynamic and multilayered structures composed of interconnected systems, are spaces where the economic, social, cultural, and environmental interactions of human settlements are concentrated (Bettencourt and West, 2010; Piña, 2014). This complex structure makes cities vulnerable to threats originating from both natural disasters and human activities, while also making them strategic intervention areas (Cutter et al., 2010; Tabane et al., 2016). According to global projections, approximately 70% of the world's population is expected to live in cities by 2050, and a significant portion of this growth will occur in developing countries (United Nations, 2014; Seto et al., 2012). This transformation is not limited to population growth; it also causes rapidly increasing demands on urban infrastructure, energy, transportation, water, and environmental systems (Bélissent, 2010). Although urbanization is generally associated with economic growth and employment opportunities, it brings with it many problems, especially in the case of unplanned development, such as the rapid depletion of natural resources, environmental degradation, the formation of urban heat islands, transportation problems, social inequalities, and infrastructure deficiencies (Novosadová and van der Knaap, 2021; Lazaroiu and Roscia, 2018). Therefore, the direct and indirect impacts of the urbanization process should be addressed comprehensively, not only in terms of spatial but also in terms of environmental sustainability and social justice (Anguelovski et al., 2019; Grabowski et al., 2023). To ensure the livability and sustainability of cities, multidisciplinary planning approaches based on the integration of the concepts of "sustainability," "resilience," and "urban transformation" are of great importance (He et al., 2020; Anastasiadis and Metaxas, 2010; Kulözü Uzunboy and Sipahi, 2020; Sipahi and Sipahi, 2024). In this context, the concept of "urban resilience" refers to cities becoming resilient to existing and potential risks, systematically renewing themselves, and improving their ability to adapt (Godschalk, 2003; Drobniak, 2012; Gilbert, 2016). Resilience encompasses not only the capacity to recover from disasters but also the ability to anticipate and prepare for risks and

maintain the sustainability of urban systems in the face of constantly evolving threats (Beatley and Boyer, 2009; Tumini et al., 2017). The ability of cities to survive in the face of factors such as climate change, disaster risk, infrastructure inadequacy, and social fragility is possible through a holistic planning approach (Albrechts, 2004; Roggema, 2020).

The application of the concept of resilience from the technical field to the urban sphere began with the adoption of ecological approaches (Zuniga-Teran et al., 2020). This concept is addressed within the framework of urban planning, relating it to sustainability in the context of climate change and disaster (Bănică et al., 2020; Zheng et al., 2024). Urban planning before and after environmental disasters aims to build urban resilience (Tyler and Moench, 2012). In this context, various strategies and planning principles have been developed to increase urban resilience, minimize the impacts of disasters, and ensure sustainable urban development (Meerow et al., 2016). The concept of "green infrastructure" stands out as a fundamental component in achieving urban resilience (Miller, 2020). Green infrastructure comprises multifunctional areas encompassing natural and semi-natural elements such as parks, forested areas, urban corridors, wetlands, recreational areas, rain gardens, and green roof systems (Pauleit, 2020; European Commission, 2013). These areas not only provide aesthetic value but also contribute to the environmental sustainability of cities by providing many ecosystem services such as improving air quality, expanding carbon sinks, protecting biodiversity, and retaining water (Beatley and Newman, 2013; De Vries et al., 2003; Nielsen and Hansen, 2007). Therefore, open and green areas are a supporting element and one of the main strategic tools in urban planning (Straupe and Liepa 2018). These areas are important socio-cultural spaces that improve people's physical and mental health, provide opportunities for socialization, and increase livability (Conzatti et al., 2022; Pakzad and Osmond, 2016; Tidball and Aktipis, 2018). Furthermore, in the context of climate change, green areas increase the microclimate regulation capacity of cities, reduce the urban heat island effect, and make disaster risks manageable (Staddon et al., 2018). Considering the resilience and sustainability aspects, it is of great importance to increase the urban green tissue in a planned manner in terms of both quality and quantity (Paudel and States, 2023). These strategically important green infrastructure elements become even more critical, especially in coastal cities (Kadić et al., 2025). Coastal cities face multifaceted climate risks such as sea level rise, coastal erosion, salinization, flood risk, and ecosystem destruction (Griggs and Reguero, 2021). These regions are also areas where tourism, logistics, and settlement pressures are concentrated (Petrişor et al., 2020). Therefore, planning coastal areas should not only include physical construction but also flexible and adaptive spatial strategies compatible with natural systems (Valente and Pinho, 2025). Addressing coastal cities within the framework of resilience has become a necessity, especially in countries with high disaster risk, such as Türkiye (Yaman Galantini and Tezer, 2018).

Rize, located on the Black Sea coast of Türkiye, despite possessing rich natural and cultural resources, faces significant environmental threats due to increasing population density and unplanned construction. With climate change, natural disasters such as heavy rainfall and landslides are becoming more frequent and destructive. This necessitates the joint planning of natural and urban systems. This study aims to develop open and green area strategies to increase the resilience capacity of coastal cities by analyzing existing environmental pressures and risks, specifically in Rize. In this context, strategic planning recommendations will be developed by creating an existing land use map, a climate change impact map, and a green area inventory. The proposed solutions include the integration of natural ecosystems (forests, wetlands), semi-natural systems (rain gardens, green waterways), and cultural infrastructures (green roofs, coastal fortifications). Thanks to this holistic approach, the study will not only contribute to Rize's transformation into a resilient city but also serve as a guide for other coastal cities facing similar challenges. Consequently, as cities become increasingly complex and fragile, a shift to a planning approach based on resilience and green infrastructure is necessary to make them safer, more sustainable, and more livable. This study concretizes this approach in the case of Rize and provides a guiding framework for resilient coastal cities of the future.

2. Materials and Methods

2.1. Study Area

The study area covers the provincial center of Rize, known as the capital of greenery in the Black Sea Region (Figure 1). Rize is a developing city where settlements and transportation systems are concentrated along the coastline due to its topography. The city, with a population of 350,506, has experienced a significant increase, especially since 2017 (TUIK, 2024). Despite being one of the cities with the highest rainfall in Türkiye (Polat and Sunkar, 2017). Rize, which has numerous natural resource assets, is observed to be declining and being destroyed due to rapid consumption. Reasons for this include natural and human-induced activities such as misuse of land and disasters. Green areas, which can be considered within the scope of urban resilience, are limited in urban areas and have a fragmented structure. The Black Sea coastal road, which separates the sea and the coast, forms the basis of the city's transportation system. The Black Sea coastal road causes many problems, including the fragmentation of living spaces, limited access to the coast, and noise pollution. The study area was divided into three zones, taking into account spatial differences and urban density, and each phase was analyzed separately. Within this scope, Zone 1

includes the Rize Fener and Terminal districts, which are home to residential areas, the university, public institutions, and open green areas. Zone 2 encompasses the central area, which includes commercial areas, recreational areas, and residential areas where urban uses are concentrated. Zone 3 stands out with its developing area, newly constructed recreational areas, and residential areas

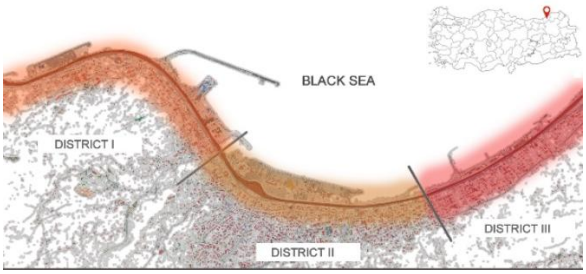

Figure 1. Study area Rize city center coastline.

2.2. Method

The study method is evaluated under five main headings: 1. Problem definition and literature review, 2. Creation of Rize climate data (temperature, precipitation), 3. Creation of current land use map, 4. Analysis of current urban open green area systems (urban corridors, urban parks, vertical gardens and roof gardens), bicycle and walking paths, and squares/assembly areas within the scope of resilience, 5. Development of new space proposals and open green area planning strategies for urban resilience (Table 1). The first stage of the study is to determine the vulnerabilities of the city and to define the problem together with the literature review in this context. First, the current land use map and climate data were created to determine the vulnerabilities of the city. In this context, residential areas, transportation networks, urban open green areas, agricultural areas, pasture areas, empty spaces, and construction areas were taken into consideration. The land use map was created using the ArcGIS program. Parameters for assessing Rize as a resilient city were considered under three main headings (1. Open green areas (urban parks, fragmented green areas, vertical gardens, and rooftop gardens); 2. Bicycle and walking paths; and 3. Squares and assembly areas). Initially, a current situation analysis was conducted, followed by proposals for new areas for the city. These analyses were obtained through on-site observations and measurements and plotted on a map. Finally, in light of these parameters, open green area planning strategies and open green area action plan proposals were developed to increase the city's resilience.

Table 1. Stages of method

	Stage	Description
1	Problem Identification and Literature Review	Identification of urban vulnerabilities and support of the theoretical framework through a literature review.
2	Compilation of Climate Data	Collection and analysis of temperature and precipitation data for the province of Rize.
3	Creation of Current Land Use Map	Mapping of residential areas, transportation networks, green spaces, etc., using ArcGIS.
4	Analysis of Existing Green Space Systems and Resilience Parameters	Examination of urban open green spaces, walking and bicycle paths, squares, and assembly areas.
5	Development of New Site Proposals and Open Green Space Planning Strategies for Urban Resilience	Formulation of new spatial proposals and strategies for planning open green spaces to enhance urban resilience.

3. Results

3.1. Rize Province Climate Data

Rize province, located in the Black Sea Region of Türkiye, exhibits typical Black Sea climate characteristics. This climate type is characterized by abundant rainfall throughout the year, being mild and humid. Rize is one of the provinces with the highest rainfall in Türkiye. Average annual rainfall is around 2,300 mm. This high rainfall contributes to the dense vegetation and diversification of agricultural activities in Rize (MGM). The annual rainfall map for Rize shows that areas receiving heavy rainfall overlap with residential areas parallel to the coast. This creates significant vulnerability in terms of urban flood risk. Because rainfall intensity is high in coastal areas, disaster risk management, infrastructure resilience, and green infrastructure implementations are of strategic importance in these regions (Figure 2).

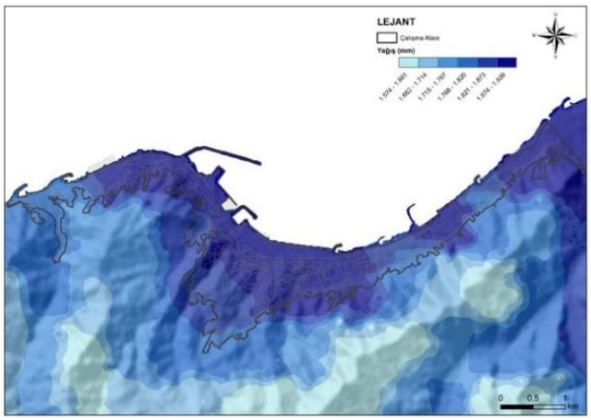

Figure 2. Rize city center annual precipitation map.

The average annual temperature in Rize is approximately

14-15°C. In summer, average temperatures reach 25-26°C, while in winter, the average temperature is around 6-7°C. Extreme temperatures are rare in Rize, and even in winter, frost is quite rare (MGM). The temperature map for Rize province shows that densely populated areas near the coast are warmer, while inland areas are cooler. The heat island effect is particularly evident in urban areas (Figure 3).

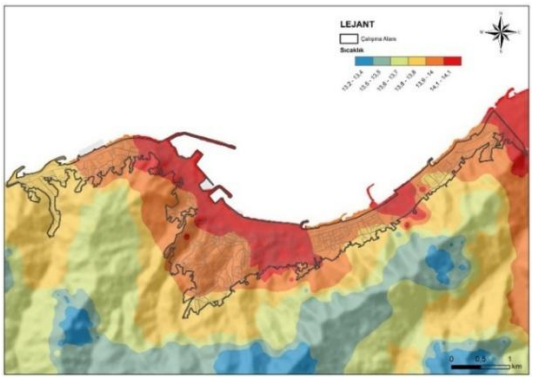

Figure 3. Rize city center annual temperature map.

3.2. Workspace Usage Map

Existing areas within the study area, such as residences, construction sites, a port, sports and entertainment areas, green areas, and unused land, were analyzed and mapped using ArcGIS (Figure 4). This comprehensive analysis provides important data to determine the current land use status in the region and inform potential development projects. According to the land use map of the Rize coastline, calculations indicate that vacant land is 160465.2 m^2, construction areas are 111.653.3 m^2, urban green areas are 268.894 m^2, residential areas are 334.216 m^2, and agricultural and pasture lands are 5.866,560 m^2. Residential areas concentrated parallel to the coast put pressure on coastal areas. Forests and pastures are concentrated in rural and sloping areas. However, the lack of a complete transition zone between these natural areas and urban settlements makes it difficult to bring ecosystem services into the city. Construction areas occupy a significant area on the map. This situation shows the ongoing construction pressure and threat on natural areas.

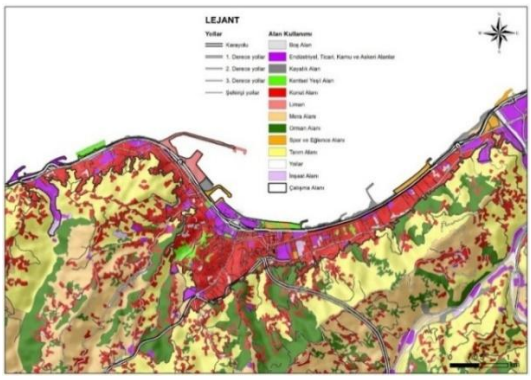

Figure 4. Workspace usage map.

3.3. Open Green Areas

Urban open green areas were examined as linear green areas that provide ecological, social, and aesthetic functions within and around the city. In this context, open green areas were evaluated under three subheadings: urban parks, fragmented green areas, vertical gardens, and roof gardens. The physical size and distribution of green areas by region were examined (Figure 5).

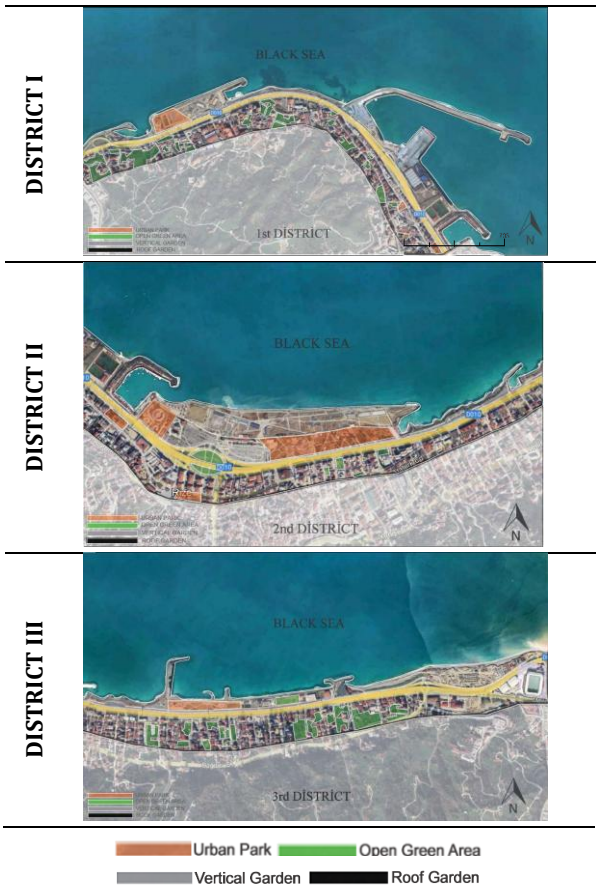

Figure 5. Analysis of existing urban open green area systems.

An evaluation of the urban parks within the study area reveals a total of seven urban parks across three regions, totaling 219.500 m^2. Within this scope, District I contains three different urban parks, covering a total area of 38,500 m^2. The parks in this region are scattered and medium-sized, and in addition to these parks, there are also small-scale playgrounds. District II has the largest urban park area, totaling 141,000 m^2. In this respect, it is considered the region with the highest green area capacity. Mesut Yılmaz Beach Park, in particular, stands out as the most dominant element among urban parks. District III contains a single large park, covering 40.000 m^2. An evaluation of the scattered green areas across the three regions reveals that they are generally small-scale, privately owned gardens. The green areas included in this scope cover 106.000 m^2 in District I, 18.000 m^2 in District II, and 81.000 m^2 in District III. There are no active vertical gardens or rooftop gardens within the

study area or within the province of Rize in general. Although such projects have been implemented in the past, they have not been sustained in the long term due to lack of regular maintenance and lack of sustainability.

Table 2. Distribution and area of open green areas by district

Open Green Areas	District		Area (m^2)
1.Urban Park	II	Deniz Feneri Recreational Area	9800 m^2
		RTE University Recreational Area	21700 m^2
		28 Ağustos Fetih Park	7000 m^2
		Mesut Yılmaz Coastal Park	120000 m^2
		Tea Bazaar	16000 m^2
		Memişağa Park	5000 m^2
	III	İslampaşa-Portakallık Park	40000 m^2
2.Partial Green Area	I.District		106000 m^2
	II.District		18000 m^2
	III.District		81000 m^2
3.Vertical Garden and Roof Garden	I.District		0 m^2
	II.District		0 m^2
	III.District		m^2

3.4. Bicycle and Walking Paths

Pedestrian paths and bicycle paths within the study area were examined and their continuity and route lengths were determined (Figure 6).

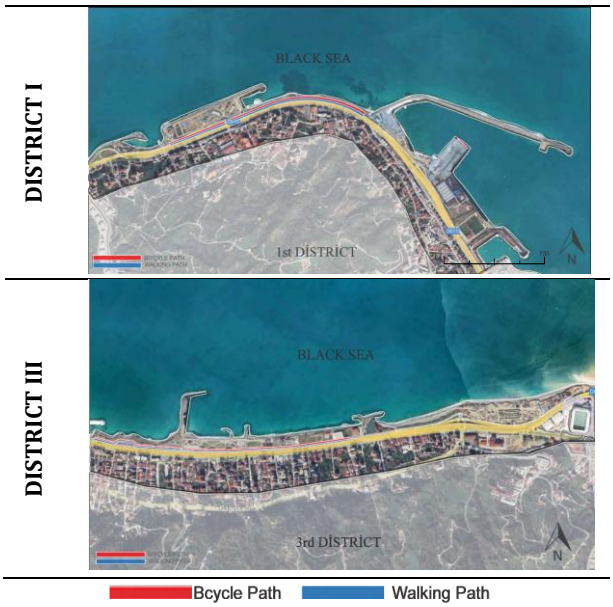

Figure 6. Bicycle and walking paths analysis in the study area.

Studies of bicycle and walking paths along the Rize coastal area reveal an uneven distribution of infrastructure regionally. In District I, the approximately 1.5 km-long walking and bicycle path within the Fener Coastal Recreation Area provides an important public space for coastal use in this area. In District III, a 2 km-long walking and bicycle path is located within İslampaşa-Portakallık Park (Table 3).

Table 3. Distribution and area of bicycle and walking paths by district

	District	Location	Distance (km)
Bicycle And Walking Paths	I	Fener Coastal Recreation Area	1,5 km
	II	There is no specifically designed bicycle or walking path in this area.	-
	III	İslampasa Portakallık Park	2 km

The absence of any established walking or bicycle paths in District II demonstrates the lack of adequate infrastructure and the fragmentation of walking and bicycle paths. This is striking in terms of both user access and regional inequality. The fact that District II holds the largest share of urban park space (as noted in previous findings) demonstrates that this deficiency remains a weakness in spatial planning. In this context, a more holistic approach to coastal areas highlights the need to develop equitable, accessible, and sustainable bicycle and walking infrastructure across all districts.

3.5. Squares/Assembly Areas

Existing squares and assembly areas in Rize province are considered important infrastructure elements within the framework of urban resilience. These areas provide safe gathering places for the public in disasters and emergencies, exchange information, and meet temporary shelter needs. Squares within the Rize province study area were identified through on-site observations. Assembly areas are shown on the map, taking into account the disaster and emergency assembly areas provided by AFAD for the Rize city center.

An analysis of disaster and emergency assembly areas and publicly used urban squares in Rize city center reveals significant regional disparities in open space use. AFAD-designated assembly areas are located in various sizes in Districts I, II, and III, but imbalances are observed in terms of the quality and size of these areas (Figure 7). The largest assembly area in District I is located within the RTE University Campus Garden. Although listed as a total of 77.866 m^2, the actual usable open space is only 5.400 m^2. This suggests that the entire area cannot function as an assembly area due to the density of construction on campus or limited access. The M. Celalettin Ökten Imam Hatip Middle School garden (235 m^2) and the surrounding area of the KYK Girls' Dormitory (1.200 m^2), located in the same area, are quite small and cannot accommodate large population densities in an emergency. District II stands out as the

area with the highest open space capacity in Rize city center in terms of disaster assembly areas. The 185,000 m^2 expanse of the Coastal Filling Area and the Municipality Parking Lot provides a significant advantage for mass emergency evacuations and assembly. In addition to this area, the Rize Central Governor's Ceremony and Park Area (12.000 m^2), Rize Central Square (7.500 m^2), and the surrounding area of Ali Metin Kazancı High School (2.000 m^2) provide a substantial total open space capacity. In District III, Çaykur Didi Stadium and its surrounding area have been designated as a 15.000 m^2 assembly area. While this area appears sufficient for the region, its assembly capacity is limited compared to the city as a whole.

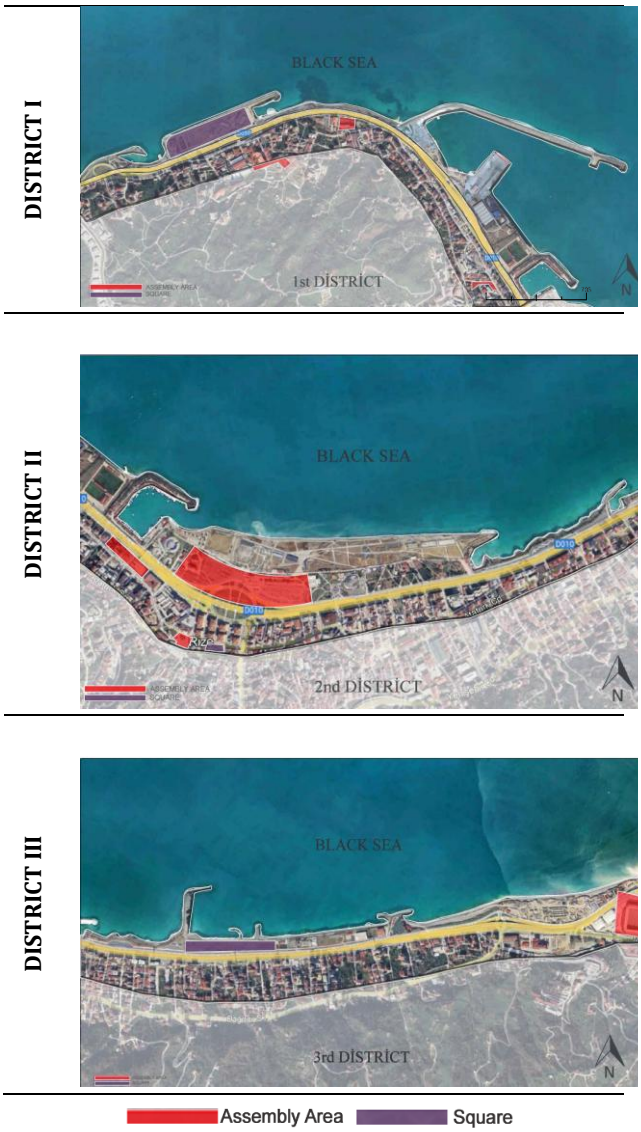

Figure 7. Square and assembly areas analysis in the study area.

A look at the squares category reveals a similarly variable regional distribution. District I offers a significant public open space for the city with 28.000 m^2 within the Fener Coastal Recreation Area. District II boasts areas that play a central role in urban life, with both the Governor's Ceremony and Park Area (12.000 m^2) and Rize Central Square (7.500 m^2). Memişağa Park also contributes to this capacity with 4.300 m^2. In the District, the İslampaşa-Portakallık Park, with its 32.500 m^2 area, attracts attention as one of the largest square areas as well as being a park (Table 4).

Table 4. Distribution of assembly areas and urban squares by district

	District	Location	Open Area (m^2)
Assembly Areas	I	RTE University Campus Garden	5400 m^2
		M. Celalettin Ökten Imam Hatip Middle School	235 m^2
		Rize Central KYK Girls' Dormitory and Surrounding Area	1200 m^2
	II	Rize Central Governor's Office Ceremony and Parking Area	12.000 m^2
		Coastal Filling Area and Municipal Parking Lot	185.000m^2
		Rize Central Square	7500 m^2
	III	Ali Metin Kazancı High School	2000 m^2
		Çaykur Didi Stadium and Surrounding Area	15000 m^2
Squares	I	Fener Coastal Recreation Area	28000 m^2
	II	Rize Central Governor's Office Ceremony and Parking Area	12.000 m^2
		Rize Central Square	7500 m^2
		Memişağa Park	4300 m^2
	III	İslampaşa-Portakallık Park	32500 m^2

When evaluated based on this data, it is observed that disaster assembly areas and squares in Rize city center are concentrated in District II in terms of area size, while existing areas in Districts I and III are more limited. Particularly in the context of disaster management, assembly areas must be distributed equally in terms of both size and accessibility. Furthermore, it should be remembered that these open spaces serve important functions not only in times of disaster but also in terms of the sustainability of daily public life and social resilience.

3.6. New Area Proposals for Urban Resilience

New areas proposed for Rize province to enhance urban resilience aim to increase resilience against natural disaster risks, increase urban open green areas, and improve quality of life. In this context, the proposals were evaluated under three main headings (Figure 1). Urban parks, assembly areas, vertical and rooftop gardens, and walking and bicycle paths not only create safe gathering spaces during disasters but also offer sustainable solutions to the impacts of climate change. These areas also increase the amount of green area in the city, supporting environmental, social, and physical resilience and contributing to the creation of a livable urban

environment. Given Rize's topographic and climatic conditions, such multifunctional areas play a significant role in urban resilience strategies (Figure 8).

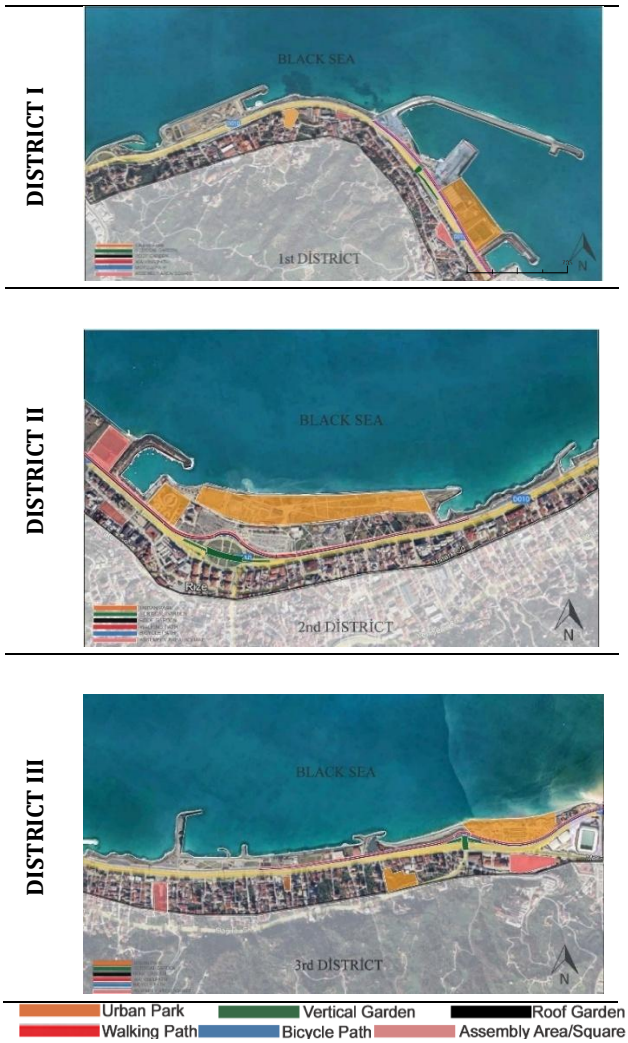

Figure 8. New area proposals for urban resilience.

3.6.1. Open green areas

Increasing open green areas in Rize is a key pillar of urban resilience strategies. Urban parks are important not only for recreational use but also for their potential to create ecological buffer zones against natural disasters.

Within District I, an approximately 10.200 m^2 unused area on Atatürk Street in the Fener neighborhood and a 56.000 m^2 area along the coast are proposed as urban parks. These areas will provide breathing space in densely populated areas and contribute to climate resilience elements such as rainwater management and heat island mitigation. In District II, a 165.000 m^2 area on the coastal embankment is being developed as an urban park. Construction is currently underway, and upon completion, this project will be one of Rize's largest open green areas and serve as a natural protection line against coastal flooding. The area's size and location make it strategically important for both environmental and social resilience. The proposed urban parks in District III are open green areas designed to serve Rize's high-density residential areas, aiming to enhance both psychosocial and ecological resilience in the pre- and post-disaster periods.

The 3.300 m^2 open space located in the Portakallık area of İslampaşa is proposed as a local-scale neighborhood park. It not only meets users' daily recreational needs but also serves as a breathing space during disasters. The 20.000 m^2 expanse next to the Faculty of Medicine is planned as a large urban park, serving both the city and the region. Due to its proximity to healthcare services, this area could also play a critical role in providing temporary post-disaster shelter, gathering places, and psychosocial support activities. The 6.000 m^2 park proposal next to the Kurşunlu Mosque in İslampaşa is considered an open space alternative that will strengthen community solidarity, integrated with religious and social structures. Each of these parks supports climate resilience (rainwater management, temperature regulation, etc.) in the pre-disaster period, while providing safe and accessible social spaces where the public can come together in the post-disaster period.

3.6.2. Bicycle and walking paths

The coastal areas of Rize's city center hold significant potential in terms of natural landscape values and urban accessibility. However, assessments indicate that bicycle and walking paths are inadequate in terms of both spatial continuity and regional distribution. Therefore, establishing an uninterrupted pedestrian and bicycle path along the coast will both support urban mobility and increase public use of the coast. In District I, the existing Fener Coastal Recreation Area, with its bicycle and walking paths, provides an important starting point. It is proposed to extend this path uninterrupted eastward from Rize Port to Mesut Yılmaz Coastal Park. This will connect the region's recreational axes and transform the coast into a continuous and accessible urban green corridor. District II, despite its extensive and high user density, lacks a well-organized walking and bicycle path infrastructure. This limits the effective use of the coast and poses a safety concern. Therefore, a new walking and bicycle path along the coast, integrated with the surrounding urban park, is proposed. This line will both enhance the aesthetic and functional value of the waterfront and provide a comfortable circulation alternative for users. The bicycle and walking path currently located within İslampaşa-Portakallık Park in District III represents a positive start for users. However, this line needs to be extended towards Çaykur Didi Stadium. This will provide uninterrupted coastal access within the district and establish a holistic urban connection between sports fields and public green areas.

Consequently, integrated bicycle and walking paths, designed parallel and uninterrupted to the waterfront in Rize's city center, will both serve sustainable transportation policies and serve as a strategic infrastructure for post-disaster evacuation routes. This planning approach will enable the waterfront to become not only a recreational area but also a vehicle for a

resilient and healthy urban life.

3.6.3. Squares and assembly areas

The proposed assembly areas for District I include the repurposing of currently dysfunctional urban spaces, such as the former Faculty of Dentistry campus (4.000 m^2) and the former bus station (6.000 m^2). These areas, due to their central location and accessibility, hold significant potential as post-disaster assembly points. The proposed assembly areas for District II consist of a 25.000 m^2 area located along the coastline, where existing fields are located, and a 3,000 m^2 unused area used as a parking lot. These areas, thanks to their large surface areas, have the potential to provide safe spaces for mass gatherings. Furthermore, their proximity to a public hospital offers the potential to facilitate access to healthcare services.

The assembly area proposals for District 3, particularly those located in close proximity to densely populated residential areas and public service areas, provide a spatial advantage for rapid response and mass evacuation in times of disaster. The proposed 8,000 m^2 area in the Portakallık area of İslampaşa could serve as a safe assembly and temporary response center in the event of a disaster, thanks to its central location and accessibility. The 20,000 m^2 area near the Faculty of Medicine, with its size and physical capacity, could serve as a significant hub not only for assembly but also for temporary shelter, access to healthcare, and logistical support. These gathering areas have the potential to serve as public squares or open spaces in daily life, and with the right arrangements, they could be used to foster social interaction not only in times of crisis but also during ordinary times.

4. Conclusion and Recommendations

Rize is a city located on the Black Sea coast, topographically limited but rich in natural landscape and cultural values. The findings of this study revealed that the city's existing open green area structure is fragmented, spatially unbalanced, and lacks functional continuity. As the results indicated, green infrastructure is still limited in the study area, which highlights the need for integrated strategies in coastal cities. The uneven area and distribution of city parks is striking. While District II boasts large-scale parks, particularly Mesut Yılmaz Coastal Park, parks in Districts I and III are more limited in number and scale. Furthermore, it has been observed that fragmented green areas do not form a systematic network and are mostly small-scale, located within private property boundaries. While contemporary green infrastructure solutions such as vertical gardens and rooftop gardens have been attempted in the past, they have not been sustained and have not been actively implemented throughout Rize.

Regarding pedestrian and bicycle paths, only limited examples exist in Districts I and III, and District II lacks a designated route. However, The district is in greatest need of these types of infrastructure, given its urban density and the vastness of its coastal area. The lack of an integrated bicycle and walking path network along the coast undermines both transportation models that support healthy living and post-disaster evacuation scenarios. This fragmentation is a significant shortcoming in sustainable transportation systems and accessible public space policies.

A similar inequality exists in terms of disaster and emergency assembly areas. While District II boasts large-scale assembly areas such as the Coastal Landfill and the Municipal Parking Lot, existing areas in Districts I and III are small, scattered, and of limited functionality. Areas like the university campus, in particular, appear large but lack sufficient accessible and usable open space. Considering the critical role of assembly areas in times of disaster, this structural imbalance poses a risk to urban resilience.

In light of all this, Rize, a coastal city facing the pressures of climate change, disaster risk, and rapid construction, needs to address green infrastructure strategies with a holistic approach. It is crucial not only to increase the number of green areas but also to establish ecological and functional connections between these spaces and design multifunctional spaces that serve different user groups. Walking and bicycle paths should be connected to form a continuous line along the coastline, integrating this line with urban parks, squares, and recreational areas. This will both strengthen urban mobility and enhance the social and physical resilience of coastal areas.

The findings of this study align with the broader literature emphasizing that urban resilience depends on the integration of ecological, social, and spatial systems rather than isolated infrastructural interventions. Similar to Godschalk's (2003) view that resilient cities require the coordination of physical and social networks, the case of Rize demonstrates that open-green spaces function as both environmental buffers and community-based resilience hubs. Moreover, as Beatley and Newman (2013) highlight, biophilic and nature-integrated design principles play a key role in sustaining livable and adaptive urban environments; the proposed strategies in this study reflect this approach by reinforcing green infrastructure and human–nature connections. Consistent with Meerow et al. (2016), who underline the need for multi-scalar and flexible planning frameworks, this study's action-oriented recommendations contribute to developing adaptive and inclusive planning practices for coastal cities. Similarly, Staddon et al. (2018) and Roggema (2020) note that resilience must be conceptualized as a dynamic and iterative process; in this sense, Rize's proposed strategies represent a locally grounded yet transferable model that integrates both environmental sustainability and social adaptability.

At the same time, unused urban spaces should be transformed into green areas, vertical and rooftop gardens should be encouraged using natural species in a climate-appropriate manner, and disaster recovery areas

throughout the city should be increased in both number and capacity. This transformation should be considered not only as an environmental but also as a social and administrative action, supported by strategies that are applicable in collaboration with the public, local government, and civil society, and aligned with the local context.

In conclusion, for Rize to become a resilient, healthy, and livable coastal city in the future, open green area strategies should be addressed with a holistic vision. These spaces should be central to urban planning, not only for aesthetic purposes but also as tools for climate adaptation, disaster management, and social integration. The strategic orientations and action plans developed in this context will provide long-term, sustainable guidance for Rize's urban transformation process.

4.1. Open Green Area Strategies and Action Plans for Resilient Coastal Cities

Green area strategies and action planning play a crucial role in increasing urban resilience. This study aims to increase the city's resilience to climate change, crises, and stress-related situations through green area planning and implementation in Rize province. Effective green area planning is crucial for sustainability, functionality, and security; these areas are fundamental to maintaining the ecological balance of cities and improving the quality of life of the public. The study aims to increase the city's biodiversity, improve air quality, and significantly enhance the public's quality of life by expanding green areas and improving existing areas. Innovative and sustainable solutions aim to contribute to making urban areas more aesthetically, functionally, and environmentally attractive, livable, and resilient. The implementation of these green area strategies and action plans aims to strengthen the sustainability of urban infrastructure and social cohesion. These strategies enable the creation of an urban structure prepared for potential future crises. The protection and development of green areas aim not only to improve current urban life but also to contribute to building more livable, resilient, and sustainable cities for future generations. In this context, the strategic management and long-term protection of green areas is critical to the future of cities. Green area strategies are indispensable tools for achieving the goals of not only increasing urban resilience, but also preserving ecological balance, improving public health, and creating sustainable cities.

Rize province, located on the Black Sea coast of Türkiye, stands out as a priority intervention area for resilient urban planning due to both its topographic limitations and high disaster risk (especially landslides, floods, and coastal inundations). In this study, open green area systems in Rize province were evaluated using the parameters of urban parks, fragmented green areas, vertical and rooftop gardens, walking and bicycle paths, squares, and disaster gathering areas. Strategic and action plans were developed in line with urban resilience principles.

An uninterrupted walking and bicycle route integrated with urban parks is proposed along the coast, increasing urban mobility and supporting post-disaster evacuation scenarios.

- Due to dense construction and land limitations, traditional horizontal green area solutions are insufficient in cities like Rize. Therefore, vertical gardens and rooftop gardens are important tools for both enhancing visual landscape quality and providing ecosystem services such as carbon sequestration, reducing the heat island effect, and rainwater management. A municipally supported "Green Roof Incentive Program" is proposed for structures with rooftop potential on existing buildings.
- The capacity of existing small-scale assembly areas should be increased, and new areas (e.g., the old bus station area) should be transformed into green assembly areas.
- It is proposed that spatial spaces be transformed into multifunctional green assembly areas. Incorporating infrastructure components such as shade shelters, water points, emergency information boards, and solar lighting in these areas will provide functional value both during crises and for daily use.
- The content of assembly areas should be repurposed.
- Privately owned gardens and semi-public spaces should be integrated into the green network system, adopting a participatory planning model.
- Small green areas and parks should be connected by bicycle and pedestrian paths and landscape transitions to create a functional green network.
- Transforming idle urban areas into green infrastructure will not only contribute to the environment but also support social integration, physical activity, and disaster resilience. Urban gardens, playgrounds, rain gardens, passive recreational areas, and educational open spaces should be integrated into these areas according to biophilic design principles.
- Green areas should be planned and implemented to adapt to climate change.

The strategy and action plans developed within the scope of the study provide a holistic framework to address deficiencies in Rize's existing open green area infrastructure and facilitate the transition to a resilient coastal city model. Uninterrupted pedestrian and bicycle paths along the coast, the transformation of fragmented areas into ecological corridors, the expansion of vertical and rooftop gardens featuring natural species, and the reuse of disaster gathering areas will enhance not only spatial but also social and ecological resilience. This approach will transform Rize into a city that is not only resilient to disasters but also a healthy, accessible, and sustainable urban system. Furthermore, integrating resilience-based spatial strategies with lifelong and participatory learning processes can enhance the social dimension of urban resilience, fostering adaptive and community-oriented design approaches (Dinçer et al.,

2022). Ultimately, this model, developed using the example of Rize, aims to provide a guide applicable to other coastal cities with similar geographical and socio-ecological vulnerabilities.

Author Contributions

The percentages of the authors' contributions are presented below. All authors reviewed and approved the final version of the manuscript.

	M.S	Ş.B.
C	90	10
D	90	10
S	100	0
DCP	40	60
DAI	50	50
L	80	20
W	60	40
CR	80	20
SR	100	0
PM	100	0

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Consideration

Ethics committee approval was not required for this study because of there was no study on animals or humans.

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