GIS BASED SPATIAL EQUITY MAPPING AND PARK PROVISION AT NEIGHBORHOOD SCALE: IZMIR CASE

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ABSTRACT

GIS BASED SPATIAL EQUITY MAPPING AND PARK PROVISION AT NEIGHBORHOOD SCALE: IZMIR CASE

Decision making and implementation processes of allocation of neighborhood parks are significant in urban planning. Neighborhood parks contribute to the continuity of biodiversity and improvement of individual/communal physical, social and mental health. Such green public areas in the city are planned under the influence of multi-factors that do not always prioritize these significances and accessibility of these areas for various social groups. As in the case of Izmir City (Turkey), ultimately, there are spatial inequity among neighborhoods in terms of the existence of public green areas. The areas with limited size of neighborhood parks have often high percentages of children, elderly and low-income—that is the social groups that need to get access in walking distance and benefit from these areas.

This study conceptualize these areas as ‘park poor’ and the potential user groups as need groups. This study argues that it is possible to develop accessible new green areas in already developed “park-poor” urban areas. Using tools of Geographic Information Systems (GISs) and relying on need-based equity approach, this study presents a GIS based procedure to assess the accessibility to existing park areas and to allocate new neighborhood parks at the neighborhood level in “park-poor” areas of Izmir (Turkey).

It contributes to the discussions about the spatial equity mapping and accessibility to areas as part of environmental justice issues. Also, arguing that urban green areas are public resources, this study emphasizes that urban planning policies must re-plan neighborhood parks based on the need-based equity that favors accessibility of neighborhood parks primarily by children, elderly, women and low income groups.

Moreover, this study differs greatly from earlier studies about its spatial scale of investigation and use of data. This study suggests park provision procedure in park-poor neighborhoods. To develop these at the neighborhood-level, a set of spatial-statistical analyzes are developed using GISs.

Key words: neighborhood parks, spatial equity mapping, need-based equity, geographic information systems.

ÖZET

CBS TABANLI MEKANSAL HAKÇALIK HARİTALANMASI VE MAHALLE ÖLÇEĞİNDE PARK TAHSİSİ: İZMİR ÖRNEĞİ

Mahalle parklarının tahsisinde karar verme ve uygulama süreçleri kentsel planlamada önemli bir konudur. Mahalle parkları, biyoçeşitliliğin sürekliliğine ve bireysel / toplumsal fiziksel, sosyal ve zihinsel sağlığın iyileştirilmesine katkıda bulunur. Kentteki bu yeşil kamusal alanlar, bu önemlerini ve bu alanlara çeşitli sosyal grupların erişebilirliğini her zaman öncellemeyen birçok faktörün etkisiyle planlanmaktadır. Izmir İlinde (Türkiye) olduğu gibi, kamusal yeşil alan varlığı bakımından, mahalleler arasında mekansal eşitsizlik vardır. Mahalle parkı sınırlı olan alanlar genellikle yüksek çocuk, yaşlı ve düşük gelirli yüzdesine sahiptir - yani bu alanlara yürüme mesafesinde erişmeleri ve bu alanlardan öncelikli faydalanmaları gereken sosyal gruplar.

Bu çalışma, bu alanları "park fakiri" ve potansiyel kullanıcı gruplarını "ihtiyaç grupları" olarak kavramlaştırmaktadır. Bu çalışma, halihazırda "park fakiri" olan kentsel alanlarda, erişilebilir yeni yeşil alanlar geliştirmenin mümkün olduğunu savunmaktadır. Bu çalışma, Coğrafi Bilgi Sistemleri (CBS) araçlarını kullanarak ve ihtiyaca dayalı hakçalık yaklaşımına dayanarak, mevcut park alanlarının erişilebilirliği değerlendirmekte ve Izmir'in "park-fakiri" bölgelerinde yeni mahalle parkları tahsisi için CBS tabanlı bir prosedür sunmaktadır.

Bu çalışma, mekansal hakçalığın haritalanması, çevresel adalet ve erişilebilirlik hakkındaki tartışmalara katkıda bulunuyor. Ayrıca, kentsel yeşil alanların kamu kaynakları olduğunu öne süren bu çalışma, kentsel planlama politikalarının mahalle parklarına öncelikle çocuklar, yaşlılar, çocuklu kadınlar ve düşük gelirli grupların erişimini destekleyen ihtiyaca dayalı hakçalık temelinde yeniden planlaması gerektiğini vurgulamaktadır.

Ayrıca bu çalışma, araştırmanın mekansal ölçeği ve veri kullanım yöntemi ile önceki çalışmalardan büyük ölçüde farklılaşmaktadır. Bu çalışma, park alanlarının yetersiz olduğu mahallelerde park alanı tahsisi için bir prosedür önermektedir. Bunları mahalle ölçeğinde geliştirmek için, CBS tabanlı mekansal istatistik analizleri geliştirildi.

Anahtar kelimeler: mahalle parkları, mekansal hakçalığın haritalanması, ihtiyaca dayalı hakçalık, coğrafi bilgi sistemleri.

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CHAPTER 1

INTRODUCTION

This thesis focuses on the ways of sustaining “need-based equity” at the allocation of urban public parks at neighborhood scales, at selected case areas in Izmir by using Geographic Information Systems (GISs). This study argues that need-based equity approach to urban green service area allocation increase accessibility to the green service areas. Regarding accessibility, this thesis aims to assess the existing accessibility pattern within neighborhoods for different socio-demographic user groups. Moreover, this thesis aims to propose location-allocation model for neighborhood parks. The accessibility of the neighborhood park is important for individuals to get social, mental and physical benefit effortlessly. Furthermore, a need-based equity approach is proceeded in provision of neighborhood parks criticizing the existing allocation models in Izmir. This study focus on neighborhoods with limited size of park area and high population number of potential users. These user groups consist of children, elderly, disabled, women with children and low-income groups (Beler Erkip, 1997; Şenol, 2019). These areas are mentioned as ‘park poor’ areas and the potential user groups are mentioned as ‘need groups’ in the study (Şenol, 2019).

The “need-based equity” perspective suggests that in the redistribution of public service and resources, the traditionally disadvantaged groups due to their class, gender, race/ethnicity or age should have the priority. The definition of these groups depends on the character of the public service. The concept of need is consistent with the idea that “unequals should be treated unequally” (Lucy, 1981). Need is also defined as the demand characteristics of socio-economic groups (Beler Erkip, 1997). This perspective supports equitable allocation (Beler Erkip, 1997) by fulfilling the inequities in access to the urban public services for these social groups, whose daily life depends on the opportunities at close environment of their home and neighborhood (Şenol, 2019). Against the rough numerical equality or political power based approaches (Lucy, 1981), need-based equity favors equitable allocation by sustaining the equal life quality and equivalence of the outcome/income ratio to users after receiving the benefits of public services (Cook & Hegtvedt, 1983).

In this manner, the accessibility of the urban public services is important to afford to get benefit effortlessly from services and facilities. The differential access to urban public services of various socio-economic, gender or age groups has been an important problematic in urban studies. Conventional measures of accessibility (place-based) have limitations to evaluate individuals of specific socio economic or demographic groups' accessibility (M.-P. Kwan, 2010; E. Talen & Anselin, 1998). In this study, accessibility is framed not by geographic distance rather by the conditions of socio-spatial contexts as a wide and inclusive understanding (Lindsey, Maraj, & Kuan, 2001; Nicholls, 2001). It is used as the allocation of public services to particular socio-demographic groups and the achievement of spatial equity on public service distribution (Emily Talen, 1998). This study evaluates the accessibility by point-based and person specific spatial framework (M. P. Kwan, 1999).

Neighborhood parks are part of the urban green public service and resources that are sustained by the state. Urban public services are defined as publicly provided (public) goods and services. The public goods have spillover effect (benefit or harm) to other communities and localities (O'sullivan, 2007; Williams, 2002). Urban services are defined as major determinant of the quality of urban life, comfort, convenience, enjoyment, and wealth (R.L. Lineberry & Welch, 1989). There are fixed services such as green service areas and also mobile services such as police force. Green service areas are merit goods as well as provide benefits for well-being of dwellers, enhance social relations and sense of safety in a community (Şenol, 2019). Neighborhood parks of green service area are defined as open spaces, environmental resources and social, ecological and economic values (Emily Talen, 2010). Neighborhood parks are green areas serving for 5000-6000 people with at most 800m catchment area, smaller than 30.000m2 and mostly preferred close to primary schools among residential units (Ersoy, 1994). The size standard is at least 10 m2 per person in Turkey (Türk & Dökmeci, 2017).

Apart from 'need-based equity', there are three different perspectives upon the equitable allocation of urban services. These perspectives have been concerned with different understandings of equity as equality-based, demand-based and market-based. The mostly used approach is 'equality-based equity' perspective, especially in practice, that comprehends equitable distribution as equal distribution of public resource and services which every individuals are expected to receive same public benefit, regardless of socioeconomic status, ability to pay, and need. Alternatively, the ‘demand-based equity’ is known as allocation of urban public services based on dwellers’ demand and so based on their capacity to access to political power and allocation mechanisms. The other is ‘market-based equity’ that comprehends the cost of the services and the degree of people’ capacity and willingness to pay for a particular service as a key factor in allocation.

The allocation of public services are significantly related with the location theories. Location theories are developed by neoclassical approach such as “VonThünen,”, “Weber”, “Park and Burgess” and “Christaller and Lösch” towards more socio-political models by Structuralist and Constructivist approaches (Hodgart, 1978; Türk & Dökmeci, 2017). The spatial distribution and specific location of urban services are ignored in classical and neo-classical approaches. The public services have been mentioned in terms of urban scale economies but not about their social effects and locations. Firstly, the central place theory approach in neo-classics considered the public services with market mechanism for determination of scale and location. The first approaches that focus on urban public services concerning public welfare and transportation cost are Tiebout’s model and Hotelling ice cream vendor problem model (Teitz, 1968). Although the earlier examples of urban service allocation models have shortcomings in terms of locational decision, they propose city-wide, nonpolitical and market-based competitive models upon homogeneous spatial contexts (Hodgart, 1978; Teitz, 1968).

Structuralist approach to urban structure has prioritize the distribution of public services by socio-political models rather than just economic. The equitable distribution is defined as a tool to sustain social justice in cities (Harvey, 2009). The allocation mechanisms of urban public services and equitable distribution of benefits in society are in the center of social justice issues. The major aims of these models are to sustain efficiency, effectiveness and social equity rather than economic optimality. Within structuralist approach, the ‘need-base equity’ perspective is the one that favors social and spatial equity in allocation models (Beler Erkip, 1997; Harvey, 1996).

After 1980s, post-modernist paradigm and social constructive approaches to urban planning have enriched the allocation mechanisms of urban services (Şenol, 2019; Türk & Dökmeci, 2017). On the other hand, urban and economic restructuring by neoliberal era after 1980s have affected the intrinsic features of public services. The capital-intensive politics and implementation to spatial contexts have challenged the public space and ignored its social and public benefit features. Therefore, there is a need to discover new allocation techniques ensuring socio-spatial justice and public benefit for dwellers (Stafford & Baldwin, 2018).

In order to make decisions on public service distribution, the detection of existing pattern of services and characteristics of users are important (Beler Erkip, 1997). In this concern, examining the spatial distribution of public green areas and sustaining equitable accessibility to these areas has been an important research agenda in the urban studies (Boone, Buckley, Grove, & Sister, 2009; Heynen, Kaika, & Swyngedouw, 2005). The distribution of urban services is not only practical but also social and policy issues. In this manner, the spatial distribution of the services is also the distribution of beneficial opportunities of public resources (Byrne & Wolch, 2009; E. Talen & Anselin, 1998). There are many approaches to explain causes of distributional pattern of urban public services (Jones & Kaufman, 1974; R.L. Lineberry & Welch, 1989; Robert.L Lineberry, 1977; Rich, 1979b). The distribution public services is examined based on the set of criteria that sustains equity and equilibrium (Harvey, 1975; Heynen, 2006). In order to examine the inequities in accessibility to urban public green areas, this study propose a spatial equity mapping procedure in already developed urban environment of Izmir.

1.1. Hypothesis and Research Questions

This study assumes that ‘need-based equity’ approach increases accessibility rather than other approaches in the allocation of urban parks in neighborhood scales, in the case areas of Izmir by using GISs. There are ‘park poor’ neighborhoods in Izmir and there are even spatial inequities within these neighborhoods. This study aims to contribute to the practical problems of park service allocation proposing a methodology, due to the lack of socio-demographic knowledge at the neighborhood level in Turkey.

The following questions are important regarding the aims of this study:

- How can GIS tools and techniques are adapted to evaluate accessibility and to proceed allocation in neighborhood scale?
  - How to allocate neighborhood parks based on 'need-based equity' in already developed neighborhoods using GIS techniques.

Sub-questions:

- How is the spatial distribution pattern of park areas in Izmir?
- How is the spatial concentration of different socio-demographic groups in Izmir?
- How is the existing accessibility of neighborhood park areas in Izmir?
- How to allocate park locations by increasing accessibility in neighborhoods of Izmir?

Regarding research question, it is seen that there is differential access to urban public neighborhood parks for individuals of various socio-economic, gender and age groups in Izmir. The study argues that the allocation of public park areas should be based on the 'need-based equity'(Lucy, 1981). GIS based heuristic approach (Ghost & Rushton, 1987) can detects the optimal location of park areas.

1.2. Aim of the Study

This thesis aims to assess accessibility of existing neighborhood parks and further to allocate park areas sustaining 'need-based equity' on neighborhood scale case studies in Izmir by using GISs. Firstly, the theoretical relation between space, location theories and public service allocation models is discussed since classical economic approaches to recent socio-political approaches. The intrinsic aim of the study is to develop critical thinking to the space concept and the conventional location models.

Secondly, this thesis aims to assess the existing distribution pattern of neighborhood parks in Izmir at city scale and assess the existing accessibility opportunities of parks at neighborhood scale for different socio-demographic user groups. The accessibility of the neighborhood park is important for individuals to afford to get social, mental and physical benefit effortlessly. The accessibility approach of the study aim to comprehend not only geographical distance but also socio-spatial diversity in spatial distribution of public benefit and opportunities. The existing spatial distribution of parks are proceed based on the ‘spatial equity mapping’ procedures in city scale (E. Talen & Anselin, 1998; Emily Talen, 2010). It is aimed to develop the spatial equity map of Izmir. Spatial equity map is developed based on the multi-criteria decision analysis procedure using spatial distribution of socio-demographic groups and neighborhood park areas.

Thirdly, going beyond the conventional models, it is aimed to propose a new allocation procedure using new GIS based technologies in existing neighborhoods of Izmir, Turkey. A ‘need-based equity’ perspective is considered in allocation model in neighborhood levels in Izmir using new GIS network analyze techniques. Relying on this perspective, this study focus on neighborhoods with limited size of park area and high population number of potential user groups. These groups are mentioned as children, elderly, women with children and low-income groups. These areas are mentioned as ‘park poor’ areas and the potential user groups are mentioned as ‘need groups’ in the study. This is important since these need groups is ignored in the context of Turkey and the method of the study is important that has a practical proposal.

Fourthly, relying on the 'need-based equity' perspective, the study aims to propose a GIS based procedure to local decision makers to detect optimum location of neighborhood parks. Therefore, the methodology of the study is important in terms of guiding the management of public resources and redistribution of public benefit implicitly.

1.3. The Organization of the Study

This study is organized based on the discussion upon the concept of space, location decision approaches and the measurement of accessibility. The operationalization of accessibility and allocation is based on the GIS based service area analysis and location-allocation implementation in neighborhood level case areas of Izmir with six following chapters. Introduction chapter explain the importance of the main issue, related literature and introduce the aim, research questions and hypothesis of the study.

Chapter 2 argues that the locational theoretical approaches have different roots upon space conceptualization. Different space understandings have affected the operationalization of urban public services allocation. The allocation mechanisms of urban public services in society are related with the broader frameworks upon location theories. These broader frameworks are the Classical Economic Approaches, Structuralist Approaches and the Communitarian approach. These approaches have different theoretical roots on space and propose different allocation aims to achieve for society. Conceptualization of space have evolved from rational view as a Euclidian simple geometry by Classical Approach towards a relational understanding comprising not only physical but also social, political, economic and ecological dimensions by Constructivist Approaches (Marston, 2000; Sheppard, 2008; Silber, 1995). These theoretical change has means to methodological developments in the assessment of spatial distribution, and further practical developments in the allocation mechanisms of public service areas.

Chapter 3 argues new technological advances in spatial measurement and operationalization of location decisions using GISs. The spatial management capabilities of GIS and the GIS-based studies in terms of their scale and methodology are mentioned. GIS based studies are categorized into two as city and neighborhood scale analysis as well as measurement of existing situation and proposal of new allocation models. This part reveals that there are limited number of the studies with neighborhood scale and new model proposition based on literature review.

Chapter 4 describes study approach, study site and methodology. The study approach lays on the 'need-based equity' and multi-criteria decision analysis. The main argument of the study is that the need-based equity perspective to urban public park allocation increase the accessibility of varied socio-demographic groups to the neighborhood parks. This part of study site gives information about the demographic structure of Izmir and spatial planning procedures of local and central governments in Turkey. This part further includes the interviews upon the allocation mechanism of neighborhood parks with the development plan departments of greater and local municipalities of Izmir. Due to the complex structure of spatial allocation models, it is argued that the multi-criteria decision analysis is the efficient methodology for this spatial problem. Multi-criteria decision analysis is a recently proposed analytic decision process design for spatial decision problems with varied measurable and non-measurable dynamics (Malczewski, 1999, 2006). Multi-criteria decision analysis process of the study is designed through Analytic Hierarchy Processes method at city scale and heuristic algorithm for optimal solution at neighborhood scale (Ghost & Rushton, 1987). The Analytic Hierarchy Processes method provides a framework for solving different types of multi-criterion decision problems based on the relative priorities assigned to each criterion's role (Saaty, 1990). The city scale data and results is driven from 215K239 numbered research project supported by the Scientific and Technological Research Council of Turkey (Şenol, Özkan, & Kaya, 2017) on the case of Izmir Metropolitan Area and central city of Izmir. With the lead of city scale analysis, the neighborhood scale analysis determines allocation of new park areas and determination of park service areas within the neighborhood scale using GISs.

Chapter 5 argues the opportunities of different methods upon mapping the spatial distribution of urban park areas and detecting spatial concentration of socio-demographic groups. It is argued that 'equity mapping' literature gives insight for the detection of 'park poor' areas of Izmir (Şenol, 2019). The spatial equity mapping can detect the inequities in access to public service areas by analytic processes. Descriptive maps of spatial distribution of parks and of social groups of the city are conducted within GIS environment by Analytic Hierarchy Processes method. The park poor areas are detected in Buca, Karabağlar and Bayraklı districts.

Chapter 6 introduces the GIS based spatial implementations in the case of Izmir and describes a set of spatial analyses of neighborhood parks on city and neighborhood scales. In this part of the study, the spatial analyses of the accessibility of existing neighborhood parks and further, the allocation of new park locations are performed respectively, with the aim of increasing the accessibility of different socio-demographic groups to park areas. GIS based service area analyses is performed to assess existing park service areas and heuristic approach to allocate new park locations. In the chosen 'park poor' clusters, for the assessment of existing park service areas Thiessen polygon Method and Service Area Analysis and further, for allocation of new park locations Location-Allocation Analysis are used respectively in GIS.

Chapter 7 describe the evaluation of the findings, outcomes of spatial statistics. The spatial analysis results shows that the integration of "need-based equity" approach and multi-criteria decision analysis as an allocation model increases the accessibility to neighborhood park areas.

CHAPTER 2

THE LOCATION THEORY OF URBAN PUBLIC SERVICES

This chapter argues the locational theories associated with their wider theoretical background. With this aim, different location theory and models are explained related with chancing spatial dimensions. The locational theories roots upon space conceptualization. Space understandings in different approaches have effect upon the operationalization of urban public services allocation. These approaches are the Classical Economic Approaches, Structuralist Approach and the Social Constructivist Approach. These approaches have different theoretical roots on space and propose different aims to achieve about location decisions. Conceptualization of space have evolved from rational view as a Euclidian simple geometry by Classical Approach towards a relational understanding comprising not only physical but also social, political, economic and ecological dimensions by Constructivist Approaches. These theoretical change has means to methodological developments in the assessment of spatial distribution, and further practical developments in the allocation mechanisms of public service areas.

Allocation mechanism of urban public services and measurement of accessibility depend on the locational approaches (Beler Erkip, 1997). Location theories are developed by comprehensive classical approaches towards social constructivist approaches. The public services in location theory are mentioned regarding of conventional economic theory and later regarding social justice and social welfare economics. While the conventional economic theory is related sustaining maximum profit and utility (Pareto-optimal allocation) in competitive market conditions. However, the issues of spatial externalities and specific location of public facilities remained unmentioned in these approaches. The social justice and welfare economy focuses on public decisions in government budget in response to welfare criteria (R.L. Lineberry & Welch, 1989; Teitz, 1968). Recent theoretical approaches on locational modelling consider multi-factors and multi-participant. These include both economic optimization and social equity. These models of public service allocation consider the optimization principle by cost-benefit analysis. This analysis sustains utility maximization under competitive market contexts. This leads to the allocation policy ensuring equity of marginal net returns from a right amount of services in practice. Therefore, recent urban studies on public service allocation sustains maximum utility and considers efficiency, effectiveness and equity at the same time (Kahraman, Ruan, & Doğan, 2003).

Definition of public service changes depending on the economic and social approaches of different eras. Public services are defined as 'the accumulation of private self-interest' at classical approaches. Then, they are defined as a component of urban structure and 'public or collective goods' and 'merit goods' in structuralism. In further approaches since 1980s, the definition has been enriched containing social, political, cultural and ecological meanings in itself. While they are defined as governmental spending in limited budgets in classical economic approach. By the concern of welfare economics, public services are defined as instruments to control uneven urban growth and of income redistribution by government. They have also gain a role to enhance social participation. However, this intrinsic roles of public services have been challenged by neoliberal era's capital-intensive politics and its spatial implementations since 1980s.

2.1. Classical Approach to Locational Change

In the 18th to the end of 19th century, the classical economic approaches was dominant with the primacy of the economic sphere. The classical economist idea concerns the self-regulating market system for the comprehensive locational theory and distribution of production and resource. The self-regulating market works well without overall regulation and voluntary transaction. Individuals are mentioned as buyers and as sellers and individuals has perfect knowledge of the market where there is a perfect competition. The self-ordering market has been expected to encourage the growth of society's capital stock, to achieve the public good and the wealth of the society.

In classical approaches, the space idea behind the location approaches is pure rationalist. The classical idea of hierarchy and physical determinism upon space are based on instrumental rationality, object-oriented and Euclidean conception. Space and time are claimed as the surrounding stages rather than actions. At this approach, space is assumed as a container and as a functional part of population and society. While economic dynamics are prioritized, social and environmental dynamics upon space are ignored. These dynamics are all mentioned as tightly interlocked within space with a functional relationship with each other and with the space itself (Graham & Healey, 1999).

The allocation mechanism of urban public services is mentioned as allocation of scarce resources to satisfy unlimited wants based on economic rationality. Planning is defined as the decision making process to allocate urban resources by economic calculations. Public interest are defined as the accumulation of private interests prioritizing private satisfaction. Systematic analysis of the urban structure such as Burgess's concentric zone model underlying causal processes is one of the important theoretical attempts. Space is mentioned as the arena of struggles and competition of sub-urban systems. Struggles of system units is comprised of four interdependent and functional stages as competition, conflict, accommodation and assimilation. Spatial distribution of public services as a sub-system can be the outcome of struggles upon space. Due to the self-regulating market based system, it is claimed that public services were not produced in this approach.

2.2. Neo-Classical Approach to Locational Change

Neo-classical approach as continuation of rational-analytic view focuses on the hierarchy of urban systems and proposed general normative arrangements of places with different sizes. The main parameters of location theories in the neo-classical approach are to define the highest and the best (optimum) usage in terms of return, price, distance, transportation cost; therefore, to determine the allocation of land use according to market principles. It is to determine the optimum land use type by calculating the product that gives the highest rent / return distance increases from the market. The allocation of urban services are managed based on the hierarchy of goods and services. The allocation of resources is based on the rational modernist and scientific approaches asserted by the philosophy of instrumental rationality (Caporaso & Levine, 1992; Harvey, 2009).

Analytic understanding of the urban system comes from equilibrium analysis. The equilibrium analyses can define an optimal allocation of resources. Each models to the public services aimed to identify natural equilibrium in an urban system. There are many

Locational Theories to explain the structure of urban settlements in that era by VonThünen (agricultural economy model), by Park and Burgess (industrial city model), by Weber (model for industrial activities) and as more developed version by Isard model, by Hotelling (trade based model), by Christaller (central place theory), by Alonso (location theory). They are typing normative approaches to modeling market-driven urban structure and the location of public goods were not mentioned specifically. The optimal location of any land-use is detected by equilibrium analyses. However, there are important approaches to the locations of public services as Tiebout's efficiency model (voting with feet) and Hotelling ice cream vendor problem model as the earlier examples of the distribution of urban services (Türk & Dökmeci, 2017). These models concerned the public welfare, public expenditure and minimum average cost (Wooders, 1980).

Arıcıoglu (2011) points that VonThünen's theory explains how the different agricultural products are placed around a center taking into account the transportation costs. Thünen explains the characteristics of agricultural land use around a central city by considering the geographical distance, transportation costs and land prices. As a result of the Thünen analysis, it has been demonstrated that the spatial order of agricultural production and land use evolves into a series of circular rings from a central city (ie market) to the outward. As the distance from the market center / city increases, the value of the land decreases. Land value and land use are differentiated depending on the cost of production, transportation cost and the change in the price of agricultural products (Arıcıoğlu, 2011; Yavan & Anlı, 2018).

The Thünen model is mentioned as the first rent theory addressing the rent spatially. The areas closer to the city market gain location rant. However, it is assumed that the area considered is isolated from the rest of the world. Therefore, the name Thünen theory is called as "isolated state". Farmers are considered as a homogenous economic people who aims maximum gain and have equal knowledge. A major urban market (central area) is assumed to be dominant in the region and all farmers sell any product at the same price. It is also assumed that transportation opportunities are same for each geography. The transportation cost is directly related to the distance (Arıcıoğlu, 2011; Yavan & Anlı, 2018).

Furthermore, Arıcıoglu (2011) points that Thünen's work has the foundations for the modern urban location theory. Urban location theory is based on the differentiation of land use types and prices according to their place within the city. Arıcıoglu mentions that Alonso has developed a new urban location theory by adapting the agricultural location model of Von Thünen to the modern cities describing the location choice of firms and households / individuals in the city. Alonso has developed a concentric zones model to explain the urban settlement system. According to the model, the ability to bid rent of each land use in the city is different to be close to the center. Land cost decline with distance from the centre of the city, due to the low accessibility and high transportation cost at the periphery. Firms and households make trade-off between rents and transportation cost depending on their locational needs. According to the principle of obtaining the highest benefit from the land use, each land uses concentrate on a specific area in the city. This condensation is in the form of circles in a homogeneous area (Arıcıoğlu, 2011; Yavan & Anlı, 2018).

As an another location model, Robert E. Park and Ernest W. Burgess developed a theory of urban ecology at 1920s, which proposed that cities are environments like nature governed by natural forces. Their model is known as concentric zone theory, describing cities with the form of five concentric rings with areas of social and physical deterioration concentrated near the city center. These zones are central business district, transition zone, inner city, inner suburb and outer suburb respectively. Concentric zone theory is one of the earliest models developed to explain the spatial organization of urban areas. The most important of the natural forces is competition. Park and Burgess suggested that the struggle for scarce urban resources and urban land led to competition between groups. The competition is also result of the division of the urban space into zones with similar social characteristics people. Park and Burgess called the change of land uses to outward from the city center as a process of "invasion" and "succession". As an inspiring example of a thematic map, they modeled the city of Chicago by using physical features, political boundaries, zoning, residential and commercial developments, and vacant areas in the city. They were most interested in identifying zones or natural areas (Brown, 2002; Quinn, 1940).

Moreover, Weber developed a location theory based on minimum travel cost at 1909. Arıcıoğlu (2011) defines the main motivation in Weber's theory as the relationship between the behavior of the industrial capital and the rapid growth of the industry city-centers focusing on transformation process in industry (Arıcıoğlu, 2011). Weber aimed to optimum site for a single industrial company. This theory separates the distance costs and the location-specific costs. Costs related to the distance are defined as transportation costs, location-specific costs are defined as agglomeration economies and local labor costs. These three factors, which determine the location of the establishment, are the advantage cost during the production process and also the stages of the company's location selection. According to Weber, the main determinant of the location of industry is the transportation costs. Therefore, the optimum site is the place where the total transportation costs are minimum. Because the labor force is mentioned to be obtained at different prices in different locations (Arıcıoğlu, 2011; Yavan & Anlı, 2018).

Arıcıoglu (2011) points that Christaller and Lösch brought a different view to the Location Theory in 1930s and they mainly analyzed urban settlement. According to Christaller, the Central Places Theory can be considered as the location theory of urban commercial activities. The distinctive feature of this theory is that it focuses on market-oriented functions. Therefore, sources of energy, raw materials, industrial inputs and the location of the labor force are not addressed (Arıcıoğlu, 2011).

Christaller theory propose an idealized system of hexagonal market areas based on the concepts of centralization, threshold and hinterland by excluding industrial placement. In Christaller's urban model, each central place has a surrounding region, an exclusive hinterland within which the town has a monopoly on the sale of certain goods or services. The phenomenon that makes a place central at any stage of seven-level hierarchical system is production of goods and services more than its own needs, in other words, it serves the hinterland. In this case, the central place is actually a market that has the ability to create a surplus and provide services to the surrounding region (Türk & Dökmeci, 2017).

Arıcıoğlu (2011) points that space is analyzed by means of the hinterland and threshold in Christaller's urban model. The main factor is the distance that determines the hinterland of a commodity. The concept of distance, expressed in terms of transport costs, represents the farthest distance for someone to go to purchase a commodity that is produced in the central location. If the distance is too much, individuals don't buy or prefer to buy it from another central place because it's too expensive due to increased transportation costs. Another factor that determines the hinterland area is the density of the population in the central location and the population in the surrounding region. In addition, the social structure and income of the population determine the hinterland of the goods. Thus, the hinterland of a central commodity represents the spatial effects simultaneously of all the factors mentioned (Arıcıoğlu, 2011).

According to Arıcıoglu (2011) and Dökmeci (2017), the theory developed by Christaller differs from Von Thünen and Weber's theories. While Von Thünen and Weber are dealing with the decisions of individual producers, Christaller moves from the individual / firm level to the city and market location systems. In addition, Thünen and Weber are mainly interested in the decision-making process in their analysis and the resultant total decisions were composed of individual decisions (Arıcıoğlu, 2011; Türk & Dökmeci, 2017).

Furthermore, according to the Dökmeci (2017) and Arıcıoglu (2011), Lösch developed a Location Theory similar to the Christaller's approach. Although Lösch's work is mentioned as the first modern and systematic study that combines earlier theories into an analytical structure, it just relates with a single producer and reaches from this to the ranking central places. The definition of market area by Lösch, is the border of total economic activities of surplus value of an individual producer. The limits of the producer's market area are determined by the transportation costs. Lösch assumes that the market area will be in the form of a circle if a single manufacturer produces surplus value due to having large-scale to eliminate transportation costs (Arıcıoğlu, 2011; Türk & Dökmeci, 2017).

Public goods are defined as collective consumption goods. This mechanism lays on the consumer-voters as their preferences for public goods. The government's expenditure for public goods and services is expected to "adapt to" consumers' preferences. The classical models claim that the location of any facility force the voter to reveal his preferences; a public services are able to satisfy consumers in the same sense that a private goods does; and they are taxed to him accordingly. Any government mechanism operates at local level tries to insure that expenditures on the public goods approximate the proper level.

Erkip (1997) points that locational theories proposed models for the total urban structure prioritizing economic facilities until 1960s. The first model proposal for the public service areas is the Tiebout's model (Beler Erkip, 1997). Tiebout's model namely voting with the feet lays on the assumption that efficient allocation of resources can be achieved by perfect consumer mobility and competition between jurisdictions. According to the Tiebout, consumers "vote with their feet" and that this "voting" creates an approximate "market-type" equilibrium in economies with local public goods. He hypothesized that this approximate equilibrium is nearly optimal and this optimal location can sustain the smallest moving costs. Charles Tiebout (1956) argues that the movement of consumers to jurisdictions takes place where their wants are best satisfied. This model is based on market-based equilibrium and inter-jurisdictional mobility (Wooders, 1980). The Tiebout model is based on five assumptions about local government and location choices:(O'sullivan, 2007)

> "1. Municipal choice. A household chooses the district or neighborhood that provides the ideal level of local public goods. There are enough municipalities to ensure that every household finds the perfect jurisdiction.
>
> 2. Perfect information and mobility. All citizens have access to all relevant information about the alternative municipalities, and moving is costless.
>
> 3. No inter-jurisdictional spillovers. There are no spillovers (externalities) associated with local public goods: All the benefits from local public goods accrue to citizens within the municipality boundaries.
>
> 4. No scale economies. The average cost of production is independent of output.
>
> 5. Head taxes. A municipality pays for its public goods with a head tax."

The Tiebout's model (1956) assumes that individuals have homogenous demand and tastes. It supports that the allocation of resources based on the same demand frequency would be Pareto optimal. The model is based on a linear relationship between distance and transport cost, maximization of profits and a homogeneous physical environment. Pareto – efficient equilibrium allocation model assumes that the citizens have perfect information on local policies and are perfectly mobile and there are no externalities. Policies that promote residential mobility and increase the knowledge of the consumer-voter would improve the allocation of government expenditures (Hodgart, 1978; Tiebout, 1956).

As seen in the Tiebout model, all classical location models assume space as a homogenous plane and the location choices on this plane are characterized by an infinite solution space. That is, any kind of facilities including public services may be located anywhere on the plane and distance measurement is according to Euclidian metric (Revelle, Marks, & Liebman, 1970). The shortcomings of these theoretical approaches are extreme simplification, deprivation, ignoring the role of governments and ignoring differences in individuals. They neglected both the social and cultural dimensions of urban life and the political-economic impact of industrialization on urban geography. The locational models of the era is criticized being dependent on American cities and had limited applicability elsewhere. They also neglect the issues of class, race, gender, and ethnicity. The rational understanding of classical approaches has been criticized ignoring externalities (Mishan, 1969), homogenizing city space as a simple geometry, accepting self-regulating market mechanisms and ignoring the socio-economic characteristics of social groups and ignoring environmental/social injustices among these social groups (Byrne & Wolch, 2009; Quinn, 1940; Rawls, 1968; Wolch, Wilson, & Fehrenbach, 2005). Spatial planning field needs to develop new tools and their translation into practices to re-configure the recent theoretical views about socio-spatial relations (Graham & Healey, 1999).

2.3. Behavioural Approach to Locational Change

Behavioral approach is a humanistic approach, it focuses on economic locational change and it is dominated in 1970s. The inductive reasoning is favored in this approach which analyses the parts of the whole and mostly at micro-scales. This approach also seek for generalization like neo-classical models. However, this approach against neo-classical models in terms of reasoning the locational change (Healey & Ilbery, 1990).

Healey and Ilbery (1990) have highlighted that behavioralism considers non-optimal behavior of economic activities or entrepreneurs and aims to propose alternative models for economic locations. Attention is focused on the decision-making process of modeling and long-term decisions. The models of economic activities including agriculture, manufacture and service considers against the perfectly informed individuals, maximizing profit and optimal site. The locational modeling is mentioned as a complex process including many variables rather than profit. The mostly emphasized ones are preferences, opinions, perceptions, satisfaction and motivations (Quinn, 1940; Rawls, 1968).

The main idea in neo-classical models is replaced with the satisficing behavior of economic activities. The behavioural changes of different economic activities are defined in a matrix model. The location of any activity depends on the degree of being informed. The satisfactory decision is chosen among alternatives based on the degree of information. The opposite of the satisfactory decision is defined as risk and uncertainty.

Due to the personal consideration as satisficing and uncertainty, the locational decisions may be at sub-optimal decision (Quinn, 1940; Rawls, 1968).

Behavioral approach is criticized for proposing poor explanation. This approach focus on the variations in behavior and the decision-making process rather than explaining the reason of behaviors. It is also mentioned that this approach fails to make generalization due to the variety in behaviors of economic activities. This approach also takes the spatial context as static and container rather than relational (Healey & Ilbery, 1990; Quinn, 1940; Rawls, 1968).

2.4. Structuralist Approach to Locational Change

Structuralist approach has grown as a challenge to the failure of the equilibrating mechanisms of the market system in terms of re-distribution of income and resources. As Harvey pointed, the self-regulating market mechanisms (hidden mechanisms) in complex city systems have increased inequalities rather than reduce them (Harvey, 1975). As Pahl (1971) mentions since public resources are, in some sense, a part of each individual's income, their spatial distribution directly affects the distribution of public welfare (Harvey, 1975; Pahl, 1971). The main concern in Structuralists is not only social welfare economy and also social, political and economic features of the society. This approach argues that the behavioral approach should be enriched by wider social, political and economic processes. Therefore, the effects of surplus value on resource allocation, worsening income distribution and socio-political processes are the main problematics of Structuralist approach. The socio-political and socio-economic behaviors and social welfare are key determinants of locational variables of spatial planning.

Structuralist approach have proposed a unitary theory of space comprising physical, socio-politic and historical dimensions. Space is defined as a product of economic, social and political processes at a specific time period. The main aim was to expose the actual mode of production and it's socially constituting social space. Explanations upon spatial contexts are time-specific. Different economic, social and political processes produce their own space at a certain time. However, this approach neglects the place issue.

Public services are mentioned as public goods provided by local governments and means of the redistribution policies. Service allocation organizes income redistribution (or hidden multiplier of income) among citizens. Spatial allocation of urban services means the spatial allocation of advantages and disadvantages as “redistributive mechanisms” (Williams, 2002). The allocation of resources should take place as an adjustment to increase inequality of income distribution (Swyngedouw & Heynen, 2003). In this manner, the redistributive objectives of local governments should be complementary at local levels.

On the other hand, allocation of urban public services is complicated due to the factors such as being time-specific, spatial externalities, limited resources, and different socio-politics groups (Rich, 1979b). Spillover effects (spatial externalities) are important input into the consideration of public service distribution. It is claimed that the activity of any element in an urban system may generate certain (unpriced and non-monetary) effects upon other elements in the system. These effects are termed as externalities or spill-over effects. Externalities can be viewed as either costs or benefits to the consumer due to the inability of market mechanisms to allocate resources perfectly (Mishan, 1969). Spillovers regarding public service have beneficial effect extending the boundaries of jurisdictions upon citizens.

Erkip (1997) has pointed that a proper public service distribution should sustain both equity, efficiency and effectiveness. These means that a proper allocation model should consider both measurable such as proximity and non-measurable criteria such as social needs. These factors relate strongly each other (Beler Erkip, 1997). Equity is the major factor that comprehend the others intrinsically. Equity is defined as the fairness of the service distribution and as an issue of distributive justice. Equity concerns socio-political features of the society and concerns what is fair. Equity criteria has four standards as input equality, output equality, adequacy and efficiency. Efficiency and output equality are the important factors that consider equity. Efficiency measures the ratio of service output to service input. Moreover, efficiency seeks different Pareto optimal size and location for individuals of different socio-economic groups. While input equality considers equal service for each citizen, output equality considers not only size of service but also characteristics of users, proximity to service, quality of service such as attractiveness and cleanness. Effectiveness as the other factor is defined as the level of demand or need satisfaction of users and the level of avoiding negative spillover to users.

In fact it is mentioned as the measure of adequacy of service quality. The ways of measuring effectiveness are survey and direct observation of outputs among users (R.L. Lineberry & Welch, 1989; Rich, 1979a).

The approaches of equity varies with the different spatial dimensions and with different operational meaning.(Lucy, 1981) Four main conceptualization is suggested as equality, need, demand and market-based equity. A need-based (compensatory) approach is the socio-politic one that sustains distributive justice in public service allocation. By the distributional justice it is aimed to improve and equalize the quality of urban life among social groups. A possible political approach to the service distribution has elaborated not only on the criteria of scarce resources, but also political demands of population, the needs of population, and the institutional ideologies of decision-makers. The main objective of service allocation is mentioned as to satisfy needs of different user groups rather than sustaining territorial equality. Similarly, Lineberry has also mentioned the importance of demand and needs of users as well as equality in public service distribution. According to this model, the frequency of public service usage is based on the needs of social groups, their socio-economic aspects and physical accessibility. Accessibility is described as proximity to and marginal cost of public services (Robert.L Lineberry, 1977).

The ‘need-based equity’ approach is a social-need based allocation, concerning social costs and social justice among different user groups. This perspective considers as already mentioned that some groups have been continuously disadvantaged in getting access to urban resources and having spatial inequalities because of their socio-economic characteristics based on class, race/ethnicity, age, gender and others. These groups have been defined as poor and low-income groups, racially/ethnically marginalized groups, children and seniors with limited resources. This perspective claims that the allocation of public resources and service areas should concern the needs of the disadvantaged groups. This framework seek for equity in the distribution of public benefits according to need which is based on disadvantaged groups due to their class, gender, race/ethnicity, age or income. Need-based equity framework consider the equity by giving priority to the accessibility of these disadvantaged groups. Proximity is mentioned as an important input for accessibility of disadvantaged groups with less mobility (Beler Erkip, 1997).

Apart from compensatory (need-based) approach, there are three different perspectives upon allocation mechanism with different equity understandings. One of these is the ‘equality-based equity’ perspective. This approach defines equitable distribution as equal distribution of public resource and services which every individuals receive the same public benefit, regardless of socioeconomic status, ability to pay, and regardless of need. This perspective is criticized as “unpatterned inequality”(Robert.L Lineberry, 1977) and for considering urban space as a simple geometry and ignoring socio-economic differences among social groups and regions in the city. Besides, the equality-based distribution does not assess the impact of those services on particular social groups and conditions. Such a perspective lack to measure and evaluate accessibility on sub-scales in which characteristics of housing and close environment relations are important. The equality-based equity as a traditional allocation of service areas seeking to equalize the number of services for jurisdictional units rather than for individuals.

Such an approach is so deeply embedded within planning practices. It continues to be a central conceptual foundation for the plan-making practices of many countries, at scales from the neighborhood to the nation. However, the tools of traditional urban service allocation are still two-dimensional, boundary-based and offer single, objective, representations of urban spaces in Euclidean terms. These traditional methodologies of planning and design are means to the reduction of realities into geometries and manage users as a same and disempowered. Time is still neglected in practice and theory of locational approaches. They are not only space-container but also referring a specific time-period 'time-container’. That means that conceptions of space is divorced from conceptions of time (Graham & Healey, 1999).

Alternatively, the ‘demand-based equity’ is known by allocation of urban public services based on dwellers’ demand and so based on their capacity to access to political power and mechanisms. The other is ‘market-based equity’ that make the cost of the service a key factor in distribution according to the degree to people’ capacity and willingness to pay for a particular service. These categories seek for the benefits of significant groups and categorize urban space according to the locations of these groups.

In brief, Structuralist approach explains the locational change in relation to the wider social, political and economic processes. Moreover, the locational decisions alter in response to the changes in socio-spatial conceptual approaches and new technologies in spatial measurements. There have been new mixed methods such as multi-criteria and multi-actor spatial decision models. These models generally use GIS based algorithms such as cellular automata, probabilistic models, heuristic algorithm models, neutral network models, and cost-benefit analyzing models. These techniques use not only equilibrium of distance, spillover effect and cost of transportation but also socio-demographic aspects of user groups. The details of GIS based techniques are explained in the next parts.

2.5. Social Constructive Approach to Locational Change

As the rising international networks and increasing competiveness between places in the neoliberal era after 1980s, spatial developments on urban space begun to consider tendency of capital rather than needs of society. Urban space has become an attraction area for capital development and local places have been asserted using their particular aspects. The definition of spatial locational problems has begun to use network based expressions and prioritize localities. The urban space and also public spaces have been defined as consumption spaces and users are defined as consumers in neoliberal era. There have been locational approaches based on networks and competitiveness of places. The communitarian approach to location theories has comprised not only network based space-place understanding but also critical approaches to the neoliberal space understanding. These are recent social movements that criticize the commodification of nature in cities and redesigning public areas as consumption space and approaches that underlines the public services as a part of environmental justice and right to the city (Şenol, 2019; Soja, 2009).

As Brenner has pointed; capitalist urbanization has evolved into neo-liberal urbanization resting on prioritization of market-disciplinary solutions and the intensification of commodification (Brenner, 2013). The self-evident outcome of neoliberal urbanization processes has been the commodification of nature based on the market rules (Swyngedouw & Heynen, 2003). These processes have been occurring within power struggles that each ethnic, race and gender based classes contend with the hegemonic power to be able to control their own environments. The main approaches explaining the new geographies of uneven spatial development emerged at all spatial scales are environmental justice, the new social movements to the capital and "Right to the City" (Soja, 2009; Swyngedouw & Heynen, 2003) and political ecology approaches (Heynen, 2006).

Particularly after 1980s, Post-Modern and Post-Structuralist theories are increasingly influential in generating reconsiderations of space and locational problems. The modern thought upon location theories and space has changed towards the relational view featuring both economic and non-economic factors by more complex spatial relations. Recent social theories stress the very real heterogeneity of the experiences of time-space within places. Cities now are widely characterized as diverse and heterogeneous. Many different notions, experiences and representations of space-time coalesce within particular places where the essence of contemporary urban life takes part in. Relational rather than absolute theories of time-space are rapidly gaining influence in urban geography studies (Graham & Healey, 1999). As Harvey mentions, such a relational theory indicates how different processes define different time-space geographies and different identifications of places and relations (Harvey, 1996).

Relational space is developed from the initiatives that seek to reconfigure geographical space through constituting social, cultural and political dimensions (Hodson, Burrai, & Barlow, 2016). On the contrary to the logical empiricist approaches, relational conceptions of space within urban theories problematize the relational capacity and social-cultural construction of each contexts. Relational conception of space-place and scale have been developed against the homogenization, generalizing and overemphasizing the landscape by the effects of capitalist development, the economic interests. The relational conception of place comes against the economic and production relations based conceptualizations (Swanstrom, 1993) such as time-space compression (Harvey, 1996), the spaces of flow (Schneider & Castells, 1997) and network spaces (Sassen, 2005). Place has been defined as only being meaningful when established by social experiences and structural components (Merrifield, 1993).

The relational approach to locational problems has also revealed the scale issue by means of interconnected relations. The conception of scale has turned from vertical, fixed and hierarchical to the linkage of both (vertical) hierarchy and (horizontal) networks of social processes (Brenner, 1998; Marston, Jones, & Woodward, 2005). The social construction of scale comes against the proposition that scaling is just constituted around the relations of capitalist production and the state jurisdiction. Smith has built the social and cultural formation of scale alternatively to its earlier economic and empirical formation efforts. His conception of scale has highlighted the role of agency and the aspects such as race, gender, disability on the social formation of scale (N. Smith, 2012). Swyngedouw (2008) has also contributed to the scale formation including nature and society, in other words the physical and the social as interwoven processes (Swyngedouw, 2008). He argues that these socio-spatial processes operate over nested and sometimes hierarchical spatial scales and are fostered by power relations. Howitt also explain the relational conceptualization of scale as triggering power of social networks and social actions upon political institutions, economic resources, territorial rights and opportunities (Howitt, 2002).

The social construction of scale is related with the unbounded social, cultural, political and economic relationships rather than a naturalized categories of jurisdictional boundaries such as neighborhood, province, and such as local, regional, national (Cox & Mair, 1988; While, Jonas, & Gibbs, 2004). Marston and colleagues (2005) construct the relational view of scale by proposing a horizontal (also called as flat) ontology of flows (Marston et al., 2005). They use the language of flows and fluidity for the concepts of movement and mobility of things, people or money etc. against the scalar hierarchies and fixity. A flat ontology consists of localized and non-localized events-relations without the predetermined hierarchies. Social construction of scale defines place as not stick to administrative boundaries, but is relational space which is the intertwined scales through the unbounded part of the whole and always in a process of interaction (Marston et al., 2005).

As mentioned above, the communitarian approach to spatial problems has challenged the ways of locational approaches. Due to the rising consciousness and current unjust urban environments, it is seen that the classical location-allocation approaches cannot sustain equity in service delivery without considering the impact of those services on particular social conditions. General equilibrium approaches are not appropriate to analyze complex urban systems and they are defined as a rough concept in service allocation (Rich, 1979a). Against the efficiency and distance-based models of classical approach, communitarian approach claims that distributional justice can only be achieved by determining the conditions of a particular society, concerning social objectives and social cost of distribution decisions (Marston et al., 2005).

The allocation of urban public services and especially green service areas have been reformed with the frame of “distributional justice”(Rawls, 1968), “social justice”(Harvey, 2009) and “environmental justice” (Öğüt Erbil, 2014; Taylor, 2000) against the environmental crisis of contemporary urbanization processes especially since 1980s (Castree, 2003). The public green service areas area evaluated as part of urban right and environmental justice. The main point of these groups is that existing conditions of accessibility and traditional allocation models of public green areas are unjust and the conditions are worsening in neoliberal era especially for disadvantaged groups such as low-income, elderly children and disabled. On the other hand, distributional justice as the satisfaction of different user groups becomes more important than territorial justice (Beler Erkip, 1997). Rawls explains distributional justice as fairness against the utilitarian doctrine of rational men and he proposes that a perfectly just society achieve “distributive justice” by the “difference principle” as an agreement to consider the distribution of natural assets and their benefits (Rawls, 1968).

Through the relational conceptualization, locational problems are comprehended by the means of social and environmental justice. Environmental justice has emerged as a civil reaction to unequal distribution of environment related resources and risks by minority groups, especially blacks in the US in the 1970s (Byrne & Wolch, 2009; Wolch et al., 2005). Furthermore, many people of color may be systematically prevented from reaching to the multiple benefits of urban green areas with consequent negative impacts upon their health. Bullard states that blacks, lower income groups and working-class persons are more subjected to disproportionally large amount of pollution and other environmental stressors in their neighborhoods.(Bullard, 2018) Environmental justice with different focuses such as Mascarenhas (Mascarenhas, 2014) environmental inequality, Szasz and Meuser (Szasz & Meuser, 1997) environmental racism, Schlosberg environmental threats/risks/ pollution(Schlosberg, 2013) distribution concern the unequal distribution of benefits from environmental services among different races and classes. They also point that ethnic minorities, indigenous persons, people of color and low-income communities confront environmental exposure mostly from air, water and soil pollution (Öğüt Erbil, 2014).

Furthermore, Marxist political ecology framework in 2000s and socio-technical transition studies in 2010s has highlighted the issue of environmental justice. Political ecology framework claims that there are urban and environmental processes that negatively affect some social groups while benefitting others (May, Hodson, Marvin, & Perry, 2013; Swyngedouw & Heynen, 2003). Marxist political ecology and socio-technical transition studies have theorized the urban as a process of socio-natural transformations and alternative ecological and economic flows of socio-technical systems (Heynen, 2006; Hodson et al., 2016). The social and physical environment of the city have been the result of processes of urbanization of nature and thus metabolic circulation of material flow. The environmental ideologies, practices and projects comprise of the process of urbanization of nature. The so-called urban ecologies as the gardens of gated communities, privatized campuses and zones, depressed neighborhoods, waste dumps and pollutant-infested areas have been examples shaping the process of historical-geographical metabolisms. These socio-natural metabolisms are organized and express capitalist urbanization processes (Swyngedouw & Heynen, 2003). The material conditions of these urban environments are not independent of social, political and economic processes. Contemporary urban socio-natural landscapes are necessarily untied for the sake of articulating who benefits and who suffers from the local urban environmental metabolisms.

Locational approaches have moderated allocation of public service via network-space models in order to sustain optimal location (Dokmeci, Cagdas, & Tokcan, 1993). In neoliberal era, the main factors as the determinants of the allocation of public services are defined as social differences, need, socio-economic opportunities such as race, taste and as well as proximity, spatial externalities and the size of jurisdictions. Against the approach of constant jurisdictions and optimal size and spillovers are claimed as the instruments of redefining the jurisdictions (Williams, 2002). Considering these determinants, the GIS based network models are proposed for the locational problems of public services. The gravity models, cellular automata method, cost-benefit analysis, recently developed multi-criteria models, GIS-based neutral networks, heuristic and probabilistic location-allocation models and fuzzy-logic location-allocation models are developed sustaining optimal location with minimum costs for public services (Cooper, 2005; Dasci & Laporte, 2007; Francis, McGinnis, & White, 1983; Türk & Dökmeci, 2017).

One of the most important and problematic public service is green service areas. Green service areas are merit goods (Beler Erkip, 1997). Moreover, they provide benefits such as physical and mental well-being, enhance social relations and sense of safety in a community (Şenol, 2019). The most important type of green service areas is neighborhood parks in terms of sustaining equity. Neighborhood parks are the green service areas locating in residential areas and should be reachable on foot. These green service areas are open spaces with environmental resources having social, ecological and economic values (Emily Talen, 2010).

However, there have been limited number of use of the GIS based models for the locations of neighborhood parks (Dökmeci, 1979; White & Garcia, 2006). Therefore, there is a need of allocation models considering socio-political and socio-demographic features of places and users rather than just being economically optimum (Türk & Dökmeci, 2017).The possible allocation model of neighborhood parks should consider needs of population, number of population, age of users, demographic features, distance-slope and climate effect, the possible intensity of use and size of the area. The appropriate proximity of neighborhood parks should be in 5, 10, 15 minutes distance to reach on foot from surrounding residential areas (Stafford & Baldwin, 2018; Türk & Dökmeci, 2017). Furthermore, this model should have variations in standards according to age, income, education, occupation, living space features and mobility opportunities of users.

On the other hand, allocation of green service areas is a technical problem in urban planning practices of states. In each country, the determination of green area measurement is mandatory and it is managed by area-based per capita standardization system. America is one of the best examples of the green space standard system. Depending on the population size, 20 m^2 per capita population is implemented for more than 500.000 inhabitants, and 13m^2 green area per person is applied in cities with population greater than 1 million. In Europe, children's playground, sports area and green areas functioning as parks are created in urban areas, while green zones are created in the edge of the urban texture. In Turkey 3194 numbered planning law is determined by the standards of green space, which entered into force in accordance with the regulations of spatial plans. The recent amount of green area is determined as 10m^2 per capita (Türk & Dökmeci, 2017).

However, it is seen that many cities in Turkey cannot provide the amount of green space specified by law. In the majority of Turkish cities, the existing green areas do not sustain spatial equity and the city is insufficient for the recreational needs of the people. For this reason, the green areas must have accessible and balanced spatial distribution in order to sustain their beneficial functions. Sustaining a healthy green space system would be possible by considering green service area requirement of the society as readily accessible to citizens. The balanced and systematic distribution of different sizes green areas within accessible distances will both favors the recreational needs of the citizens and will make significant contributions to the urban ecosystem.(Benek & Şahap, 2017)

CHAPTER 3

PROVISION OF PARKS IN GEOGRAPHIC INFORMATION SYSTEMS

The operationalization of locational problems in Geographic Information Systems is also much related with the space conceptualization. The biggest technological issue for GISs is the management of space and spatial planning processes. Operationalization of spatial analyses in GISs and use of GIS tools are developed by changing understanding of space and locational approaches in urban and human geography. The locational approaches alter in response to the changes in new technologies in spatial measurements. There have been new mixed methods such as multi-criteria and multi-actor spatial decision models. These models generally use GIS based algorithms such as cellular automata, probabilistic location-allocation models, heuristic algorithm location-allocation models, neutral network models, and cost-benefit analyzing models. These techniques use not only equilibrium of distance, spillover effect and cost of transportation but also socio-demographic aspects of user groups.(Gold, 2006)

3.1. What is Geographic Information Systems?

GISs are both system and science that incorporation of object-oriented programming and object-relational databases spatially. The need to query the attributes of the spatial objects produced this incorporation of spatial mapping and databases. GISs are digital system compose of spatial mapping and databases that provide attribute query, traditional spatial analysis functions (buffer zone, polygon dissolve, overlay) and 3D modeling.(Gold, 2006) This system both provide to analyze vector (point, polygon and polyline) and raster data.(Michael F. Goodchild, Yuan, & Cova, 2007) GISs also offer a powerful set of tools for analyzing spatial data in which linking the socio-demographic features of exposed population with physical features of the built environment.(Poulstrup & Hansen, 2004)

GIS can provide an interpreting environment for decision makers to organize and interpret complex spatial information in their decision-making process, and hence, for the optimal location of public facilities.(Yeh & Chow, 1996) Cartographic display of GIS is an important opportunity in both urban modelling and spatial decision support systems.(Densham, 1994)

GIS is used to create a “simulation” that is modeling the change over time of the attributes (e.g. population density), change over time of the spatial location of the objects or change over time of the connectivity. Full simulation is produced by defining some mathematical function to describe the behavior of the process. All of these types of change are forms of simulation such as terrain surface interpolation as simulation of attribute change with changing location. “Managing Change” is also important issue that is applied to many problems. “Change” becomes the issue of Interaction and Visualization in GIS. Models of managing change is becoming an increasingly important issue across the world, which means that GI Science is expanding into other disciplines.(Gold, 2006)

Furthermore, the broader implications of GIS use in varied disciplines are referred as critical spatial thinking.(Michael F. Goodchild, 2011) In this thesis, critical spatial thinking is addressed via the integration of relational view of space, place and scale with the GIS science.

3.2. Space, Place and Scale in GISs

The most important technological issue for GISs is mentioned as the management of space (Gold, 2006). GIS models ‘space’ with reference to the coordinates of a location. Geographic data contains attribute information. Referring to geographic space implies some range of scales. GIS works with spatial data, at scales where it can change the location of a human observer. The space is fundamentally three dimensional, but for many applications a projection onto a single two-dimensional datum, or perhaps onto a terrain surface. Due to the fact that gravity encourages objects to accumulate at some particular datum, GIS can works with 2D as well as with the third dimension. Scale is also important in terms of detail – the aggregation level of data collection, or generalization, depends on the application.

Place issue is in GIS is called as the Euclidian spaces enriched with human experience (Couclelis, 1992). The geographical concept of place refers to the areal context of events, objects, and actions, and includes both natural elements and human constructions. It also incorporates the notion of change through time. Place is defined as a location that has been given shape and form by people (Curry, 1996; Hall, 1992). Modelling a place has been discussed involving the people's experiences, subjective views of individuals, their activities, as well as the physical environment in which they act to reveal agent-environment mutuality.(Whitehead, 1981) These variables can be personal actions and narratives in order to characterize the uniqueness of a place, symbolic representations as symbols, socioeconomic and cultural factors and typologies that referencing places. The extensive work of modeling the interactions between agents, their actions, and environments can also be used for further data mining procedures in GISs.

GISs can be used to facilitate nested multiscale analysis as well as "scaleless" analysis.(Gold, 2006) Within this perspective, geostatistics provides a powerful framework for addressing scale-free (scaleless) approaches through the generation of statistical surface representations of space. To overcome rigidities of hierarchical scales, the geostatistic creates continuous surface by using point data and network models of social processes (Marston et al., 2005; Mennis, 2002). The integration of "scaleless" spatial analysis into GIS leads to a better match with people's spatial interactions rather than coordinate-based models (Jordan, Raubal, Gartrell, & Egenhofer, 1998).

One of the most recommended functions of geostatistics in GIS is spatial interpolation. Interpolation estimates the value of some variable of unmeasured locations based on measured values at some set of locations. It is used for interpolating a continuous surface based on point observations or for resampling raster or vector data to a different set of points. The main argument of the interpolation is that values of variables distributed over geographic space show strong spatial autocorrelation. Interpolation allows to see the strongly correlated values of variables over distance. Thus the spatial scales of a variable can be defined that has interval or ratio properties (Michael F. Goodchild, 2011).

There are many functions rather than interpolation for space modeling analysis upon multiscale in GIS. These functions focus on defining and relating space and further visualizing the spatial relationship. Common spatial analyze functions include point density analyze for defining hinterland and network analyze based inverse distance measurement, travel time measurement, k-nearest neighboring and contiguity analysis. By these analyses, it is also available to create 2-D and 3-D models of how features interact with each other across space without spatial boundaries. The conceptualization of spatial relationships reflect inherent relationships among the objects, events, people etc. It is also influenced by characteristics of the data. The functions that assess spatial neighboring relationship are the Spatial Autocorrelation Analysis (Global Moran's I), Hot Spot Analysis (Getis-Ord Gi), and Cluster and Outlier Analysis (Anselin Local Moran's I). These tools generate spatial relationship based upon statistical measurements (Chun & Griffith, 2013).

3.3. Location-Allocation Studies using GISs

GIS has been used as a means of spatial analytical methods not only for assessment of existing distribution of urban facilities but also for proposing new location models. The studies mainly focusing on the distribution of green service areas have developed “spatial equity mapping” to reveal injustices in access regarding different social groups to these areas (Emily Talen, 1998; Wolch et al., 2005). There have been also studies that propose a methodology for allocation of green service areas.(Sister, Wolch, & Wilson, 2010) This part reviews the literature upon GIS based spatial analytical techniques of firstly equity mapping (Emily Talen, 1998) and further the methodology of allocation by GIS techniques. The GIS based equity mapping literature is categorized first according to their implementation scales, then to the accessibility measurement techniques and allocation methods.

In terms of implementation scales, there are mainly two spatial scaled studies as city and neighborhood levels. GISs offer many domain of inquiry for modelling the urban service allocation and assessing accessibility in city scales. City scale studies have majorly assessed the spatial distribution of urban services, facilities or resources via mapping the equity and accessibility patterns by using GIS techniques and methods.

While the earlier studies generally use descriptive thematic mapping (Unal, Uslu, & Cilek, 2016; Yavuz & Eminağaoğlu, 2007) or radius methods, cellular automation and linear programming method (Abler, Adams, & Gould, 1971). Recent studies uses point density method (Benek & Şahap, 2017), gravity models and spatial decision support systems (McLafferty, 2003a; Rushton, 2001) according to their geographical location and size of area across the city (Knox, 1978; McLafferty, 2003b; Emily Talen, 2010). Their accessibility measurement lay on zone based integral (traditional) measurement approach and zone of aggregation as administrative boundaries (M. P. Kwan, 1999; E. Talen & Anselin, 1998).

The gravity models have been used for the measurement of the travel cost or minimum distance to urban services such as medical services(Knox, 1978), health care services(McLafferty, 2003a), and neighborhood parks.(Emily Talen, 1998) The gravity model is used as a model of spatial interaction. The gravitational force between resident location and park location is proportional to the attractiveness of the park area and inversely proportional to the square of the distance between them. Therefore, demand for parks is expected to fall at a negative rate with distance. In these terms, the computed accessibility score characterizes the use (or demand) of every park. Therefore, the access score will be lower where distances to parks are greater.(M. J. de De Smith, Goodchild, & Longley, 2007) On the other hand, spatial decision support systems integrate GIS with an array of analytic methods and combine a geographic database, a system for database management and querying, a user interface, and a set of analytical tools.(Rushton, 2001)

Within the context of neighborhood scale, there are limited number of studies that focus on the neighborhood and lower scales. Not only social differences in neighborhoods but also physical aspects of the neighborhood influence allocation models at micro scales (Biddulph, 2012; Nyunt et al., 2015). Existing neighborhood studies generally use Thiessen polygons method (Boone et al., 2009; Moise, Kalipeni, & Zulu, 2011; Sister et al., 2010) to detect park service areas and for park allocation analysis at neighborhood scales. Thiessen polygons method is an interdisciplinary concept that is used extensively in many different fields such as archeology, astrology, cartography, ecology, geography, geology, marketing, meteorology, physics and urban and regional planning. Thiessen polygons method, also known as Voronoi polygons, are formed around a set of points in a given area, assigning all the points in that area to the closest point member. Any place on a Thiessen polygon is closer to any point in that polygon, than any other member of the set of points. The Thiessen polygon is created by drawing bisectors that perpendicularly intersect these straight lines after all points on a given area are joined with the shortest straight line. The spatial mosaic created in this way is called the Voronoi diagram. The basic logic here is that any object within any Thiessen polygon is closer to the points in that polygon than any other point.(Yamada, 2016).

However, network-based analysis proposes more advanced spatial analysis. The network based Service Areas Analysis in the network techniques is mentioned more efficient to detect park service areas. This analyze use network distance rather than linear distance and has ability to take into account the spillover effects of urban service facilities. Besides, this analyze relies upon point-based spatial framework rather than zone-based methods as in the Thiessen Polygon Method.(Oh & Jeong, 2007) Moreover, network based location-allocation analysis propose allocation model using probabilistic allocation rules as fuzzy-logic (Beaumont, 1980; Hodgson, 1978; Linthorst & van Praag, 1981) and heuristic algorithms(Ghost & Rushton, 1987).

The heuristic algorithm based Location-Allocation analysis is used for finding the optimal location of facilities and either for evaluating their existing locations.(Ghost & Rushton, 1987) Facilities to be located are defined as the "supply points" and places with fixed locations are defined as "demand points". The sum of the demands allocated to the facilities is defined as ‘inflow to each facility’. Specifically, procedure of location-allocation models find the most appropriate location of (urban) facilities by optimizing objectives of capacity constraint (inflow), minimize impedance distance, minimize facilities or threshold constraint. The effects of different objectives as well as different level of the same objective on the provision of facilities can be examined by different allocation patterns; such as different distance-impedance parameter (minimize impedance), different sum of all inflows (maximize coverage) or different capacity of service facilities (maximize coveraged capacity).

Location-allocation analysis assigns a number of facilities to a number of population that may sustain different problem types. Facilities to be located are the “supply centres” and places with fixed locations are “demand points”. It is also a minimizing (distance) impedance problem (p-median problem), that involves the determination of the location of demand points at which facilities should be located in order to minimize the total distance between demand points and the nearest supply center.

Impedance is defined as a cost between two points (xi yi; xj yj) that can be distance, time or travel effort. The distance as impedance is calculated as(Yeh & Chow, 1996)

$$d_{ij} = \sqrt{(x_i - x_j)^2} + \sqrt{(y_i - y_j)^2} \quad (3.1)$$

The location-allocation problem is one of combinatorial optimization, which means there may be number of potential solutions. It is mentioned that optimal solutions cannot be obtained by examining all the combinations. Therefore, one of the most efficient methods for solving the location-allocation problem is defined as the heuristic algorithm (Ghost & Rushton, 1987). The key component of a location-allocation model is based on heuristic algorithm to choose service locations minimizing impedances such as average distance or maximizing population coverage.(Ghost & Rushton, 1987) Location-allocation works in a two way that simultaneously locates facilities and allocates demand points to those facilities.(M. J. de De Smith et al., 2007) The algorithm is calculated by allocating each demand point (residential units) (i) to its closest supply centre (park areas) (j) and and calculate new locations (z) for the new supply centres (park areas) for each group of demand points. This algorithm proposes alternatives for allocating population to supply centers and locating these centers where the sum of the weighted distances from all demand points to this optimal location is minimum. While locating the supply centers, first a region is subdivided into sub regions and then the optimal location of supply center within each sub region is calculated through a number of iterations until the difference between iterations is under 0.01. This algorithm calculates the least number of iterations and it is most appropriate algorithm for large data sets (Rushton, 1979). This algorithm randomly selects demand points as starting locations for the supply centres and form groups of demand points by allocating each demand point i to its closest supply centre j and calculate z;

$$z = \sum_{i=1}^{n} \sum_{j=1}^{m} a_{ij} w_i d_{ij} \quad (3.2)$$

where:

a_{ij}= (1 if demand point *i* is closest to supply centre j, 0 oetherwise)

w_i= weight associated with each demand point

d_{ij}= distance between demand point *i* and supply centre *j*

Moreover, through the location-allocation procedure, the heuristic algorithm creates an origin-destination (OD) cost matrix. This matrix uses network distance between park areas and residential units. The analyze references the OD cost matrix when analyzing potential solutions to the location problem. Additionally, it ranks the destination calculations based on the minimum distance impedance of travels from that origin (park facilities) to each destination (residential units). The minimum impedance is calculated for each origin-destination pair, and is scored in the attribute table of the output lines as the distance cost (Ghost & Rushton, 1987; Rushton, 1979).

In brief, measurement of equity has affected the use of spatial analysis and spatial strategies in GISs. Different approaches have analyzed the urban service location differently based on the different conceptualization of equity and space. Spatial relationships have been advanced by the relative and relational conception as mentioned in the Table 3.1. The relational links between space, place and scale have re-defined the way of spatial analyzing procedures.

Table 3.1. The conceptual relationship of Space Equity and GIS based accessibility analysis

approach	equity	space – place- scale	demand groups	accessibility measurement	methods
social constructive and relational	need-based	• socially constructed relative and relational • represented as material projects/interventions in localised settings • networks of events, things, people etc.	• localised movements or groups • categorized according to socio-economic characteristics • individuals/particular groups - based	• space-time activity pattern measurement (people-based)	• AHP • MCDS • Network analyses • Thiessen Polygons • Heuristic approach • Probabilistic approac • Fuzzy logic
structuralist	need-based	• zone-based	• groups of consumer • group - based	• integral measurement (zone-based)	• Gravity models • Spatial-Interaction Models • Buffer, radius method • Cellular Automata • Spatial autocorrelation • Linear programming • Euclidian distance
behavioral	demand-based	• zone-based • homogeneous zones	• politically powerful groups • group - based	• integral measurement (zone-based)	• Gravity models • Spatial-Interaction Models • Buffer, radius method • Cellular Automata • Spatial autocorrelation • Linear programming • Euclidian distance
neo-classical	equality-based	• zone based • homogeneous zones • analytic - euclidian, • as a container and as a functional part of society, • place is ignored	• rational and same individuals • society/group - based	• integral measurement (zone-based)	• Gravity models • Spatial-Interaction Models • Buffer, radius method • Cellular Automata • Spatial autocorrelation • Linear programming • Euclidian distance

CHAPTER 4

STUDY APPROACH, SITE AND METHODOLOGY

This chapter describes study approach, study site and methodology. The study approach lays on the 'need-based equity' and study methodology is multi-criteria decision analysis. The main argument of the study is that the need-based equity perspective to urban public park allocation increase the accessibility of need groups to the neighborhood parks. In terms of study site, this part gives information about the demographic structure of Turkey and Izmir. Moreover, spatial planning procedures of local and central governments in Turkey are explained. This part further includes the interviews upon the allocation mechanism of neighborhood parks with the development plan departments of greater and local municipalities of Izmir.

Need-based equity(Lucy, 1981) approach is social-need based allocation, concerning social costs and social justice. This perspective considers as already mentioned that some groups have been continuously disadvantaged in getting access to urban resources and having spatial inequalities because of their socio-economic characteristics based on class, race/ethnicity, age, gender and others. These groups have been the poor and low-income groups, racially/ethnically marginalized groups, children and seniors with limited resources (Byrne & Wolch, 2009; Sister et al., 2010; Emily Talen, 2010). This perspective has claimed that the allocation of public resources and service areas should concern the needs of the disadvantaged groups. This framework seek for equity in the distribution of public benefits according to need, termed "compensatory" equity(Crompton & Wicks, 1988) which is based on disadvantaged groups due to their class, gender, race/ethnicity, age or income. Need-based equity framework consider the equity by giving priority to the accessibility of these groups (Lucy, 1981; Emily Talen, 1998). These groups are defined as need groups in the study due to being significant and potential users of neighborhood parks (Şenol, 2019; Emily Talen, 2010).

The accessibility approach of the study aim to measure not only geographical distance but also socio-spatial diversity in spatial distribution of public benefit and opportunities. Accessibility is conceptualized as individuals' reaching to and benefiting from the green public spaces within minimum walking distance.(Emily Talen, 2010) This study focuses on access of the need groups to neighborhood parks with minimum transportation cost. This study evaluates the people-based accessibility to urban public services using non-zonal point-based spatial framework (M. P. Kwan, 1999) on neighborhood scale. The unit of analysis is set as neighborhood parks, dwelling units and other urban public facilities, and maximum walking distance is set as 300m network distance (Barton, Hugh; Grant, 2010; Çetiner, 1991). The accessibility measurement of the study evaluates accessibility of need groups to neighborhood parks concerning the socio-spatial opportunities and constraints using network-based GIS techniques.

Due to the complex structure of spatial allocation models, this thesis argues that the multi-criteria decision analysis is the efficient methodology for urban service allocation problems. The multi-criteria decision analysis is an analytic decision making process design tool for spatial decision problems with varied measurable and non-measurable dynamics (Malczewski, 1999, 2006). Relying on the data of park poor areas of Izmir (Şenol, 2019), the multi-criteria decision analysis process of the study is composed of Service Area Analysis and heuristic algorithm based Location Allocation Analysis of parks on neighborhood scale.(Ghost & Rushton, 1987)

The results of city scale analysis are taken from the research project.(Şenol, 2019) The methodology of the project is proceeded by the weighted sum of varied spatial criteria by analytic hierarchy process. This method provides a framework for solving different types of multi-criterion decision problems based on the relative priorities assigned to each criterion's role.(Saaty, 1990) The hierarchical structure development is developed for analytic hierarchy process at the city scale. With the lead of project's results, this thesis evaluate the accessibility of neighborhood parks and allocate new park locations at park poor neighborhoods of Izmir.

The allocation of neighborhood parks is discussed as an accessibility problem as well as equitable allocation problem (Abler et al., 1971; Massam & Goodchild, 1971; Rushton, Haggett, Cliff, & Frey, 1980). These are mentioned as geographical problem(Abler et al., 1971) by equilibrium of conflicting goals and also socio-politic problem (Harvey, 1975, 1996) in Izmir city. Neighborhood scale process determines the evaluation of existing park service areas and allocation of new park areas using GIS. The new proposal for park locations is managed by using heuristic algorithm based location-allocation analysis in GIS. The location-allocation analysis uses also analytic hierarchy process due to having many varied spatial criteria for locating a new park area at the neighborhood scale.

4.1. Study site

4.1.1. Context of Turkey

The Turkey's population has reached 82.003.882 in 2018 by increasing 1.193.357 persons compared to the previous year. The population of women are 49.8% of the total population, while men are 50.2%. In terms of the population ratio of need groups in Turkey, the population of children, elderly, low-income and women with children are examined. The population ratio of children (0-14) is 23% of the total population. The population ratio of elderly is 8.8% of the total population. The population ratio of low-income group is 28.7% of the total population. The population ratio of women with children is 34.7% of the total population. The 92.3% of the total population of Turkey resides in city centers and districts, while 7.7% resides in villages (TURKSTAT, 2019).

The spatial planning practice of Turkey is explained according to the organization and planning hierarchy and planning legislation. The central government and their administrative units have a hierarchal structure and they are responsible to plan the futures of district, province and region scales through development and regional planning actions. The hierarchal structure of administration units are ministries, development agencies and municipalities respectively. Each institution has authority upon different jurisdiction scales. Planning agencies and ministries are responsible for the regional, national or sectoral plans at regional levels via regional environmental plans. Environmental plans mainly aim to develop strategies for the futures of settlements at the sub-regional, regional and national level. The development directions on the sectoral basis, means for economic development, and sectoral actors are developed within these plans (CSB, n.d.).

At the provincial level, the municipalities as local government are responsible for provincial and lower scale spatial planning by master development and implementation plans. The master plans are produced by the metropolitan municipalities by comprehensive planning practices. The provincial level spatial plans are also dependent upon hierarchical structure from general upper to sub spatial scales. The municipalities plan general land use and transportation decisions, the distribution of green, education, health, administrative and religious etc. service areas, the planned population densities and the population projections for their jurisdiction boundaries. District municipalities plan the sub-scales implementation plans by the guide of upper level comprehensive spatial plans. The implementation plans propose urban design level solutions including parcels, buildings, park areas etc. with street and sidewalk- wide (CSB, n.d.).

In Turkey, the amount of urban green areas is stated as 10 m2 "active green area" per person in Regulation on the Principles Regarding the Construction of the urban development by the law numbered 3194. The distribution of $10m^2$ green space consists of 1.5 m^2 children's playground, 2 m^2 neighborhood park, 3.5 m^2 urban park and 3 m^2 sports areas per person. In the 23804 numbered legislation, the concept of green space is defined as a collection of playgrounds, kindergarten, recreational activities and coastal areas reserved for community benefit. Besides, the fair, botanical gardens, zoos and regional parks are within the scope of green service areas (Arıcıoğlu, 2011).

4.1.2. Context of Izmir

Izmir is the third biggest metropolitan area of Turkey with a population near 5 million (4.320.519 in 2018). While the 49, 82% of the population is male, 50,18% is female. Izmir Province is located in the middle of the Aegean coasts at the west of the Anatolian Peninsula in Figure 4.1 and 4.2. Izmir province has 30 districts within the Izmir Metropolitan Municipality jurisdiction boundary. The central city extends along its bay area to the west and immediately on the hills to the east.

It is at the intersection of important industry, transportation, agriculture, commerce and tourism nodes. Izmir has a constantly increasing population. Izmir is the third most populated city in Turkey. According to population statistics of 2018, Izmir’s rate of migration is 5.64 ‰. Population density of Izmir is 352 people and it is the third dense city in Turkey (TURKSTAT, 2019).

Figure 4.1. Context of Turkey (Google Earth, 2019)

Figure 4.2. Location of Izmir (Şenol, 2019)

The city scale descriptive data of Izmir urban region are extracted from the research project (Şenol, 2019). Izmir city region is examined in terms of the spatial distribution and population of need groups in the project. The population of age groups in Izmir are mapped based on the three-level categorization as high, medium and low in the project (Table 4.1.). The number of population is high in the northern neighborhoods of Bornova and Karşıyaka and later in the direction of Karabağlar and Gaziemir varied between 21.681 - 34.467 and it is low at the Konak and behind the Alsancak Port and around the periphery varied between 6143 -12.058 number of people. However, the population density is high at the inner part neighborhoods of Konak, Karabağlar and Karşıyaka; low at Güzelbahçe, at some neighborhoods of Karşıyaka and Bornova, varied between 700- 25 person/square meter. The neighborhood density of the population of children (3-13) is "high" at Buca, Bayraklı and the inner part of the Bornova district. The neighborhood density of the population of elderly is relatively "high" at the coastal parts of Karşıyaka, Narlıdere and Alsancak-Konak districts. The income level is "low" at Karabağlar, Buca, inner part of Bayraklı and Bornova. The neighborhood density of women with low education level is relatively "high" at the inner part of Konak and Karşıyaka (Table 4.1.).

Table 4.1. Neighborhood ratios of demographic variables

Variables	**Classification**		
	"High"	**"Medium"**	**"Low"**
Neighborhood pop. density	640—316	315—123	122—21
Park area per person (m2)	17.95—6.90	6.80—2.00	1.99—0.00
Income level	2.60—1.60	1.59—1.00	0.99—0.29
primary education or pre-education of women (eik)	1.00—0.50	0.49—0.30	0.29—0.05
(0-2) age neigh. ratio	0.08—0.05	0.04—0.02	0.02—0.01
(3-5) age neigh. ratio	0.07—0.05	0.04—0.02	0.02—0.01
(3-13) age neigh. ratio	0.82—0.45	0.44—0.24	0.23—0.00
(14-22) age neigh. ratio	0.32—0.15	0.14—0.10	0.09—0.07
65 + (elderly) neigh. ratio	0.58—0.20	0.19—0.10	0.09—0.01
number of population	12059-34467	6038-12058	2047-6037

In addition to population and age groups statistics, the current total size of green areas in Izmir province is calculated as 40.293.854, 44 m^2 (Şenol et al., 2017). As the province population is 4.320.519 by 2018, the green area per person is 9,32m^2. However, the total green area of Izmir has comprise of various types of green areas including active and passive areas. These are neighborhood parks, sport areas, restricted public areas, playing fields, cemeteries and other green areas. According to the calculations of the research project, neighborhood park area per person is maximum 679,43 m^2, is minimum "0" m^2 and "average" size is 2,03 m^2 in Izmir Province. The total number of neighborhood parks area size is 11.552.769m^2 within total green area. The average park area per person in the neighborhood is 7.51 m^2 (Şenol, 2019). According to the metropolitan municipality categorization, the total 'active green areas' is 4, 92 m^2 per person, while the total 'passive green areas' is 9, 52 m^2 per person in Izmir (Şenol, 2019).

4.2. Study Methodology

This thesis is composed of the evaluation of the planning procedure of neighborhood parks of the Izmir Metropolitan Municipality via interviews and spatial analysis of the accessibility and the proposal of new allocation model. The interviews with the municipality reveal the general understanding of the planning approach to green service areas. In further, this thesis evaluates the existing accessibility of neighborhood parks and propose an allocation model for the location detection of parks on neighborhood scale. This study lays on the need-based equity(Lucy, 1981) perspective and designed through as GIS-based non-probabilistic multi-criteria decision analysis (Malczewski, 1999).

The multi-criteria decision analysis is a methodological approach that facilitate categorization of and resolving complex, multi-weighted and multi-participant decision problems into sets of decision criteria (Malczewski, 1999). Most location decisions are complex problems and require multi-criteria objective models. Some examples of spatial planning problems are the allocation of public goods and services (schools, health facilities) or the location of locally unwanted land uses (prisons, heavy industry, waste disposal facilities), the macroform of communities (long-range land-use plans), and the protection of natural habitats and resource areas (designation of national parks) in scales from city to neighborhood. Most of these problems are multi-faceted and require varying degrees of interaction between multiple interests in the decision-making process. Multiple criteria, multiple actors and interest in the spatial decision problems require the definition of criteria weights firstly based on their effect on the decision. Since weights of criteria may be subjectively defined and affect decision outcomes substantially, they are often the source of the uncertainty in pluralistic decision-making problems. For assessing weights of criteria, multi-criteria decision analyze method is enable to utilize traditional ‘objective’ or quantitative data with subjective and value-based data (Feick & Hall, 2004; Malczewski, 1999, 2006).

There are two main approaches to deal with weight of criteria uncertainty in multi-criteria decision analysis. These are probabilistic and non-probabilistic approaches. Probabilistic approaches assume that weights of criteria may not be known with complete certainty, that a range can be defined for each weight of criterion. Typically, this approach uses fuzzy logic simulation method to select weights of criteria among these ranges. In contrast, non-probabilistic weight of criteria approaches is not dependent on any assumptions or simulation. Instead, the stable weight is investigated for each criteria by experiencing the results of an amount of change in weights or assigning the value of coefficient of correlation to each weight (Feick & Hall, 2004; Van Huylenbroeck & Coppens, 1995). This approach is used mostly in locational decision problems such as allocation of public services (schools, health facilities).

Multi-criteria decision analysis methods extend the decision support capabilities of GIS by providing evaluation of alternatives for resolving spatial planning problems. (Malczewski, 2006) As mentioned, this study lays on the GIS-based heuristic location allocation approach (Ghost & Rushton, 1987) in neighborhood scale that is managed by multi-criteria decision analysis. As a case study design, this thesis is mainly outlined at neighborhood scale analysis. However, the results of analysis in city scale are taken from the study of scientific research project that I studied in as a researcher (Şenol, 2019). Neighborhood scale spatial analyses is managed for this thesis by heuristic algorithm based Location-Allocation analyses in GIS.

Spatial equity mapping of Izmir is taken from the study developed by Şenol (2019). The spatial equity map shows the park poor areas that have limited green area and at the same time that have high population of need groups. Using the data at city scale developed by Şenol (2019), this thesis takes a further step and analysis allocation of parks at the neighborhood scale. To do that, this thesis has two main stages as assessment of the accessibility of existing parks and proposition of locations for new neighborhood parks. The accessibility analysis for the existing locations is managed by Service Area

Analysis(Oh & Jeong, 2007) and proposition of location is managed by heuristic algorithm (Ghost & Rushton, 1987; Yeh & Chow, 1996) based Location-Allocation (Cooper, 1963; Leonardi, 1981) analyses in GIS.

There are three kind of data source as seen in the Table 4.2.. One of them is socio-demographic data of Turkish Statistical Institute at neighborhood scale. The other is point-based vector data of parks and schools taken from the study developed by Şenol (2019). Lastly, point-based vector data of selected park poor neighborhoods are produced by author of this thesis using GIS based Google Earth Aerial Photo in order to perform spatial analyzes.

Service area analysis mainly use the geographic location of neighborhood parks and network distance to measure accessibility. This analysis calculates service area of each parks using network distance between residential units and geographic location of neighborhood parks. Moreover, this analysis considers all kinds of spatial constraints such as slope level and impedance distance. The main objective is to produce service areas of parks with minimum transportation distance. The units of analysis are the centroids of neighborhood parks, centroids of other urban public facilities (such as health clinics), centroids of each residential units in the neighborhoods and the existing road network. Centroids of parks polygons are managed as the access points for neighborhood parks (Boone et al., 2009; Higgs, Fry, & Langford, 2012).

Table 4.2. Sources of data used in analyses of park provision

Source	Type	Content	Year	Scale
Turkish Statistical Institute	string	pop., age groups pop., education level	2015	neighborhood based
Study developed by Şenol(Şenol, 2019)	vector	locations of school, park	2019	point-based
Google Earth Aerial Photo	vector	locations of residential units, health center, mosque, headmen' office	2019	point-based
Google Earth Aerial Photo	vector	population of residential units	2019	point-based
Google Earth Aerial Photo	vector	street network, slope levels	2019	point-based

The location-allocation analysis manages a spatial problem by combinatorial optimization, which means there may be number of potential solutions. It is mentioned that optimal solutions cannot be obtained by examining all the combinations. Therefore, one of the most efficient methods for solving the location-allocation problem is defined as the heuristic algorithm. The algorithm is calculated by allocating each residential units (demand points) to its closest parks (supply centers) with shortest network distance and calculate locations for the new park areas (new supply centers) for each group of residential units (demand points). This algorithm proposes alternatives for allocating population to park areas and locating (optimal location) these areas where the sum of the distance from all residential units is minimum (Yeh & Chow, 1996).

Before implementation of location-allocation modeling, case areas are selected among park poor areas of Izmir. A priority schema is produced to select the case areas. The priority schema has two main steps and they elaborate on the physical infrastructure, public transportation facilities and the number of population of need groups at park poor areas (see Table 5.1.). The areas that sustain all these criteria at the same time are detected as case study areas to perform Location-Allocation modeling. These areas are the neighborhood clusters with high population of need groups, limited park areas per capita, poor public transportation facilities and not walking friendly built environment.

In brief, the major steps of the implementation of the study are summarized as in the Table 4.3.

Table 4.3. The major steps of the data processing for spatial analyses

	reasons	**approach and method**	**scale**
1	setting priority criteria to choose case areas among park poor areas	Need-Based Equity Approach	city scale
2	assessing service areas of existing neighborhood parks in chosen case areas	Thiessen polygon method and Service Area Analysis	neighborhood scale
3	data preparation on neighborhood scale for location-allocation analysis	spatial data digitizing and aggregation in GIS	neighborhood scale
4	the location-allocation analysis of park poor areas	heuristic algorithm approach	neighborhood scale

CHAPTER 5

SPATIAL EQUITY MAPPING OF IZMIR IN GIS

This chapter aims to introduce the GIS based spatial equity mapping procedure of Izmir and the detection of case areas for park provision. It is argued that ‘spatial equity mapping’ literature gives insight for the detection of the inequities in access to public service areas by analytic processes. Therefore, Şenol (2019) deploys the spatial equity mapping and detects ‘park poor’ areas as well as ‘park rich’ and ‘park moderate’ areas of Izmir. Spatial equity is produced by the weighted sum of spatial distribution map of park area per capita and spatial distribution map of the need groups in neighborhoods. Using these weighted maps, Şenol (2019) produced the spatial equity map of Izmir by analytic hierarchy process method in GIS. Relying on the results of Şenol (2019) especially about ‘park poor’ areas, this thesis chooses three neighborhoods as its case study areas. Detection of case areas are managed in two steps: firstly the neighborhoods with highest population are chosen and secondly the neighborhoods with park poor neighbors are selected among them. There are totally 8 neighborhoods as case study areas in Buca, Karabağlar and Bayraklı districts.

5.1. Allocations of Parks by Izmir Greater Municipality

The interview of the planning staff at the Izmir Greater Municipality highlights the comprehensive planning practices and green area allocation procedure. According to the interviews, the comprehensive plan at the city scale (the scale of 1/25000) aims to sustain equality-based equity at the allocation of green areas within the jurisdiction. However, the plans do not sustain 10m^2 green area per capita in each neighborhoods (Izmir Greater Municipality, 2018). On the other hand, the municipality claims that they considers the population density, immigrant population, the location of schools and socio-cultural land-uses and the demand of the head-men at the allocation of neighborhood parks within neighborhood jurisdictions. However, the location decision of neighborhood parks does not consider the physical accessibility within neighborhoods. The municipality claims that the location of public property is the most determinant factor in location decision of public green areas.

The design principle of the municipality is mentioned as a “design for need” understanding for interior design of neighborhood parks. The staff defines two main criteria for design as physical characteristics of the area and socio-demographic features of the population. Climate, aspect, slope and topography are mentioned as the sub-categories of physical conditions. On the other hand, population density, income level, age groups and the demand of the citizens are the categories of socio-demographic condition. In neighborhood scale, the design implementation of the municipality is also hybrid that is demand-base and need-base equity (Izmir Greater Municipality, 2018).

5.2. The Spatial Distribution of Park Need Groups and Neighborhood Parks in Izmir

In this part of the study, the spatial distribution of neighborhood park area per capita and the spatial distribution of population of park need groups are conducted based on neighborhood scale. The park need groups are defined as children (3-13), elderly (65+), women with children (0-5) and low-income groups. The thematic maps represent the neighborhood ratio of need groups’ population and park area per capita in each neighborhood.

City scale analysis are driven from the study developed by Şenol (2019). According to the findings of the project, the spatial distribution of need groups is examined as the population of children (3-13), elderly (65+) and low income groups. Based on the spatial distribution maps, the high spatial concentration of need groups are detected across the Izmir city. The neighborhood ratio of total number of children (3-13) and elderly (65+) at provincial level vary across the neighborhoods. They vary in opposite direction and between coastal line and the hilly neighborhoods as in the Figures 5.1 and 5.2 (Şenol, 2019).

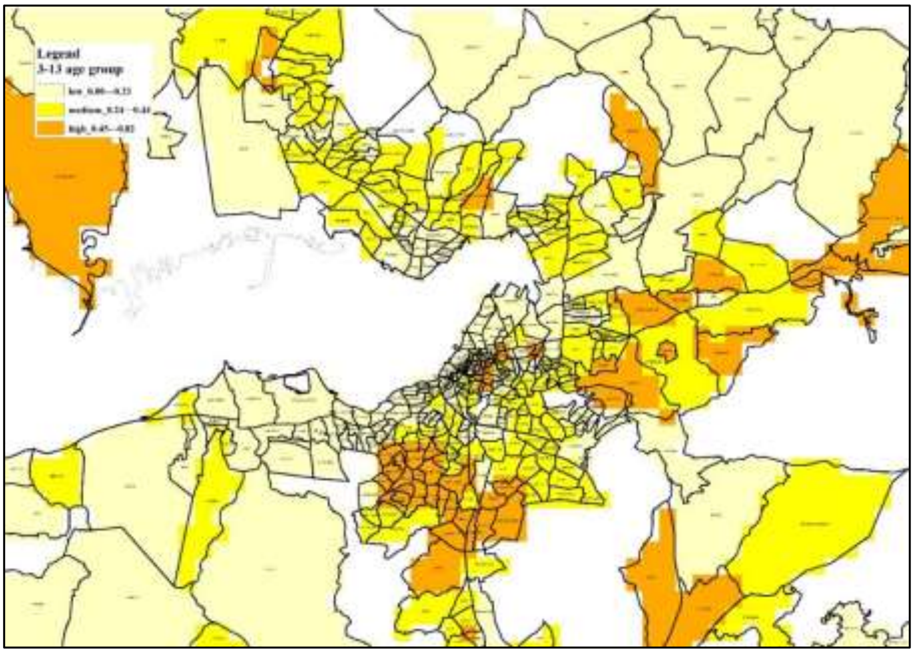

Figure 5.1 Neighborhood ratio of children population (Şenol, 2019)

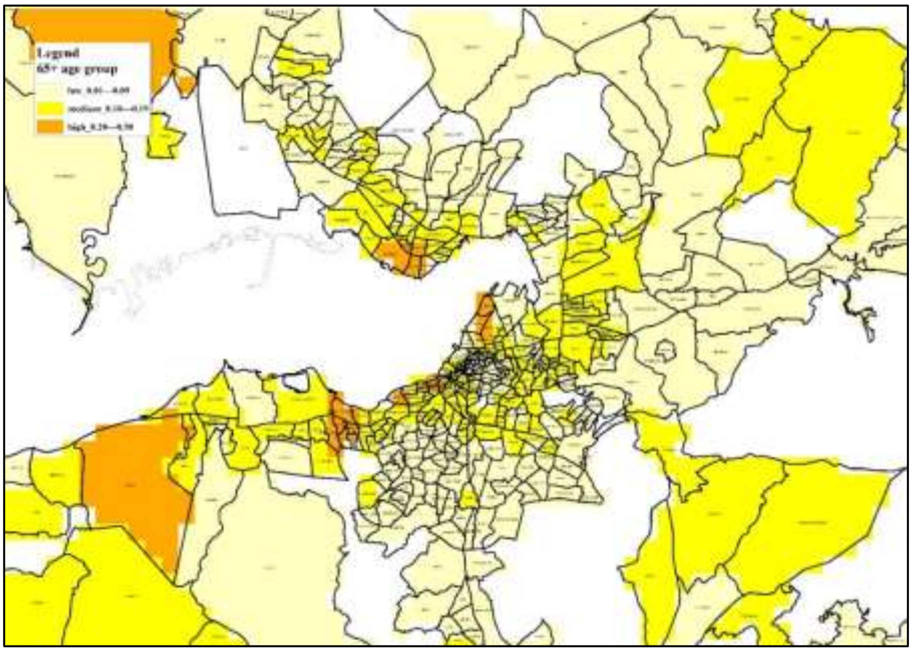

Figure 5.2. Neighborhood ratio of elderly population (Şenol, 2019)

The spatial distribution of neighborhood parks is examined at city scale. According to the findings of Şenol (2019), the size of neighborhood parks are mostly between 500 -2.000 m2 in central districts. According to the spatial distribution of park area per capita in Figure 5.3., the districts of Bornova, Narlıdere, Bostanlı and Çiğli are park rich areas in terms of park size (Şenol, 2019).

Moreover, the neighborhoods with higher household income level, high percentage of high education level (high school and university), low percentage of low (primary school) education level, low population density and low population percentage of age (0-5) are tended to be "park rich" in terms of neighborhood parks in the central district districts, whereas the neighborhoods with opposite situations are tended to be "park poor" areas. In order to detect the spatial equity map of Izmir, the statistically related data are weighted summed in GIS. The correlation coefficients are defined as weights of each data and each data are categorized according to the categorization in the Table 4.1 (Şenol, 2019).

The results of spatial equity mapping by Şenol (2019) shows neighborhood areas of Izmir according to their share of park areas per capita as well as population characteristics identified by regression analysis. Park poor areas in the map points to the intersection of lowest park area per capita and highest population of need groups. The spatial equity map is categorized in order to reveal park-poor and park-rich areas of Izmir city (Figure 5.5). The overlay map shows that “park poverty” (in yellow color) is more dramatic in the hilly areas away from central coastal districts (Şenol, 2019). According to the equity map, there are mainly three park poor clusters in the Bayraklı, Karabağlar and Buca districts (in yellow color with hatching in Figure 5.5) of Izmir. The case areas are selected from the park poor neighborhoods in these districts of Izmir.

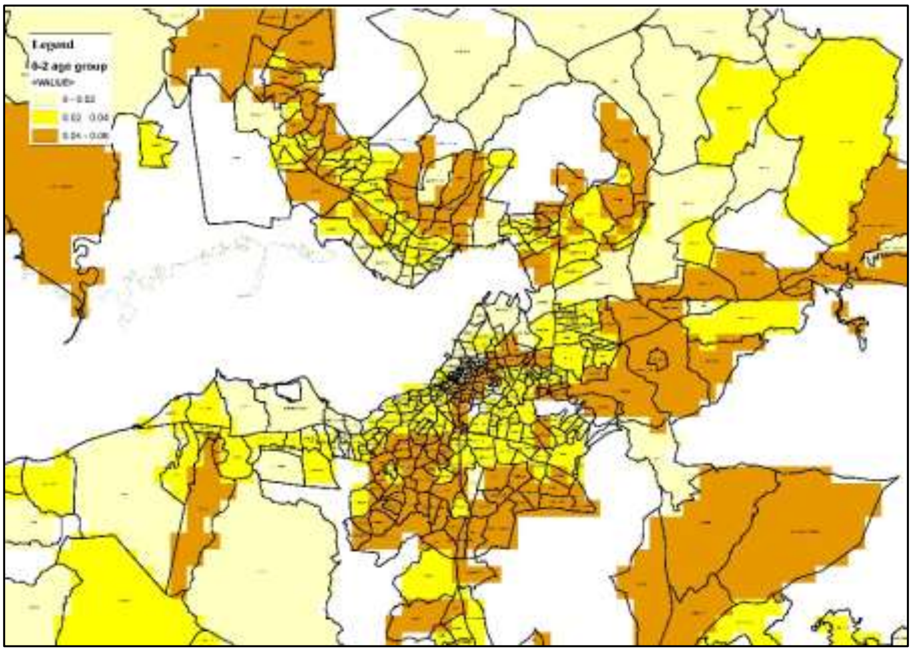

Figure 5.3. Neighborhood ratio of women with children population (Şenol, 2019)

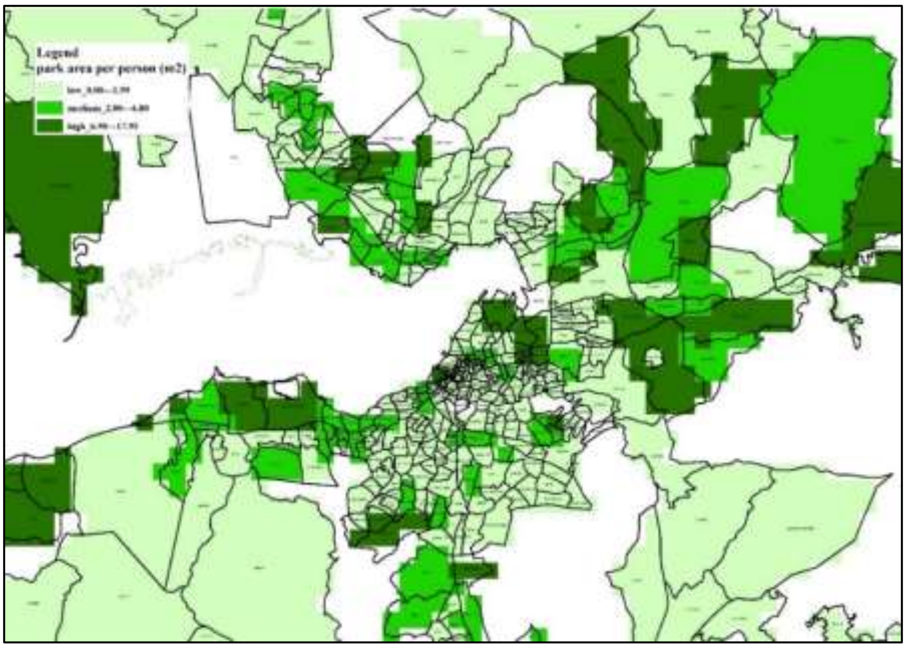

Figure 5.4. Park area per capita (Şenol, 2019)

5.3. Detection of case areas among park poor areas of Izmir

This thesis aims to assess existing accessibility of neighborhood parks and further to sustain 'need-based equity' at the allocation of parks at neighborhood scale in Izmir by using GISs. In this part of the thesis, a detection of case areas is proceeded among the park poor areas of Izmir. There are 30 park poor neighborhoods at central districts of Izmir and case area selection procedure consists of priority criteria. The elimination of park poor neighborhoods is performed in two main steps respectively. Firstly (1) the most populated neighborhoods are chosen, secondly (2) the neighborhoods with park poor attached neighbors are chosen among the first selection and (3) thirdly these neighborhoods are examined in terms of their physical and demographic features.

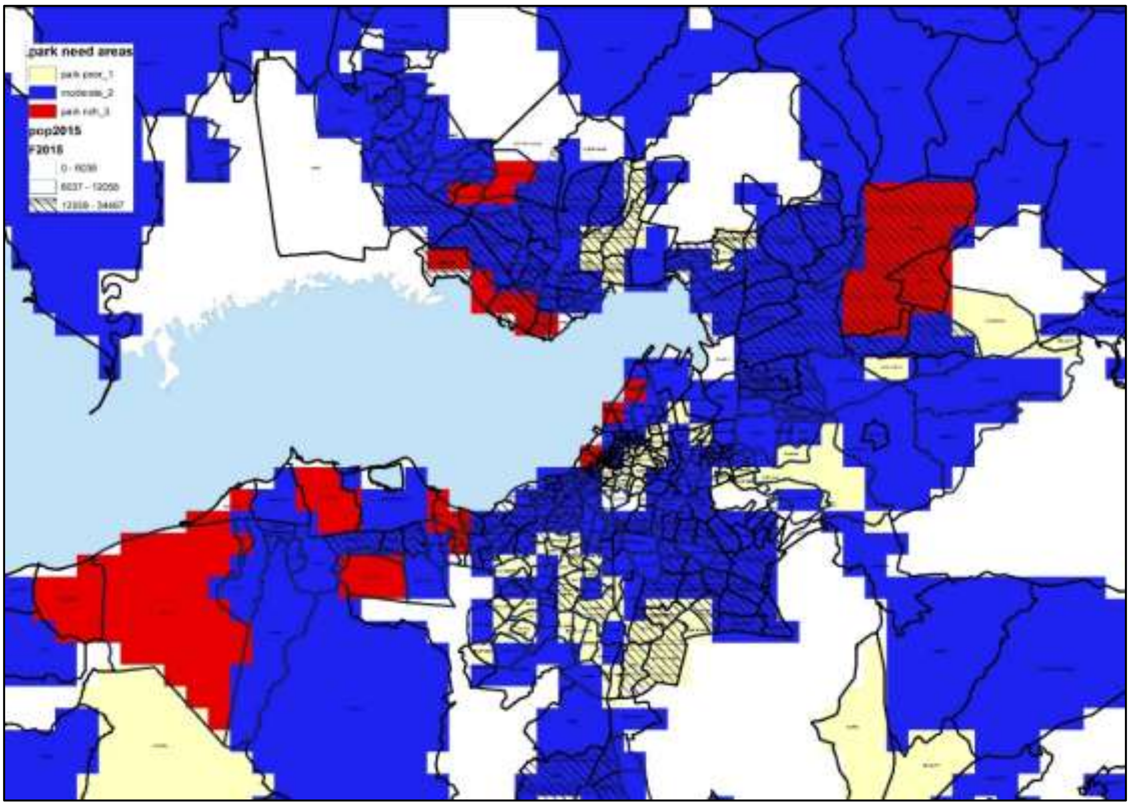

Figure 5.5. The spatial distribution of park poor areas (Şenol, 2019)

For the first step, according to the population categorization at the Figure 5.5., the neighborhoods with population more than 12,143 are selected among park poor areas.

There are 12 “high” populated park poor neighborhoods in 3 different districts as in Buca, Bayraklı and Karabağlar (Table 5.1.) (Şenol, 2019).

Table 5.1. The demographic features of park poor areas

districts	neighborhoods	park poor clusters	pop.	pop. density
BAYRAKLI	R.SEVKET INCE	cluster bayraklı 2	12424	237.23
BAYRAKLI	GUMUSPALA	cluster bayraklı 1	15442	201.58
BAYRAKLI	EMEK		12992	173.17
BAYRAKLI	ORG.NAFIZ GURMAN		15854	111.75
BAYRAKLI	YAMANLAR		17938	99.74
BUCA	GOKSU	cluster buca	28388	352.84
BUCA	YESILBAGLAR		17944	290.38
BUCA	CAMLIKULE		18549	238.79
BUCA	INONU		17211	152.45
BUCA	MUSTAFA KEMAL		16288	75.82
KARABAĞLAR	GUNALTAY	cluster karabağlar	19905	269.52
KARABAĞLAR	YUNUS EMRE		21848	226.05

For the second step, the neighborhoods having park poor attached neighbors are selected among 12 park poor neighborhoods (Table 5.2.). There are 8 neighborhoods with park poor neighbors in Buca, Bayraklı and Karabağlar. These areas are considered as park poor clusters. It is seen that these selected areas are clustered and these are mentioned as park poor clusters. There 3 main park poor clusters in central neighborhoods of Izmir located at Bayraklı, Buca and Karabağlar districts (Figure 5.6.).

For the third step, the street layout, gross/net dwelling density and slope levels of these selected clusters are examined via satellite image in GIS to assess the population density and built environment (Table 5.2.) Moreover, the population of each need groups and income level in these neighborhoods are examined.

Table 5.2. The physical features of park poor areas

districts	**neighborhoods**	**neighborhoods typology**	**net average dwelling density (dw/ha)**	**the percentage of vacant lands' size**	**slope degree (%)**	**average slope degree (%)**	**built environmnet**	**the public transportation infrastructure**
BAYRAKLI	R.SEVKET INCE	park poor_ medium pop	130	4.50%	2-15	2-15	detached housing grid street layout	Limited Bus Lines
BAYRAKLI	GUMUSPALA	Park moderate_ high pop	125	2.80%	0-15	0-20	detached housing and new gated communities grid street layout	Limited Bus Lines
BAYRAKLI	EMEK				0-15			
BAYRAKLI	ORG.NAFIZ GURMAN				0-20			
BAYRAKLI	YAMANLAR				0-20			
BUCA	GOKSU	park poor_ medium pop	89	4.50%	0-6	0-8	detached housing new gated communities grid street layout	İzban urban rail, 2 urban rail station, 1 main bus station, Bus lines
BUCA	YESILBAGLAR				0-6			
BUCA	CAMLIKULE				0-6			
BUCA	INONU				0-8			
BUCA	MUSTAFA KEMAL				0-15			
KARABAĞLAR	GUNALTAY	park poor_ medium pop	111	1.65%	2-10	2-10	detached housing new gated communities grid street layout	Bus lines
KARABAĞLAR	YUNUS EMRE							

Comparing to the all neighborhoods of Izmir, it is seen that the population of children (3-13) and the population low income household are high in these clusters (Table 5.3.) (Şenol, 2019).

Table 5.3. The socio-demographic features of park poor areas

districts	neighborhoods	Household (relative) income	Age 3_13_neigh. ratio	Elderly neigh. ratio	Women with low education (primary) level (eik) neigh. ratio	baby(age 0-2)_neigh_ratio
BAYRAKLI	R.SEVKET INCE	0.78	0.42	0.077	0.4	0.0469
BUCA	GOKSU	0.83	0.46	0.044	0	0.0562
BUCA	YESILBAGLAR	1.02	0.44	0.047	0.38	0.0573
BUCA	CAMLIKULE	0.97	0.42	0.052	0.35	0.0547
BUCA	INONU	0.82	0.46	0.049	0	0.0579
BUCA	MUSTAFA KEMAL	0.85	0.48	0.035	0.4	0.0686
KARABAĞLAR	GUNALTAY	0.83	0.45	0.054	0.39	0.0541
KARABAĞLAR	YUNUS EMRE	0.84	0.42	0.07	0.38	0.0440

The cluster in Karabağlar comprise of Yunus Emre - Günaltay neighborhoods (Figure 5.7.); the cluster in Buca comprise of Göksu -Yeşilbağlar - Çamlıkule – Mustafa Kemal - İnönü neighborhoods (Figure 5.8.) and the other cluster in Bayraklı has R.Şevket İnce neighborhood (Figure 5.9.). Each of these clusters has park poor neighbors with "high" population.

In Karabağlar cluster, the built environment features are detached housing, small building plots and high density (more than 70 dw/ha net density). There are a few number of gated community dwellings with bigger subdivision. The population density is 247 people/m^2. The gross density is 42dw/ha and net density is 111dw/ha. The size of vacant lands are between 74-9279 m2, the total size of vacant lands is 119.270m 2, and they are mostly located in Günaltay neighborhood. The percentage of vacant lands is 1.65% of total cluster area. The slope level is varied between 2-6% in Yunus Emre, 2-10% in Günaltay neighborhood (see Table 5.2.).

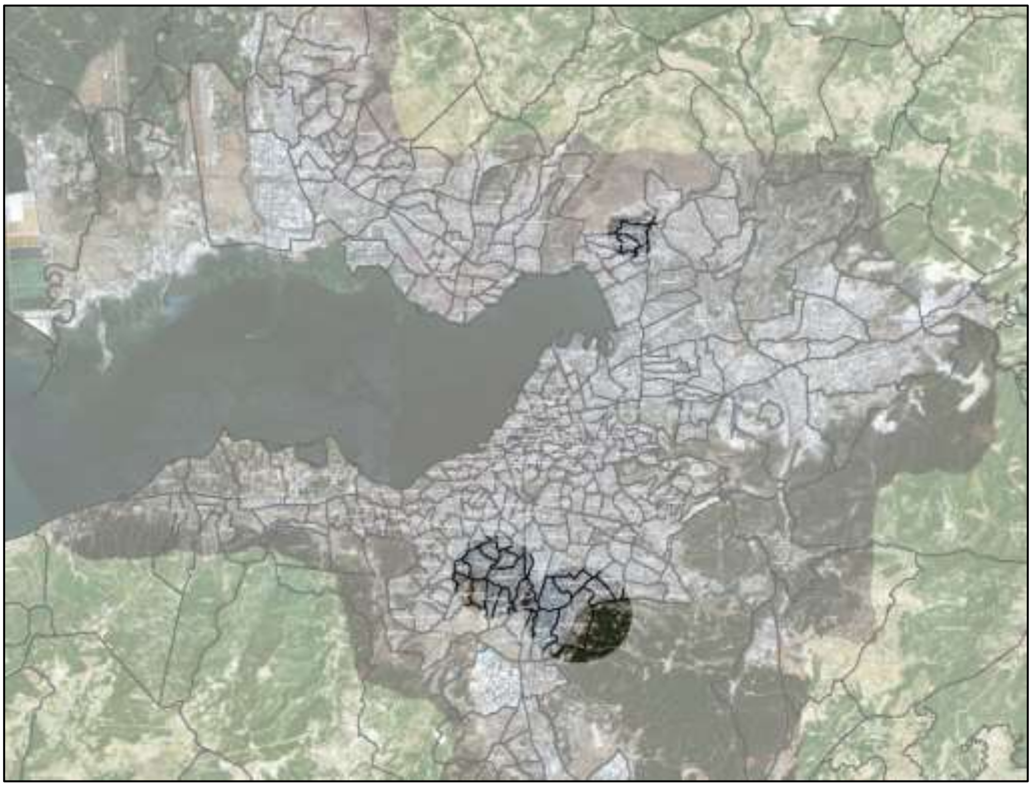

Figure 5.6. Park poor clusters in central neighborhoods of Izmir

Figure 5.7. Karabağlar cluster with Günaltay and Yunus Emre neighborhood

In Buca cluster, the built environment features are detached housing, small building plots and has high density. There are a few number of gated community dwellings with bigger subdivision. The average population density is 221 people/m2. The gross density is 30dw/ha and the net density is 89dw/ha. The size of vacant lands are between 120-14.965m^2. The total size of vacant lands is 252.352m^2 and the bigger vacant lands are mostly in Mustafa Kemal and Çamlıkule, the smaller vacant lands are located in Göksu and İnönü neighborhoods. The percentage of vacant lands is 4.5% of total cluster area. The slope level is varied between 0-10 %. The hilly areas higher than 8% slope degree are located in Mustafa Kemal neighborhood and those areas are out of dwelling units (see Table 5.2.).

Figure 5.8. Buca cluster with Göksu -Yeşilbağlar - Çamlıkule – Mustafa Kemal - İnönü neighborhoods

In Bayraklı cluster with R.Şevket İnce neighborhood (Figure 5.9.), the built environment features are detached housing, small building plots and has high density. There is only one gated community construction at the periphery of the neighborhood. The neighborhood has totally 23.966m^2 vacant lands and they are varied between 55-14.527m^2. The percentage of vacant lands is 4.5% of total cluster area. The population density is 237 people/m^2. The gross density is 49dw/ha and net density is 130dw/ha. The slope level in Bayraklı cluster are varied between 2-15%. It is the hilliest area among park poor neighborhoods. (Table 5.2.).

Figure 5.9. Bayraklı cluster with R.Şevket İnce neighborhood

By selecting park poor clusters, they are also examined in terms of socio-demographic features that were determined by the research project.(Şenol, 2019) These three cluster have low level of 'household income', medium level of 'low education level of women' neighborhood ratio (eik), and high level of (0-2) baby neighborhood ratio, low level of elderly (65+) neighborhood ratio, high level of children (3-13) neighborhood ratio among all neighborhoods in Izmir (see Table 2.1. in chapter 2 and Table 5.3.). In sum, they are “low” income level neighborhoods with “high” level of children population.

Relying on “need-based equity” perspective requires to detect the areas of first priority in park provision among park poor areas. The detection of first priority areas is proceeded in two steps. By the elimination steps, the park poor areas for park provision are detected in Buca, Karabağlar and Bayraklı districts. The main reasons to choose these three park poor clusters are their high population and lack of opportunity in access to park areas at their close environment. Although these areas are similar in terms of socio-demographic structure of residents, they are different in spatial context. These areas have different street network, slope levels, residential density and subdivision pattern.

CHAPTER 6

GIS BASED EVALUATION AND PROVISION OF PARK LOCATIONS AT PARK POOR NEIGHBORHOODS OF IZMIR

This chapter introduces the GIS based accessibility assessment in the park poor areas of Izmir and describes a set of spatial analyses of park provision at neighborhood scales. In this part of the study, the assessment of accessibility to existing neighborhood parks and further, the allocation of new park locations are performed respectively. The main aim is to increase the accessibility of various socio-demographic groups to park areas. As a methodology, a vector based network analysis is performed in GIS to assess existing park service areas and to allocate new park locations. GIS based service area analyses is performed to assess existing park service areas and heuristic approach to allocate new park locations. In the chosen "park poor" clusters, for the assessment of existing park service areas Thiessen polygon Method and Service Area Analysis and for allocation of new park locations Location-Allocation Analysis are used respectively in GIS. The GIS based analysis reveals that there are spatial inequities in terms of accessibility to park areas in already park poor areas of Izmir. Moreover, heuristic algorithm based allocation approach detects the most suitable location to increase access to park areas in various spatial contexts.

In the chosen park poor clusters, the assessment of existing park service areas is conducted by using two different service area analyses in GIS. These spatial analyses are Thiessen polygon Method and Service Area Analysis. These analysis are used comparatively to reveal their effectiveness in service area analysis. The allocation of new park locations on neighborhood scale is performed by Location-Allocation Analyses in GIS for finding optimal site of new park locations for different locational problem types and generate viable alternatives for decision makers.

In this study, the accessibility measurement is determined via point-based, non-zonal approach(M.-P. Kwan, 2010) and it is calculated based on inclusive distance and slope criteria on the actual street network for each socio-demographic groups Varied spatial criteria for different age groups are defined and managed via GIS procedures to reflect diversity in the ways of people move and inhabit space.(Stafford & Baldwin, 2018)

These spatial criteria include a number of impedance cutoff. The impedance cutoff is set as metric distance limit and as slope degree limit that are different for each age groups. The distance impedance cutoff is the network costs between the park areas and each of the demand points that were allocated to that park area. When the impedance is expressed as a distance decay, the access measurement relates with a gravity-based measure. Otherwise, if the impedance function is used to include opportunities in a given distance limit and exclude others, the access measurement relates with a cumulative-opportunity measure. This measurement indicates how many opportunities are accessible within a given travel time or distance from a reference location.(M. P. Kwan, 1999) For this study, cumulative opportunity measurement is adopted to strengthen the inclusive approach.

As a consideration of the spatial analysis procedures in GIS, it is shown that how to measure the individual accessibility on the base of different age groups and how to allocate walkable neighborhood parks on the neighborhood scale of Izmir. It is revealed that the special properties of different socio-demographic groups affect the accessibility of urban service areas as well as physical features of built-environment. The assessment of accessibility to existing neighborhood parks are based on the minimum transportation cost criteria and they are determined by Service Area Analysis in GIS. The service area is determined by the sums of the user’s mobility between residential units and a park facility. The user’s mobility is affected by the distance and slope, by the capacity of the facility and by the existence of other alternative facilities.(M F Goodchild & Booth, 1976) By determination of service areas, it is revealed that there are even spatial inequities within park poor neighborhoods. In further, the allocation procedure of neighborhood parks are also based on the minimum transportation cost criteria and they are determined by Location-Allocation analyses in GIS. Allocation procedure is based on the network distance, slope and population.

6.1. Evaluation of Accessibility to Existing Neighborhood Parks by using Service Area Analysis

The aim of this part is to evaluate the accessibility to existing neighborhood parks and detect the areas with lack of access to parks in park poor clusters. This part is describing the spatial analyze procedures to analyze park service areas and measuring the accessibility to existing parks within three park poor clusters as Buca, Karabağlar and Bayraklı comparatively. Furthermore, the other aim is to compare the opportunities of Thiessen Polygon Method and Service Area Analysis for assessment of the park service areas in GIS. In this part, Thiessen Polygon Method and Service Area Analysis are performed for Buca cluster firstly. After its implementation, the Thiessen Polygon method is not deployed further, because of its limitations, and so the Service Area Analysis is used for the cases of Bayraklı and Karabağlar cluster.

Buca cluster has Göksu, Yeşilbağlar, Çamlıkule, Mustafa Kemal and İnönü neighborhoods that are located at the periphery of the highway of Izmir in Buca district. There are total 11620 dwelling units, 12 schools, 14 mosque, 2 medical centers in the cluster and warehouses in the İnönü and Mustafa Kemal neighborhoods in the Buca cluster. Buildings except these are residential and mix-used along the two main street. The height of buildings are 12-floor height at most and the majority have 2 and 3 floors. The slope level is between 0-6 % at most of the areas and 15% at some parts of the Mustafa Kemal neighborhood (Table 5.2.).

Bayraklı cluster has R. Şevket İnce neighborhood that is located in the inner part of Bayraklı district at the periphery of the highway of Izmir. There are total 2257 buildings including 3 schools, 3 mosque and 1 medical center in the neighborhood. Buildings except these are residential. The height of buildings are 8-floor height at most and the majority (554) have 2 floors. The R. Şevket İnce neighborhood is located at more hilly areas with slope levels between %2-%15 (Table 5.2.) comparing to other clusters' neighborhoods.

Karabağlar cluster has Günaltay and Yunus Emre neighborhoods that are located in the inner part of Karabağlar district. Their land use compose of residential mostly and mix uses at main streets along the neighborhoods, urban service areas such as mosques, parks, schools and local health care services. There are 12 schools, 14 mosque, 2 medical centers in the cluster and warehouses in the İnönü and Mustafa Kemal neighborhoods in the Karabağlar cluster. Buildings except these are residential and mix-used along the two main street. The height of buildings are 6-floor height at most and the majority have 2 and 3 floors. The slope level is varied between 2-10 % at the cluster (Table 5.2.).

6.1.1. Evaluation of Park Service Areas in Buca Cluster

The spatial analyze procedures of accessibility come into operation by the assessment of park service areas. First, park service areas are created via existing parks and the areas with weak or lack of access are detected within Buca cluster. For park service area analysis, the Thiessen Polygon Method is used and the size of green areas per person is calculated within these service areas. For this calculation, the population data is re-organized. This data is aggregated using the population-weighted mean center of each residential units. Therefore, the population information for each area is created by multiplying building levels with number of units and average household information of Izmir. .All residential units are determined as demand points and their population are weighted to each park areas. Non-residential units such as mosques, schools and commercial units are not included in the population calculations. Park accessibility within park service areas are conducted for each population weighted residential units via street network.

According to the Thiessen Polygon analysis, park service areas are created ignoring the street network as in the Figure 6.1.. It is revealed that there are more than one first- degree park need areas (yellow color in Figure 6.1.) by calculating the park area per capita within Thiessen Polygons. Moreover, all park service areas are too large in terms of accessibility of individuals such as children, disabled and elderly groups.

The analysis of park service areas by the Service Area Analysis reveals that there are areas with lack of access within Buca cluster. A network-based service area is a region that covers all accessible streets within a specified distance and slope impedance. The spatial analysis with 300m walking distance and streets with maximum 4% slope shows that 36% of the Buca cluster have weak access to park areas for particular age groups as children (3-13), elderly and disabled as seen in the Figure 6.2..

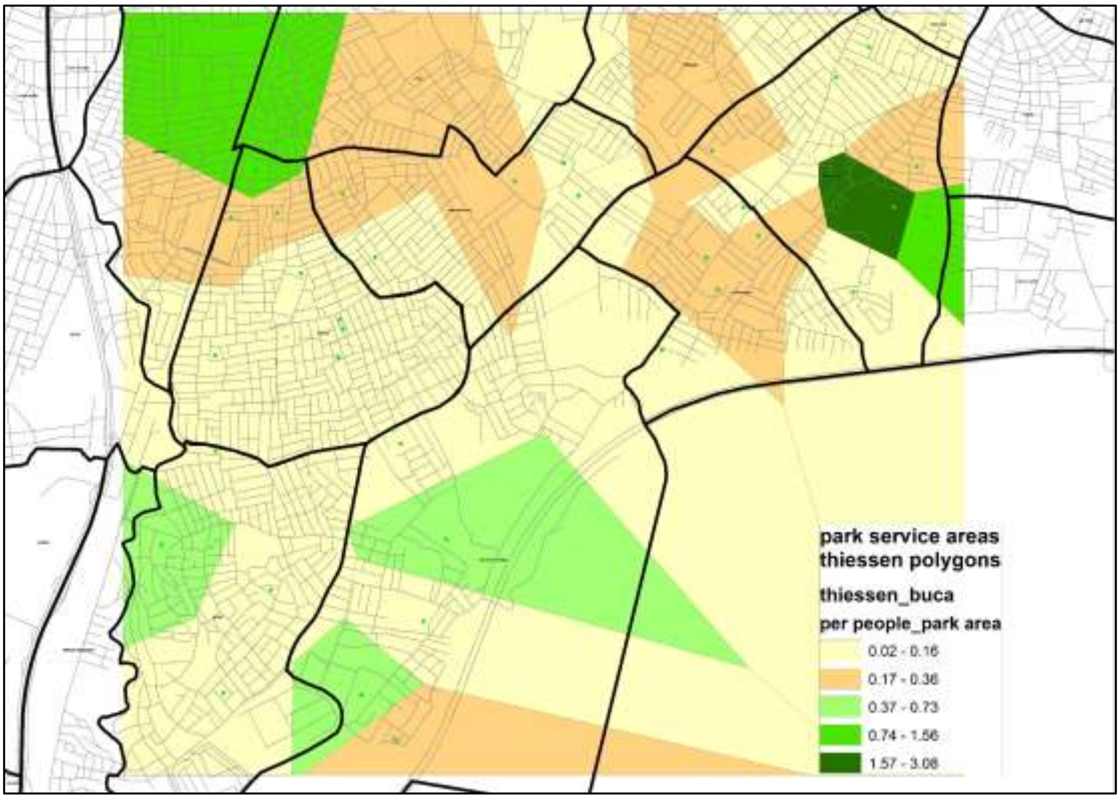

Figure 6.1. The park service areas of Buca cluster by Thiessen Polygon Method

According to the results, 4812 of 11620 dwelling units having access in 300m walking distance to any park area.

By applying two different methods, it is seen that there are limitations of Thiessen Polygon Method and opportunities of Service Area Analysis method in terms of assessing accessibility. Although the Thiessen Polygon Method detects the park service areas covering the closest dwelling units, they are created based on only the park locations. Furthermore, Thiessen Polygon Method is a zone-based method as creating polygon areas ignoring actual network distance and impedance effects of distance and slope as externalities. For that reason, in order to measure the actual service areas of neighborhood parks, the Service Area Analyze tool is also performed in Buca cluster. The service area analysis detects park catchment area of each park based on the network distance.

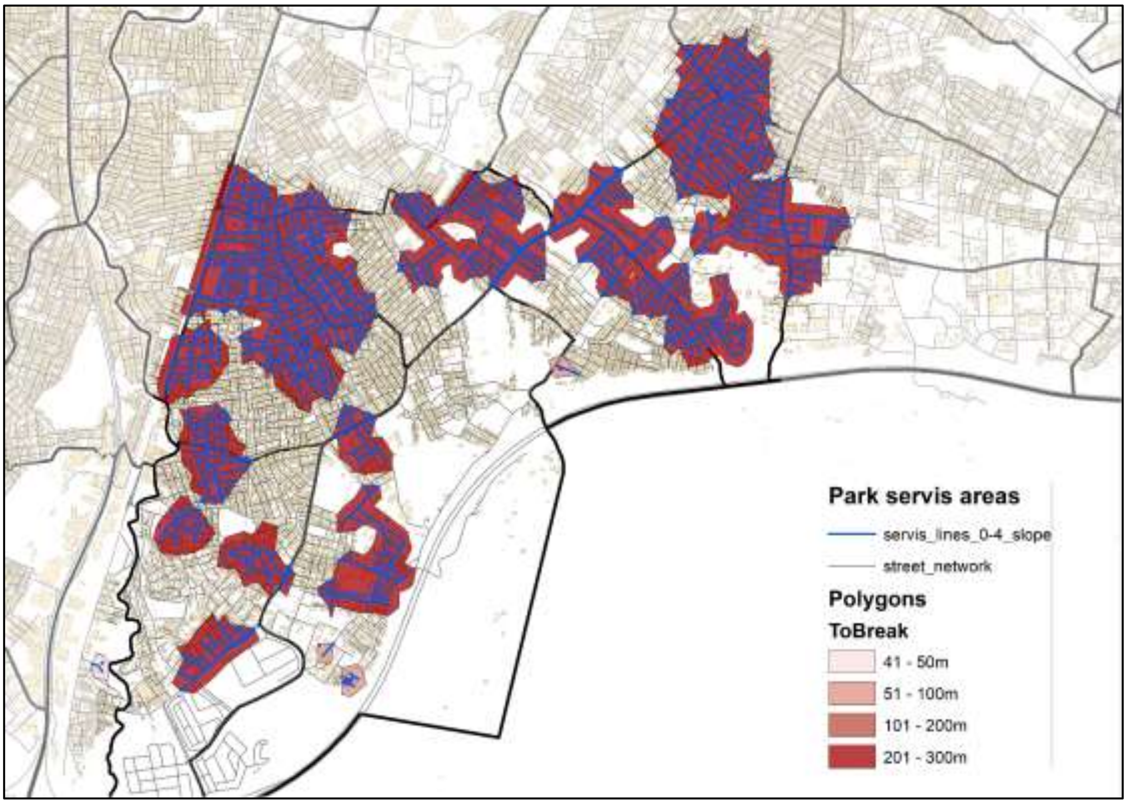

Figure 6.2. The park service areas of Buca cluster by Service Area Analysis

The accessibility criteria is set as 300m from each park locations to residential units (Barton, Hugh; Grant, 2010; Çetiner, 1991) and the streets with slope higher than 4% are defined as line barriers. Therefore, the actual walkable catchment areas of parks are calculated.

6.1.2. Evaluation of Park Service Areas in Karabağlar Cluster

Within the neighborhoods of Karabağlar cluster, the GIS procedures of the Service Area Analysis are performed respectively to assess park catchment areas and measure accessibility to park areas. The spatial pattern of Karabağlar cluster with the analysis of the accessibility via Service Area Analysis (SAA) reveals that there are also areas with lack of access to neighborhood parks. The spatial analysis with 300m walking distance and maximum 4% slope level shows that 55% of the Karabağlar cluster have weak access to park areas for particular age groups as children (3-13), elderly and disabled as seen in the Figure 6.3.. According to the results, 1113 of 5166 dwelling units having access in walking distance to any park area within 300m catchment area.

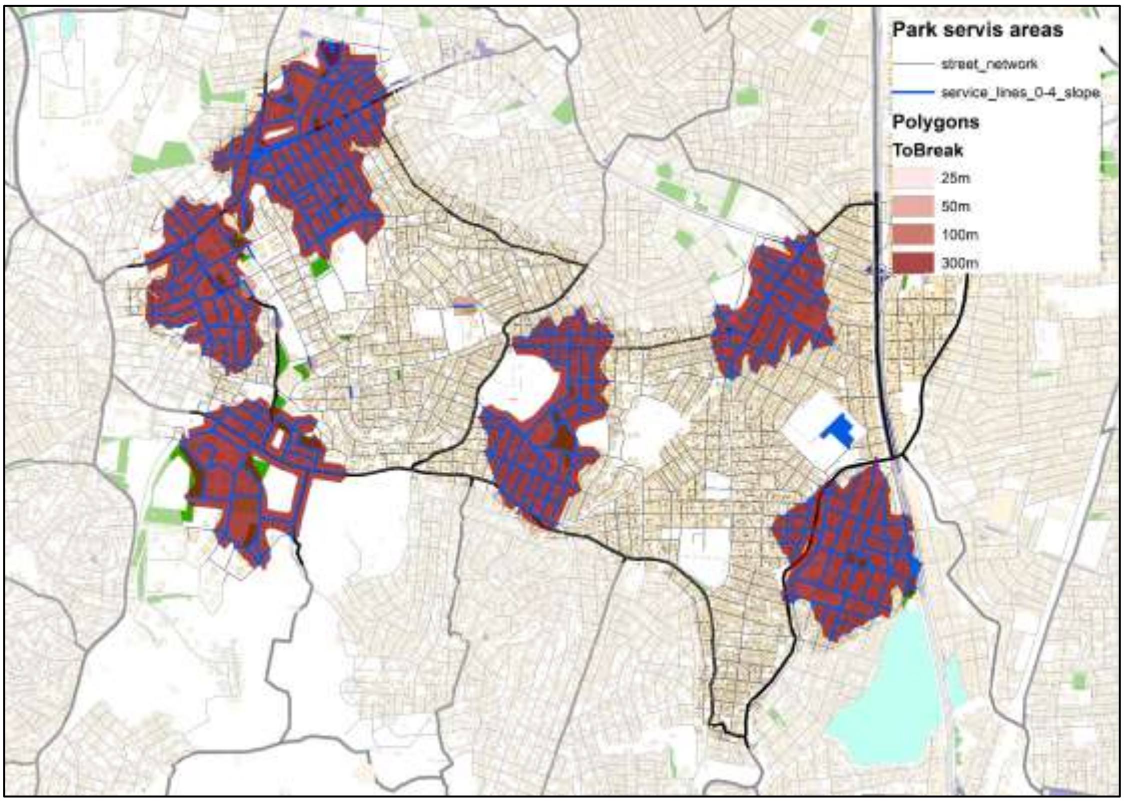

Figure 6.3. The park service areas of Karabağlar cluster by Service Area Analysis

6.1.3. Evaluation of Park Service Areas in Bayraklı Cluster

In Bayraklı cluster, only with the neighborhood of R. Şevket İnce, GIS procedures of the Service Area Analysis are performed respectively to assess park catchment areas and measure accessibility to park areas. The spatial pattern of Bayraklı cluster with the analysis of the accessibility via Service Area Analysis reveals that there are also areas with lack of access. The spatial analysis with 300m walking distance and maximum 4% slope shows that 70% of the Bayraklı cluster have weak access to park areas for particular age groups such as children (3-13), elderly (65+) and disabled as seen in the Figure 6.4.. According to the results, 62 of 1851 dwelling units having access in walking distance to any park area within 300m catchment area.

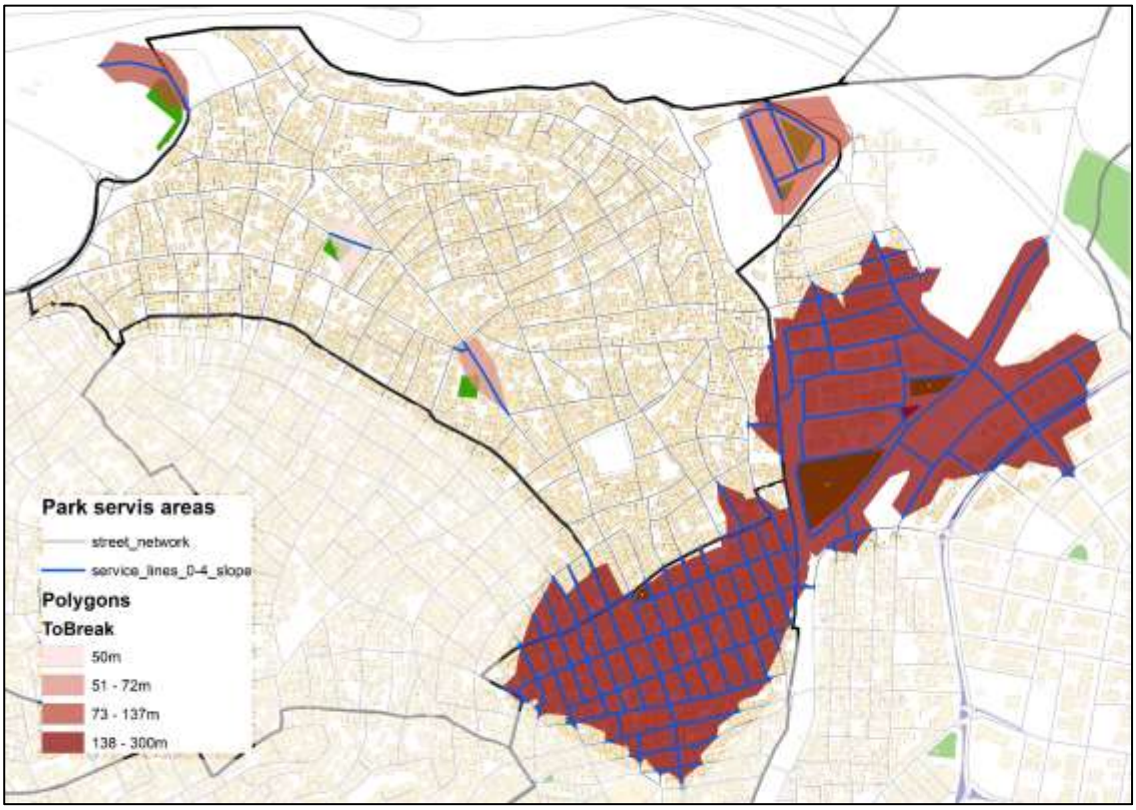

Figure 6.4. The park service areas of Bayraklı cluster by Service Area Analysis

The aim of the service area analysis is to detect inequities in access to neighborhood parks by the simulation of actual network layout and the built-environment within neighborhoods. Within the spatial criteria, slope becomes a major aspect that affect the accessibility pattern of clusters. According to the results of Service Area Analysis, Bayraklı cluster is revealed as the least accessible area due to high level of slope degree and urban pattern not corresponding to the hilly areas. Even though there are limited number of neighborhood parks, they are not in a walkable distance and slope level as seen in Maps 6.4.. The transport distance to park areas is between 50-300m with 0-4% slope . Karabağlar cluster has more park areas in terms of numbers and size, and it is less hilly than Bayraklı, however there are also big areas that have no access due to high level of slope degree and urban pattern as seen in Map 6.3.. The transportation distance to park areas is between 25-300m with 0-4% slope. On the other hand, with less hilly areas and low level of slope, Buca cluster is the most accessible area as seen in Map 6.2.. The transport distance to park areas is between 62-300m with %0-4 slope degree and parks serve to bigger areas than other clusters (Table 6.1.).

Table 6.1. The measurement of accessibility to existing parks

<table>
<tr><th>districts</th><th>neighborhoods</th><th>total area (ha)</th><th>size of park service areas (ha)</th><th>number of residences (demand points)</th><th>the number of residential units that have no access (within 300m)</th><th>Percentage of residences with no access</th></tr>
<tr><td>BAYRAKLI</td><td>R.SEVKET INCE</td><td>52.4</td><td>31.6</td><td>1851</td><td>1789</td><td>96.7</td></tr>
<tr><td>BUCA</td><td>GOKSU</td><td rowspan="5">547.7</td><td rowspan="5">355.6</td><td rowspan="5">11620</td><td rowspan="5">6808</td><td rowspan="5">58.6</td></tr>
<tr><td>BUCA</td><td>YESILBAGLAR</td></tr>
<tr><td>BUCA</td><td>CAMLIKULE</td></tr>
<tr><td>BUCA</td><td>INONU</td></tr>
<tr><td>BUCA</td><td>MUSTAFA KEMAL</td></tr>
<tr><td>KARABAĞLAR</td><td>GUNALTAY</td><td rowspan="2">170.5</td><td rowspan="2">136.6</td><td rowspan="2">5166</td><td rowspan="2">4053</td><td rowspan="2">78.5</td></tr>
<tr><td>KARABAĞLAR</td><td>YUNUS EMRE</td></tr>
</table>

6.2. Provision of Park Locations in Park Poor Clusters of Izmir

The aim of this part is to propose an allocation model of neighborhood parks in already developed urban area with maximum accessibility of park need groups. This allocation model is important in terms of achieving maximum accessibility in already park poor neighborhoods. This allocation model is performed by using the heuristic algorithm based location-allocation analysis (Ghost & Rushton, 1987) that proposes spatial alternatives for locating facilities using GIS (Malczewski, 2006). In order to allocate new park locations, the Location-Allocation Analysis (Yeh & Chow, 1996) is used to detect the optimum location among alternatives (candidate areas) by using GIS.

For operationalization of location-allocation problem within clusters, there are three main step as defining accessibility criteria, defining potential park areas (candidate areas) for new park areas (supply centers) and digitizing population weighted residential units (demand points). An inclusive accessibility criteria is set for solving the location-allocation problem of park areas and in order to produce benefit for each social groups live in clusters such as children, women with children, seniors, elderly and disabled. The inclusive neighborhood planning is noticed to consider the diversity of abilities and ages in walking. To better identify accessibility of the diverse population, it is suggested to pay attention to walking speed, footpath connectivity, infrastructure condition, weather/climate and gradient/slope (Stafford & Baldwin, 2018). Moreover, it is suggested to consider social interaction points, crossing placement, public service areas, rest points, traffic and pedestrian ways (Stafford & Volz, 2016). Accessibility criteria is set as same in the service area analysis, 300m continuous network distance to residences and other public services with maximum 4% slope level.

This accessibility criteria are installed to Location-Allocation Analyses as spatial limitations. These limitations are considered in four main categories. These are impedance effect of distance, impedance effect of slope, distance to other public service areas and the size of new park areas. The spatial limitations are detected as slope level higher than 4%, lower than the size to be efficient to include service facilities (such as toilets, café, banks, playing area etc.) and network distance longer than 300m (Barton, Hugh; Grant, 2010; Çetiner, 1991) to other public facilities and to all residential units. These other urban facilities are determined as public health centers, public and private schools, religious areas, shopping centers, public libraries and headmen’s offices within the neighborhoods.

Candidate areas are defined by detecting vacant lands and other type of green areas (such as refuges or the gardens of public areas) within each clusters. The available vacant lands that sustain all spatial criteria are allocated as a candidate park area in the Location-Allocation Analysis. The existing pattern of clusters have many ‘vacant lands’ that can be transformed into a new park area (candidate park area). Buca cluster has 138 vacant lands including 128 building plots, 7 refuges and 2 headmen’s office garden and 1 pedestrian street within the neighborhoods. Karabağlar cluster has 35 vacant lands including 21 building plots, 11 refuges and 2 headman’s office garden and 1 local squares within the neighborhoods. Bayraklı cluster has 18 vacant lands, all of them are building plots (Table 6.2.).

The candidate parks are chosen among these vacant lands that are covered by the service area of other public facilities. For this selection, the Service Area Analysis is performed for each other type of public facilities. These candidate park areas are detected and there are 21 candidate park areas in Karabağlar cluster, 5 candidate park areas in Bayraklı cluster and 100 candidate park areas in Buca cluster (Table 6.2.).

The residential units are defined as demand points and they weighted by their population calculated by household number multiplied unit number. There are 11620 residential units in Buca and the total population is calculated as 250460 people. There are 5166 residential units in Karabağlar and the total population is calculated as 53402 people. There are 1851 residential units in Bayraklı and the total population is calculated as 17260 people. The number of residential units and population that have access to the park areas is computed by OD cost matrix.

For the implementation of Location-Allocation Analysis; all candidate park areas, residential units as demand points, spatial limitations and street network layout are uploaded to GIS. These candidate park areas are installed to the Location-Allocation Analyze in GIS and located such that as many demand points (residential units) as possible are allocated to park facilities within walking network distance. Each residential unit inside the walking distance of a park area allocates its demand weight to that park area. Any dwelling units outside the impedance distance to park locations is not allocated.

The Location-Allocation Analysis is used to calculate optimum locations of park areas sustaining minimum distance as well as cumulative opportunity. The aim of minimum transportation cost is sustained by using ‘minimize impedance’ criteria. Each of the solutions locates park areas and allocates residential units as demand points to the proposed park locations. Minimize Impedance (P-Median) locates facilities that the sum of all weighted costs (weighted demand is multiplied by the distance to the facility) between demand points and locations is minimized. The allocation is based on distance among all demand points.

Performing location allocation analysis sustaining all the accessibility criteria mentioned above, the data preparation becomes an important part. The process of data preparation in GIS is explained step by step:

The steps of the data preparation process:

1. The population calculation of each residential unit by multiplying number of floors, number of units and the Izmir average household population.

Table 6.2. The population, existing parks and vacant land capacity of park poor clusters

clusters	population	number of residence units as demand points	size of existing neighborhood parks (m2)	size of green area per capita (existing)	number of vacant lands	number of potential park areas	size of potential park areas (m2)
BUCA	250460	11620	49861	0.51	138	100	120-8873
BAYRAKLI	17260	1851	3825	0.31	18	5	200-800
KARABAĞLAR	53402	5166	34298	0.82	35	21	240-4500

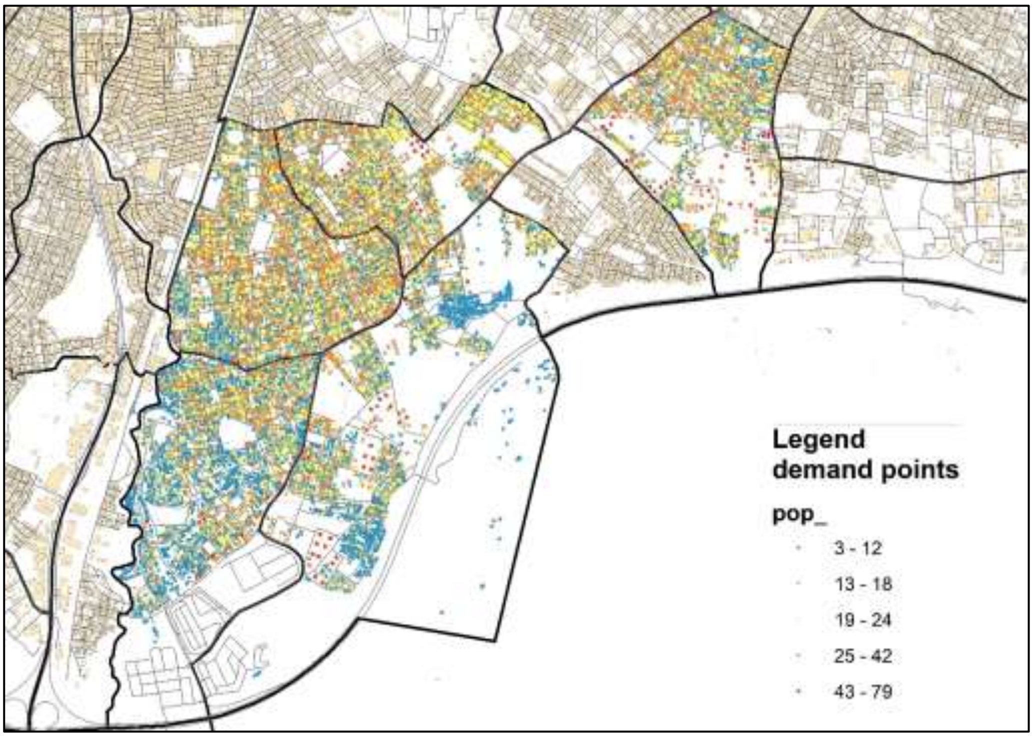

Figure 6.5. Process 2, populations of residential units

2. The identification each residential units as demand points to location-allocation analysis and weighting each unit by their number of population (Figure 6.5.)
3. The identification of slope levels of street network (Figure 6.6.)
4. The identification of street with slope level higher than %4 as line barriers to the location-allocation analysis (Figure 6.7.)
5. The identification of existing park locations to Location-Allocation Analysis and weighting them by their size (Figure 6.8.)

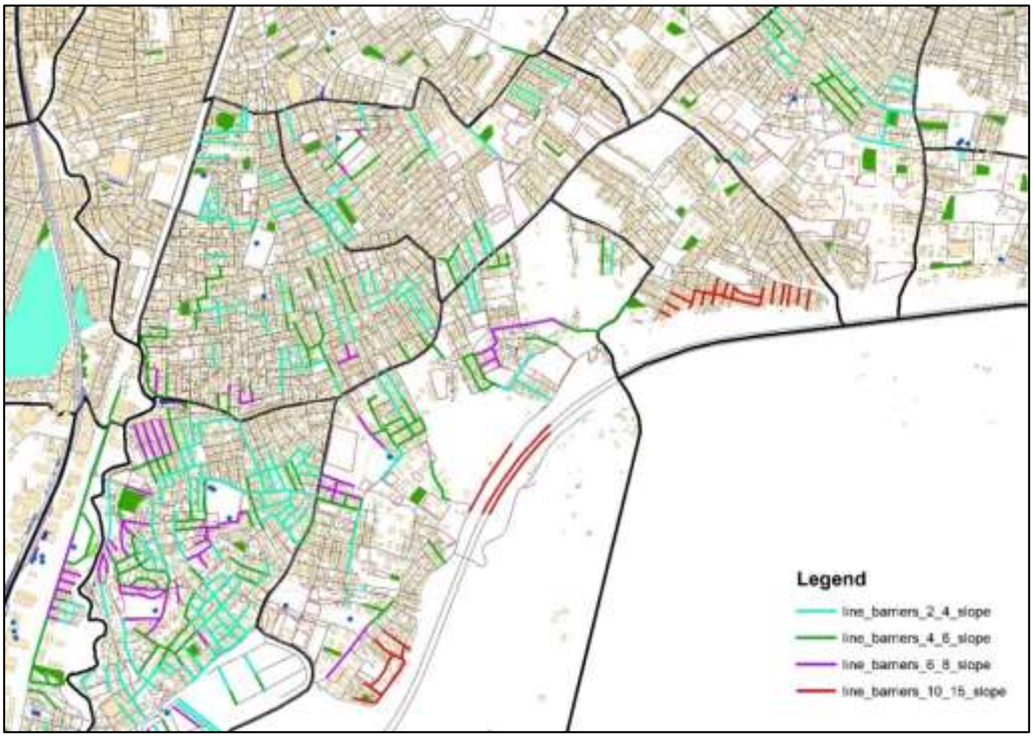

Figure 6.6. Process 3, slope levels of street network and line barriers

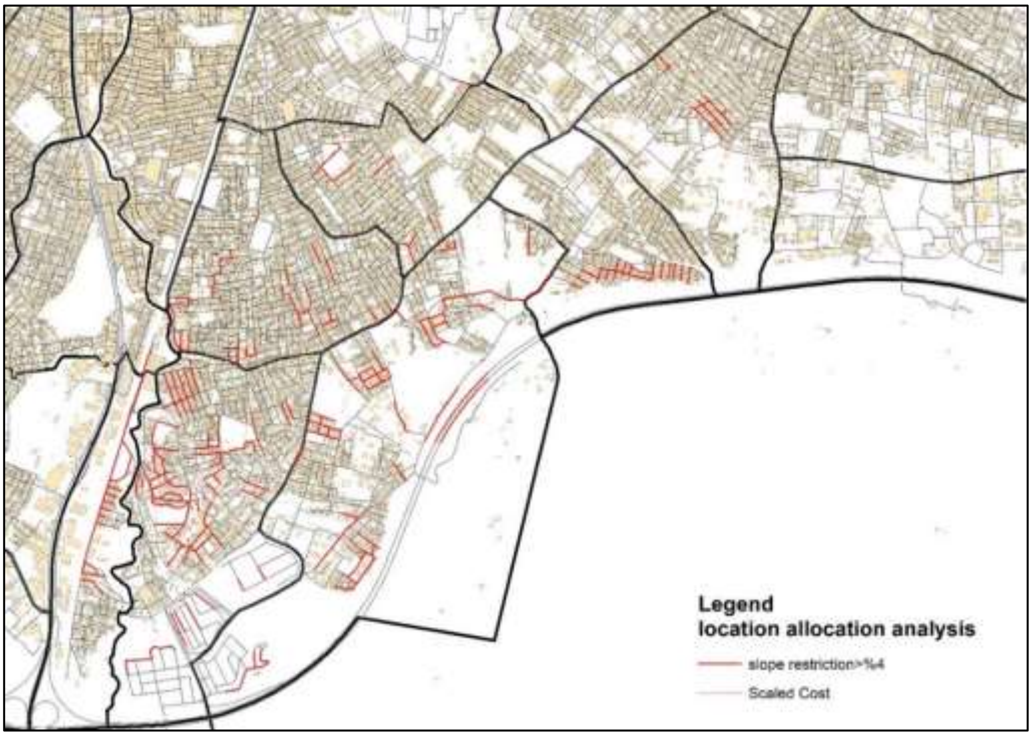

Figure 6.7. Process 4, streets with slope higher than 4% as spatial barriers

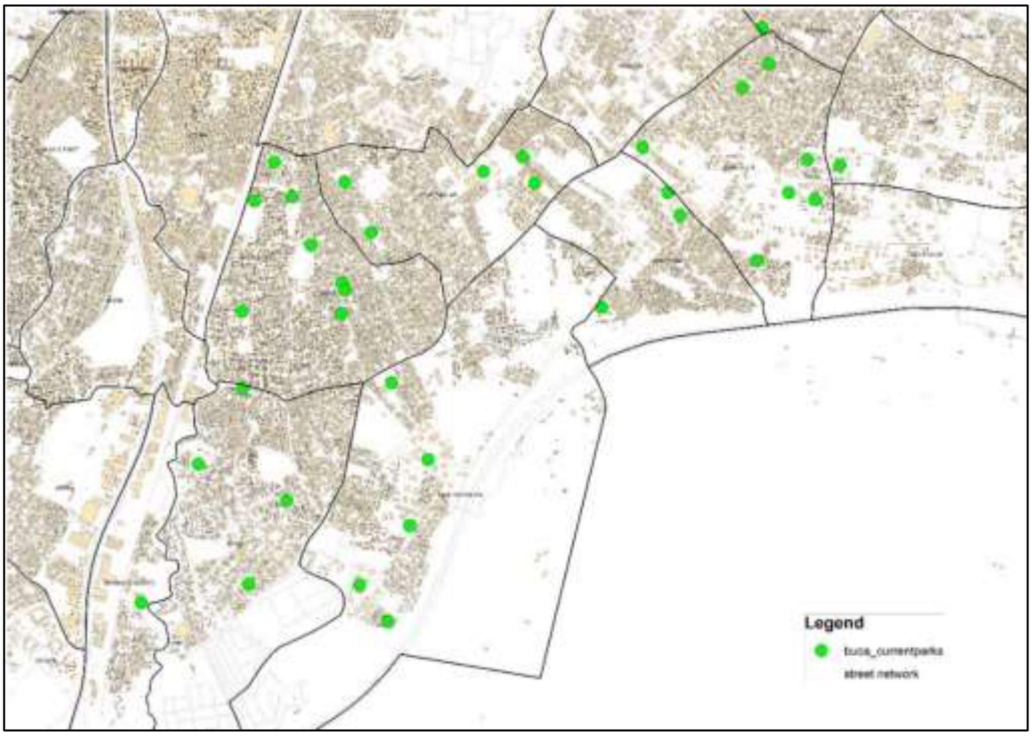

Figure 6.8. Process 5, existing neighborhood parks

6. The detection of all vacant lands and all green areas (Figure 6.9.)
7. The calculation of (300m) service area of all other existing public service facilities and the selection of candidate parks among vacant lands that are covered by these service areas to sustain cumulative opportunity (Figure 6.10.)
8. The identification of the candidate park locations to Location-Allocation Analysis (as a candidate park) and performing the location-allocation analysis to choose new park areas

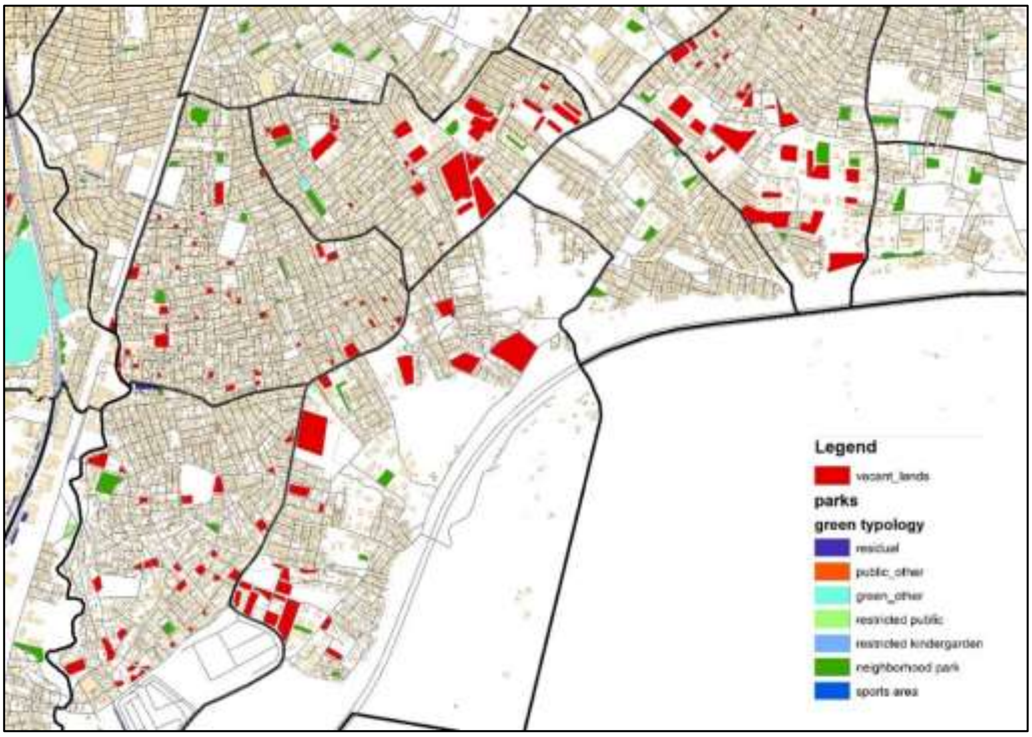

Figure 6.9. Process 6, vacant lands and existing green areas

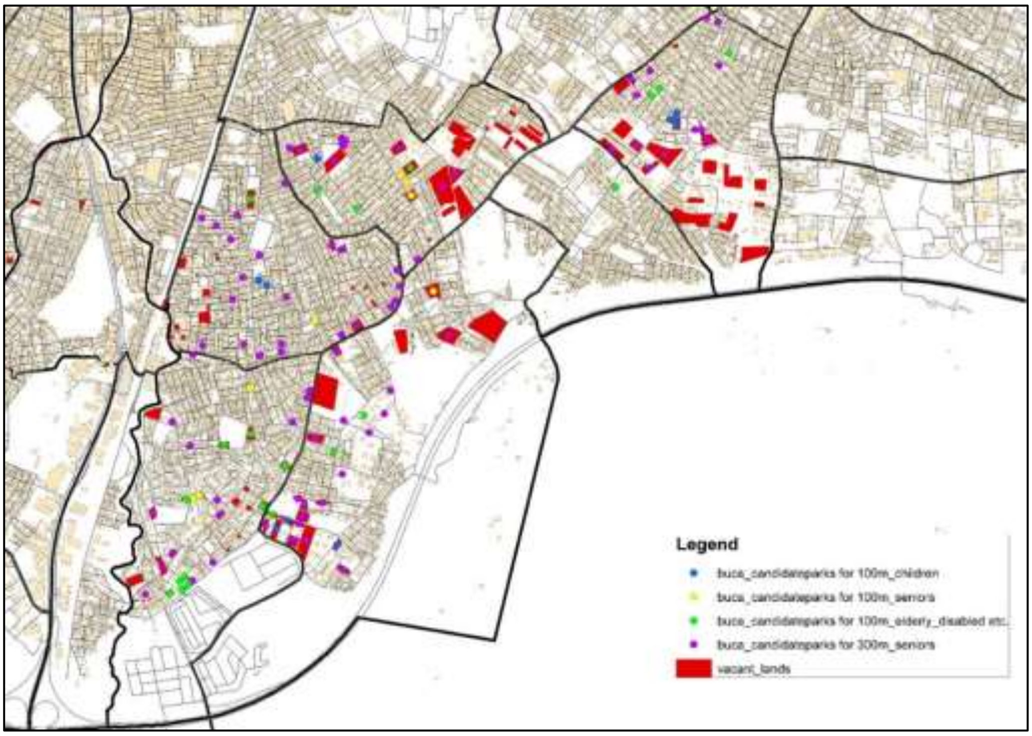

Figure 6.10. Process 7, the selection of candidate parks from vacant lands

6.2.1. Provision of Park Locations in Buca Cluster

In Buca cluster, based on the settled accessibility criteria, location-allocation analysis choices 65 of 100 candidate areas as new park locations (Figure 6.11.). By the new park areas, 9044 of 11620 residential buildings have gain access to any park area within 300m walking distance. The size of candidate park areas is between 120-8873m^2 that is suitable to include service facilities. The total size of chosen park areas is 58525m^2, while the size of current neighborhood parks is 49861m^2. Thus, the total green areas reach to 108386m^2 (Table 6.3.).

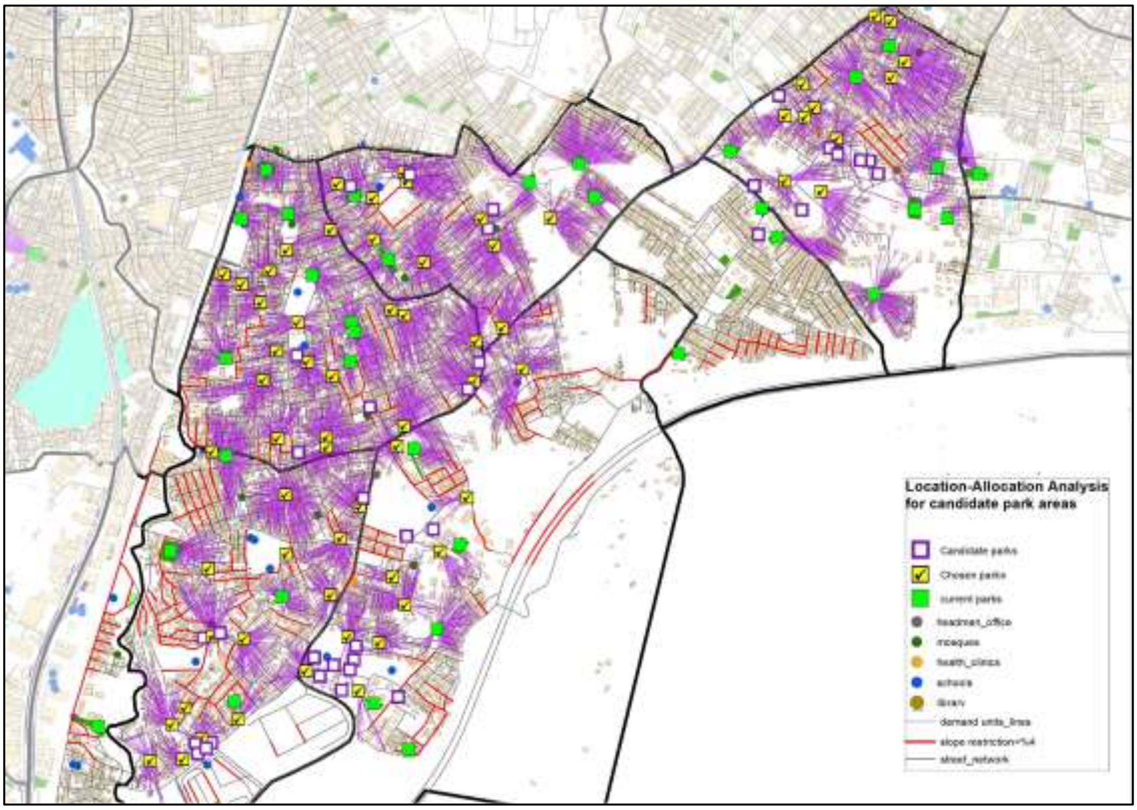

Figure 6.11. Location-Allocation Analysis for Park Provision in Buca - Minimize Impedance

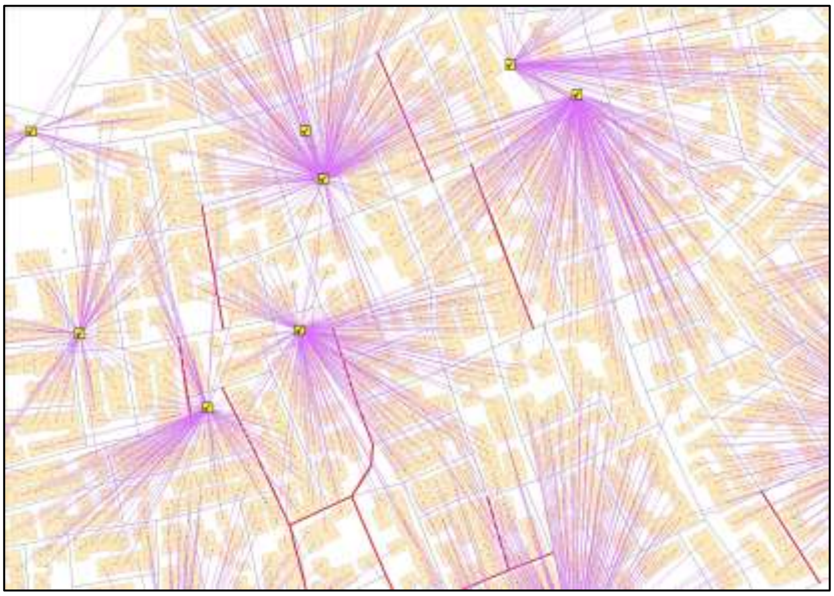

Figure 6.12. Details of Demand-Supply Lines of Location-Allocation Analysis in Buca

6.2.2. Provision of Park Locations in Karabağlar Cluster

The results of the location-allocation analysis show that 5 of 21 candidate areas are chosen based on the setting accessibility criteria as new park locations in Karabağlar cluster. By the new park areas, 2120 of 5166 residential units have gain access to any park area within 300m walking distance (Figure 6.12.). The size of candidate park areas is between 240-4500m^2 that is suitable to include service facilities. The total size of chosen park areas is 6862m^2, while the size of current neighborhood parks is 34298m^2. Thus, the total green areas reach to 41160m^2 (Table 6.3.).

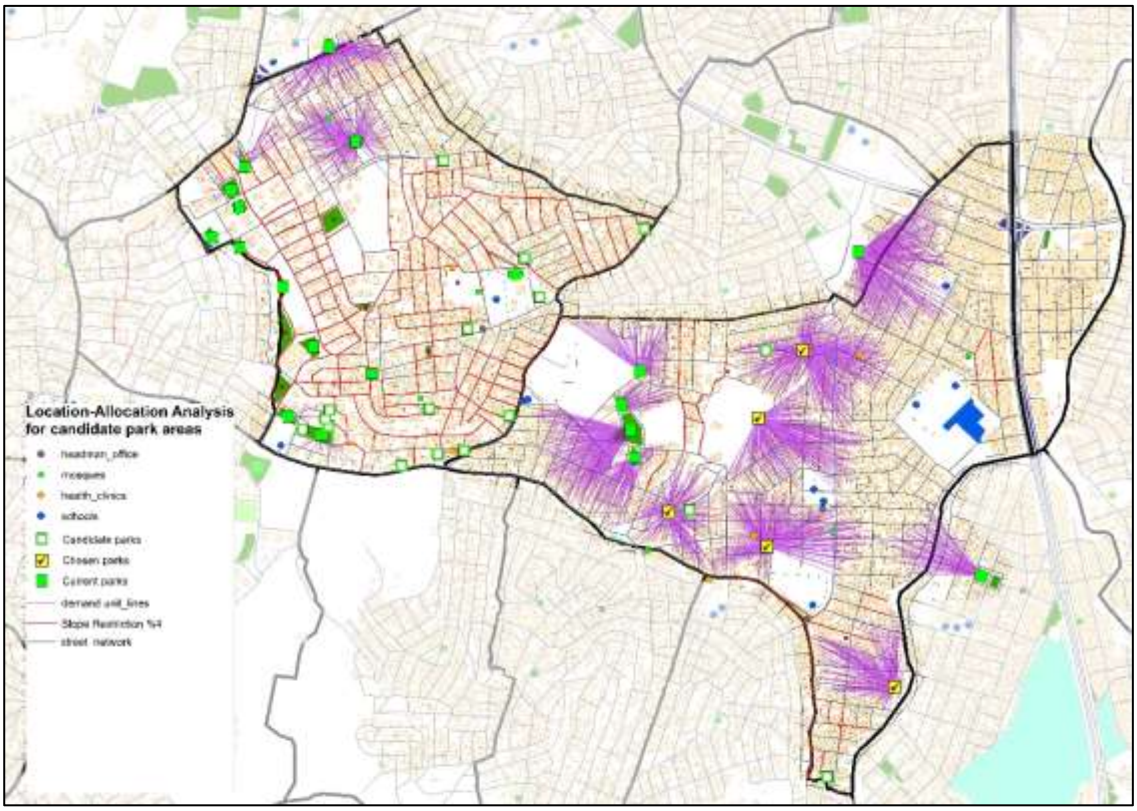

Figure 6.13. Location-Allocation Analysis for Park Provision in Karabağlar - Minimize Impedance

6.2.3. Provision of Park Locations in Bayraklı Cluster

In Bayraklı cluster, based on the setting accessibility criteria, 3 of 5 candidate areas are chosen as new park locations (Figure 6.13.). By the new park areas, 74 of 1851 residential units have gain access to any park area within 300m walking distance (Figure 5.13.). The size of candidate park areas is between 200-800m^2 that is efficient to include service facilities. The total size of chosen park areas is 1371m^2, while the size of current neighborhood parks is 3825m^2. Thus, the total green areas reach to 5196m^2 (Table 6.3.).

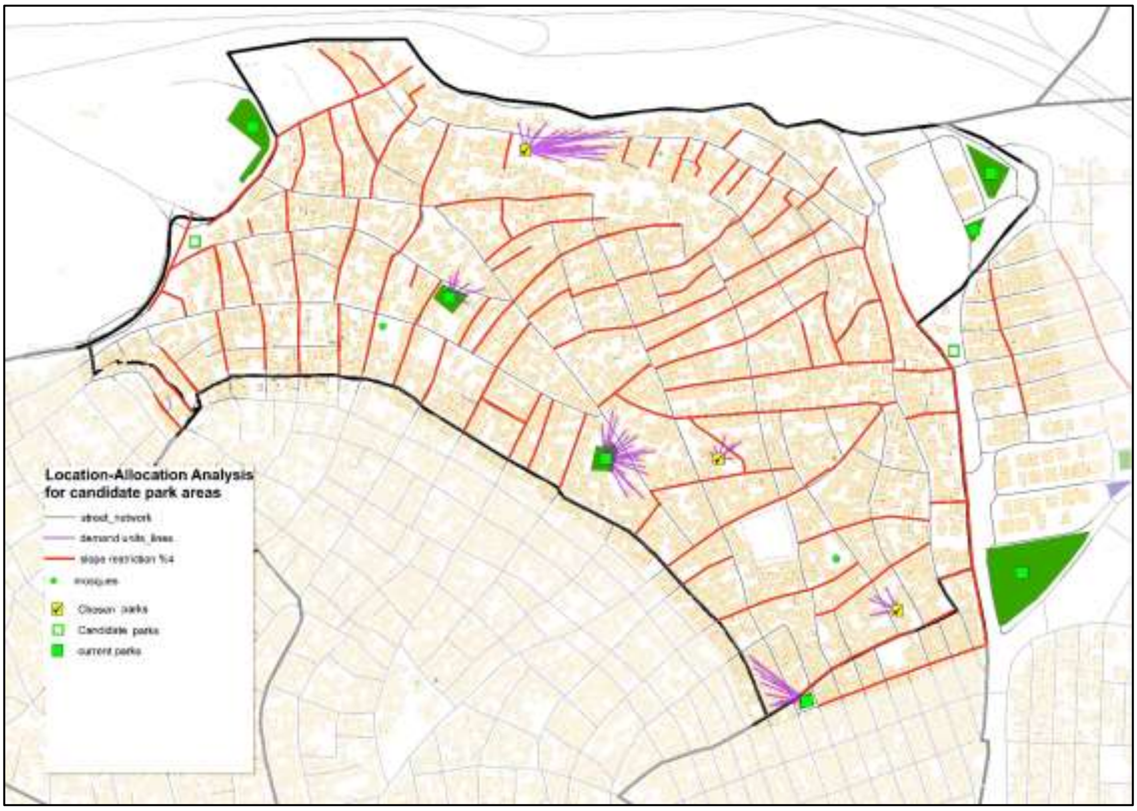

Figure 6.14. Location-Allocation Analysis for Park Provision in Bayraklı - Minimize Impedance

The main reasons to choose these three park poor clusters are high population and lack of opportunity to access to park areas at close environment. These three areas have the priority in park provision in terms of their high number of children population and lack of green area. Although these areas are similar in terms of socio-demographic structure of residents, they are different in spatial context. These areas have different street network, slope levels, vacant land capacity, location of vacant lands, residential and population density and subdivision pattern. These spatial differences become determinant factors in location- allocation pattern of park provision analysis.

Regarding the results of location-allocation analysis (Table 6.3.), it is examined that the number of residential-population density availability of vacant lands and slope level are the most important dimensions that affect the resulting pattern of Location-Allocation Analysis and the choice of optimum location for new park areas. These factors are the main reason of the number of chosen parks among candidate areas. The highest number of chosen park areas is in Buca cluster, due to its low level of slope, dispersed spatial pattern of vacant lands and also high number of vacant lands.

Table 6.3. The provision of park areas in park poor clusters by location-allocation analysis

the location-allocation analysis						
clusters	population	minimize impedance				
		number of chosen areas	sum of inflows (people)	% near (coverage capacity)	average distance cost (m)	total size of neighborhood parks (m2)
BUCA	250460	65	201790	81	133	108.386
BAYRAKLI	17260	3	658	4	62	5196
KARABAĞLAR	53402	5	22904	42.9	43	41.160

6.3. Comparison of the Accessibility to Existing and Proposed Park Locations

This part aims to evaluate the results of the location-allocation analysis by comparing to the existing distribution of neighborhood parks. The spatial distribution of proposed park areas are examined whether it sustain the goal of reducing the transportation cost compared to the existing distribution. Verification is performed by statistical analyzes made on proposed and existing distributions and the resultant distribution is visualized by service area analysis. The transport costs in distance of existing and proposed distributions are tested by Paired t-test, Kolmogorov Smirnov test, and absolute mean error analysis and visualized in graphs by Kernel density analysis (Marsh & Schilling, 1994; Randles & Wolfe, 1979). These analysis are performed to strengthen the hypothesis that these two distributions are statistically different. The test results expressed as in Table 6.4., it shows that there is a significant difference between existing and proposed distributions of transport cost (as p-value is 0.00) between any park areas and any residential units. It is observed that the walking distance decreases by 173 meters to parks in Buca cluster seen from 11620 network distance between parks and residences in proposed distribution. The walking distance decreases by 83m to parks in Karabağlar seen from 5167 network distance between parks and residences in proposed distribution. The walking distance decreases by 138 m to parks in Bayraklı cluster seen from 1852 network distance between parks and residences in proposed distribution.

Table 6.4. Statistical results of the current and proposed distance distribution

clusters	**indicators**	**current (m)**	**proposed (m)**	**Paired t-Test(p-Value)**	**Kolmogorov Smirnov Test**
BUCA	mean	252.0067975	135.6803104	0.00	z: 33.795 (p-value:0.00)
	median	226.7743136	116.7893101		
	Max	5678.02226	5341.744081		
	Min	0	0		
	SD	233.3369447	201.8309495		
	MAE	173.639972			
KARABAĞLAR	mean	294.9240208	235.8534795	0.00	z: 8.146 (p-value:0.00)
	median	286.1160884	209.240895		
	Max	916.1361898	856.4134822		
	Min	0	0		
	SD	170.0335629	163.7025357		
	MAE	83.29598865			
BAYRAKLI	mean	226.651516	152.4474466	0.00	z: 8.957 (p-value:0.00)
	median	219.7598079	148.1407492		
	Max	854.6132154	664.5743098		
	Min	0	0		
	SD	130.966533	93.07603671		
	MAE	138.6608919			

Kernel density analysis is made for each cluster in order to reveal the difference between existing and proposed distributions. Besides, Service Area Analysis is performed to map proposed spatial pattern for each clusters. With the kernel density analysis, the two distribution are plotted on the same scale, and it is seen that the proposed distributions significantly reduce the distances between residential units and neighborhood parks (Figure 6.14.). Assuming that the proposed areas are designed as new park areas, Service Area Analysis is performed to see the resultant park service areas (Figure 6.15.). As shown on the map, access to parks in Buca by the allocation of new park areas covers nearly 99% of the population.

The total area of green space is increased in the neighborhoods and the walking distance to park areas is decreased to less than 250m with smaller park service areas (Table 6.3.). Total size of park is increased and minimum park size is 120m^2 and the maximum is 8873m^2 and average park area per capita increase to 0.84 m^2 (Table 6.2.). The proposed spatial distribution of parks depends on the spatial criteria as slope degree and the location of other public facilities. The slope criteria is the most determinant spatial factor for location decisions and it affected the resultant spatial allocation pattern of each clusters. The other important determinant spatial factor is the current vacant land capacity of park poor areas. Regarding vacant lands, not only their number but also their location matter in location-allocation analysis. These two factors are the main reason of the biggest difference between current and proposed distances in Buca (Table 6.4.) and the least number of park provision in Bayraklı cluster (Figure 6.13.). Moreover, the number of population and residential density are also a determinant important factor in minimizing distance. The least decrease in walking distance is performed in Karabağlar cluster (Table 6.4.), due to the high number of population and low number of vacant land (see Table 6.2.). Therefore, the different spatial layouts create different allocation patterns of any urban service area/facility. Moreover, the GIS-based modelling and simulation provides to experience allocation models and resultant spatial distribution.

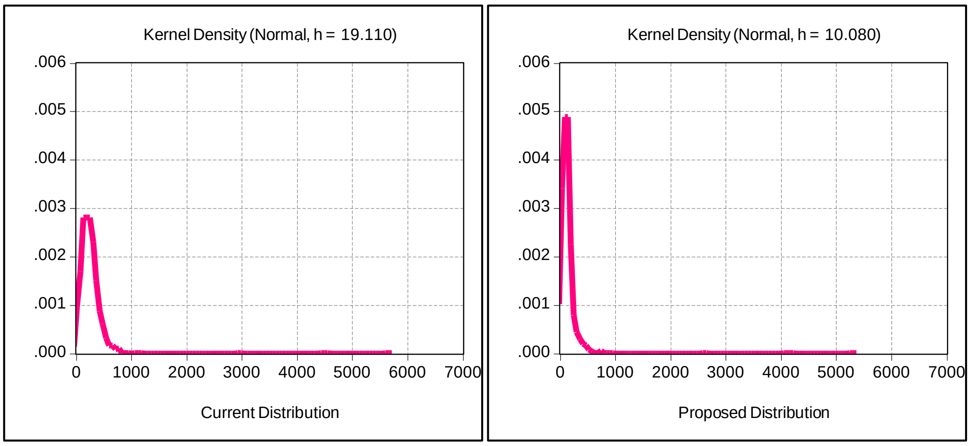

Figure 6.15. Kernel density analysis for Buca cluster

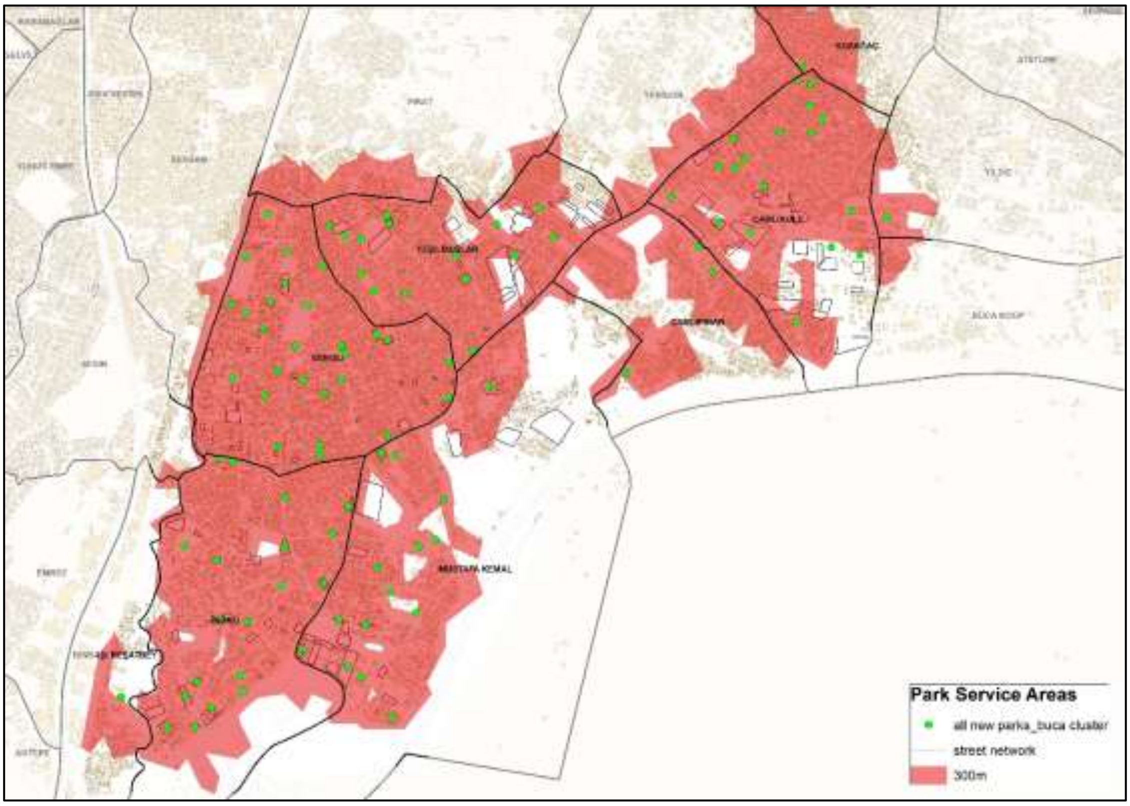

Figure 6.16. Proposed park service areas of Buca cluster

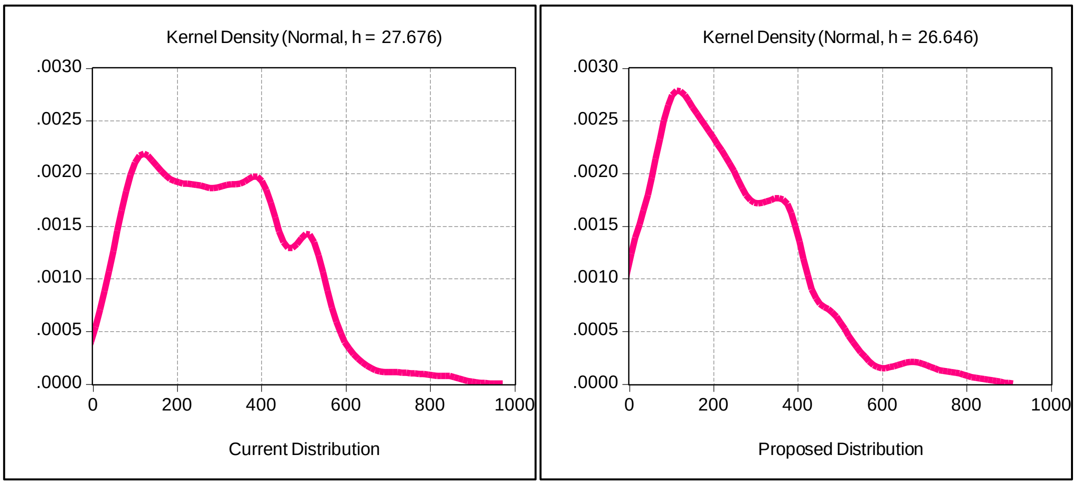

Figure 6.17. Kernel density analysis for Karabağlar cluster

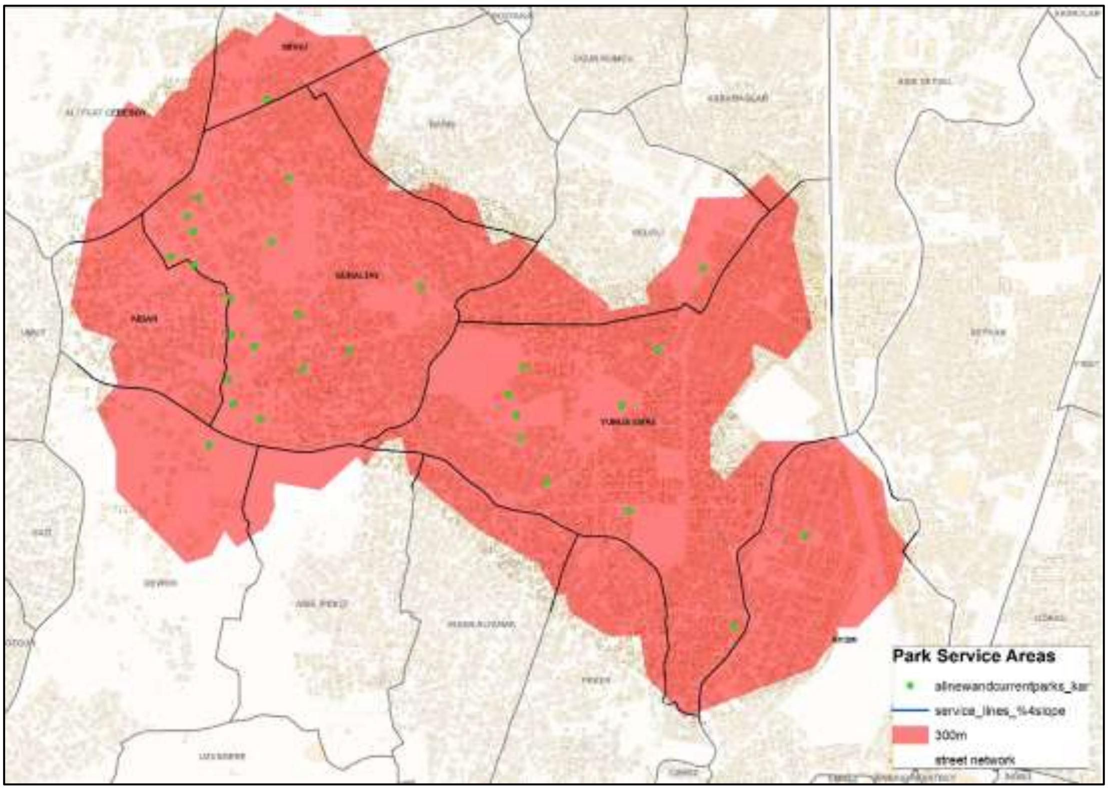

Figure 6.18. Proposed park service areas of Karabağlar cluster

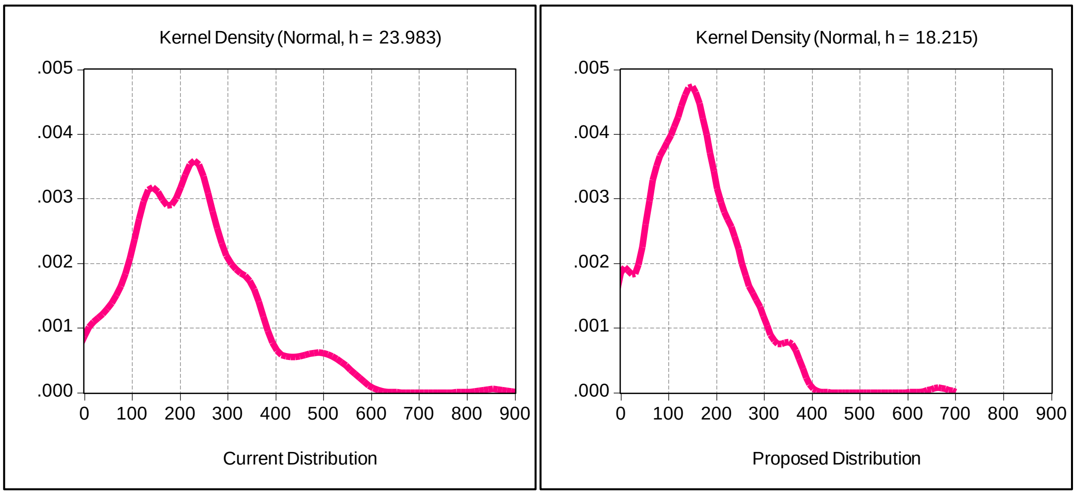

Figure 6.19. Kernel density analysis for Bayraklı cluster

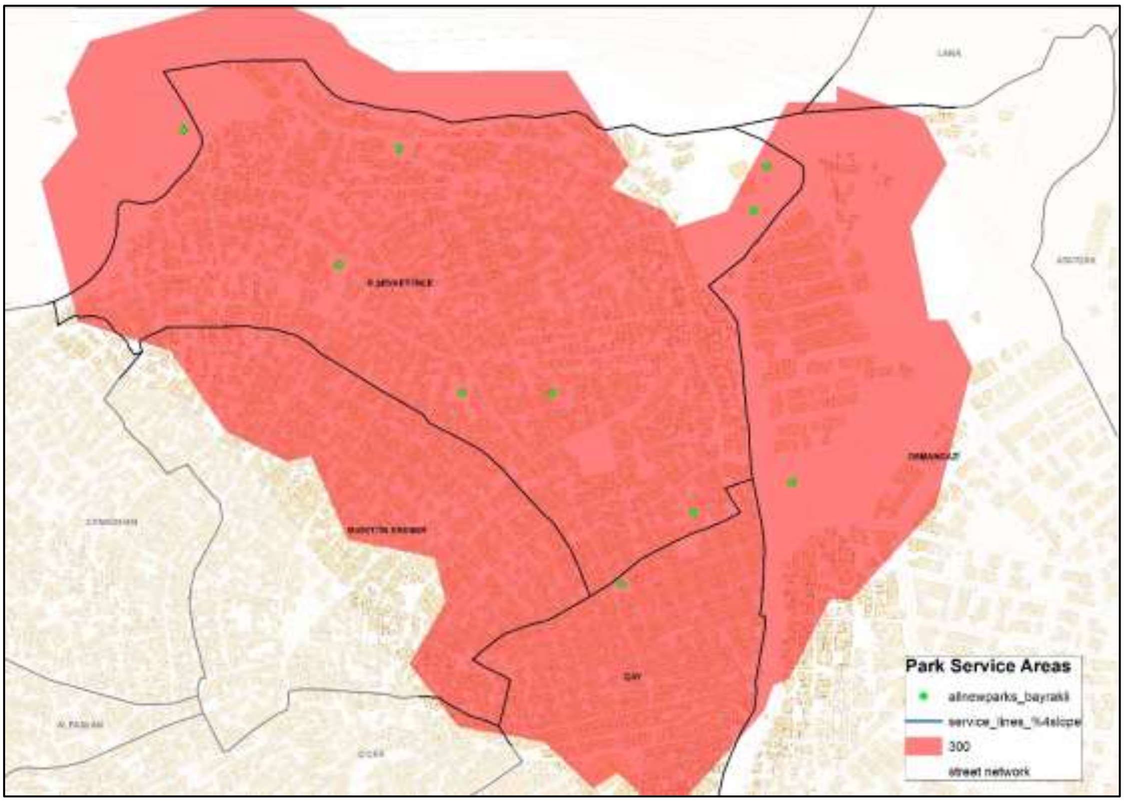

Figure 6.20. Proposed park service areas of Bayraklı cluster

The approach and simulation method of this study aims to contribute to the development of location–allocation strategies for new green public areas via multi-criteria decision making process. Municipalities and public agencies can use these GIS-based procedures to identify optimum locations for many different urban service areas in already developed urban regions.

According to the results of the spatial analysis, there is spatial inequity and differential access to neighborhood parks not only between the neighborhoods of the city but also within the park poor neighborhoods. It is revealed that the spatial layout and population density are matters in accessibility and there is a socio-spatial diversity within the neighborhoods rather than homogeneity.(Neutens, Schwanen, Witlox, & De Maeyer, 2010) The analysis at upper scales (city scale) cannot reveal the differences in access to local opportunities and individual experience of accessibility. The traditional models assume that residents of an area with sufficient access, they all benefit from the services provided within it. Against such lack of these models, point-based spatial analytical perspective is used in accessibility measurement in GIS as a wide and inclusive understanding (Apparicio, Abdelmajid, Riva, & Shearmur, 2008; Lindsey et al., 2001; Nicholls, 2001; Tsou, Hung, & Chang, 2005). This perspective reveal the actual distance recognizing the scale of the facility, the number of people to support and their socio-economic characteristics, the density of the area and the thresholds of the geography for different user groups (Barton, Hugh; Grant, 2010).

CHAPTER 7

CONCLUSION

This thesis aims to assess spatial inequities in accessibility to parks in park poor neighborhoods of Izmir. Furthermore, this thesis aims to sustain “need-based equity” at the provision of parks in these neighborhoods by using GISs. In order to fulfill shortcomings in access to public green areas, it is important to reveal existing pattern of spatial accessibility. The assessment of spatial accessibility is performed by Service Area Analysis considering various spatial criteria at neighborhood scale. Accessibility is considered as the achievement of spatial equity for providing different gender and age groups with opportunities for benefitting from public service/resources. Besides measuring the existing situation of neighborhood parks for the accessibility of these groups, this thesis also proposes and implement network based GIS-based tools for how to decide about better and/or new locations of parks at neighborhood scale.

The potential contribution of the thesis can be related to the literature, methodology and data sources of the thesis. About the contributions related to the literature, the thesis emphasizes the need-based, rather than equality-based, equity perspective at the public service allocation even in within neighborhoods. This perspective also brings on critical thinking to the concept of space and location theories. As discussed in Chapter 2, this study addresses the role of space as representing social and physical diversity in the assessment of accessibility and in location-allocation models. The other important theme is the neighborhood scale integration of spatial equity analysis. As discussed in Chapter 4, this thesis is designed through multi-criteria decision analysis at neighborhood scale. Network based accessibility measurement of existing parks and new park allocation are performed at neighborhood scale. Last one is the pioneer methodological process in creating data units for spatial analysis especially in the data-poor context of Turkey. As managed in Chapter 6, the neighborhood scale spatial data are produced in GIS environment.

7.1. Need-based Equity Perspective to Park Provision at Neighborhood Scale

This thesis considers need-based equity perspective in allocation of public neighborhood parks in park poor neighborhoods of Izmir. Different from the literature, this thesis focuses on the ways for sustaining need-based equity at neighborhood scale. It gives priority to disadvantaged groups in allocating and getting access to public services. While examining locational approaches with its reliance on need-based equity perspective, this thesis elaborates on the role of the space concept and considers relative conception of space as the base of need-based equity approach. As discussed in Chapter 2, enhancement in space concept develops the operationalization methods of location allocation models. This thesis considers space as a relational concept in spatial analyses. With the rising importance of social justice in public service distribution, the "need-base equity" perspective has been favored with the concepts of spatial equity and spatial diversity in locational models. These models reframe the space as a relational concept. Relational space conceptualization is sensitive to the individual/group differences in spatial accessibility. In this manner, space concept is considered as time and place contexts-dependent.

This thesis argues that there is spatial diversity in urban areas (Şenol, 2019). Şenol (2019) detects the heterogeneous spatial pattern of demographic structure in Izmir as mentioned in Chapter 4. The high income level and high population of elderly and seniors are clustered along the seashore neighborhoods of Karşıyaka, Narlıdere and Güzelbahçe districts. These neighborhoods have the highest park size capacity in Izmir. On the other hand, the neighborhoods with low income, low educated women and high children population are clustered especially in inner parts of Karabağlar, Buca and Bayraklı districts. Besides, the park size capacity of these neighborhoods are the lowest in Izmir. These neighborhoods with high population of need groups and low park size capacity are mentioned as "park poor" areas (Şenol, 2019). Due to the park poor characteristics of these neighborhoods, these areas are prioritized for park provision analyses in this study.

In Izmir, the groups with low-income level, women with low education level and 0-5 age group are detected as disadvantaged groups in reaching the neighborhood parks in Izmir (Şenol, 2019). While these groups are mentioned as park-need groups, the geographical locations with relatively low level of green area per capita and these groups are park poor areas of Izmir. Need-based equity perspective requires to prioritize these park poor neighborhoods in park provision. While there are 30 park poor neighborhoods in Izmir, this study used other criteria (such as size of neighborhood population) to identify a smaller group of neighborhoods as priority areas for park provision.

7.2. GIS based Spatial Analyses at Neighborhood Scale

The methodological approach of the thesis is important in terms of spatial equity mapping at neighborhood scales by using GIS. Despite new advances in spatial management of GISs, there are limited number of studies focusing to neighborhood scales especially compare to those focusing on city and urban scales. As discussed in Chapter 5, the spatial equity mapping in sub-scales achieves the limitations of zone-based and standardization-based approaches to accessibility and location-allocation. The integration of spatial equity mapping to neighborhood scales reveals the differential accessibility of individuals to parks and spatial inequities in already park poor neighborhoods of Izmir. Studies with data about urban scales and bigger zone areas cannot reveal the differences in access to local opportunities and spatial inequities in individual experiences. Moreover, spatial analyses at neighborhood scale reveal that the spatial context matters in accessibility to parks as mentioned in Chapter 6. Thus, the study differs from majority of studies that focus on spatial distribution of parks at urban scale. The scale of the study is important for developing on-site implementations. The focus of the thesis about neighborhood scale makes this study as one of the few works abroad and in Turkey.

This thesis aims to propose park location-allocation modelling at neighborhood scale, while considering physical characteristics (as topographical, land use and transportation networks) and population characteristics of selected neighborhoods by using network analyses of GIS. Şenol (2019) detects that among park poor areas of Izmir, there are more than one priority areas that need to have park provision. These areas are clustered at Buca, Karabağlar and Bayraklı districts. Each of these park poor areas is a heterogeneous geographical area with various slope levels, residential and population density. The area with highest slope level is located in Bayraklı district. The area with highest population is located in Buca district. Their street and parcelization networks are grid-iron layout. Their vacant land capacity is also different and Buca area has the highest number of vacant lands. The existing situation of physical criteria as slope level of streets, vacant land capacity and population density is the determinant factor in park location-allocation. The location of potential park areas are chosen from the vacant lands sustaining accessibility to parks by walking with minimum distance and minimum slope level. Considering physical features of these areas and minimum impedance (slope and distance) criteria, the highest decrease in walking distance to parks is achieved in Buca area by park location-allocation analyses (see Chapter 6). As mentioned, the main reason of the highest difference between existing and proposed situations in Buca area is the smooth topography (slope level lower than 4%) and highest number of vacant land capacity.

7.3. Data Preparation Process

This thesis aims to contribute achieving data limitations of sub-scales in Turkey by using GIS. This thesis lays on two main data source as Turkish Statistical Institute and the data of the study developed by Şenol (2019) as a scientific research project. However, these sources offer city scale and zone-based neighborhood scale data, there is lack of point-based sub-scale data. While the Turkish Statistical Institute proposes zone-based data, the point-based data of neighborhood scale is produced by author using GIS. For the spatial analyses of the thesis, the unit of analyses is considered as the geo-coded vector points of residences, parks and other public service facilities in park poor areas.

The limitations and lack of data for digital use are achieved by producing vector data from GIS based open sources. The available data of Turkish Statistical Institute is neighborhood based in Turkey. However, these data is not vector and not suitable to use in detailed spatial analyses. In order to achieve limitations of zone-based string data, the vector data of residences, street network and public facilities in park poor areas are digitized in GIS. The digitization is performed by using 2019 aerial photo of Izmir that is available in ArcMap base maps. After producing vector data, these data require re-classification in the same interval and scale to use in spatial analyses as detailed in Chapter 6.

Consequently, this thesis aims to propose an alternative process to standard-based spatial planning approach for public service allocation in Turkey. The current spatial planning system in Turkey is zone-based and has standard implementations on land use developments. This thesis proposes a spatial planning process that notices social well-being and spatial equity rather than rough standardization. Against the limitations of current planning system, point-based and inclusive spatial analyzing model is proposed for park allocation in neighborhood and sub-scales. This thesis also supports the local policy-makers of Izmir by identifying the areas with limited public service and opportunities. The spatial equity mapping of Izmir is produced as a means of guide for further spatial development decisions in Izmir. GIS-based multi-criteria decision analyses is proposed as a set of tools for spatial strategy development in public service distributions of Izmir Greater Municipality. The process of spatial analyses is also important to enhance the use of GISs in public service distributions by local authorities.

For further studies, utilization of the need-based equity perspective and the proposed spatial analyses can achieve the limitations of zone-based planning approaches commonly used by policy makers and public planning authorities, as in the case of Izmir and Turkey. Besides its contribution to scholarly works, this thesis aims to highlight for the need of integration of land use planning practices with the current GIS based city guides by local municipalities. Although many municipalities have GIS based city guide systems in Turkey and these systems have point-based detailed spatial (vector) data, they are not actively used in spatial planning processes and land development decisions. Similarly, public agencies and ministries related to public services too can deploy the results of this thesis. As a recent project, for instance, Ministry of Interior of Turkey improves a new project for recording data about population characteristics according to their place of dwelling. It is called the Spatial Address Recording System or as “MAKS (Mekansal Adres Kayıt Sistemi)” in Turkey.

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