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MEASURING THE ACCESSIBILITY OF SOCIAL AND TECHNICAL INFRASTRUCTURE AREAS BY VIA GIS: THE CASE OF IZMIR KARABURUN

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ABSTRACT

The increase in land prices and dense construction conditions leads to a gradual decrease in green areas and social reinforcement areas in the urban built environment in the process of spatial agglomeration. This situation leads to a decrease in the quality of the urban environment. Building Law No. 3194 recognises the necessity of planning the reinforcement areas required by the population in order to create habitable quality environments in built environments. The law emphasises the standards regulating social and technical areas, and the Spatial Plans Construction Regulation sets out the coefficients and accessibility of these standards. The fact that the sizes are determined in the light of the standards increases the quality of life of the urban dwellers by enabling them to use them effectively, but it does not ensure the integrity of the system by constructing more planned urban systems. Accessibility refers to hierarchies related to different scales, such as pedestrian, public transport, transit transport, etc., in line with the hierarchy of plans. However, social and technical infrastructure areas are functional identities that provide basic urban services such as green space, education, health, municipal facilities, etc., which point to housing groups and neighbourhood scale at the lowest level of the hierarchy of urban systems and emphasise pedestrian accessibility. This study is based on the hypothesis that the social and technical infrastructure areas indicated in Building Law No. 3194 can be evaluated together with spatial data and their accessibility adequacy can be evaluated more rationally through geographic information systems. For this purpose, spatial and attribute data on the existing social and technical infrastructure assets of Izmir-Karaburun District will be collected and queried by the spatial analysis method using the open source QuantumGIS. In the results of the study, the social and technical infrastructure adequacy map of Karaburun district will be revealed, and a strategic spatial decision scenario regarding the accessibility of urban services will be created. It is thought that the study will contribute to urban management and urban planning disciplines and provide inventory information about Karaburun district.

Keywords: Geographical Information Systems, Spatial data, Accessibility, Urban Planning, Karaburun

SOSYAL VE TEKNİK ALTYAPI ALANLARININ ERİŞİLEBİLİRLİĞİNİN CBS İLE ÖLÇÜLMESİ: İZMİR KARABURUN ÖRNEĞİ

ÖZET

Arazi fiyatlarının artışı ve yoğun yapılaşma koşulları, mekânsal yığılmalar sürecinde kentsel yapılı çevrede yeşil alanlar ve sosyal donatı alanlarının giderek azalmasına yol açmaktadır. Bu durum, kentsel çevrenin niteliğinin düşmesine sebep olmaktadır. 3194 sayılı İmar Kanunu, yapılı çevrelerde

yaşanabilir kalitede çevreler oluşturulabilmesi için, nüfusun ihtiyacı olan donatı alanlarının planlanmasını zorunluluk olarak kabul etmektedir. Kanun sosyal ve teknik alanlarını düzenleyen standartlara vurgu yapmakta ve Mekânsal Planlar Yapım Yönetmeliği ile de bu standartlara ilişkin katsayıları ve erişilebilirlikleri ortaya koymaktadır. Standartlar ışığında büyüklüklerin belirli olması kentlilerin etkin bir biçimde kullanılabilmesi yaşam kalitesini arttırdığı gibi, daha planlı kentsel sistemlerin kurgulanarak sistem bütünlüğünü de sağlamamaktadır. Erişilebilirlik, planların hiyerarşisi doğrultusunda yaya, toplu taşıma, transit taşıma vb. farklı ölçeklere ilişkin hiyerarşileri ifade etmektedir. Ancak sosyal ve teknik altyapı alanları kentsel sistemlerin hiyerarşisinin en alt basamağında konut gruplarını ve mahalle ölçeğine işaret etmekte ve yaya erişilebilirliğine vurgu yapmakta olan, yeşil alan, eğitim, sağlık, belediye tesisleri gibi temel kent hizmetlerini sunan işlevsel kimliklerdir. Bu çalışma, 3194 sayılı İmar kanununda işaret edilen sosyal ve teknik altyapı alanların mekânsal verilerle beraber değerlendirilerek erişilebilirlik yeterliliklerinin coğrafi bilgi sistemleri aracılığı ile daha rasyonel değerlendirilebileceği hipotezine dayanmaktadır. Bu amaçla, İzmir-Karaburun İlçesi'nin mevcut sosyal ve teknik altyapı donatı varlıklarına ilişkin mekânsal ve öznitelik verileri toplanarak, buffer ve ağ analizi yöntemiyle analiz edilecektir. Çalışmanın bulgularında Karaburun ilçesinin sosyal ve teknik altyapı yeterlilik haritası ortaya konulacak ve kentsel hizmetler erişilebilirliğe ilişkin stratejik mekânsal karar senaryosu oluşturulacaktır. Çalışmanın kent yönetimi ve kent planlama disiplinine katkı sağlayacağı ve Karaburun ilçesine dair envanter bilgi sunacağı düşünülmektedir.

Anahtar Kelimeler: Coğrafi Bilgi Sistemleri, Ağ Analizi, Erişilebilirlik, Kent Planlama, Karaburun

1. INTRODUCTION

The adequacy of technical and social infrastructure areas in urban settlements requires planning depending on the population size and the hierarchical position of the relevant size. Nowadays, as a result of intensive migration to urban areas, excessive housing demand, and population agglomeration, built environments are often inhabited without completing their technical and social infrastructures, and unfortunately, built environments are shaped without urban facilities and with low quality of life. Legislation has a guiding and binding effect on the procedure and implementation of urban plans in Türkiye. The Regulation on the Construction of Spatial Plans provides important limitations and guidance for urban planners by setting out spatial standards through the 'Annex-2 Table'. In Building Law No. 3194 and Regulation on the Construction of Spatial Plans, urban service facilities, which are defined as social and technical infrastructure, are categorised hierarchically and with graded expression according to various population groups. Education, nursing homes, health, religious, socio-cultural, administrative, and green area facilities are defined as social facility groups (1), and service infrastructures such as electricity, petroleum, natural gas, drinking and utility water, sewerage, treatment, and all kinds of energy, transportation, and communication are defined in the technical infrastructure areas (2) group, and the standards of the required sizes proportional to the population are determined.

Social and technical infrastructure areas directly determine the quality of the urban built environment in terms of including the public uses required for a settlement to fulfil its functions (Keleş, 1990; Okumuş, 2014). The Regulation on Spatial Plans Construction defines social infrastructure areas as '*the general name given to education, health, religious, cultural, and administrative facilities, indoor and outdoor sports facilities, open and green areas such as parks, playgrounds, playgrounds, squares, recreation areas, and open and green areas built by the public or private sector to meet the cultural, social, and recreational needs of individuals and society and to increase their quality of life with a healthy environment'*. Determining the adequacy of social facilities correctly is important for spatial planning studies. In the legislation, these standards are determined as 2 m2/person for the education area, 0,75-2,00 m2/person for the culture area, 1,50 m2/person for the health area, 0,75-1,50 m2/person for the social area, 0,5-0,75 m2/person for the place of worship, and 10 m2/person for open and green areas (ÇŞViDB, 2024). These standards present the minimum standards determined to create healthy environments. However, urban built environments are expected to exceed these standards. At this point, spatial planning is expected to comply with the standards.

Accurate and realistic calculation provides important data for decision-making. Urban planning literature uses different tools such as fuzzy logic Mert &Yilmaz, 2009; Dede & Şekeroğlu, 2020; Küçükyağcı & Ocakçı, 2019), extrapolation population projection method (Ayhan Selçuk, 2014), and geographical information systems (Aksoylu et.1996; Osmanlı, 2012; Yenice, 2012; Yasak, 2021; Gümüş et., 2024). According to the Building Law and legislation, any urban equipment area in a settlement unit is characterised as inadequate if it is below the standards and as adequate if it meets these standards. Approval of spatial plans depends on their compliance with these standards.

The fact that population is the only variable of the standards has become a subject of debate, causing differences of opinion among scientists (Aksoylu et.1996; Osmanlı, 2012; Yenice, 2012; İV, 2024). Especially in metropolises (and metropolitan status in Türkiye is determined by population size), these standards cannot be met. While some scientists argue that one of the most important reasons for the non-implementation of zoning plans is the high standards of social facilities, the other group criticises the lack of planned urbanisation. Due to intensive and rapid urbanisation, spatial planning of living spaces, and human relations affecting each other, increasing psychological and sociological interaction, it has become a necessity to meet spatial needs and to create livable spaces. In this framework, ensuring at least urban spatial standards will enable resource utilisation.

The focus of this study is to evaluate the accessibility of technical and social infrastructure areas indicated in Building Law No. 3194 with spatial data and to evaluate their accessibility adequacy through geographic information systems. For this purpose, spatial and attribute data on the existing technical and social infrastructure assets of Izmir-Karabun District will be collected and tested by the spatial analysis method using GIS techniques. In the findings of the study, the adequacy map of Karaburun district in terms of urban services will be revealed, and a strategic spatial decision scenario regarding accessibility will be created.

1.2 Spatial Planning Standards in Turkey

Spatial planning standards in Türkiye are a set of norms and principles aiming to organise settlement areas in a sustainable, functional, and livable manner. These standards ensure that land use decisions, infrastructure and superstructure developments, transport, and social facilities are designed in a balanced manner in spatial planning processes. In Türkiye, planning standards are determined and put into practice within the framework of the Building Law and Spatial Plans Construction Regulation. These standards regulate the minimum area requirements and functional distribution, which differ depending on population density and settlement type. For example, the size and organisation of housing, trade, industry, education, health, green areas, and other social facilities are determined by planning standards. These standards aim to realise urban development in a controlled manner and in accordance with the principles of environmental sustainability. They also take into account factors such as disaster risk management, climate change, protection of natural resources, and sustainable use of cultural heritage. The implementation of spatial plan standards in Turkey is supervised by local administrations, the Ministry of Environment, Urbanisation, and Climate Change, and other relevant public institutions. In the process of setting and updating standards, it is aimed to plan urban, rural, and coastal areas with a holistic approach by taking into account scientific research, expert opinions, and international norms. In this context, spatial planning standards are a fundamental tool serving the purpose of creating liveable cities within the framework of sustainable development and environmental awareness.

The underlying literature base for this research stresses the importance of a GIS approach to investigating the issues at hand, focusing on buffer and network analysis methods for understanding accessibility and strategic planning in both social and technical infrastructure domains. For example, Miller and Shaw, 2001 said that the GIS-based network analysis offers an effective platform for carrying out diverse transportation planning and delivering a wide range of urban services. On other hand, according to Zhan and Noon, 1998 observed the performance of several shortest path algorithms in real-world road networks. Yigitcanlar, 2008 identifies the potentiality of GIS-based accessibility planning in a sustainable management of urban infrastructure. On the contrary, Mitchell (2005) describes how buffer analysis has been used within urban planning and how its use has affected the better delivery of services to residential areas.

In that respect, Kamacı Karahan (2020) deals with the possibility of using GIS to analyze urban accessibility and areas of social infrastructure in Turkey, allowing clear relevance to how these methodologies contribute to improving decision-making processes. Tango and Topçu (2021) mentioned the importance of access analysis in managing technical infrastructure sustainably in urban areas. The strategy developed from their study will help improve the accessibility of social and technical infrastructure and is thus foundational to the current study. This literature provides a strong theoretical and practical foundation for the study, highlighting the critical role of GIS analyses in spatial planning for urban services. Various researchers in the field of urban planning continue to work on urban standards and their implementation from different perspectives (Öztürk & Erdoğan, 2021; Dede & Şekeroğlu, 2020). Similarly, when we look at the numerical standards in the Planned Areas Zoning Regulation and Spatial Plans Construction Regulation, it is seen that not only social technical infrastructure standards but also walking distances (Article 12) are mentioned. In the building plans; '*playgrounds, playgrounds, open neighbourhood sports areas, family health centres, kindergartens, nurseries, kindergartens and primary school functions should be planned in the service impact area that should be reached on foot by taking into account the distance of 500 metres, middle schools approximately 1.000 metres and high schools approximately 2.500 metres'*. In the areas of religious facilities, it is proposed to plan '*small mosque 250 metres, medium (district) mosque 400 metres in the service impact area that should be reached on foot*'. However, '*in settlements with a gross population density of 100 people/ha or less, in scattered rural settlements or in built-up areas, walking distances may be increased in case there is no area of suitable size and quality or there are natural or artificial thresholds that make it difficult to reach these functions*.' It also emphasises some special conditions with this statement.

In this context, in the method of this study, the adequate sizes of social reinforcement areas and accessibility criteria of the spatial plans construction regulation will be evaluated by means of geographical information systems.

2. METHODS

Karaburun district of Izmir was selected as the study area. Karaburun is located in the Egean region of Turkey. Karaburun is a peninsula on the coast of the Aegean Region of Turkey, in the north-west of the region commonly called the Urla Peninsula. It is bordered by Urla to the east and Çeşme to the south. It is only 15 miles from the Greek island of Chios (Xios) to the west. Lesvos Island (Lesvos) is to the north and Foça is to the north-east. The eastern and northern coasts of the peninsula form the southern part of the Gulf of Izmir. It is the second-smallest district of Izmir in terms of population. According to the TUİK data as of 2023, Karaburun's total population is 13.379. On the other hand, the population increases significantly in the summer season with the presence of secondary housing and annual tourism visitors.

Karaburun Municipality was established in 1902 and can be considered as one of the oldest municipal institutions. After the metropolitan law numbered 6360, 1 town and 13 villages were transformed into neighbourhoods and included in the municipality boundaries. Karaburun administratively covers sixteen neighbourhoods (Merkez Mahallesi, Mordoğan, Ambarseki, Bozköy, Hasseki, Saip, Tepeboz, Yayla, Eğlenhoca, İnecik, Kösedere, İskele, Küçükbahçe, Salman, Parlak and Sarpıncık). It has two islands, Sahip Island and Küçükada, and its terrain is generally hilly. This settlement, is geographically located between 38° 38' 17" N, 26° 30' 48" E. coordinates. It has a typical Mediterrian climate, with hot and dry summers and cold and rainy winters.

According to the data provided from satellite images, the focal point of the study is the neighbourhoods within the administrative boundaries of Karaburun district. Social facilities (education, health, and public) and technical infrastructure areas within the research area were identified and digitised with the help of high-resolution satellite images and on-site observation. This database was analysed by transferring it to the attribute table, and thus the data was transformed into a spatial data set. The sizes of the social reinforcement areas in the area have been evaluated in terms of their compliance with the reinforcement standards of the Spatial Plans Construction Regulation and their compliance with the accessible standards of the same regulation. The technical and social infrastructure areas used in the study were obtained from on-site observation and current maps. Spatial

adequacy analyses of urban technical and social infrastructures were carried out on a digitised database using ArcGIS Pro software. For each neighbourhood, the distribution of urban service areas per capita was determined, and then spatial accessibility levels were analysed using network and buffer analysis methods. With these analyses, urban service areas were evaluated.

Buffer analysis is a spatial process that calculates the areas within a certain distance or buffer distance from a point or area (Kamacı Karahan, 2020). This process is especially used in areas such as land use, accessibility, impact areas, and transport planning. In GIS-based accessibility studies buffer analysis (Kamacı Karahan, 2020; Tango & Topçu, 2021; Vural, 2024) shows which points or areas are accessible within a certain distance. This analysis provides decisive assistance in decision-making to increase people's capacity to access. Due to the fact that the method uses a simple modelling technique, the complex structure of settlements and areas is not taken into account during the analysis.

Network analysis is a spatial process that evaluates the optimal routes, shortest paths, and connectivity within a network of roads, pathways, or infrastructure (Miller & Shaw, 2001). This method is widely used in areas such as transport planning, logistics, emergency services, and urban mobility. In GIS-based accessibility studies, network analysis (Miller & Shaw, 2001; Zhan & Noon, 1998; Yang & Bell, 1998) identifies the most efficient routes or reachable areas based on travel distance, time, or cost. This approach plays a crucial role in decision-making processes aimed at improving connectivity and service delivery. However, because network analysis models rely on predefined networks, they may not fully account for unstructured or informal paths and settlements, which could limit the accuracy of accessibility predictions in some contexts.

The integration of buffer analysis with network analysis in this study may decidedly enhance the accuracy and completeness of the spatial accessibility analysis for both social and technical infrastructure realms. Yet, buffer analysis provides only a very simple way of accounting for the closeness of urban facilities by calculating distances of constant value from certain points or areas, it commonly simplifies the actual complexity of the urban environment by considering neither real travel routes nor barriers. In contrast, network analysis treats actual networks of travel routes, considering the relationships within road systems and transportation hierarchies, thus often uncovering more realistic patterns of accessibility inside areas that feature either complicated or sparse infrastructures.

Each of these techniques allows for a complementary approach: buffer analysis rapidly identifies potential gaps in service accessibility through the use of simple distance metrics, while network analysis refines these through the illustration of the accessibility of these services when real-world travel factors are considered. Coupling these approaches will thereby create a deeper understanding of access to service, ensuring that urban standards in terms of distance are met and that urban residents can practically use these services within current transportation and pedestrian structures. Applying this dual-method approach expands the scope for realism in recommendations for urban planning within the study and thus constitutes a unique contribution to the areas of urban management and planning strategies.

The integration of both buffer and network analyses within GIS brings forth an important means of assessing accessibility in general to urban services. Buffer analysis gives an easy way in which one can estimate the zone of influence around features, such as public service access points, to check on accessibility. However, it has traditionally oversimplified the complexity of the urban network by failing to account for actual travel paths. On the contrary, network analysis extends it with considerations of real routes, travel times, and conditions of roads; hence, it gives way to a more realistic assessment of accessibility. Combining said aspects yields a number of advantages, for instance, as revealed in the study on network analysis of health care access in Cairo: including such aspects as traffic and walking paths, the evaluation of accessibility is many times more precise than in a standard buffer analysis (Ahmed 2017). Integrating these approaches enables the urban planner to enhance service delivery and ensure proximity and functional access to essential services, making the decision-making process in urban management efficient. This integrated approach not only expands the perception of urban accessibility but also captures the limitation in using one approach.

3. RESULTS

There are 2 primary schools and 2 middle education institutions (941 student population) in the study area. A 10-bed health centre, 1 health centre, 2 health houses, and 1 emergency aid station provide health services (İV, 2024). The district has a dispersed rural settlement pattern due to its geographical characteristics.

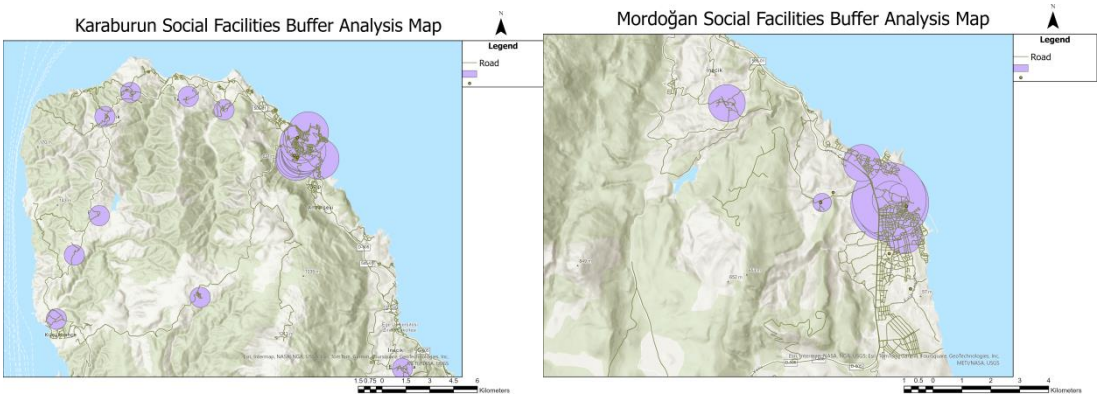
In this study, firstly, spatial adequacy analyses were performed for active green areas. In this regard, technical and social equipment areas in 16 neighbourhoods in Karaburun were digitised and processed using QGIS software. Technical and social equipment areas were categorised within the framework of the table in Annex-2 of the Spatial Plans Construction Regulation. The study covers areas such as green areas, educational facilities, health facilities, municipal service areas, public market areas, and worship areas. For spatial adequacy analyses, settlement cluster and neighbourhood population data were used.

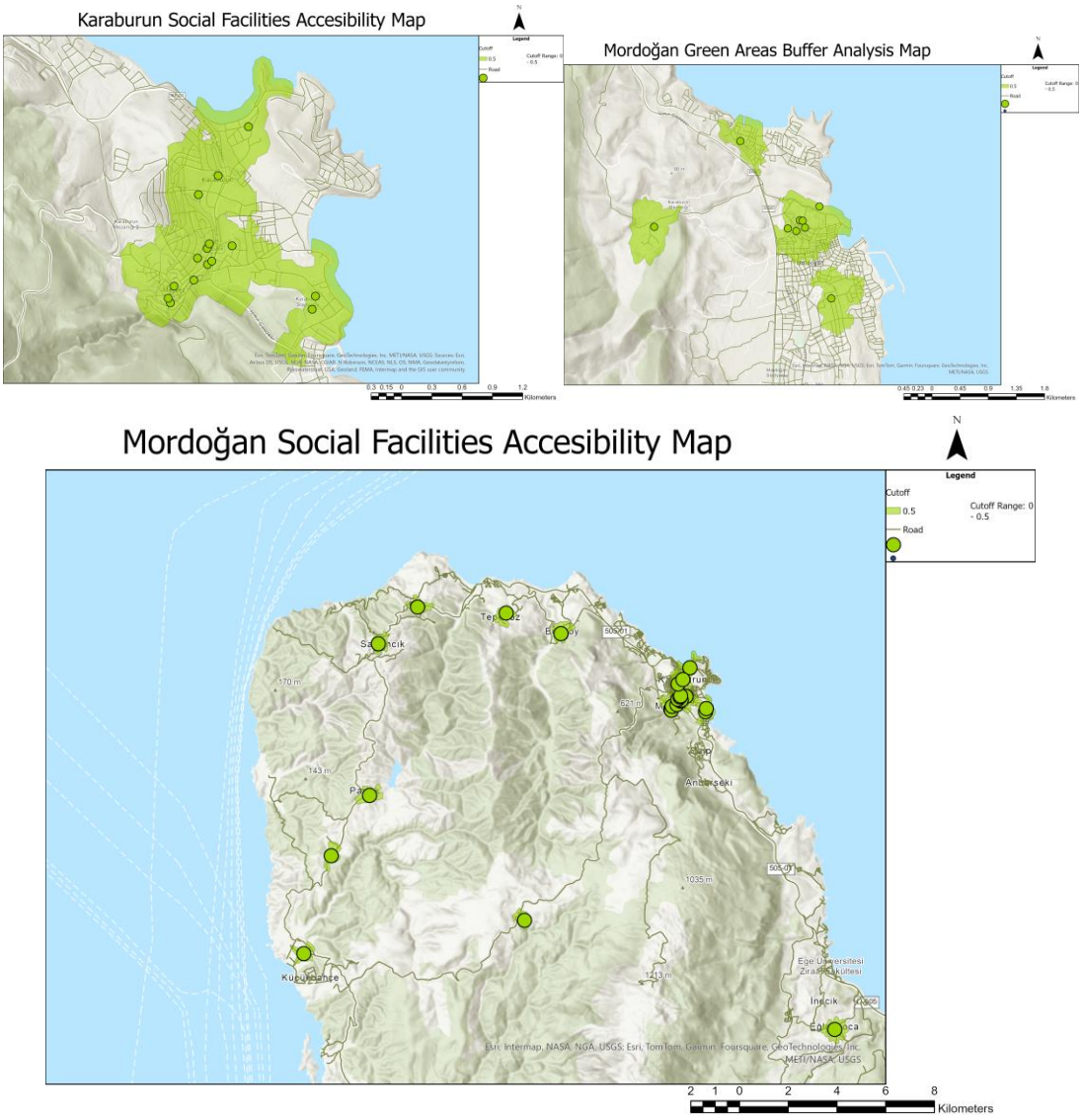
Considering the size of the education facility area, it was determined that an area of 12 ha. was allocated, and it serves a total of 941 students. In terms of accessibility, it was observed that the education areas are located in İskele and Mordoğan neighbourhoods (Table 1.). However, it does not fit within the service radius defined as 500 meters walking distance emphasised by the Spatial Construction Regulation (Figure 2.).

Table 1. Karaburun Technical and Social Infrastructure Standards for neighbourhood

Infrastructure areas	M2/person	Minimum Area (m2)	Existent (ha)	Plan (ha)
Education Facility Area	2,00	5000-8000	12	2,67
Open and Green Spaces	10,00		18,53	13,37
Health Facilities	1,50	750-2000	5,3	2,00
Social and Cultural Facility Areas	0,75	1000	1,05	1,00
Worship Area	1,00		1,57	1,33

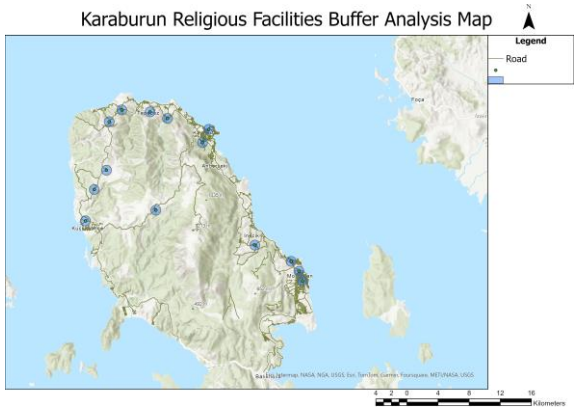
Figure 2. Karaburun Technical and Social Infrastructure Areas Accessibility

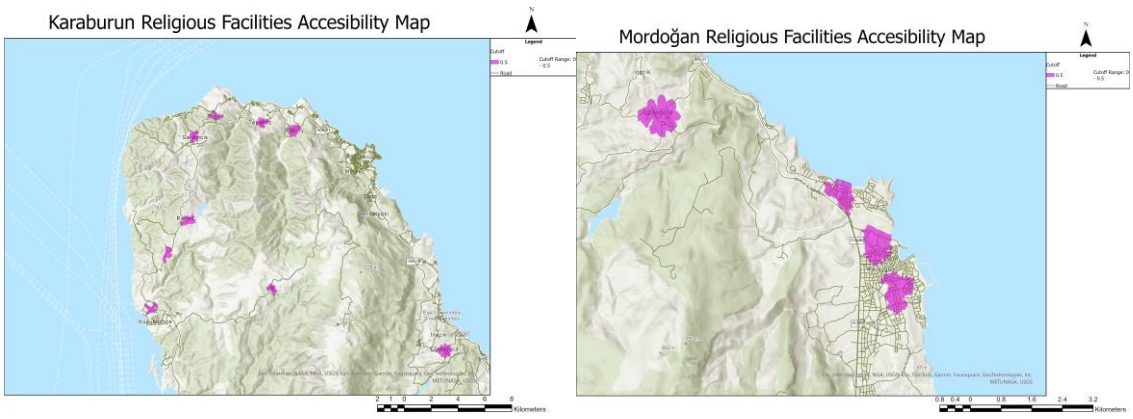




There are only mosques in the study area as places of worship. With a total of 14 mosque structures, it has been identified as the social reinforcement area with the highest number. In terms of accessibility, although there are places of worship in most of the built-up areas, they are insufficient in many areas in terms of the service radius that fits into the urban spot (Figure 3).

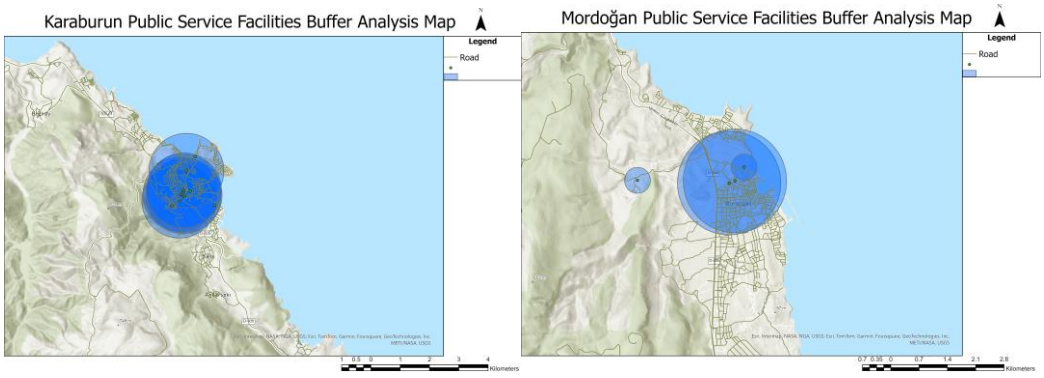
Figure 3. Karaburun Worship Areas Accessibility





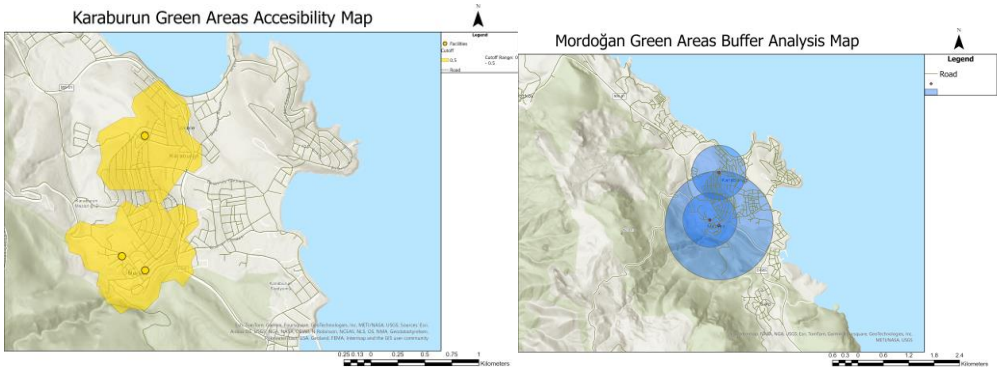
There are a total of 9 public service areas in the study area. Since there are no accessible standards in the Spatial Construction Regulation, the service areas are located in the western sub-region in terms of service area radius (Figure 4).

Figure 4. Karaburun Public Service Areas Accessibility



In the study area, 2 public bazaars, 1 university area, and 1 social facility were identified. In terms of open and green areas, a very limited number of planned areas could be observed (Figure 5).

Figure 5. Karaburun Open and Green Areas Accessibility



When the study area is reviewed, the presence of social facilities and open and green areas is more diverse and numerous in the Merkez, İskele, and Mordoğan neighbourhoods, which are located in the western sub-region of the area and have a more settled settlement pattern (Figure 6, Figure 7).

Figure 6. İskele and Merkez Neighborhood Accessibility

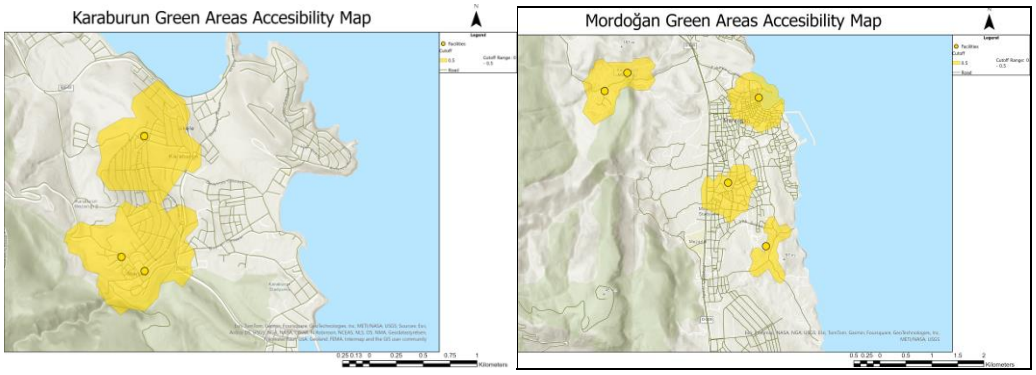
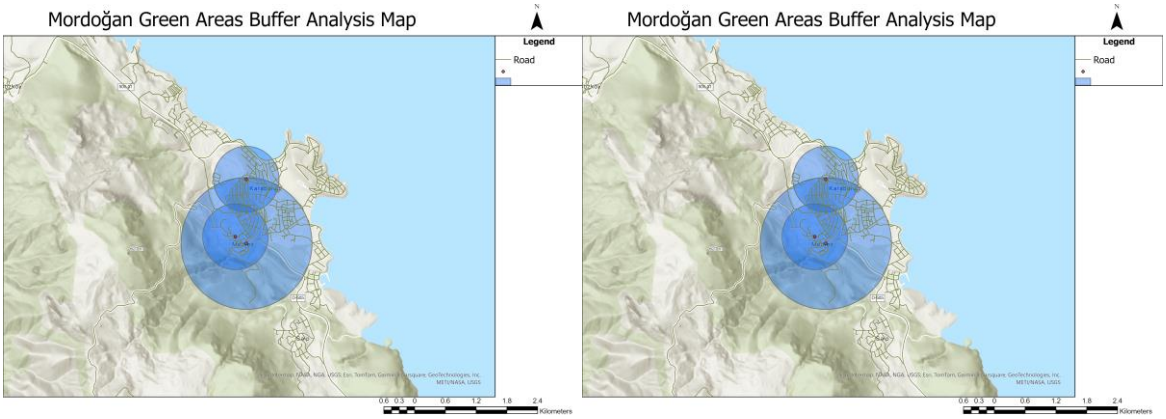


Figure 7. Mordoğan Neighborhood Accessibility



When the technical and social infrastructure areas throughout the study area are analysed in terms of planning hierarchy, it does not comply with the hierarchical spatial plan structure in terms of population sizes and settlement stratification indicated by the Spatial Construction Regulation.

4. CONCLUSION AND DISCUSSION

Technical and social infrastructures are important urban facilities that provide the balance of urban resources and user requirements within the planning hierarchy. Facilities are determined according to the population data in the area they serve. The quality and size of the equipment that should be included in urban systems are determined by the Spatial Plans Construction Regulation with minimum conditions. Karaburun is a settlement with a dispersed urban built environment and sparse population density, where natural environmental elements continue to exist.

It has been determined that the urban built environment of the study area is located in the coastal band, and there is no settlement in the centre of the peninsula due to topography. Analysing the coastal peripheries of the peninsula, it is seen that the inhabited structure is located on the western coasts, and therefore, technical and social infrastructures, in accordance with the requirement of planning principles, are located intensively in the geography where the population is located. The eastern side of the study area is mainly shaped by secondary residential areas and settlements with closed gates. In terms of urban infrastructure investment, this sub-region mostly includes uses related to places of worship. Examining the accessibility distances, it is seen that the service radii provided by the regulation and the urban built environment do not harmonise. This will result in a decrease in the quality of urban life in the study area; residents who cannot receive services will use transportation vehicles to receive services, and their ecological footprint will increase. In the upper-level service demands, they will form agglomerations in the nearest or most comprehensive centres where the upper-level services are provided. Although the differences in the eastern and western sub-regions of the study area are thought to be based on the use of secondary housing and sparse population, due to the Covid-19 pandemic experienced in 2019-2021 and the Izmir earthquake in 2020, the tendency of the urbanites towards low-rise, gardened, and low population density residential areas and the tendency of these residences to turn into residential areas used in all seasons is monitored. In the light

of the available data, it has been determined that the size of technical and social infrastructure is deficient for the resident population, and when the visitors are estimated, it is considerably deficient, and when evaluated in terms of access, it is determined that access can be provided in a very limited part of the study area. In this context, the rapid development of technical and social reinforcement areas planned in the zoning plans is important for the settlement to be healthy and livable.

In future studies, population scientists should obtain data on the population structure in the sub-region, and urban planners should make spatial planning decisions by evaluating the demographic structures in this sub-region, which will make important contributions to the creation of more realistic spaces with high quality of life. During this process, basing decision-making mechanisms on data-driven and scientific foundations will increase the success rate in urban planning. Integrating governance approaches into the planning process will strengthen public participation and coordination among stakeholders, contributing to achieving social, economic, and environmental sustainability goals in the sub-region. In this context, the effective use of demographic and spatial data will enhance the efficiency and accuracy of planning processes, supporting transparency and accountability principles within management systems. When rational and data-driven approaches are integrated into urban planning processes, it becomes easier to make strategic decisions from a management science perspective. This allows for better analysis of scenarios, potential risks, and opportunities during the planning process, leading to the development of flexible and adaptive plans for management processes. For future applications, this approach will enhance resilience in cities, providing a foundation for a more comprehensive and holistic consideration of spatial and socio-economic dynamics.

REFERENCES

Ahmed, S., Ibrahim, R. F., & Hefny, H. A. (2017, July). GIS-based network analysis for the roads network of the Greater Cairo area. In Proc. of 2nd International Conference on Applied Research in Computer Science and Engineering.

Aksoylu, S., Uyguçgil, H., Altan, M., Tutal, O. (1996), Coğrafi Bilgi Sistemlerini Kullanılarak Sosyal Donatı Alanlarının Sınanması, Coğrafi Bilgi Sistemleri Sempozyumu, İstanbul, 195-201.

Ayhan Selçuk, İ. (2014), Kısa Dönemli Kentsel, Sosyal ve Teknik Altyapı Alan İhtiyacının Kestiriminde Bir Araç Olarak Ekstrapolasyon Nüfus Projeksiyon Yönteminin Kullanımı: Kütahya Örneği, Uluslararası Hakemli Tasarım ve Mimarlık Dergisi, 2(1): 98-119.

ÇŞViDB, "Mekânsal Planlar Yapim Yönetmeliği", https://www.resmigazete.gov.tr/eskiler/2014/06/20140614-2.htm. (07.10.2024).

Dede, O. M., & Şekeroğlu, A. (2020). Türkiye'de kent planlamada mekânsal standartlar üzerine bir değerlendirme. Humanities Sciences, 15(3): 96-110.

Gümüş, M. G., Çiftçi, H. Ç., & Gümüş, K. Buffer ve Network Analiz Teknikleri Kullanılarak Kentsel Aktif Yeşil Alanlar için Mekânsal Yeterlilik ve Erişilebilirlik Analizi. Dokuz Eylül Üniversitesi Mühendislik Fakültesi Fen ve Mühendislik Dergisi, 26(77): 281-290.

İV, İzmir Valiliği, http://www.izmir.gov.tr/karaburun, (07.10.2024)

Kamacı Karahan, E. (2020), Stratejik Planlama Ekseninde Erişilebilirlik: Tampon ve Ağ Analizlerinin Karşilaştirmali Değerlendirilmesi. Niğde Ömer Halisdemir Üniversitesi Mühendislik Bilimleri Dergisi, 9 (1): 335349. DOI: 10.28948/ngumuh.620361.

Keleş, R. (1990). Housing Policy in Turkey, Housing Policy in Developing Countries, London.

Küçükyağcı, P. Ö., & Ocakçı, M. (2019). Bulanık Mantık Yönteminin Kentsel Alan Çalışmalarında Kullanımı. Kent Akademisi, 12(2): 299-308.

Mert, Z. G., Yilmaz, S. (2009). Kocaeli mahalleleri donatı yeterliliğinin bulanık mantık yaklaşımı ile değerlendirilmesi. Eskişehir Osmangazi Üniversitesi Mühendislik ve Mimarlık Fakültesi Dergisi, 22(3): 167-183.

Miller, H. J., & Shaw, S. L. (2001). Geographic Information Systems for Transportation: Principles and Applications. Oxford University Press.

Mitchell, A. (2005). The ESRI Guide to GIS Analysis, Volume 2: Spatial Measurements & Statistics. ESRI Press.

Okumuş, D. E. (2014). Kentsel dönüşümde sosyal donatı alanlarının değişimi ve kentsel yaşam kalitesine etkisi: Ataşehir Barbaros Mahallesi örneği (Doctoral dissertation, Fen Bilimleri Enstitüsü).

Osmanlı, N., (2012), İlköğretim Okulu Donatı Erişilebilirliğinin Coğrafi Bilgi Sistemi Platformunda Değerlendirilmesi, Yüksek Lisans Tezi Şehir ve Bölge Planlama Anabilim Dalı Selcuk Üniversitesi, 2012, s.13.

Öztürk, M., & Erdoğan, A. (2021). Plan Tutarlılıklarının Testi İçin Bir Yöntem Önerisi: Mekânsal Planlar Değerlendirme Kılavuzu. Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 23(4): 1709-1735.

Suri, L. (2021). Mevzuatta Tanımlanmayan Donatı Gereksinimi 'Anne-Çocuk Evi'. Avrupa Bilim ve Teknoloji Dergisi, (25): 75-86.

Tango, S., & Topçu, O. (2021). Access analysis for sustainable urban technical infrastructure management: A GIS-based approach. International Journal of Urban and Regional Research, 45(1): 45-65.

Vural, E. (2024). Şanlıurfa Merkez İlçelerinde İtfaiye İstasyonlarının Coğrafi Bilgi Sistemleri ile Erişilebilirlik Analizi. Kent Akademisi, 17(3): 852-866.

Yasak, Ü. (2021). Sürdürülebilir Kentleşme Bağlamında Kentsel Hizmetlere Erişebilirlik: Eğitim Kurumlarına Erişebilirlik Yönüyle Muğla Kenti Üzerine Bir Analiz. International Journal of Socıal Humanıtıes Scıences Research, 8(74): 2353-2367.

Yang, H., & Bell, M. G. (1998). Models and algorithms for road network design: A review and some new developments. Transport Reviews, 18(3): 257-278.

Yenice, M. S. (2012). Kentsel yeşil alanlar için mekânsal yeterlilik ve erişebilirlik analizi; Burdur örneği, Türkiye. Turkish Journal of Forestry, 13(1): 41-47.

Yigitcanlar, T. (2008). Planning for sustainable urban infrastructure: GIS applications in infrastructure management. Sustainability, 10(4): 124-136.

Zhan, F. B., & Noon, C. E. (1998). Shortest path algorithms: An evaluation using real road networks. Transportation Science, 32(1): 65-73.