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Measuring the Green Infrastructure Resilience in Turkey

KARABAKAN Berfin

Department of City and Regional Planning
Izmir Institute of Technology
İzmir, Turkey 100/2000 YOK
(Higher Education Council) Scholarship Holder
bkarabakan66@gmail.com

MERT Yelda

Department of City and Regional Planning
İskenderun Technical University (ISTE)
Iskenderun, Hatay, Turkey
yelda.mert@iste.edu.tr

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Cities today face significant difficulties and even risks due to the negative effects of climate change, uncontrolled urbanization, and rapid population growth. Many urban scenarios are being developed to mitigate potential risks and threats. One branch of these scenarios is built upon the concept of sustainability, for which the notion of "resilience" is of utmost importance. It is this notion of resilience that was examined in this study, based on the case of socio-ecological system features of Edremit, Van, Turkey. These features were evaluated in terms of changes that will potentially take place, and the analysis for this was performed using the Green Infrastructure Spatial Planning (GISP) method. In this approach, green infrastructure benefit criteria are mapped in the Geographic Information System (GIS) environment and various conclusions are drawn from the evaluation of these maps. The results of the study show that the green infrastructure systems of Edremit play an important role in providing a certain degree of resilience. It was, therefore, revealed as part of this study that measuring and evaluating the resilience properties of different cities is important. Also, urban policies and spatial strategies should be defined considering local characteristics and values as there is no one-size-fits-all solution in this regard.

Keywords: Resilience; urbanization; urban resilience; socio-ecological systems; green infrastructure systems; sustainability.

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1. Introduction

Various studies are carried out in areas related to solving potential problems foreseen as part of the future. As nodes of dense human populations, cities constitute an important place in such studies. More than half of the world's population live in cities and this number grows every day. This rapid urbanization brings with it many challenges and threats. The most important amongst these is arguably the sustainable development of the world. Considering this, various urban scenarios have been developed by researchers to address the need for sustainable and liveable cities for the future of humanity. These solutions include sustainable city development, smart cities, resilient cities, eco-cities, garden cities, etc.

The "resilient city scenario" is a solution that is enjoying a renewed interest amongst the researchers. The term "resilience" appears as a notion associated with different concepts in many disciplines (see Fig. 1) in the literature (Alexander, 2013). The idea of resilience is used in different fields such as psychology, structural engineering and management strategy, but in the social sciences, it is primarily discussed in the context of society and ecology. In engineering, resilience is generally defined as the capacity of a system to resist an interruption and bounce back (Davoudi, 2012). Resilience is mainly defined as the ability to cope with destruction occurring within a system (Walker and Salt, 2006). The concept of resilience first appeared in ecology-focused studies in the 1970s. Specifically in the field of planning, as a response to the increasing effects of climate change in urban areas, resilience was brought in to game by only late 1980s (Holling, 1985). Resilience in this perspective can be defined as the ability to cope with all the hazardous situations that a

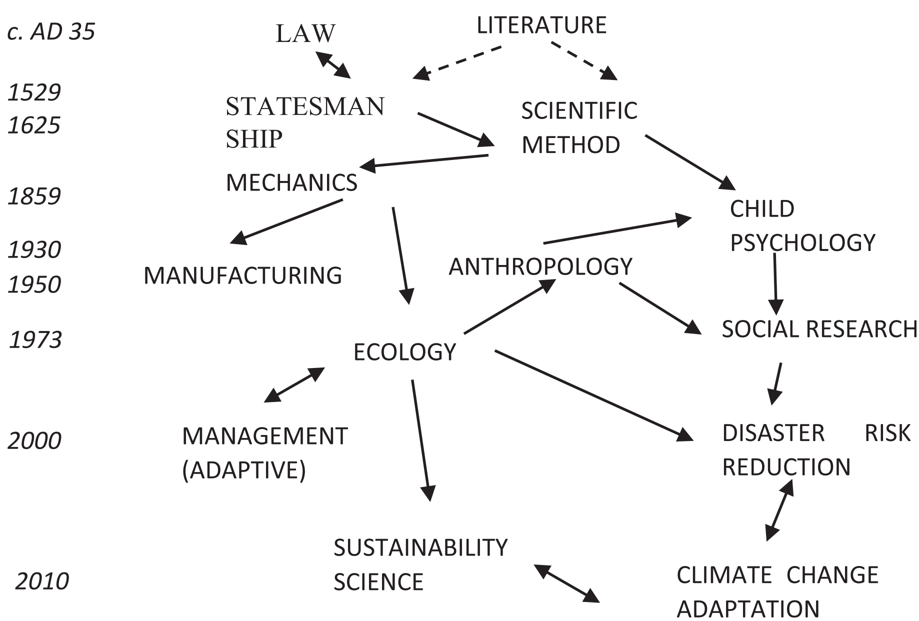

Fig. 1. Schematic diagram of the evolution of the term "resilience" (Alexander, 2013).

city may encounter in the physical, environmental, social, and economic frameworks and the ability whether a city has systems that will adapt and respond to these situations as rapidly as possible.

In the 1990s, resilience received attention in the field of planning and was included in the studies. Since then, the concept of resilience have been considered regarding existing and future risks that are threats for many cities, and many policies are already being developed through scientific studies (Meerow *et al.*, 2016). The United Nations International Strategy for Disaster Reduction (UNISDR) defines resilience as "The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" (UNISDR, 2009). The primary aim of the resilience theory is to contribute to complex socio-ecological systems and their sustainable management, especially to climate change (Meerow *et al.*, 2016). Socio-ecological systems have also been examined as part of such studies, revealing how the complexity caused by the mutual relationship between humans and nature is linked to the negativities experienced. The socio-ecological approach reveals the necessity of resilience in order to cope with possible uncertainties in the future, as all systems are in a continuous change cycle with nonlinear ways (Rodin, 2014). In this context, both ecological systems and social systems were found to have important roles in determining the overall resilience of an urban location. The significance of sustainable designs and the current global discourse on climate change adaptation have also been taken into account in many studies (Emmanuel and Krüger, 2012; Roostaie *et al.*, 2019).

Various basic practices and measures are discussed to integrate the idea of resilience into urban planning theory and practice (Sharifi, 2019). Since resilience is emerging as a new focus of planning, application methods should be characterized and the differences in applying the concept compared to classical plans should be revealed. Achieving these objectives will help the resilience methods to further develop the cities healthily.

2. Resilience and Socio-Ecologic Resilience

Resilience is an expression most used to demonstrate the ability to quickly return to the previous state. In human geography research, however, the concept of resilience has been used to define the relations of capacity, diversity, and stability in human societies (Zimmerer, 1994). At this point, it should also be emphasized that there are various definitions and interpretations of the term based on the discipline it's being used in, but generally, the term resilience corresponds to a certain type of strength and endurance (Stead, 2014).

Hudson (2010) defines a "resilience system" as a system capable of adapting without going out of the orbit of development or switching to a new system, adjusting and adapting to change without harming system balances. The Rockefeller Foundation (2019) explains the concept of resilience on the topic of climate change and treats it as a capacity to "respond to changing climatic conditions and any corresponding impacts". Biggs *et al.* (2015) define resilience as "the capacity to cope with change and the ability to

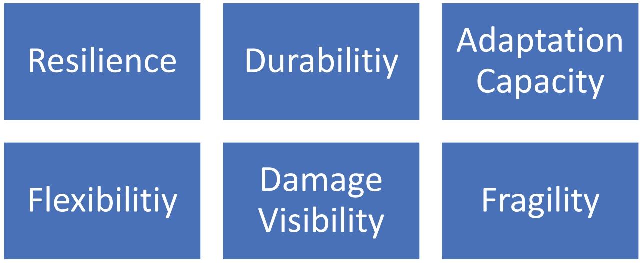

Fig. 2. Concepts related to resilience (Karabakan, 2020).

continue to evolve", and claim that the resilience of an ecosystem qualifies as a measure of "how much discomfort an ecosystem can handle in a qualitatively different state".

The network topology method for the urban street network was used in a study as a combination of nodes and links for investigating relationships between "urban resilience" and different centrality and connectivity measures related to network topology (Sharifi, 2019). The results provide insights into the physical properties that are required to design resilient streets and street networks.

The concept of resilience with different meanings has been associated with various other notions as well, such as durability, flexibility, adaptability, loss/damage visibility and fragility (see Fig. 2). Among these concepts, the relationship between vulnerability and resilience is discussed extensively in recent studies, where one is often seen as the opposite of the other.

Many local governments around the world are developing resilience plans for their cities. Besides, efforts are being made to develop greener, fairer, and less susceptible cities based on resilience planning, land use, and comprehensive heritage and sustainability planning.

Socio-ecological resilience is based on the idea that ecological and socio-economic systems are related and can influence each other. In this idea, the emphasis is that the socio-ecological systems contribute to sustainability in the long term (Bingeman *et al.*, 2004). The concept of socio-ecological resilience recognizes the interdependence between people and nature and the importance of viewing and analyzing the two as a connected and dynamic system (Walker *et al.*, 2016).

There has been a positive trend towards an urban infrastructure concept which includes the green infrastructure idea in planning. Green infrastructure has been developed as an important approach that helps create functional, sustainable, and liveable cities (Meerow, 2017). Green infrastructure systems play a major role in ensuring urban resilience, and when it's not implemented with proper urbanization policies, the residents are deprived of its many benefits. These benefits include improved rainwater management, access to urban green areas, reduced effect of urban heat island, better air quality, closer natural landscape connections and decreased social sensitivity (Meerow, 2017).

3. Materials and Methods

This study was conducted by performing a multi-dimensional resilience analysis for a section of the Edremit district of Van province of Turkey. For this purpose, the study area was evaluated in terms of a total of six criteria (Table 1) with an approach based on the Green Infrastructure Spatial Planning (GISP) model (Meerow, 2017). These criteria are as follows.

(a) Rainwater management.
(b) Green area accessibility.
(c) Landscape connections.
(d) Air quality.
(e) Urban heat island effect.
(f) Social sensitivity is shaped.

The GISP model chosen as the main method in the study is based on the Geographic Information System (GIS), which has been evolved into a multi-component method, including stakeholder analysis. For each of these components, the most appropriate analysis method is applied depending on the local conditions and the data available. In the situation analysis for the six criteria of this study, all spatial data were converted into raster data in the GIS environment, which were then converted into a format suitable for use.

Criterion (a): Urban flood sensitivity analysis was deemed suitable for the rainwater management criterion. In the context of this analysis, the slope, elevation, lithology, land use, water table depth, and active channel distance information was obtained from existing maps (Selçuk *et al.*, 2016). Each of the six layers was defined in the GIS by the average weighted values, and a flood sensitivity model was created.

Table 1. Spatial indicators and data sources for the criteria (Karabakan, 2020).

Criteria	Spatial indicators	Data sources
Stormwater management	Data analysis of six spatial layers (slope, elevation, lithology, land use, water table depth and active channel distance)	Six layer maps produced from the current map of 1/1000 scale (Selçuk *et al.*, 2016)
Green spaces accessibility	Population forecast without access to the park; Active green areas located within 500 meters of residential areas	The road network layer, active green area layer, and TÜİK neighborhood data of 2018 produced from Edremit current map
Urban heat island effect	Land surface temperatures	Temperature average data for July/2018 and August/2018
Landscapes connectivity	The physical connection of natural habitat	Green area data from land use of 2018
Air quality	Vehicle-induced particulate matter emissions	Continuous and portable vehicle count station data of the 11th Regional Highways Directorate of 2018
Social vulnerability	Indicators that are related to social vulnerability	TUIK social, education, and economic indicator data for 2018

Criterion (b): Another criterion was the overall access to the green areas. GIS was used as a tool to calculate distances as well as the time required to walk to the nearest green area. All spatial locations within a walking distance (500 meters) to a park constitute the basic data for the analysis. In the study, Edremit neighborhood borders, open green area borders (parks, playgrounds, public green spaces belonging to public institutions, and urban parks), street and road networks, and the demographic data layers were used to determine access to green areas. Access points of the parks along the walkable road networks were also defined. A dataset was thus created using the Network Analysis in the GIS, and the population count that was within walking distance to green areas was obtained.

Criterion (c): This criterion was the evaluation of the landscape connection, for which the "land use data" and the "dense green texture" in the Edremit district were determined as main data points. Green texture polygon layers were created and were then converted into raster data using the Geospatial Modelling Environment software. Landscape metrics in the GIS were then used to measure the physical connection between habitat patches.

Criterion (d): In the analysis of the "urban heat island" effect, the average daytime surface temperature of Edremit (July–August, 2018) was calculated for the year 2018. Temperature data for 100 meters of meshes were obtained using Landsat 8. The temperature data derived from the study area were then compared and analyzed. The LTS tool was used using the ERDAS IMAGE model marker for the extraction of urban heat islands.

Criterion (e): In the air quality assessment based on traffic emissions, the data were obtained by considering the daily number of vehicles passing through Edremit main road arteries, Bitlis–Van highway, and Van–Hakkari highway. The average amount of particulate matter spread by pollutants was multiplied by the total number of vehicles, and the impact areas with a distance of 300, 200 and 100 m were evaluated using the buffer analysis tool in the GIS.

Criterion (f): In the social vulnerability analysis, partial data from TurkStat 2018 Van-Edremit socio-economic, population and demography, and health data were used. A total of six variables were used in the model, which did not allow for a holistic study due to insufficient volumes of data. The data obtained were mapped by applying a normalization process in the GIS environment, and then defining the data features. In the next stage, weighing was applied to the indicators and a social vulnerability map with percentage values was created.

In addition to these criteria, an expert survey analysis was also performed within this framework with the contribution of participants from different disciplines (Urban Planner, Architect, Landscape Architect, and Environmental Engineer). In the surveys, the participants were asked to evaluate the six criteria with a score ranging between 1 and 6 to determine a priority level for each of them. A lower score meant a higher priority. The weighted average of the survey results was evaluated and brought into the analysis.

4. Case Study Area: Edremit, Van, Turkey

The province of Van is located in the Eastern Anatolian region of Turkey (Fig. 3). Edremit district is in the city centrum, on the shores of the Van Lake. Together with İpekyolu and

Fig. 3. Location of the case area: Edremit, Van in Turkey.

Tusba districts, Edremit is built within the largest closed basin of Anatolia. The district itself is located towards the south of the city centrum and is positioned by the lake.

The district is neighbored by the Gürpınar district in the east, Van Lake in the west, and Gevaş district in the south. It has a population of 125.884 (TÜİK, 2018) distributed in a total of 27 neighborhoods in the district. Of these neighborhoods, the Yeni Cami, Eski Cami, Yeni Mahalle, Erdemkent, Erenkent, and Esentepe neighborhoods constitute the study area (see Fig. 4). The total population of these six neighborhoods is 22.674 (TÜİK, 2018).

Edremit District has an important place in the city of Van with its unique texture. Besides being located on the shores of Lake Van, it is a value for the city of Van with its dense green texture (Figs. 5 and 6). Recreation areas on the coastline of the district are important public areas serving the city and are used extensively by urban residents.

The neighborhoods near the shore of Van Lake (Eski Cami, Yeni Cami and Yeni Mahalle) attract attention with their green texture and low construction densities. Additional housing for the city was needed after the 7.1 magnitude earthquake in 2011, and it was planned and

Fig. 4. Neighborhood borders in the case of Edremit.

Fig. 5. General view of Edremit.

Source: Author archive, July 2019.

Fig. 6. The texture of Eski Cami, Yeni Cami, and Yeni neighborhoods.

built in the south of Edremit district (Erenkent and Esentepe neighborhoods). The region where the mass housing is built attracts attention with intensive construction (Fig. 7).

5. Analysis and Evaluation

With the GISP approach applied in this study Edremit district's rainwater management, access to the green area, urban heat island effect, air quality, landscape connections, and social vulnerability criteria were analyzed (Meerow, 2017). The results of these analyses were used to evaluate regional resilience in terms of green infrastructure. In addition, the consulting expert opinions were taken into consideration and combined with weighted averages of the survey results. The results were then evaluated to finalize the analysis.

Source: Author archive, July 2019.

Fig. 7. The texture of Erenkent, Erdemkent and Esentepe neighborhoods.

5.1. *Stormwater management*

Stormwater management, which is an important component of urban green infrastructure, provides important benefits such as carbon dioxide reduction, efficient use of energy, improvement of air quality, prevention of disasters, and water quality (McFarland *et al.*, 2019). Green infrastructure systems play a role in reducing the vulnerability of urban systems against storm waters and floods (Meerow, 2017).

In the rainwater management analysis for Edremit District, six different layers (Fig. 8) (active channel distance, slope, land use, lithology, height and water table depth) were evaluated and a flood sensitivity analysis was performed. The results show (Fig. 9) that the flood sensitivity is low in areas parallel to the lakeshore where the urban texture is preserved. However, it is observed that flood sensitivity is higher in urbanized areas where more impermeable surfaces exist.

5.2. *Greenspace accessibility*

Green areas are an important factor in determining the livability and the quality of life of a city. From the neighborhood scale to city-wide applications, light green spaces designed for different purposes offer opportunities for residents' recreational activities like sports and entertainment (Stessens *et al.*, 2017). They also contribute to the improvement of air quality, help mitigate climate change, and help stormwater control (Fan *et al.*, 2017). Green spaces are therefore an important application for local and central governments to improve urban space and life quality. Green spaces constitute an important part of urban green infrastructure systems. It has been revealed that the existence and accessibility of green spaces, which provide the capacity to withstand the stress and risks caused by climate change, play a role in providing physical and social resilience and climate

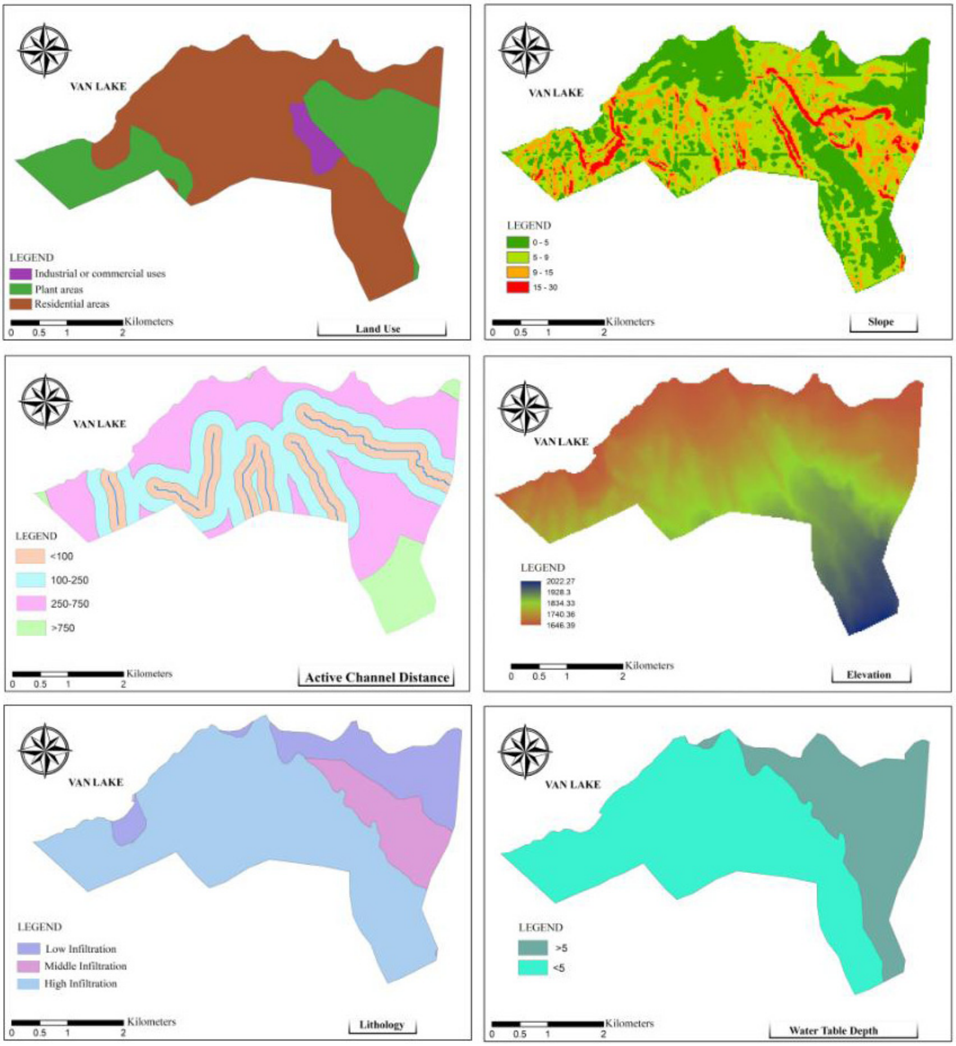

Fig. 8. Edremit stormwater management (Karabakan, 2020). (a) Land use, (b) slope, (c) active channel distance, (d) elevation, (e) lithology and (f) water table depth.

adaptation services (Pamukcu-Albers *et al.*, 2021). The green spaces of different scales in the city, the people who can access these areas and the fact that the green areas are at a level to meet the recreational activities are important factors in meeting the need for green spaces (Cetin, 2015). When access to green spaces shows a balanced distribution within urban distances, it is an important criterion in providing social resilience by enabling recreational activities and physical resilience by contributing to the urban ecosystem.

While planning the green space, which spaces will be determined as green spaces and how many people will go to the green area? It is based on the criterion of maximizing accessibility in order to make it easier to access within a certain time. In addition, the

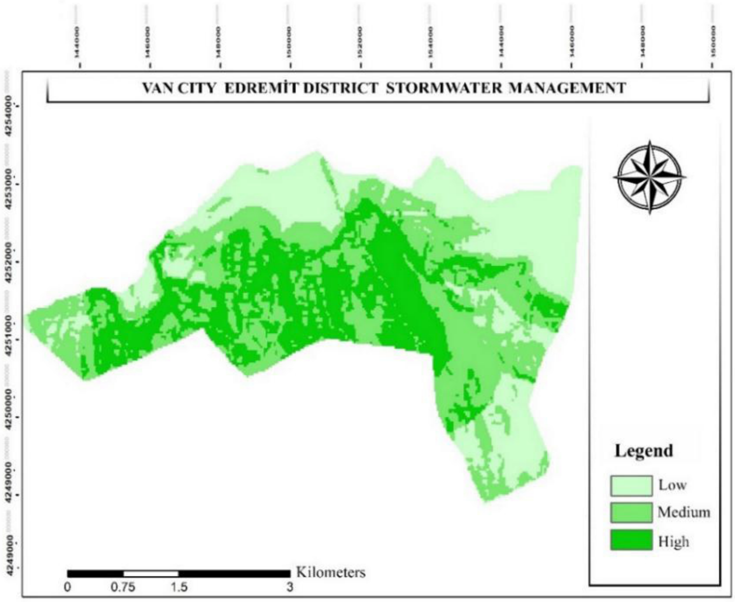

Fig. 9. Combined stormwater management with flood sensitivity analysis in Van/Edremit (Karabakan, 2020).

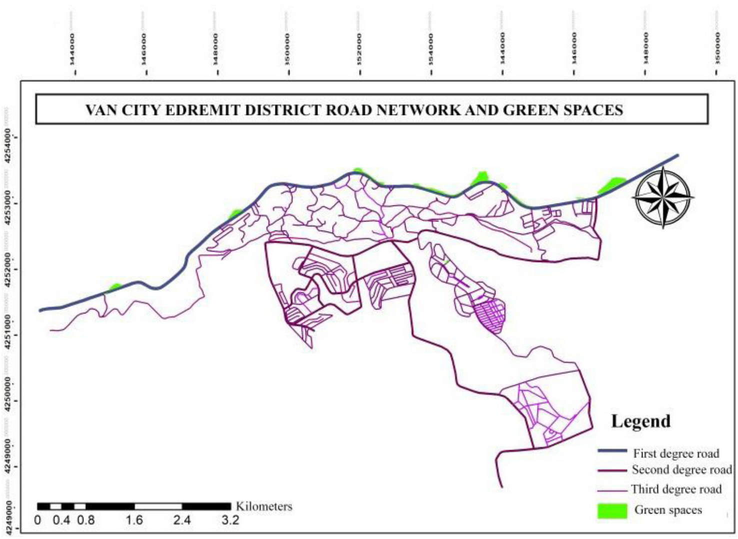

Fig. 10. Road network and green spaces (Karabakan, 2020).

characteristics of low-income and minority social groups that do not have access to the benefits of green spaces should be defined and it should be aimed to minimize this social inequality in access (La Rosa, 2014). Reducing the sensitivities that arise in this context is important for creating a resilience community.

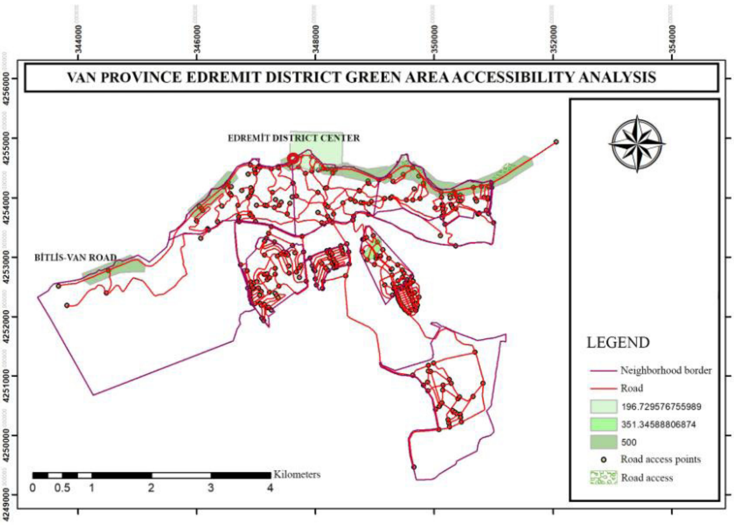

Fig. 11. Green spaces and access analysis (Karabakan, 2020).

Several public green spaces serve the denizens in the shoreline regions of the Edremit district. Green areas are also quite dense in the settlement area (Yeni Cami and Eski Cami neighborhoods) between the coastal area and the second-degree artery extending in the east–west direction parallel to the shore (Fig. 10). However, since this dense green spaces mostly consists of private properties, it is in a passive-green position.

The resulting green space for the public housing areas (in Erdemkent, Erenkent and Esentepe neighborhoods) towards the south of the district is not compatible with the requirements of the densely populated location. It is believed that this insufficient active green area affects the quality of life in the region negatively.

When the green area accessible (Fig. 11) to the population was analyzed, it was revealed that 42% of the population in the study area had access to planned green areas within a walking distance (500 meters) from their residential areas. The reason for the relatively less access to green areas despite the district having a dense green texture is that most of these areas belong to private properties, and therefore are closed to public access.

It is noteworthy that in Fig. 12 where the population densities are shown together with the access analysis, the accessibility is very low for the densely populated areas. In the neighborhoods on the coastal strip within the study area, access to green areas is high. Despite the high-density population in the mass housing areas, on the other hand, there is no access to any green areas.

5.3. *Urban heat island effect*

The literature studies suggest that the most suitable time for data collection for urban heat island effect research is during the intervals where temperatures are the highest. In this study, the data obtained from the regional meteorology station in Van were examined, and the data from the hottest two months (July 24.8°C and August 23.6°C, average) were used

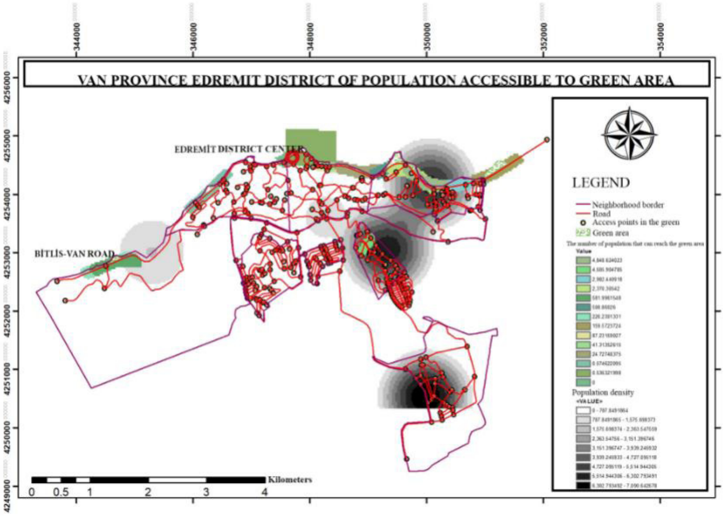

Fig. 12. Green spaces and access population (Karabakan, 2020).

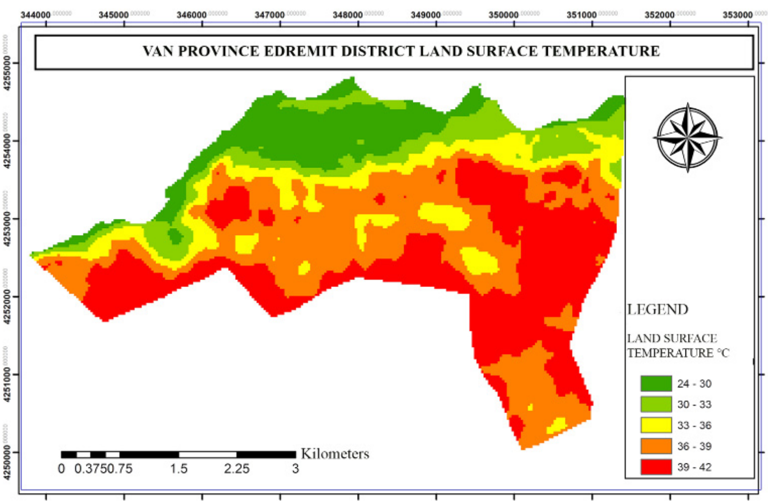

Fig. 13. Land surface temperatures (Karabakan, 2020).

in the analysis. These data were used to construct an urban heat island map for the Edremit District (Fig. 13).

Inspecting this map, it is evident that the urban heat island effect is high in Erdemkent, Erenkent and Esentepe neighborhoods where the residential areas and hard floors are the most common in the district, resulting in surface temperatures ranging between 36 and 42 degrees Celsius. Remarkably, the effects of urban heat islands are quite weak in Eski Cami and Yeni Cami neighborhoods due to the presence of an intense green texture and low construction density (Fig. 14).

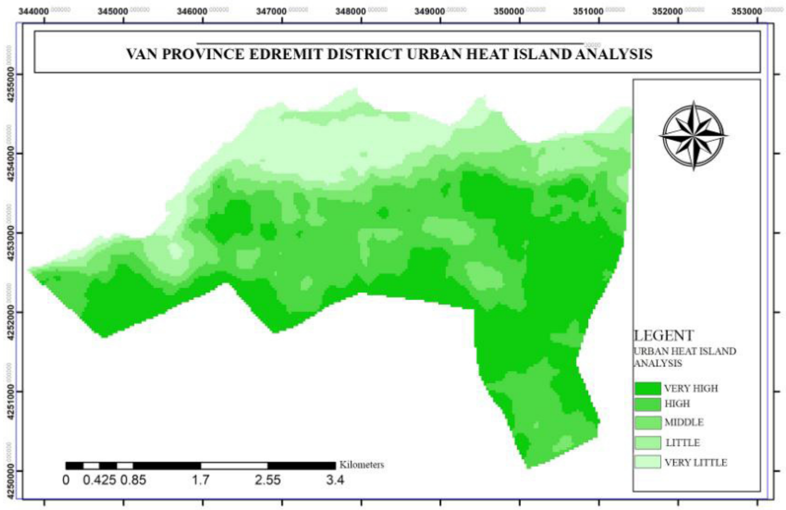

Fig. 14. Urban heat island effect (Karabakan, 2020).

For the area where the new housing sites were constructed after the earthquake, however, a high urban heat island effect seems inevitable because the area has a very high construction density and the social facilities are insufficient. The site also has a high density of hard grounds (impermeable surfaces). Due to the province having 1,800 meters' altitude, the temperature felt in sunny weather is relatively high. The excessive hard floors in this case further increase the heat island effect by causing high surface temperatures, and negatively affect the comfort of the inhabitants. Inclusion of passive green space in the urban heat island analysis shows that there is a passive green space covering a dense area on the land cover. The fact that the water surface provides a heat reducing effect plays an important role in the low urban heat island effect in the Eski Cami, Yeni Cami and Yeni neighborhoods, because they are on the coast of Lake Van.

5.4. *Landscape connectivity*

Under the influence of constant land cover changes that take place without proper planning, the size and continuity of natural habitats are decreasing. This decrease results in the functional disintegration of certain green areas, the areas that still preserve their natural texture are becoming increasingly important (Meerow, 2017). It is possible to see various criteria in the literature of landscape connections, which are a guide for making conservation decisions of natural habitats. Decision-makers are required to evaluate the most appropriate criteria and to produce conservation policies according to the assessment.

Edremit district is an important recreation center in the city of Van due to its green texture. In addition to being located on the lake coast, the district has a high volume of passive green areas (including private properties), and its landscape connections are high (see Fig. 15). However, the connection in Erdemkent, Erenkent and Esentepe neighborhoods planned after 2011 was found to be weaker in comparison (Karabakan, 2020).

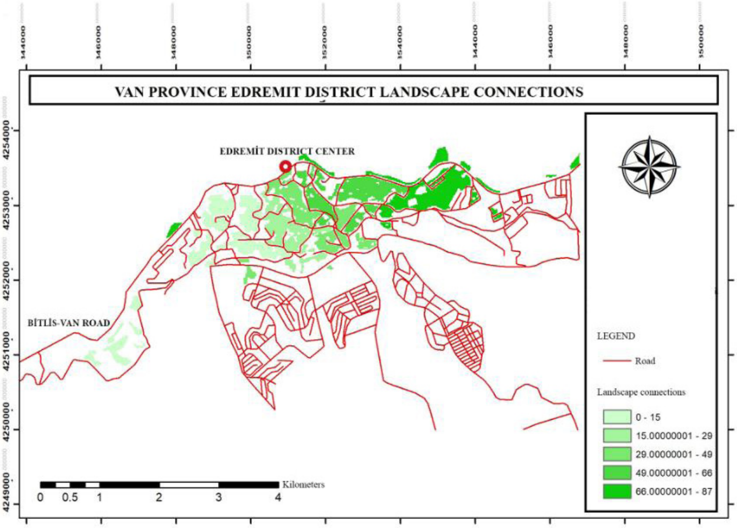

Fig. 15. Landscape connectivity analysis (Karabakan, 2020).

Table 2. Spatial statistics of landscape connections' current situation.

SDI	SEI	AWMSI	MSI	CA
3.771062	0.848831	1893019	1675455	2.17326
TE	ED	MPE	MPS	
72.28236	33.259877	0.0803137	0.024147	
MPAR	NumP	MPFD	MedPS	
143.918829	90	1	0.0127	

Following the criterion, spatial statistics of patch density and size, shape and edge metrics were examined. As a result of the statistics, the average shape index (MSI) was determined as 1.675.455 m^2 and the total landscape area value (TLA) was found to be 2.17326 m^2 (see Table 2).

5.5. *Air quality*

Air pollution is one of the most important problems of urbanization, and its effects are being felt at an increasing rate locally, regionally and globally. Urban areas are usually exposed to air pollution caused by a variety of sources, but due to the low industrial settlement, the widespread use of natural gas, and low traffic density, the situation is not as dire in the study area (Jayasooriya *et al.*, 2017).

The data regarding air pollution of vehicular sources used in the air pollution assessment of Edremit district were modeled according to the General Directorate of Highways (Karayolları Genel Müdürlüğü, 2018) traffic data, and were evaluated over two station points. When these results were examined, Van-Bitlis highway was found to be the region

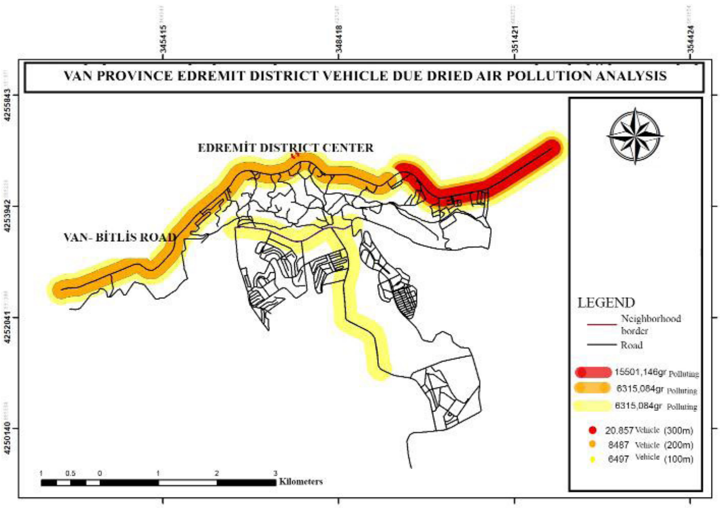

Fig. 16. Vehicle sourced air pollution analysis in Edremit district (Karabakan, 2020).

Table 3. Edremit district social vulnerability indicators (TÜİK, 2018).

Neighborhood	Population	Female population	Household population	Population below 15	Population over 65	Illiterate population	Disabled population	Integrated sensitivity rates (%)
Yeni Cami	1,072	551	254	268	97	58	18	2.7
Eski Cami	1,679	840	361	474	107	49	27	4
Y. Mahalle	6,076	3,060	1,268	2,015	196	203	100	15.3
Erenkent	16,583	8,319	4,470	5,225	602	354	274	41
Erdemkentt	6,391	3,109	1,753	2,328	90	53	106	15
Esentepe	7,456	3,751	1,843	2,850	128	176	123	21

where the highest number of vehicles passes per day, which is incidentally where the pollutant rate is most intense (see Fig. 16). As a result of the data received from the two stations, the total amount of vehicle air pollutants was calculated as 6.284 kg/day.

5.6. *Social vulnerability*

The term vulnerability is commonly used in many different fields such as psychology, social work, ecology, gender studies, sociology and geography. Social vulnerability refers to potential negative situations that may affect people. While evaluating the resilience of a city, the ability of its social systems to cope with the threats should also be evaluated along with its physical systems (Berkes, 2007). In that regard, social vulnerability is considered to be the measure of the resilience of societies against stress sources like outside pressure, natural or human-made disasters, or disease outbreaks. The resilience approach addresses the biophysical, social, and economic elements of a region as a single socio-ecological component (Walker *et al.*, 2016).

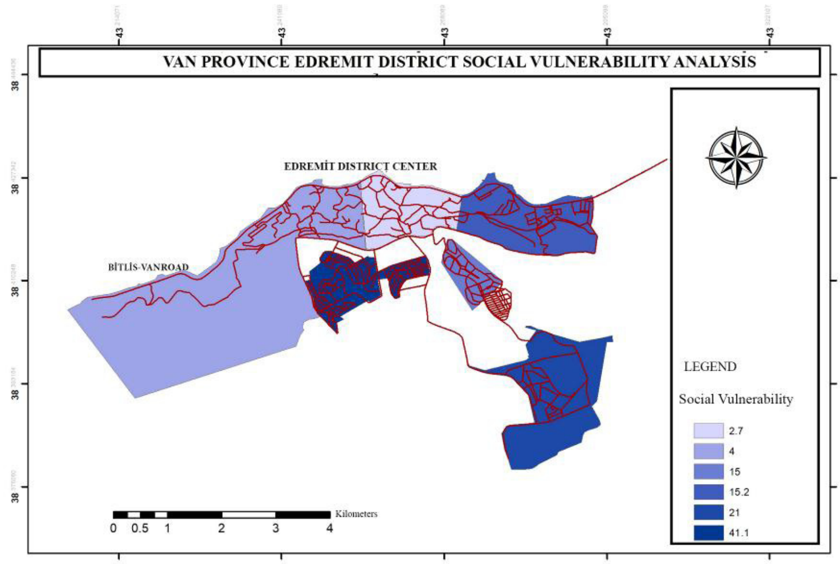

Fig. 17. Social vulnerability analysis (Karabakan, 2020).

Table 4. Weighted averages of social vulnerability criteria.

Yeni Cami	Eski Cami	Yeni Mahalle	Erenkent	Erdemkent	Esentepe
0.126009	0.18668	0.714051	1.91347	0.70005	0.98007

The social vulnerability criterion considered in this context is for the Yeni Cami, Eski Cami, Yeni Mahalle, Erenkent, Erdemkent and Esentepe neighborhoods of Edremit district. As a result of the evaluation of the social demographic-economic indicators given in Table 3, the vulnerability analysis was performed (see Fig. 17) according to the weights given in Table 4.

5.7. *Stakeholder analysis*

In addition to all these analyses, a survey was conducted to receive the opinions of experts who have sufficient knowledge of the study area, all of whom were at least undergraduates.

A total of 27 experts (planners, architects landscape architects and engineers) participated in this survey, and the evaluation of their scoring reveals that according to the experts, the decision-makers of the Edremit district should give priority to green spaces accessibility, rainwater management, and urban heat island management criteria, while it seems they believe the social vulnerability aspect can somewhat be ignored. In terms of air quality and landscape connections criteria, the experts believe the needs of the district are that of average levels. It is noteworthy that the importance is given to "green spaces accessibility" was found as 2.185 with a weighted average (a high priority in terms of the

Table 5. The results of the survey (Karabakan, 2020).

Criterion	1	2	3	4	5	6	Weighted average	Average priority
Rainwater management	4	10	6	3	1	3	2.852	2
Green spaces accessibility	14	6	1	2	2	2	2.185	1
Landscape connectivity	3	4	3	4	9	4	3.889	5
Air quality	0	7	5	7	6	2	3.667	4
Urban heat island effect	5	1	7	5	4	5	3.630	3
Social vulnerability	1	1	3	6	6	10	4.667	6

survey scoring), whereas the weighted average priority for the social vulnerability was as low as 4.667 (see Table 5).

6. Conclusion

Cities face rapid population growth and climatic changes, which bring with them many social threats and challenges. The concept of resilience is believed to be important in dealing with such potential difficulties without significant harm to the location. Resilience as an interdisciplinary perspective has been developed considering the relationships between different concepts and notions, and it has many definitions. In recent years, the notion of resilience has been integrated into spatial planning, which represents great hope for future cities. The fact that it is becoming widespread in urban policy reports and plans worldwide reveals the importance of the concept for urban planning.

In this study, a resilience assessment of the Edremit district's green infrastructure was performed using the GISP approach. The analysis evaluates the mechanisms of the location for coping with the negativities experienced in the cities and whether the location can resist against potential future threats caused by such changes or not. In this direction, as a first step, literature research was conducted, and a holistic resilience framework was drawn. In the next stages, the relationship between resilience and urban systems was discussed and a focused system was defined for the study area. Green infrastructure benefits determined as part of the system were then analyzed. The criterion analysis has revealed positive results in areas where the existing green texture is protected. Certain areas, however, were found to be in the opposite situation, and the results show vulnerabilities in terms of urban resilience.

Remarkably, the expert opinion and actual policy-makers agree on the fact that the most important criterion is accessibility to green areas. It is predicted by this analysis that the systems of the study area are partially resilient to potential threats, but adverse situations caused by urbanization and zoning pressure are beginning to wear this resilience down. As a result of the analyses performed, the local characteristics of the district were found to be very important criteria in providing resistance against potential future risks. However, with the current urban planning approach of the decision-makers, it is evident that these unique features of the district are being ignored and the potential of resilience will be further interrupted with the ongoing construction pressure. As things currently stand, of the six neighborhoods evaluated in the study, the resilience assessment of three neighborhoods (Yeni Cami, Eski Cami and Yeni Mahalle) in the old settlement on the coastline are on a positively resilient stance. The three remaining neighborhoods (Erdemkent, Erenkent and Esentepe) in the south of the district, on the other hand, were found to be faltering in this regard.

The results of the study also reveal that measuring and evaluating the resilience of different locations is important in terms of gaining a clear insight into how the potential future changes might affect the city. The characteristics of the concept of urban resilience can only be defined locally, and since each urban system has its own characteristics and capacities, no single plan can solve all potential risks for resilience properties. Decisions should be made, therefore, by evaluating each of the environmental spaces that constitute an area, and by accurately determining their suitability for settlement from a resilience perspective. In the end, we believe decision-makers should include the concept of resilience in their urban planning strategies to ensure a long, sustainable future for their locales.

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