

T.R
VAN YUZUNCU YIL UNIVERSITY
INSTITUTE OF NATURAL AND APPLIED SCIENCES
LANDSCAPE ARCHITECTURE

**ACCESSIBILITY OF GREEN AREAS BY USING NETWORK ANALYSIS IN
GIS ENVIRONMENT CASE OF ERBIL CITY**



M. Sc. THESIS

PREPARED BY: Salar Hassan ABDALKARIM
SUPERVISOR : Assoc. Prof. Dr. Serkan KEMEÇ

VAN-2019

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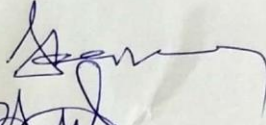
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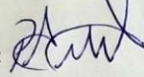
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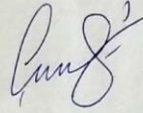
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THESIS STATEMENT

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Salar Hassan ABDALKARIM



ABSTRACT

ACCESSIBILITY OF GREEN AREAS BY USING NETWORK ANALYSIS IN GIS ENVIRONMENT CASE OF ERBIL CITY

ABDALKARIM Salar Hassan
M. Sc. Thesis, Landscape Architecture Department
Supervisor: Assoc. Prof. Dr. Serkan KEMEÇ
August 2019, 123 pages.

This study was carried out in 2017 and 2019 to measuring the accessibility of green spaces by using network analysis in GIS environment case of Erbil city. Firstly, all green spaces digitized in AutoCAD program after that all green areas classified and all roads classified according to speed limitation which include 15km/hour, 25km/hour, 45km/hour and 70km/hour. The quarters border with quarter's population digitized to calculate the number of residents which green area service reach. After that all datasets converted to GIS network analysis to measuring the accessibility of green areas for populations within 300m, 600m and 900m distance or 5 minute, 10 minute and 15 minute walking for Mini parks and Neighborhood parks and 5 minute, 10 minute and 15 minute driving for Community parks and District parks, green spaces created by polygons and point, all roads by line, by using tabulate intersection tool within network analysis calculated. Results show that for community parks for 5 minutes driving the %68 of population have accessibility, for 10 minutes of driving there are accessibility for %99 of population and for 15 minutes driving there is accessibility for %100 of population. For District parks with 5 minutes driving %70 of population have accessibility. For 10 minutes driving there is accessibility for %96 of residents and for 15 minutes driving there is %100 accessibility. For the Mini parks with 5 minutes walking %22 of population have accessibility, for 10 minutes walking there is accessibility for %52 of population. For 15 minutes walking %70 of population have accessibility. For neighborhood parks the results show that for 5 minutes walking %43 of population have accessibility, for 10 minutes walking there is accessibility for %71 of residents to District parks. For 15 minutes walking %80 of Erbil city have accessibility.

Keywords: Accessibility, Erbil green areas, Network analysis.



ÖZET

CBS AĞ ANALİZİ KULLANILARAK YEŞİL ALANLARDA ERİŞİLEBİLİRLİK: ERBİL ŞEHİRİ ÖRNEĞİ

ABDALKARIM Salar Hassan
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Tez Danışmanı: Doç. Dr. Serkan KEMEÇ
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Bu çalışma 2017 ile 2019 yılları arasında, Erbil Şehri'nin CBS ortamındaki ağ analizlerini kullanarak yeşil alanların erişilebilirliğinin ölçülmesi amacıyla yapılmıştır. Öncelikle, AutoCAD yazılımı ile şehirdeki tüm yeşil alanlar manuel olarak sayısallaştırılmıştır. Öte yandan, ağ analizlerinde kullanılacak çalışma alanının tüm yolları ortalama hızları 15 km/saat, 25 km/saat, 45 km/saat ve 70 km/saat olmak üzere dört tipte sınıflandırılmıştır. Analizler sonucunda elde edilen Mini parklar ve Mahalle parkları için 5 dakikalık, 10 dakikalık ve 15 dakikalık yürüme mesafesi ve Topluluk parkları ve Bölge parkları için ise 5 dakikalık, 10 dakikalık ve 15 dakikalık sürüş mesafesi çokgenleri ve mahalle alan objelerinin kesiştirilmesi ile ilgili servisi alan insan sayıları hesaplanmıştır. Sonuçlar, Erbil Şehrinde, Topluluk parkları için 5 dakikalık sürüş süresinde nüfusun % 68'inin erişilebilirliğinin olduğunu, 10 dakikalık bir sürüş süresinde nüfusun % 99'unun erişilebilirliğe sahip olup, son olarak 15 dakikalık sürüş süresi içinde halkın % 100'ünün topluluk parklarına erişiminin bulunduğunu. Diğer taraftan yürüyüş sürelerinin dikkate alındığı Mini park ve Mahalle parkları için ise sonuçlar, 5 dakikalık yürüyüş süresinde Mini parklar için Erbil Şehir nüfusunun % 22'sinin erişilebilirliğe sahip olduğu ve 10 dakikalık yürüme süresinde ise Erbil sakinlerinin% 52'sinin mini parklara erişimi bulunmaktadır. 15 dakika yürüyüşle Erbil şehrinin % 70'i Mini parklara erişebilir. Mahalle parklarındaki sonuçlar ise; Erbil şehir nüfusunun% 43'ünün 5 dakikalık yürüyüş erişilebilir alanı içinde olduğunu ve 10 dakikalık bir yürüyüş için Erbil sakinlerinin% 71'inin bölge parklarına erişimi bulunmaktadır, 15 dakika yürüyüşle Erbil şehrinin% 80'i Mahalle parklarına erişebilir olduğu şeklindedir.

Anahtar Kelimeler: Ağ analizi, erişilebilirlik, Erbil yeşil alanları.



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2019

Abdalkarim Salar Hassan



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SYMBOLS AND ABBREVIATIONS

Some abbreviations used in this study are presented below, along with descriptions.

| Symbols | Description |
|----------------|----------------------------------|
| °C | Degree Celsius |
| Cm | Centimeter |
| km | Kilometer |
| m | Meter |
| mm | Millimeter |
| kcl | Kilocalories |
| N | North |
| E | East |
| SVG | The State Government of Victoria |
| ha | Hectare |
| WHO | World Health Organization |



1. INTRODUCTION

Urban green areas are places which provide people opportunities for a wide range of leisure, sport and recreational activities. As such, public green areas and recreational facilities are important for the social economic and health of cities and towns (Sallis et al., 2004). Therefore, there was a greater desire for creation of organized public green areas such as public parks and open sport facilities in the residential areas of the towns and cities. These urban green areas have become one of the essence urban functions and land uses in the urban development plan. Although, a number of such public green areas and recreational facilities have been developed in the Erbil city urban areas, it has been noticed that except for a small numbers of major parks and organized ones, the others are not utilized because of many reasons. The main reason of underutilization of the urban green areas are refers to many factors that include lack of accessibility, lack of attractiveness, inappropriate location, behavioral issues like lack of time and life style, social issues, the success of urban green areas and open recreational spaces depends greatly on accessibility, (Project for Public Spaces, 2011). Physical accessibility such as quality and availability of access facilities cost of accessibility; time distance, the link from the residential areas as well as parking and safety is considered as one of the most significant characteristics influencing successful using of these urban green areas. In a similar way, visual accessibility variables like sight distance, visibility of the parks are argued to influence utilization of the urban green areas.

Accessibility of urban green areas in the city in general affected due to the reduction of an efficient and enough public transportation system; increase of commercial and related activities engulfing their space; unavailability of good types of physical communication facilities such as roads, pedestrian facilities, safety, parking and measures and also the growing in traffic volumes resulting in traffic congestion and elongated travel time. In a similar way, the accessibility to urban green areas is measured by characteristics like continuity, nearness, connectedness, walkability, convenience as well as pedestrian and vehicle access infrastructure and visual accessibility parameters. So, it is crucial to evaluate the most significant determinants,

which influence accessibility of public green areas in the residential areas of a city and then develop planning and design guidelines to improve accessibility so that the urban green areas will be more vibrant and optimally used.

Therefore, the objective of this study is to identify the most significant accessibility factors that deter the using of public urban green areas, and examine their level of influence on the using of green areas in the residential areas of Erbil city. Studies explained that the ratio between road networks to pedestrian facilities (paved pathway) network, number of access streets to the green areas, size in area of green areas, which influence the using of the urban green areas to varied extent. An optimal level of number of access streets to the green areas, proportionate pavement facilities on the roads providing access to urban green areas will enable significant improvement in the using of green areas in the residential areas of Erbil city. (Das and Honiball, 2016).

1.1. Urban Green Areas

Urban green areas are open spaces in urban areas that are mainly covered by vegetation which can be public or private (Baycan-Leven et al., 2002) urban green area can involve parks, community gardens, forests and natural reserves. In this study, only public urban green spaces are being studied because these public green spaces are free of charge and most populations are not able to access private green spaces.

Green areas as a concept is generally used to refer to a tract of land that is covered wholly or partially with living vegetation grass or trees and openly accessible by the public free of charge and has the ecological, social and economic benefits (Henderson and Wall, 1979). Frederick Law Olmsted used the word "park" in his address in 1870 " A Consideration of the Justifying Value of a Public Park" to mean a large tract of land set apart by the public for the enjoyment of rural landscape (Czerniak, 2007). The State Government of Victoria (SGV) has defined green space as an area that publicly owned, protected land, that is set aside primarily for nature conservation recreation, public gatherings and passive outdoor enjoyment (SGV, 2008). The State Government of Victoria determined that the public green space (involving publicly owned parks, gardens, squares, waterways, forecourts and green space on universities campuses and schools, nature strips along streets, major sporting areas that are managed

by the government) should face to the city residents freely. Green spaces usually contain great numbers of trees and large areas with grass cover. Their environmental contributions are important. urban green areas improve the goodness of urban environment by arranging urban air temperature and moisture, prevent water pollution and urban air purifying, and sustaining biodiversity (Hirokawa, 2011; Sun and Chen, 2013; Watmough and Atkinson, 2013). Green spaces have activity in helping store and process storm water and cooling air temperature in the urban center, and provide habitat for a rich community of animal, plant, bird, aquatic and microbial species.

Air pollution in urban areas is a great problem for human health as it can cause heart disease, headaches, coughing, lung disease, respiratory, throat, eye irritation and cancer (Bedimo-Rung et al., 2005). urban green spaces duty as "green lung cells" in refreshing, cleaning and enriching the urban areas view, improving residents living standards and raising human health for urban residents by providing accessible public green space for them to conduct free time activities and social interactions (Tannier and Vuidel, 2012; Moseley and Marzano, 2013). Advantageous effects of physical activity on diabetes, cardio vascular disease, osteoporosis, colorectal cancer, depression and fall-related injuries (Lee and Maheswaran, 2011), and on length of human live (Takano and Nakamura, 2002) are well documented. Urban Green areas participate to improved human mental health as the provision of natural space enable people to properly relax rest and thus reduce stresses (Tannier and Vuidel, 2012).

Urban green spaces can be the main places for social interactions because green spaces provide opportunities for individuals to interact with other people, gathering of friends and the neighborhood acquaintance (Moseley and Marzano, 2013). Increased levels of physical activity and recreation and social activities participation in sport, due to easy access to and frequent use of green space can promote health, reduce illness, enhance concentration on study and work, increase effectiveness in study and productivity in workplace, and well-being, at both individual and community levels. Otherwise, green spaces can protect residents from unnecessary or dispensable spending on the medicines by reducing illness and green space enhance study performance or working outcome because of protection community mental health.

Green spaces raise the health condition and then productivity of the urban residents, and elevate the aesthetic and economic position of the urban system (Elkin and McLaren, 1991; Givoni, 1991; Tzoulas, 2007; Jun and Li, 2012). Green spaces can cause decrease the negative contributions of pollution, noise and extreme temperatures and increase the positive impacts of fresh oxygen and biomass produced through photosynthesis from the environmental processes. Various studies have found that a nearness to green spaces had the positive effect on the property value. In other hand, urban green spaces can attract tourists from elsewhere which can lead to considerable economic and social benefits (Knetsch, 1964; Hammer and Coughlin, 1974; Eom and Lee, 2009).

1.1.1. Access to green spaces

One of the important subjects which have been emphasized in literature relating to the public green areas and public recreational facilities is the access, which basically influence their success (PPS, 2013). The access to public green areas is related with improved physical and mental health of individuals (Sugiyama et al., 2008; Payne et al., 2005; Potwarka et al., 2008). green areas users are more likely to realize good levels of health and physical activity compared with non-users (Deshpande et al., 2005) because there is a proof that lack of accessibility of green areas and distance from green areas are inversely related with utilize and physical activity behavior (Kaczynski and Henderson, 2008).

The essential green areas access for residential inhabitants of a city is built on the number of green areas, spatial configuration of green areas and their spatial distribution over neighborhood areas or local regions. Therefore, it is a popular practice to base spatial accessibility on the location, proximity and size of the green areas, which participate to the use of the green areas (Zhang et al., 2014). Accessibility of a location is judged by its relations to its surroundings. A successful public green area needs to be without difficulty accessed and commuted through and it can be seen from both an up close and distance. Generally, availability of local public green areas within walking distance is positively related with green areas use, whereas the need of driving to reach a park often restricts its use (Wilbur et al., 2002). Also, other green areas attributes such as location and safety may also affect the use of public green areas. Some scholars

explained that walking time or distance from home has appeared to be the most important condition for access and use of green spaces (Herzele and Wiedeman, 2003). short distance and easy access to green areas increase the number of visits to green areas, inhabitants in close proximity to a green areas access and use it more frequently (Atiquil Haq, 2011; Herzele and Wiedeman, 2003). For example, a research in Helsinki city capital of Finland found that inhabitants living close less than (0.50 km) visited the green areas more frequently more than 4 times per week (Neuvonen et al., 2007; Atiquil Haq, 2011). Researchers also explain that public green areas must be at the neighbourhoods centre and not more than five minutes' walk for residents (Etzioni, 1998).

Accessibility can have a wide meaning. However, in green area literature, accessibility refers to the walking distance between the residential areas and the access points of the green spaces. The United Kingdom prepared a set of guidelines called Accessible Natural Greenspace Standards (ANGSt) for evaluating the access to green areas (Comber et al., 2008). The standards are listed below:

1. No one have to live more than 300m from the nearest green area of at least 2 hectare in size.
2. There should be at least one accessible 20 hectare in size site within 2 km from urban residential area.
3. There should be one accessible 100 hectare size site within 5 km.
4. There should be one accessible 500 hectare size site within 10 km.

Despite the fact that the ANGSt model gives a detailed set of guidelines, it is not suitable for every city or country. Some countries might not have as many green spaces as in the UK, and not all green spaces are accessible. A quarter mile has become the standard distance threshold that people are willing to walk to reach a park or recreation area (Boone et al., 2009). In order to measure the distance of walking from the nearest green area to residential areas to, GIS is a useful tool to calculate the time required, as well as distance. Accessible green areas are defined as areas that free of cost for the public and at most used by users living in the surrounding area (Natural England, 2010). Usability has been studied by researchers by following the main idea that people's perception of green areas is effected by specific factors connected to the presence of man-made and natural elements.

1.1.2. Green area accessibility limits

Green spaces differ in size and attributes for this reason have different level of influences. Some studies indicate that people visit neighborhood green space more frequently than district or regional green space (VDSE, 2002). Neighborhoods have been considered as a meaningful territorial element of urban life for more people and a planning ideal in many parts of the world (Lee, 1968; Pacione, 1982; Martin, 1998). A neighborhood should provide a number of green areas that serves for an extend of uses; to ensure all inhabitants have accessibility to neighborhood green area within a specific distance (800m, 1200m, or 1600m etc); and to ensure the walking network links the green area to the broader green area network - as the network of green area may form a main component of a voyage through a neighborhood (Lee, 1968; Pacione, 1982 and Martin, 1998).

Table 1. 1 Standards for distance from green areas

| Source | Green space area | Maximum distance to residence |
|----------------------------------|------------------|-------------------------------|
| Natural England (2010) | 2-20 ha | 300m |
| | 20-100 ha | 2000m |
| | 100-500 ha | 5000m |
| | >500 ha | 10000m |
| Van Herzele and Wiedemann (2003) | <1 ha | 150m |
| | 1-10 ha | 400m |
| | 10-30 ha | 800m |
| | 30-60 ha | 1600m |
| | 60-300 ha | 3200m |
| Oh and Jeong (2007) | >300 ha | 5000m |
| | 0.15 – 1 ha | 250m |
| | 1 – 3 ha | 500m |
| | 3 – 10 ha | 1000m |
| | >10 ha | No limit specified |

1.1.3. Green area per capita

The World Health Organization (WHO) proposes providing a 9.0 m² minimum of green areas per capita (World Health Organization, 2010), this amount in size of

green areas is only appropriate if the greenery is reachable (Takano et al., 2002), safe (Frumkin, 2003) and usable (Singh et al., 2010). According to the World Health Organization (WHO) the typical amount, would be 50 m². Erbil city has nearly 6m² of green spaces per person.

Table 1. 2 Cities that have a higher range green areas per capita

| City | Green area /capita (m ²) |
|-------------------|--------------------------------------|
| Rennes | 25.27 |
| Ljubljana | 25.97 |
| Rotterdam | 28.30 |
| Bern | 30.51 |
| Montpellier | 33.00 |
| Berlin | 37.84 |
| Dublin | 40.00 |
| Genoa | 49.39 |
| Curitiba (Brazil) | 52.00 |
| Nantes | 57.00 |
| Budapest | 61.80 |
| Krakow | 65.45 |
| Warsaw | 68.49 |
| Leipzig | 93.65 |
| Helsinki | 102.86 |
| Zurich | 111.91 |
| Marseilles | 118.22 |
| Vienna | 125.44 |
| Edinburgh | 144.59 |

Source: Haq, 2011; Vázquez, 2011

Table 1. 3 Cities that have lower range of green areas per capita

| City | Green area /capita (m ²) |
|------------------|--------------------------------------|
| Buenos Aires | 1.90 |
| Tokyo | 3.00 |
| Istanbul | 5.00 |
| Barcelona | 5.60 |
| Malaga | 7.79 |
| Santiago (Chile) | 10.00 |
| Sarajevo | 11.00 |
| Toronto | 12.60 |
| Salzburg | 13.44 |
| Madrid | 14.00 |
| Turin | 19.44 |
| Birmingham | 20.00 |
| New York | 23.10 |

Source: Haq, 2011; Vázquez, 2011

1.1.4. Importance of green areas

Urban Green areas are crucial for making cities sustainable, healthy and energy efficient. However, for Urban Green areas to participate to the ideal level, they should be planned, developed, designed, managed and maintained suitably so that they are accessible both in terms of population coverage and area. The Urban Green areas produce a various set of ecosystems of fundamental importance for well-being of human and their dynamics are shaped by activities of human. Many green areas in cities that have got separated from the wider environment tend to lose characteristics of biodiversity because of continuous construction activities. For this reason, protecting green areas in isolation will oftentimes fail to sustain the ability of urban ecosystems to produce value and they should be well integrated in the overall city landscape (Oh and Jeong, 2007 and Brook, 2010).

1.1.4.1. Ecological benefits

1. Trees of green areas absorb pollutants and control the effect of human, activities by such as releasing oxygen and absorbing pollutants.
2. Green areas by Providing clean air, water and soil contribute to the maintenance of a healthy urban environment.
3. Green vegetation of green areas decreases the surface temperatures, which led to reduce air conditioning load by an average of 50%.
4. The green areas make the urban micro climate better and protect the balance of the city's urban environment.
5. The green areas maintain the local cultural and natural heritage by providing habitats for a variety of wildlife and keep a variety of urban resources (Rowntree, 1988 and Hirokawa, 2011).

1.1.4.2. Physical benefits

1. Green areas provide a refreshing contrast to the harsh shape, texture and color of urban area buildings, and activate the senses with their harmony color.

2. Specific types of green area may provide a bigger variety of land uses and opportunities for a broad range of activities can be of real benefit to health and help to develop lifestyle.
3. Green areas take part in social interaction by creating opportunities for inhabitants of all ages to interact with each other.
4. Urban green areas emphasize the variety of urban areas by reflecting the different communities they serve.
5. They develop cultural life by providing spaces for, civic celebrations, festivals and theatrical performances.
6. Urban green areas provide safe children play area and causing children's mental, physical and social growth and play a significant role in the basic education of school children with related to the nature and environment. (Lee and Maheswaran, 2011)

1.1.4.3. Economical benefits

1. Proximity to green areas and view of green spaces increases the real estate prices, property owner's value urban areas by the premium they pay to live in the neighborhood of urban green areas. Plots adjoin green areas add to value. In densely populated quarters this effect is even more noticeable.
2. Effect of neighborhood parks on the dealing price of multi-storied residential units in cities explains the fact that neighborhood parks could raise price.
3. Shady trees of urban areas offer considerable benefits in reducing building air-conditioning load and increase level of improving urban air quality by reducing smog. The savings related with these benefits vary widely according to climatic region (Elkin et al., 1991 and Jun et al., 2012).

1.2. Accessibility of Green Area

Accessibility, walkability and mobility are terms usually used in studies that concerning to urban green area studies. Generally the term accessibility is usually used to refer to the easiness for a specific agent to get to a specific destination through a specific network system by specific mode of travelling (Talen and Anselin, 1998).

Walkability is often used to imply the perceived easiness of getting around a specific neighborhood on feet by a specific travelling agent (Inani and Abdul, 2012). And Mobility is often used to indicate a specific agent's ability for moving around a specific network system considering all modes of travelling feasible to that agent (Litman, 2003).

1.2.1. Accessibility

One of the characteristic features of human behavior is the ambition and ability to move across the all over the world to exchange merchandise and information over distance (Hodgart, 1978). Commuting, migrating, shopping, collecting, distributing, communicating and vacationing commonly occur over some distance. Thus, accessibility is obliged to require special shapes of public social behavior-spatial interaction.

There are various definitions for the term accessibility. One of the best definitions is that accessibility is the simplicity with which activities in the society can be reached, containing needs of people, trade and industries and public services. Distance measures are the most straightforward accessibility measures, counting the distance from one place to different opportunities. It can be measured as average distance, weighted area distance or distance to the nearest opportunity. The estimation of these distances can be done in many ways, from simple straight-line distances to more complicated impedance formulations (Makri and Folkesson, 1999).

One type of accessibility is spatial accessibility which is based distance measurements. Accessibility refers to people's ability to reach goods, services and activities, which is the ultimate goal of most transport activity (Hansen, 1959 and Huisman, 2005) speaks of it as 'a significant concept employed to understand patterns in the location of facilities and to indicate broad features of the behavior of people, as well as evaluating the ability of services to meet people's needs', whereas El-Geneidy and Levinson (2006) think that it is 'a measure or indicator of the performance of transportation systems in serving individuals living in a community. The term "accessibility" is defined as "easily approached or entered" (Pickett, 2004), "the quality

of being accessible, or of admitting approach” (Oxford, 2002), or for the planning context as “the potential for interaction” (Hansen, 1959).

In most situations, measures of accessibility involve both an impedance factor, reflecting the cost or time of reaching a purpose and an attractiveness factor, reflecting the qualities of the potential aim point. Researchers have utilized different forms of accessibility measures and have elevated many important issues concerning with these measures (Handy and Niemeier, 1997). Simple “cumulative-opportunities” measures count the number of important destinations within a selected distance or time from the selected point, with more options in both destinations and modes of travel mean greater accessibility by most definitions. (Hansen,1959) said that the accessibility is (a potential of opportunities for interaction) or considered accessibility as a measure of (the intensity of the possibility of interaction) and (the spatial distribution of activities about a point, adjusted for the ability and the desire of people or firms to overcome spatial separation) (Hansen, 1959).

Ingram (1971) showed that accessibility means having the ability of being reached, so, implying a measure of the nearness between two points and that accessibility (is related to the ability of a transportation system to provide a low cost and/or quick method of control the distance between different places). He announced that accessibility ((may loosely be defined as the inherent characteristic (or advantage) of a place with consideration to controlling some form of spatially operating source of friction such as, time and distance (Ingram, 1971). He made a difference between the relative accessibility between two points and the total accessibility at a point. The integral accessibility is defined, for a given location as the degree of interconnection with all other locations on the same surface and the relative accessibility is defined as the degree to which two locations on the same surface are connected which is generally asymmetric He noted that the distance separating two locations affects the degree of relative accessibility between the locations and proposed the normal or Gaussian curve as the most satisfying distance function for measuring the degree of relative accessibility between two locations. Focusing on the use of physical accessibility of population groups to a various activities and opportunities to measure regional performance in health, education, income, and the like, (Wachs and Kumagai, 1973)

defined accessibility in terms of the ease with which citizens may reach a variety of opportunities for employment and services.

(Wachs and Kumagai, 1973) pointed out that:

1. The accessibility of a space to social activity and economic centers limits its value, the intensity of development which will happen on it and the social and economic uses to which it will be put.
2. There are major spatial and demographic variance in the accessibility of specific urban population groups to a variety of cultural opportunities and economic.
3. Accessibility difference has an effect on living conditions within an urban area.
4. Accessibility could help to preparation planning and policy to the equalization.
5. Current information of the extent to which physical accessibility variety within the urban area exist and influence the relative standards of living condition of specific groups is completely restricted by the availability of pertinent knowledge.

(Wachs and Kumagai, 1973) argued that ‘a useful program to the measurement of physical accessibility is the account of the number or density of travel opportunities of specific types within selected time distances or travel-cost variations from the residential locations. (Wachs and Kumagai, 1973). One of accessibility implications is the chances available to companies and individuals to reach those places in which they do their activities. In the wide sense of the word, the concept of accessibility has social, economic, technological role. Accessibility is maybe the most important concept in explaining and describing regional functions and forms because the accessibility of a location to social, cultural, and economic resources can set the value of this place, thus, influence the inclination of distribution of populations. The accessibility is one of the elements to show the quality of life in urban area. There is a relationship between the spatial distribution and intensity of development, and the quality and quantity of travel within an urban area through accessibility, (Wachs and Kumagai, 1973 and Burns, 1976) used accessibility to indicate the easiness with which any area activity can be reached from a location using a specific transportation system, and used accessibility reflect the size of service provided by transportation systems to different locations (Burns and Golob, 1976). They argued that measures of accessibility based onto a priori assumptions about factors effecting travel demand, like opportunities weighted by a reducing impedance function of the interaction costs of reaching those opportunities, or

cumulative functions of the opportunities reachable within a specific travel time, lack strong underlying theory from which causality in transportation decision making can be inferred. As a result, they suggested combining a utility-maximizing theory of travel decision-making behavior into measures of accessibility to opportunities. (Kwan, 1998) argued that the concept of accessibility was frequently operationalized and defined in various ways depending on the matter and context of its application (Ingram, 1971; Morris et al., 1979; Handy and Niemeier, 1997). For examples, accessibility can be considered as an attribute of locations, indicating how easily particular positions can be reached (Dalvi and Martin, 1976 and Song, 1996), or as a property of people describes how easily an individual can reach places of activity (Guy, 1983 and Hanson and Schwab, 1987). Accessibility measures can be utilized to indicate either the existing of physical connections or the level of physical separation between two places (Muraco, 1971 and Edward, 1996) or to be accessibility more comprehensively determined by both the person-specific space-time autonomy of individuals and the urban environment e.g. (Burns, 1979; Villoria, 1989 and Miller, 1991). (Kwan, 1998) explained that measures of accessibility of place ascribe the same level of accessibility to different individuals in the same area, pay no attention to the different space-time restrictions experienced, and consequently accessibility to opportunities enjoyed by all individuals (Pirie, 1979; Landau et al., 1982; Richardson and Young, 1982). pay particular attention to evaluating individual accessibility as compared to place accessibility, (Kwan, 1998) conceptualized accessibility based on the construct of a prism-constrained feasible opportunity set, and explained that the operationalized space-time measures are more qualified for reducing interpersonal differences, especially the effect of spatiotemporal constraints, and therefore are more beneficial for unraveling gender / ethnic differences in accessibility.

Concentrate on passenger transport, (Geurs and Wee, 2004) define accessibility as the range to which land-use and transport systems enable individuals to reach activities by a combination of transport modes methods. They also made a difference between access and accessibility. They specified four elements of accessibility: land use, transportation, temporal and people.

1. The land-use element reflects the quality, amount and spatial division opportunities supplied at each destination, the demand for these opportunities at locations of origin,

and the facing of provision of with demand for opportunities, which may consequence competition for activities.

2. The transportation element describes the travel impedance a people need to overcome due to the length between an origin and a destination using a particular transport mode, such as the amount of time of travel, waiting and parking costs and effort including level of comfort, accident risk and reliability. This impedance product from the facing between the supplying of infrastructure involves its location and characteristics such as number of lanes, maximum travel speed, public transport timetables, travel costs and the demand connected to both freight travel and passenger travel.

3. The time element reflects the availability of opportunities at various times of the day, and the time available for individuals to take part in specific activities.

4. Depending on people's physical condition, availability of travel modes. And opportunities which depending on people's The inhabitance element reflects the needs which based on educational level, income, educational level, age household situation, abilities which income, travel budget, educational level of individuals. These features affect a person's level of access to transport modes and spatially divided opportunities, and may highly impact the total aggregate accessibility result (Cervero and Landis, 1997; Shen, 1998 and Geurs and Ritsema, 2003).

Figure (1.1) explains the connections between these elements of accessibility for example, the distribution of activities is a great factor on travel demand and may introduce time restrictions and has an effect on individual's opportunities. A people's abilities and needs influence the valuation of cost, time and effort of movement, kinds of relevant activities and the times in which one participates in particular activities. Accessibility as a factor of location for firms and inhabitant's influences travel demand, individual's social and economic opportunities and the time needed to do activities. (Geurs and Wee, 2004) argued that an accessibility measure has to take all four elements ideally into account', noted that utilized accessibility measures concentrate on one or more elements of accessibility, depending on the perspective taken, and specified four basic perspectives on measuring accessibility: infrastructure, location, person and utility. The infrastructure measures analyses the observed or simulated performance or service level of transport infrastructure (Linneker and Spence, 1992 and Ewing, 1993).

1. The location element that measures analyze the level of accessibility to spatially distributed activities from origin points, with or without incorporating capacity limitations of supplied activity (Hansen, 1959; Ingram, 1971 and Dalvi and Martin, 1976).
2. The utility element that measures analyze the economic advantages that people get from access to the activities which spatially distributed (Koenig, 1980; Handy and Niemeier, 1997 and Dong et al., 2006).

Geurs and Wee (2004) recorded five criteria of accessibility, involving operationalization, interpretability and communicability, theoretical basis, and ease of use in economic and social evaluations figure (1.1).

Geurs and Wee (2004) explained that an accessibility measure, in theory, must

1. Be responsive to changes in the system of transportation, i.e. the difficulty or ease for people to cover the distance between an origin point and a destination point with a specific transport mode, including the amount of costs, time and effort.
2. Be responsive to changes in the system of land-use, i.e. the quality, amount and spatial distribution of provided opportunities, and the spatial division of the demand for those opportunities, and the confrontation between provision and demand.
3. Sensitive to temporal limitations of opportunities.
4. Take individual opportunities, abilities and needs into account.

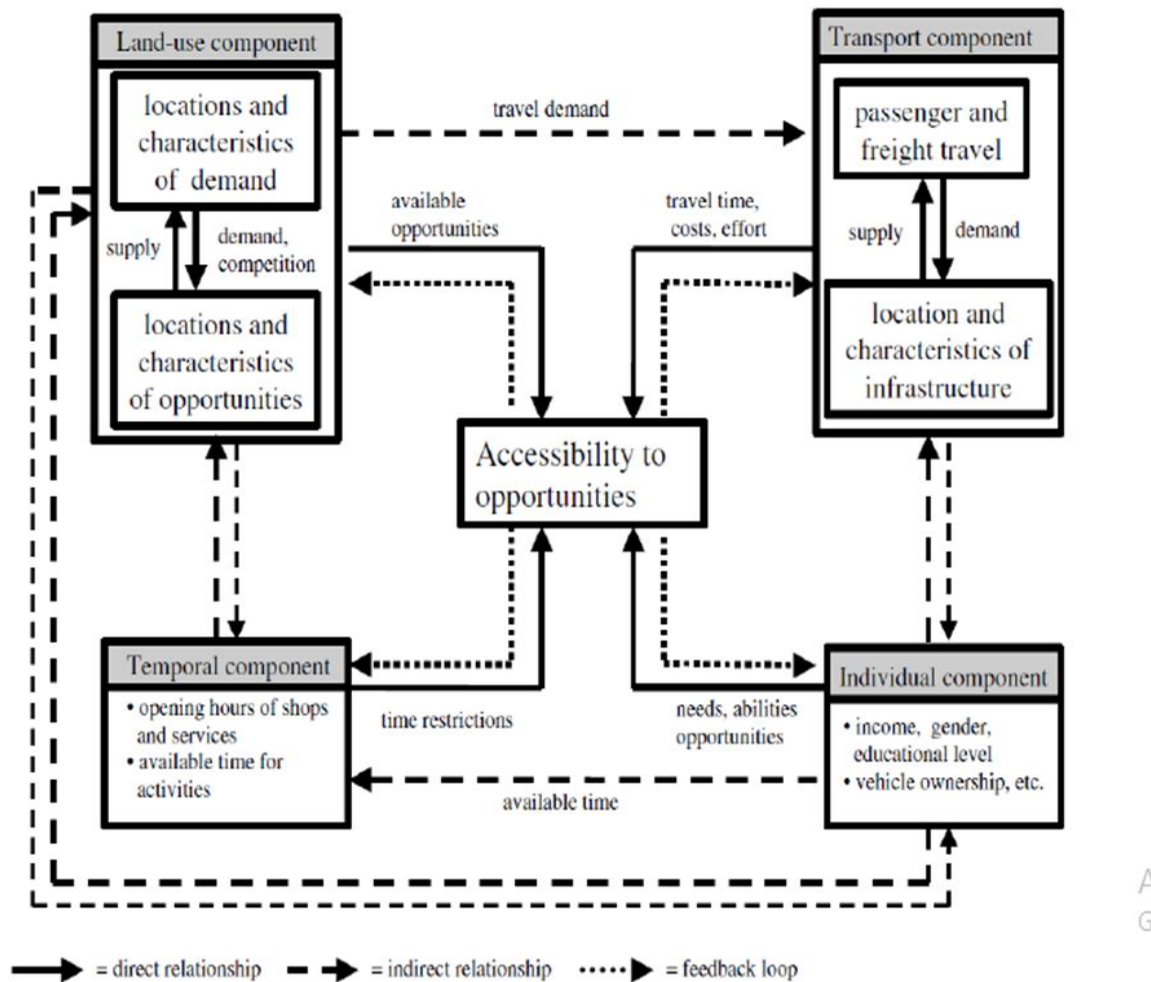


Figure 1. 1 Relationships between components of accessibility. (Geurs and Wee 2004).

Hence, saving all other conditions unchanging, an accessibility measure must behave as follows (Geurs and Van, 2004):

1. If the service level such as travel costs, time and effort of any transport mode in an area decreases or increases, accessibility must decrease or increase to any activity from any point within that area.
2. If the number of opportunities for an activity decreases or increases in any place, accessibility to that activity should decrease or increase from the same place.
3. If the request for opportunities for an activity with specific capacity restrictions decreases or increases, accessibility to that activity have to decrease or increase.
4. An enlargement of the number of opportunities for an activity at any place must not change the accessibility to that activity for people do not able to take part in that activity

Growing in one transport mode or growing in the number of opportunities for an activity must not change the accessibility to people with capacities or insufficient abilities.

1.2.2. Accessibility and mobility

The scholars defined the term mobility as the quality or situation of being mobile and the term mobile is defined as the ability of moving or of being moved readily from site to site (Pickett, 2004), or in the transportation planning context, as the movement potential, the capability to get from place to place (Hansen, 1959 and Handy, 1993). For example, the level-of-service measures used in transportation planning are measures of mobility; higher volume-to-capacity ratios mean slower travel times, less ease of movement, and thus lower mobility.

Mobility is associated to the impedance component of accessibility and good mobility is neither a necessary nor a sufficient condition for good accessibility. May be for a society to have good level of mobility but in the same time has low accessibility, for example a community with broad roads, low levels of crowding but comparatively few destinations for activities, or inadequate or undesirable destinations. It may be also for a society to have high level of accessibility with low level of mobility, for example a community with severe crowding but within a desired destinations and short distance of needed.

Efforts that concentrate on elevating mobility purpose at harmonize with growing level of travel, improving the systems efficiency and increasing the movement's potential, efforts that concentrate on enhancing accessibility goal at the passenger rather than the system and concern if inhabitation has access to the activities that they want or need to take part in.

Transportation planning concentrate on mobility has over time encouraging sprawling patterns of evolution that limit options. In the suburban areas of metropolitans, transportation service is comparatively sparse and destinations are commonly further away walking distance, leaving inhabitations with no choice but drive. For those who travel by transportation modes other than the personal automobile and those whose desires and needs are not met by the types of facilities, shopping and

other services found in the suburb areas, the outcome is a decline in accessibility. So for those inhabitants that prefer to drive, accessibility will finally decline in suburban areas (Handy, 2002). Transportation planning concentrates on accessibility and creates advantages by expanding options. For instance, the need to drive can be reduced by arranging policies to encourage small-scale partition development in urban areas, thereby bringing shopping centers within walking distance, operating a bus route that connects commercial areas to residential areas, or providing access to services by the Internet and remove the need for driving completely. Inhabitants get to do the things they want to do and need while reducing the cost and time devoted to driving, and the society as a whole gets potentially lower costs for maintaining roads as well as less negative effects on the environment, many studies connect the mobility with the capability of human being's movement, or regard mobility as a physical ability to perform the movement freely and stably, no matter where the purpose place is. An integrated modeling framework was used in recent years, to examine the factors that have an impact on urban home shopping activities (Hamed and Easa, 1998). To model residents, post work activity and to trace the movements of travellers through time and space (Hamed and Mannering, 1993). Therefore, the feasibility of public transportation, pedestrian walk, or automobile ownership determines different 'weights' of mobility (Dawkins et al., 2005). Some studies have explained that car ownership increases movement from residences to facilities (Lovett et al., 2002; Pasaogullari, 2004 and Lotfi and Koohsari, 2009).

Mobility, take into account walking as the only mode of transportation. Walkability is oftentimes used to measure the city or town livability. At first, the walkability concept may be regarded to be accurately associated to pedestrians. Walkability of neighborhood demands for mixed-land uses that create shorter distances between destinations and residences. Elements such as the variety of routes and directness to purpose places and of the interconnecting street patterns are synergistically determining distances between activities, and can be evaluated objectively using geographical information systems (GIS) software. Demographic and social and attributes must be considered when examining how environments might be associated to walking, as such factors may act to temperate the relationship between walking behavior and walkability. For Australian adults, walking is the most common form of moderate activity reported in population surveys (ABS, 2000). (Owen, 2007) explained that those

who live in workable environments in Australia have a tendency to make more frequent travels to nearby destinations for example, the neighborhood green area, which might reduce motor vehicle travels (Owen et al., 2007).

1.2.3. Accessibility and equity

Equity means the services allocation fairness and concerns primarily who gets what (Wicks and Crompton, 1986). Equity shows a practically impossible situation where all inhabitants have come to a pact that they are equally treated and reallocation of public services is no necessary yet (Talen, 1998), because social equity occasionally doesn't coincide with regional justice (Pinch, 1985), and equity in social goods like public services is in conflict with hazard distribution of environment (Humphreys, 1988). There prevail very different and often competing explanations of equity. Regarding with the equity of services location decisions, (Wicks and Crompton, 1986) suggested three basic principles: identifying equal opportunity as the starting point, supporting deviations from this point of departure if the deviations serve the least advantaged, and establishing a minimum threshold below which quality or quantity should not fall. Based on the efforts of categorizing the definition of equity (Lucy, 1981; Crompton and Wicks, 1988 and Marsh and Schilling, 1994). (Talen, 1998) set a scheme of four categories of the definition of equity:

1. equality-based equity.
2. demand-based equity.
3. Market criteria-based equity.
4. Compensatory equity.

The word equality explained a situation in which inhabitants have the same rights, advantages, and the term equity explains a status in which all inhabitants are treated equally and no one has an unjust advantage (Figure 2.1).

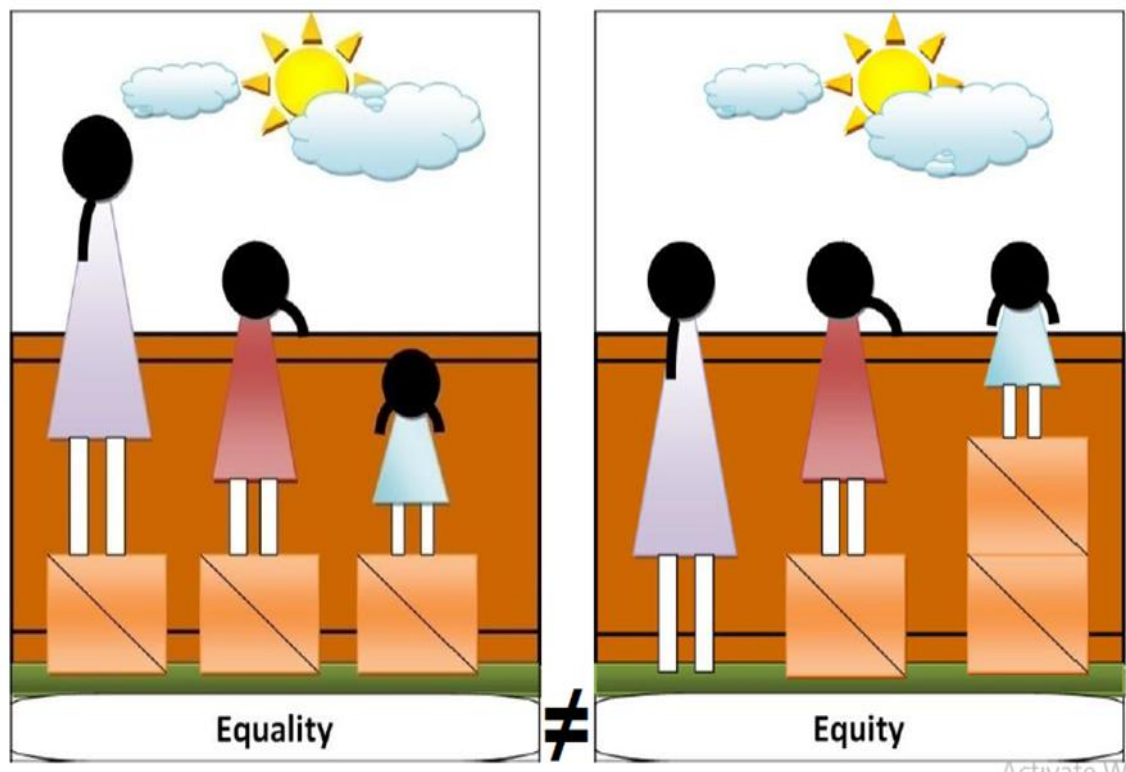


Figure 1. 2 Equity against equality.

Among these definitions, the equality-based definition is more generally used in studies that related with accessibility (Ikporukpo, 1987), because it is more adjustable to accurate measurement. It is less stringent in data requirements than other methods, and the Achieving of equity in terms of need, or market criteria may be in need of information that may not be easily available (Cho, 2003). Good accessibility to urban public facilities and resources is one of the most significant elements of quality of life for urban inhabitants (Pacione, 1989). proximity to public services participate to residents' well-being by increasing their opportunity, elevating the value of a residential property, and leading to the savings on travel costs that can be expended on other consumptions (Pacione, 1989). Reduce travel costs to reach facilities and services may result in substantial redistribution of income between urban dwellers (Pahl, 1971). Accessibility is measured in terms of spatial relationship between places and equity is described by equitable opportunity in services distribution. Accessibility is deal with efficiency and trying to distribute public facilities as uniformly as possible to maximum access, while equity is more dealing with the impact of distribution of public facilities or resources to people who may utilize them (Nicholls and Shafer, 1999). Equity is not

every times in accordance with efficiency because equity takes a meaning only on the basis of the user's demographic or socio-economic characteristics. many studies have shown the matters that related to equity and accessibility in services delivery (Ottsmann, 1994; Talen, 1998; Talen and Anselin. 1998; Nicholls and Shafer, 1999 and Lindsey et al., 2001), and accessibility has been utilized as a social indicator used to find that the equity in allocation of services has been achieved or not. In the use of services, it is not at all times beneficial to measure accessibility merely by means of simple distance. Just having close to a public resource may not mean it is accessible because the cost of utilizing the facility may not be within the level of the financial capabilities or social standing of the individual's (Cho, 2003).

1.3. GIS and Green Area

GIS plays a significant role in environmental justice and analyzing green areas accessibility. The GIS and network analysis within it can compute time of travel from one place to another place. Studies use network analysis within GIS and to explain how different religious groups, ethnic groups, socio-economic groups and access urban green space (Comber et al., 2008 and Kuta et al., 2014). The reason that many studies utilize GIS to carry out analysis of environmental justice is because to solve different social problems after recognize the possible issues. Importance of equal access to the green space must pay attention by planners, because all inhabitants living inside a city deserve same equal accessibility to public green areas. Studies can raise the awareness of utilizing GIS so that scholars can utilize it to address different kinds of environmental or social issues. This research will participate to scientific knowledge because it is the first to utilize GIS network analysis to study the accessibility of public urban green areas, in the city of Erbil. Network analysis within GIS lets landscape architects, urban planners to understand how environmental justice have an effects on cities and to help societies have more equitable accessibility to environments that healthier such as public green spaces (Sister et al., 2010). In other hand, GIS network analysis can use as a methodology for architects and urban planners to analyze the neighborhoods that are in need of renovation.

There are two popular measurement methods that are utilized to study accessibility: Network analysis and Euclidean. Urban planner mostly uses Euclidean technique which is called straight line distance for measuring accessibility (Coutts et al., 2010; Coutts et al., 2013 and Moseley et al., 2013), but the Euclidean technique is simplifies the real world because it does not account for impediments to movement across city. In other hand, network analysis is depending on the actual roads and their related speeds and is much more correct in an accessibility studies (Ghanbari and Ghanbari, 2013 and Steadman, 2004).

1.4. Hierarchy and Typology of Green Areas

There are many approaches to classify and sequence green areas and this issue is normal because laws and regulations differ in each country from the other country. The lifestyle and climate are varying according to different places; hot areas need more green areas than cold areas. Generally, a land use plan is formulated to indicate broad land uses and networks of services depended on the population expected. The land use distribution norms are based on limitations of work force and population density. Green areas are generally considered as recreational use in the Master Plan. according to Urban development plans formulation and implementation (UDPFI) Guidelines, 1996 of Ministry of Urban development of India, the proportion of recreational areas to the total urban area should be between 20-25 % in metropolitan cities, 18-20% in medium towns and large cities and 12-14% in small towns, the ratio of green areas of Erbil city consist of % 12.3 to the total urban areas. The types of urban greens in settlements according to (UDPFI) are as follows:

1. National Park is an area which is set aside for the conservation and protection of outstanding natural, flora, fauna, natural scenic areas and geological formations. the park prevents hunting, capturing or killing of fauna or deprivation of any animal of its habitat, And prevent using weapons for saving wildlife therein, and on condition that these issues are under the control of the park authorities.
2. District Park is a designated term according to the hierarchy of green areas in a city. District Park is an important recreation use with a large area and is developed to provide vital spaces should contain many recreation facilities.

3. Neighborhood Park: Neighborhood Park: is built up and developed at the neighborhood level is planned on an area of 2.000-4.000 m². For a population of 10,000 The Park is within easy reach of and located within the developed residential areas at walking distance.
4. Mini parks: in the hierarchy of green areas is the lowest level, developed and planned an area more than 125 m² for a population of 2,500 like play-areas for children with.
5. Playgrounds are provided at the neighborhood level for a population of 5,000. They are also provided usually in the educational institutions for the use of the college and school students.
6. Green Belts Include park belt, green girdle, rural belt, rural zone, agriculture belt, country belt, they may or may not be in ownership of the city, town, local body.
7. Green strip is developed along the arterial roads or for separating urban areas from other uses. It is also developed on a vacant land for example land under high tension power supply lines.

The hierarchy approach introduced by the Institute the Institute of Leisure and Amenity Management (ILAM)

1. Principal/City/Metropolitan green areas is built up and developed at the metropolitan level is planned on an area that more than 8.0 hectares, with a Town/City wide catchment, a wide range of facilities and a varied physical resource, which would usually be recognized as a visitor attraction in its own right
2. District green areas developed at the district level is planned on an area up to 8.0 hectares in extent with a catchment area from 1500 to 2000 meters, with a variety of facilities such as sports field, playing fields, play areas and a mixture of landscape features
3. Neighborhood green areas developed at the district level is planned on an area up to 4.0 hectares in extent serving a catchment area of between 1000 to 1500 meters with both a variety of facilities and landscape features
4. Local green areas is planned on an area up to 1.2 hectares in extent serving a catchment area of between 500 and 1000 meters, usually consisting of landscape features, informal green area and a play area but lacking other facilities that a available other parks.

National Recreation and Park Association (NRPA) of USA introduced an approach for parks area per population (Parks Acreage per 1,000 populations). There are another approach by (Nigel Dunnett et al., 2002). Department of Landscape, University of Sheffield and Department for Transport, Local Government and the Regions: London.

Table 1. 4 National Recreation and Park Association (NRPA) of USA Standards

| Park category | Standard park size | NRPA Standard (Acres/1000 residents) |
|-------------------|--------------------|---|
| Neighborhood park | 1-15 Acres | 1-2 Acres /1000 population |
| Community parks | 16-99 Acres | 5-8 Acres /1000 population |
| Special use parks | Variable | 3 Acres /1000 population |
| Linear parks | Variable | 5 Acres /1000 population |

Table 1. 5 Typology of green areas

| A Typology of urban green space | | | |
|---------------------------------|------------------------|------------------------|---|
| Main types of Green Space | | | |
| ALL URBAN GREEN SPACE | Amenity Green Space | Recreation Green Space | Parks and gardens Informal recreational areas Outdoor sport areas Play areas |
| | | Incidental Green Space | Housing green areas Other incidental areas |
| | | Private Green Space | Domestic gardens |
| | | Productive Green Space | City farms Allotments Remnant farmland |
| | Functional Green Space | Burial Grounds | Cemeteries Churchyards |
| | | Institutional Grounds | School grounds Other institutional grounds |
| | | Wetland | Open / running water Marsh. Fen |
| | Semi-natural habitats | Woodland | Deciduous woodland Coniferous woodland Mixed woodland |
| | | Other Habitats | Grass land Disturbed ground |
| | | Linear Green Space | River and canal banks Transport corridors Other linear features. |



2. LITERATURE REVIEW

Increasingly, researchers and urban analyst have started to concentrate on the distribution of green areas accessibility in urban settings

Ann (1991) utilized GIS to measure accessibility as straight line distance from open green spaces including rivers, green belts and water bodies to residential areas (Ann, 1991). Some research results explained that spaces within a linear distance of 700m from open areas composed 98.6% of the all areas ciity of Seoul, and so the provision of open areas was judged to get more than adequate (Eom et al., 2008 and Eom and Lee, 2009). (Gobster, 1995) In exploring issues related to access and use of green space and recreation facilities by poor and minorities found that sections of the Chicago River Corridor adjacent to lower-income minority neighborhoods tended to have lower vegetation quality, poorer maintenance, and low accessibility as compared to sections adjacent to higher-income 'white' neighborhoods and he hypothesized that lower-income minority neighborhoods may not have access to quality open space environments like those available to upper-income majority neighborhoods. (Talen, 1998) utilized an equity mapping method and a need based measure of equity derived from professional standards of green areas planning and documents of planning policy to explore accessibility to green areas in Pueblo, Colorado. She found that areas of Hispanic populations had low accessibility. (Nicholls, 2001) studied distributional equity within a system of public green areas in Bryan County, Texas and accessibility, using GIS and the Mann-Whitney U test procedure in SPSS and the results show that no inequality was present. (Lindsay and Maraj, 2001) explored the nature of green ways as public spaces in Indianapolis, Indiana. Their research study used simple GIS analysis of census and proximity as a measure of accessibility and other datas to determine equality of accessibility. The results show that minorities and low income majorities have unequal accessibility to open spaces. Recently, the Gaussian-based 2SFCA approach was utilized to estimate green areas accessibility in Georgia (Dai, 2011) and the results show that many of the census tracts are beyond walkable distance to the nearest green area.

(Massey, 2004) argues that the income levels, environmental quality, and health care access can involve human health. So the minority groups should have a similar living environment and facilities as the high income groups have. Chemical or toxic wastes lead to human health problems, such as cancer. Inhabitants who live neighboring these areas many a time have health problems because the poor level of the environment and quality of life. Good Access to urban green areas can help less these health problems, but the high quality of the living environment should not be controlled to the high income groups. (Bolin et al., 2005) argued that the historical development of socio-spatial effect produced unequal and unsafe environmental burdens in low-income and minority communities in Southern Phoenix. Therefore, environmental hazards and understanding the current and historical distribution of different racial groups are necessary to search environmental injustice. In the same way, (Bolin et al., 2005) studied how racial categories and companion social relations were constructed by the White majorities to produce a stigmatized area of economic and marginality racial exclusion in South Phoenix at the end of 19th centuries. (Wolch et al., 2005) argue that some minority groups don't have good accessibility to green areas and parks in Los Angeles as the city has become increasingly dense and grown. Minority and low income groups usually live in the inner city, areas generally without good-planning behind their built environment. as a result, inhabitants who live in those areas frequently lack recreation facilities like green areas the demand for urban green areas is increasing because people can socialize with friends, get fresh air, play with children or socialize with friends. However, most of the research studies have shown that low incomes and minority groups have less access to these green areas. (Pearce et al., 2006) used network analysis approach in New Zealand to measure community resource accessibility. Number of researches prefers the network analysis approach is because it has an advantage over the covering approach as it reflects the actual travel and avoids all the barriers that make routes inaccessible by pedestrians. (Grineski et al., 2007) found that in the city of Phoenix the environmental injustices are not equally distributed. Scholars have examined environmental justice in the Phoenix urban area and the socio-spatial distribution of different types of facilities in the Phoenix metropolitan area in relation to the demographics of nearby neighborhoods and they found that ethnicity and social-class are direct related to the distribution of air pollution immigrants, low-income and

Latinos inhabitants have the higher exposure to pollutants than the high incomes and White residents. (Comber et al., 2008) studied green areas access for different ethnic groups and religious in Leicester, UK, and they explained that Sikh, Hindu and Indian groups, which are the ethnic minorities in Leicester, have limited access to green areas. (Comber et al., 2008) utilized network analysis to determine the green areas access for different religious and ethnic groups in the UK. (Boone et al., 2009) found that more African Americans in Baltimore, Maryland have access to green areas within 400 meters walking distance while White people have access to more green spaces in less than 400 meters' distance. Many research studies have explained that the distribution of parks frequently disproportionately service mostly more affluent groups and White; the unequal distribution of green areas has become a serious environmental justice concern. Regardless of the fact that it is impossible to alter an existing neighborhood, it is important to study where injustice exists and ways that this injustice can be overcome. (Coombes and others, 2010) found that residents living in high accessibility area to the green areas were more likely to realize the physical activity recommendation and less likely to be obese or overweight. Coombes suggests that the provision of good access to green areas in metropolitan areas may lead to promote physical activity of population (Coombes et al., 2010) (Sotoudehnia and Comber, 2011) studied perceived and physical accessibility to urban green areas in the UK, and they explained that only 15% of the Leicesters population meets the physical access up to 300m. (Zhang and others, 2011) explained that the developed states in the western and Midwestern US have higher neighborhood green area accessibility, while developing states have lower accessibility (Dai, 2011) More recently, the Gaussian-based 2SFCA approach was utilized to determine green areas accessibility in Georgia and the results show that Georgia still faces the challenge that many of the census tracts are beyond walkable distance to the nearest green area. (Bennet et al., 2012) used network analysis approach to measure the walking distance to the nearest playground and to determine the number of users of a playground using the playground's service area. (Wendel, 2012) studied the unproportional distribution of larger and more desirable green areas throughout Santa Cruz, Bolivia, and found that not all urban inhabitants are experiencing the same benefits (Wright et al., 2012). (Kuta et al., 2014) studied urban green area accessibility for different socio-economic groups in the UK as well and they found that socio-

economically deprived group lack access to green space within 300m from the residence. (Kuta et al., 2014) applied network analysis approach to estimate the accessibility to green area for socio-economically deprived groups.



3. MATERIALS AND METHODS

3.1. Materials

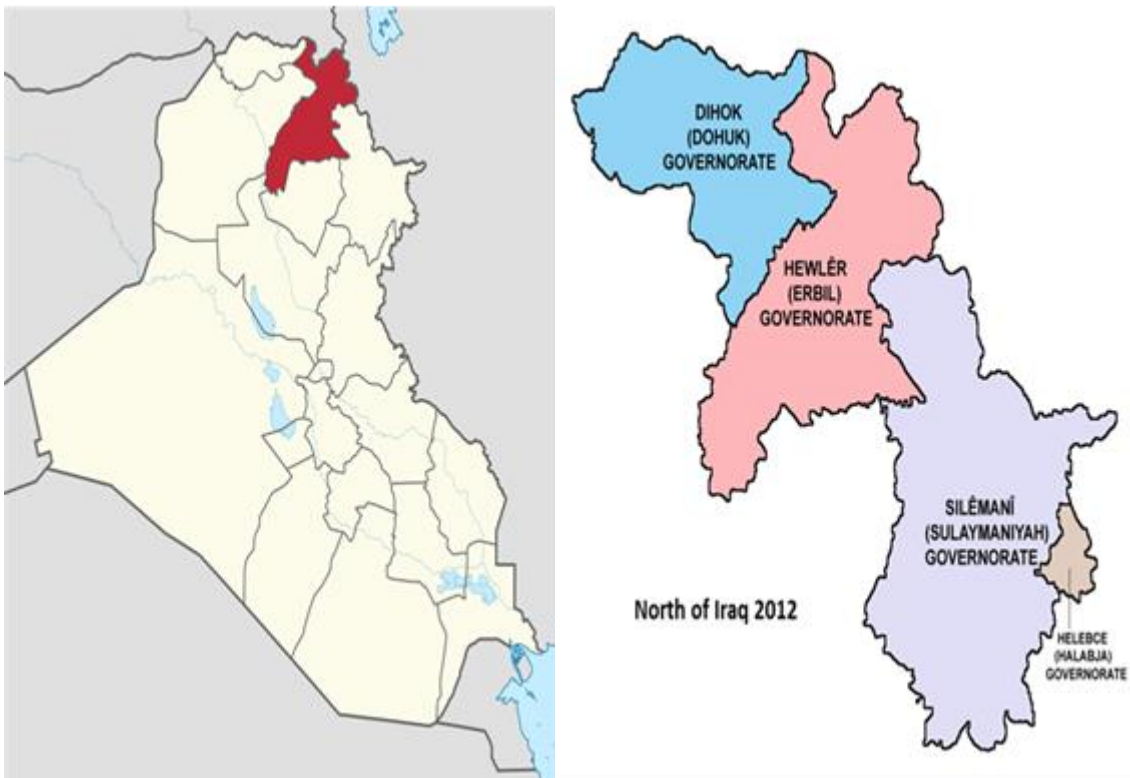
3.1.1. Study area

This work was carried out in 2016-2019 in the Erbil city it has nearly 1000,000 population according to KRG statistics office, because Erbil city has hot weather in the summer it is necessary to provide a green areas in terms of number and properties in other hand should has a good accessibility for green areas and residents can easily access to public green areas. There are many urban green areas in Erbil city, for this study all public green areas were selected according to Erbil city municipality and directorate of green areas, which include many types of green areas according to their areas and facilities.

A study area should contain many criteria because better measure map and comprehend the value and practical importance of accessibility to green area such as:

1. Availability of required datasets that and accessible for the study area to allow the study to focus on matters related to the mapping, measuring and analysis of green areas accessibility.
2. The study area must have a higher level of accessibility to allow verifications and workable field based observations when necessary.
3. The study area should be a great significance metropolitan area with green areas provision and development to allow the assessment of space and time changes in relationships between demand and availability of urban green areas.

For that reasons mentioned above, the Erbil city has been selected as a study area where concentrated researches about the accessibility to green space are deserved.



Map 3. 1 Study area. (The U.S. Agency for International Development (USAID)).

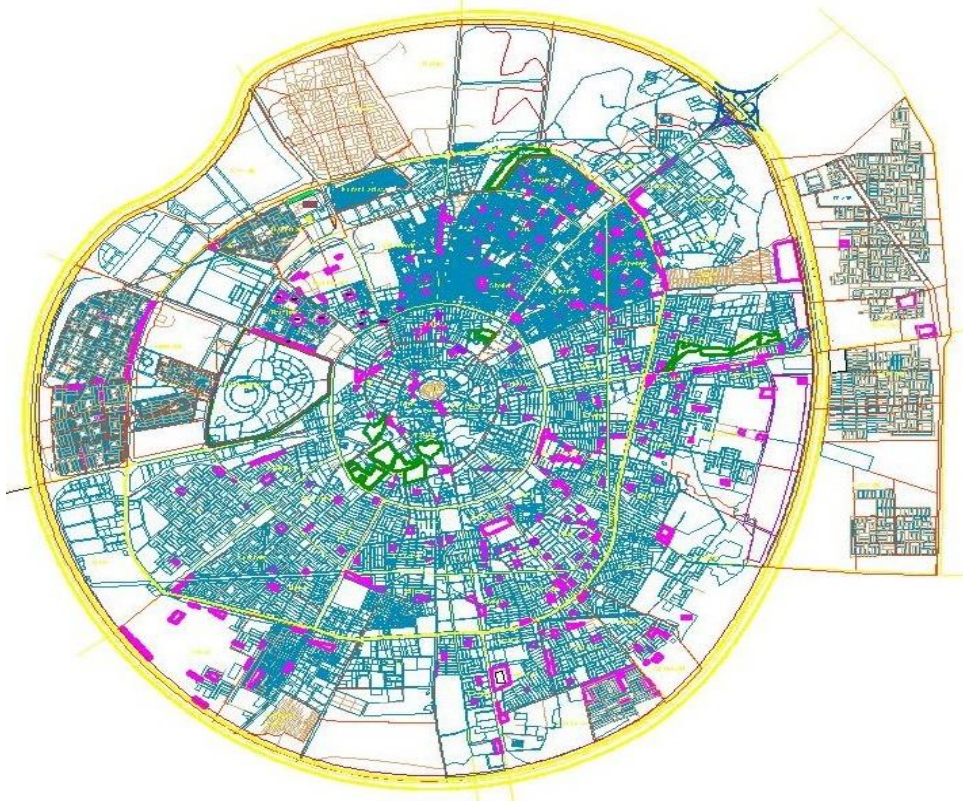


Figure 3. 1 Erbil city.

3.1.2. Geographical location of the study area

This work was carried out in 2016-2019 in the Erbil city which is located in the north of Iraq with Latitude: $36^{\circ}11'33.25''\text{N}$ and longitude: $44^{\circ}0'38.23''\text{E}$ and Elevation of Erbil city from sea level 429.00 m.

3.1.3. Erbil climate properties

The climate of the Erbil city has been recognized concurring to Koppen classification as bone-dry and semi-arid climate (steppe -BSh and Mediterranean – Csa). It is cold and damp in winter and hot and dry in summer, with short autumn and spring seasons compared to winter and summer. In winter, this locale falls beneath the impact of Mediterranean cyclones that moves east to northeast over the locale. The Arabian Sea winds move northward passing over the Arabian Gulf carrying extraordinary sums of dampness causing huge sums of precipitation over the locale. In summer, the locale falls beneath the impact of sub-tropical tall weight belts and Mediterranean anticyclones. The sub-tropical tall weight centers that moves from west to northeast and north it passing over the Middle Eastern Landmass carrying sand to the region. The highest every day temperature may reach as tall as 50°C in hot summer periods, while the low every day temperature can drop to 0°C in cold winters. (Anonymous, 2016) therefore it is necessary to Erbil city to provide green areas in terms of number and properties for inhabitants because more of days in year are hot.

3.2. Methods

The method used in this study is the selection of public green areas and then classification according to activity in to passive which consist of two groups and active which consist of four groups according to the area size and facilities provided, all quarters of Erbil city were selected with their population, in other hand all roads and streets were classified according to speed limitations, all of this data sets prepared by AutoCAD tool then converted to GIS to analyze and calculate time cost to access green areas and the area that covered by public green space services and number of residents to whom the service reaches as explained in diagrams (3.1)and (3.2) (Kemec et al., 2015).

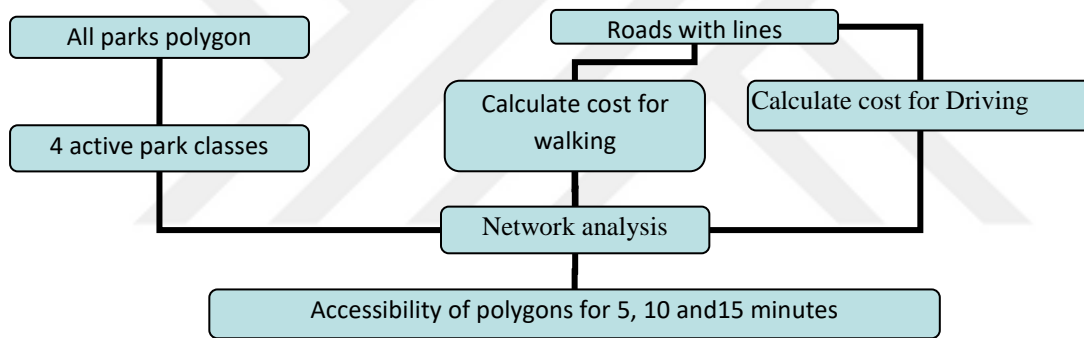


Figure 3. 2 Methods for analyzing in GIS Network analysis tool.

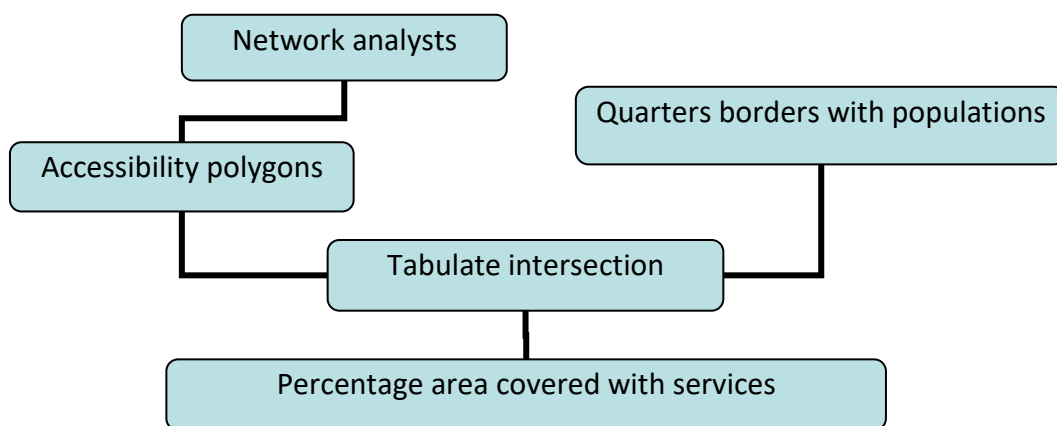


Figure 3. 3 Methods of calculating area and population covered by services.

3.2.1. Data anagement

All datasets for this study were generally obtained from three sources as explained in table (3.1)

1. Erbil city municipality
2. Directorate of green area engineering
3. KRG statistics office

3.2.1.1. Data acquisition

1. All green areas boundary as generated manually with polygons with (AutoCAD) there are 297 green areas are existing in this study area classified in to two categories active green areas and passive green areas, active green areas include 10 Community parks table (3.3), 10 District park (3.4), 189 Neighborhood parks table (3.5) and 55 Mini parks with areas are less than 2000m² table (3.6). And passive green areas include 14 Forested area table (3.7) and 19 Green belts table (3.8), these 297 green spaces distributed around different areas of Erbil city.
2. Road network and Streets classified manually to main roads and sub roads separated in to four layers according to speed limitation generated manually with (AutoCAD line DWG file) as shown in figure (3.2).
3. Demographic population data according to quarters of Erbil city by KRG statistics office as explained in table (3.9).
4. Quarters border selected by Erbil municipality (Polygon DWG AutoCAD file) as shown in figure (3.3), (Sayin et al. 2017).

Table 3. 1 Data used in this study

| No. | Datasets | Purpose of data sets | Sources of datasets |
|-----|----------------------|---|---------------------------|
| 1. | Green areas polygons | to determine the green areas | Directorate of green area |
| 2. | Road networks | to calculate distance with time access to green areas | Erbil city municipality |
| 3. | Population | To calculate population | KRG statistics office |
| 4. | Quarters border | Combine with population data | Erbil city municipality |

3.2.2. Classification of Erbil green areas

There six types of green area in Erbil city which classified in to two categories according to green areas usability as explained in diagram (3.3).

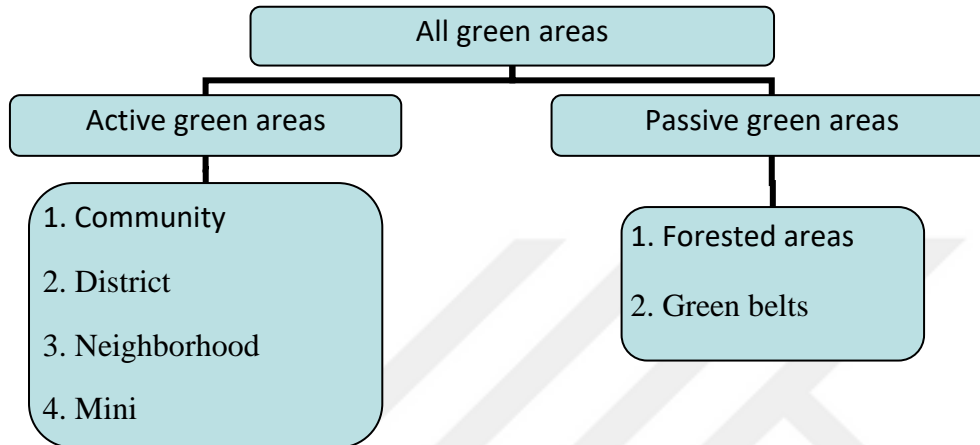


Figure 3. 4 Classification of green areas.

3.2.2.1. Active green areas

1. Community parks

Community parks are considered as a largest green area in size and well known amongst all residents. Community green areas contain all facilities and serve all age groups and provide a wide variety of chances to a broad cross section of residents.



Figure 3. 5 Sami Abdulrahman Park.



Figure 3. 6 Sami Abdulrahman Park.



Figure 3. 7 Sami Abdulrahman.Park



Figure 3. 8 Minara Park.



Figure 3. 9 Minara Park.

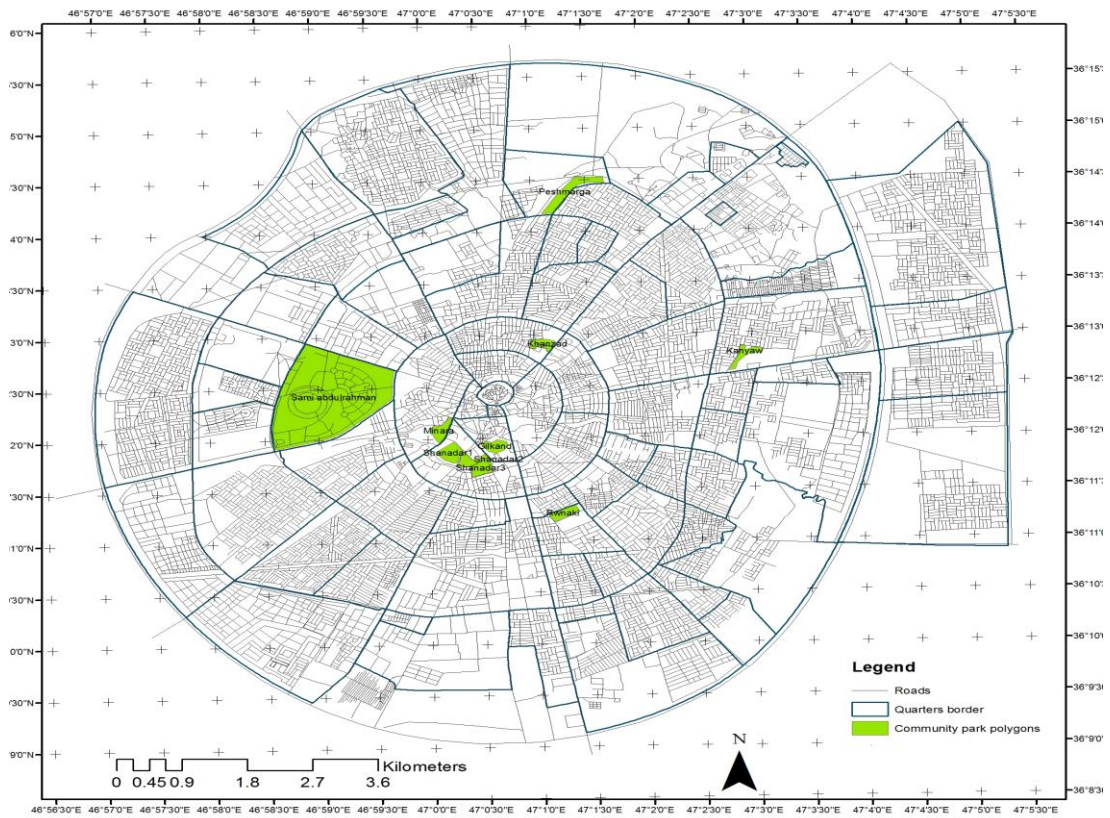


Figure 3. 10 Community parks polygon.

2. District parks.

A District park is a mid-sized green area providing space for recreation or sport and facilities. These types of green areas serve large groups in the city and are attractive to a range of users. They serve several communities or suburbs and are quite well known for this residents living in their catchment.



Figure 3. 11 Kanyaw Park.



Figure 3. 12 Shar Park.

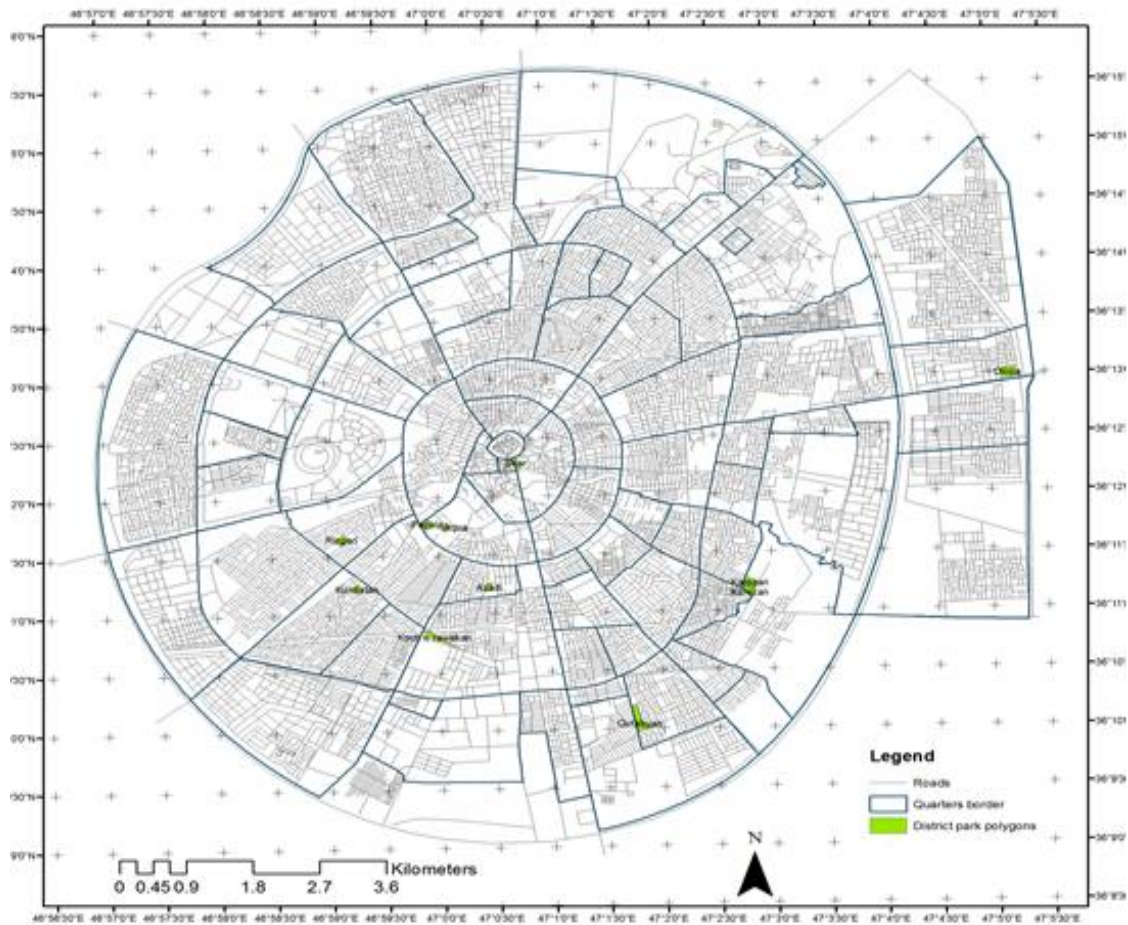


Figure 3.13 District Parks polygon.

3. Neighborhood parks

Neighborhood Parks are planned to serve a small population area, a convenient standard size and population for this kind of green space is 1hectare per 1000 person and usually range in size from 0.5 hectare to 4hectare, Provide facilities for a range of age groups. Neighborhood Park considered one of the most significant features of green areas system. Is deemed one of the major elements in neighborhood design its essential role is the provision of recreational area for the neighborhoods that surrounds it. These types of green areas location should be at the Centre of the neighborhoods and have a service area of about 800meters convenient and safe pedestrian access ranging in size from over 0.25hectare up to 5hactares.



Figure 3. 14 Pashew Park.



Figure 3. 15 Kurdistan Park.

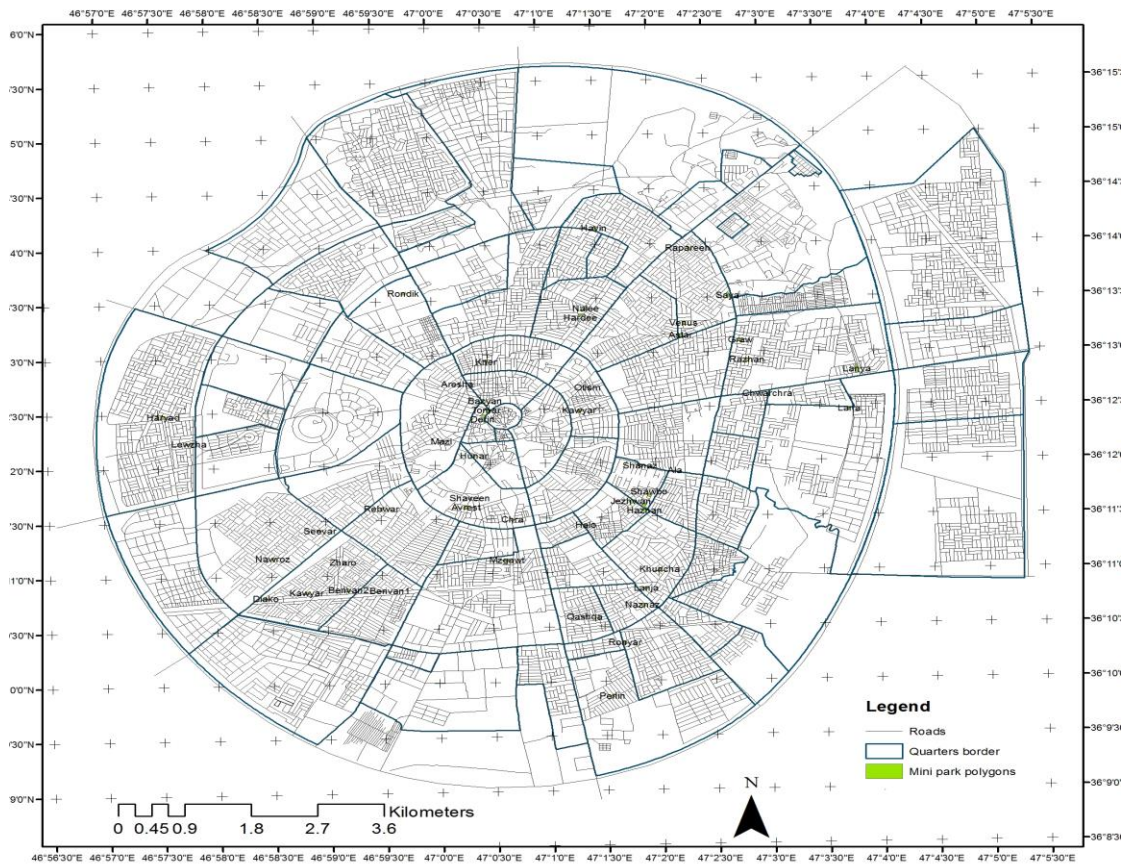


Figure 3. 2. Mini Parks polygon.

3.2.3.1. Passive areas which were not used daily or continuously consist of

1. Green belts
2. Forested area

Table 3. 2 Community parks of Erbil city with areas and quarters located

| No. | Name | Area (m ²) | Location quarter |
|-----|------------------|------------------------|------------------|
| 1. | Sami abdulrahman | 2,068,955 | Sami abdulrahman |
| 2. | Shanadar 1 | 114,293 | Zanyari |
| 3. | Peshmarga | 131,116 | Salahaddin2 |
| 4. | Minara | 93,856 | Minara |
| 5. | Runaki | 54,895 | Runaki |
| 6. | Kanyaw | 58,500 | Gulan |
| 7. | Shanadar 2 | 67,776 | Zanyari |
| 8. | Shanadar 3 | 53,340 | Zanyari |
| 9. | Glkand | 73,000 | Taajeel |
| 10. | Xanzad | 46,000 | Tayrawa |

Table 3. 3 District parks of Erbil city with areas and quarters located

| No. | Name | Area (m2) | Location quarter |
|-----|--------------|-----------|------------------|
| 1. | Rangin | 14,169 | Nishtiman |
| 2. | Kurdistan | 10,314 | Kurdistan |
| 3. | Azadi | 7,832 | Azadi |
| 4. | Qutabyan | 26,762 | Zanko |
| 5. | Shar | 8,557 | Khanaqa |
| 6. | Aquapark | 8,482 | Zanyari |
| 7. | Dlopa | 30,460 | Hawleri new |
| 8. | Kochurawakan | 13,465 | Azadi |
| 9. | Karezan | 37,000 | Karezan |
| 10. | Papula | 11257 | Zanyari |

Table 3. 4 Neighborhood parks of Erbil city with areas and quarters located

| No. | Name | Area (m2) | Location quarter |
|-----|-------------|-----------|------------------|
| 1 | khabat | 2293 | Saydawa |
| 2 | Brusk | 6357 | Saydawa |
| 3 | Shadan | 4056 | Mstawfi |
| 4 | Kurd u arab | 2623 | Tayrawa |
| 5 | Gashaw | 5418 | Tayrawa |
| 6 | Sema | 10871 | Tayrawa |
| 7 | Baghishar | 5912 | Khanaqa |
| 8 | Mediya | 5887 | Zanyari |
| 9 | Kara | 4072 | Zanyari |
| 10 | Choli | 3997 | Zanyari |
| 11 | Tangabar | 5988 | Setaqan |
| 12 | Mand | 2623 | Setaqan |
| 13 | Pashew | 4438 | Setaqan |
| 14 | Goran | 2622 | Minara |
| 15 | Harvin | 4021 | Minara |
| 16 | Gizng | 4761 | Bakhtyari |
| 17 | Zhilamo | 7000 | Bakhtyari |
| 18 | Rebin | 3012 | Bakhtyari |
| 19 | Kaziwa | 3280 | Bakhtyari |
| 20 | Dastan | 4040 | Bakhtyari |
| 21 | Zhyar | 3290 | Bakhtyari |
| 22 | Didan | 3000 | Bakhtyari |
| 23 | Shapol | 2831 | Bakhtyari |
| 24 | Judi | 9376 | Bakhtyari |
| 25 | Analinda | 3904 | Shorsh |
| 26 | Aynda | 10210 | Shorsh |

Table 3.4. Neighborhood parks of Erbil city with areas and quarters located (continued)

| No. | Name | Area (m ²) | Location quarter |
|-----|------------|------------------------|------------------|
| 27 | Baran | 3,622 | Shorsh |
| 28 | Shiraz | 6604 | Shorsh |
| 29 | Ranj | 3993 | Shorsh |
| 30 | Ashti | 6100 | Salahaddin |
| 29 | Ranj | 3993 | Shorsh |
| 30 | Ashti | 6100 | Salahaddin |
| 31 | Peshawa | 5317 | Salahaddin |
| 32 | Salahaddin | 3510 | Salahaddin |
| 33 | Kani | 2385 | Kani |
| 34 | Zanayan1 | 3090 | Kani |
| 35 | Zanayan2 | 2451 | Kani |
| 36 | Nyan | 5070 | Kwestan |
| 37 | Arkhawan | 3020 | Kwestan |
| 38 | Kwestan | 2116 | Kwestan |
| 39 | Namam | 2599 | Kwestan |
| 40 | Shanel | 4050 | Kwestan |
| 41 | Nisar | 2582 | Kwestan |
| 42 | Soz | 12281 | Naz |
| 43 | Gona | 2270 | Naz |
| 44 | Darin | 2529 | Nwsaran |
| 45 | Shawnm | 3777 | Nwsaran |
| 46 | Shanya | 13577 | Waziran |
| 47 | Sonya | 17527 | Waziran |
| 48 | Waziran | 5487 | Waziran |
| 49 | Wezha | 11866 | Waziran |
| 50 | Kosar | 4400 | Ari |
| 51 | Hazhin | 2516 | Ari |
| 52 | Glarya | 4872 | Brayati |
| 53 | Brayati | 4140 | Brayati |
| 54 | Kavin | 4030 | Brayati |
| 55 | xanda | 8870 | Brayati |
| 56 | Avar | 9528 | Brayati |
| 57 | Bina | 3090 | Brayati |
| 58 | Zikhan | 2133 | khanzad |
| 59 | Aylul | 8255 | khanzad |
| 60 | Niga | 2386 | khanzad |
| 61 | Kawani | 3614 | khanzad |
| 62 | Sarkand | 21974 | khanzad |
| 63 | Fedrali | 4268 | khanzad |

Table 3.4. Neighborhood parks of Erbil city with areas and quarters located (continued)

| No. | Name | Area (m2) | Location quarter |
|-----|---------|-----------|------------------|
| 64 | Narin | 5544 | khanzad |
| 65 | Marjan | 2823 | Raparin |
| 66 | Amad | 3369 | Raparin |
| 67 | Bala1 | 2736 | Raparin |
| 68 | Bala2 | 4669 | Raparin |
| 69 | Zhivan | 2021 | Raparin |
| 70 | Baxan | 5390 | Raparin |
| 71 | Shalaw | 2905 | Raparin |
| 72 | Sardam | 2793 | Raparin |
| 73 | Razaw | 3355 | Raparin |
| 74 | Kamyar | 2170 | Raparin |
| 75 | Chaman | 2089 | Raparin |
| 76 | Aso | 4247 | Raparin |
| 77 | khak | 25626 | Safeen |
| 78 | Maf | 7425 | Safeen |
| 79 | Safeen1 | 5951 | Safeen |
| 80 | Saffen2 | 4400 | Safeen |
| 81 | Darya | 7139 | Gulan |
| 82 | Kayhan | 3253 | Gulan |
| 83 | Renas | 2275 | Gulan |
| 84 | Hazha | 5078 | Gulan |
| 85 | Betwata | 7853 | Hawleri new |
| 86 | Lezanin | 7858 | Hamreen |
| 87 | Rezband | 2253 | Zanayan |
| 88 | Ashna | 3315 | Zanayan |
| 89 | Lawlaw | 4048 | Zanayan |
| 90 | Grtk | 3036 | Zanayan |
| 88 | Ashna | 3315 | Zanayan |
| 89 | Lawlaw | 4048 | Zanayan |
| 90 | Grtk | 3036 | Zanayan |
| 91 | Avin1 | 7474 | Sarwaran |
| 92 | Avin2 | 4544 | Sarwaran |
| 93 | Avin3 | 6412 | Sarwaran |
| 94 | Avin4 | 16620 | Sarwaran |
| 95 | Avin5 | 8451 | Sarwaran |
| 96 | Govar | 5544 | Sharawani |
| 97 | Parwa | 4426 | Sharawani |
| 98 | Aras | 5500 | Sharawani |
| 99 | Golchin | 8398 | Sharawani |
| 100 | Avrin1 | 5010 | Sharawani |

Table 3.4. Neighborhood parks of Erbil city with areas and quarters located (continued)

| No. | Name | Area (m ²) | Location quarter |
|-----|---------------|------------------------|------------------|
| 101 | Avrin2 | 8425 | Sharawani |
| 102 | Chnar | 3920 | Chnar |
| 103 | Peshraw | 4995 | Chnar |
| 104 | Krewa | 6531 | Chwarchra |
| 105 | Lana2 | 3593 | Chwarchra |
| 106 | Lana3 | 4092 | Chwarchra |
| 107 | Dyrbakir | 3200 | Chwarchra |
| 108 | Chrakhan | 4208 | Chwarchra |
| 109 | Nashmil | 7455 | Khebat |
| 110 | Xawar | 4527 | Khebat |
| 111 | Sarbaxoyee | 2270 | Khebat |
| 112 | Shahidan | 4968 | Khebat |
| 113 | Galarezan | 5280 | Khebat |
| 114 | Zhila | 3038 | Khebat |
| 115 | Gulan | 14945 | Khebat |
| 116 | Varin | 12112 | Karezan |
| 117 | Zhilya | 9439 | Mamostayan |
| 118 | Nawzhin | 5493 | Mamostayan |
| 119 | Tarza | 3727 | Mamostayan |
| 120 | Taman | 4069 | Mamostayan |
| 118 | Nawzhin | 5493 | Mamostayan |
| 119 | Tarza | 3727 | Mamostayan |
| 120 | Taman | 4069 | Mamostayan |
| 121 | Shokhan2 | 2762 | Mamostayan |
| 122 | Zhin | 2175 | Mamostayan |
| 123 | Nahri | 9717 | Mamostayan |
| 124 | Hiwa | 3722 | Mamostayan |
| 125 | Kazhik | 2400 | Mufti |
| 126 | Dahen | 2440 | Mufti |
| 127 | Zaza | 2752 | Mufti |
| 128 | Yadi namran | 3140 | Mufti |
| 129 | Jgar goshakan | 3289 | Mufti |
| 130 | Korek | 2190 | Mufti |
| 131 | Kazea | 7423 | Mufti |
| 132 | Pers | 2330 | Mufti |
| 133 | Halgurd | 4372 | Mufti |
| 134 | Hana | 2100 | Hana city |
| 135 | Raz | 3847 | Havalan |
| 136 | Shko | 4769 | Havalan |
| 137 | Razha | 2506 | Havalan |

Table 3.4. Neighborhood parks of Erbil city with areas and quarters located (continued)

| No. | Name | Area (m2) | Location quarter |
|-----|-------------|-----------|------------------|
| 138 | Laveen | 7782 | Havalan |
| 139 | Kayxusraw | 2433 | Rasti |
| 140 | Baram | 3378 | Rasti |
| 141 | Nawcha | 4944 | Rasti |
| 142 | Bestan | 3761 | Rasti |
| 143 | Komari | 3330 | Runaki |
| 144 | Hezha | 5413 | Runaki |
| 145 | Shovan | 3000 | Runaki |
| 146 | Sina | 3170 | Runaki |
| 147 | Sitak | 3966 | Runaki |
| 148 | Zhala | 4172 | Runaki |
| 149 | Ramtan | 21611 | Majidawa |
| 150 | Kukhti | 2613 | Mantikawa |
| 151 | Jihan | 6867 | Mantikawa |
| 152 | Hedi | 2861 | Azadi |
| 153 | Mamzan | 5342 | Azadi |
| 154 | Yana | 2060 | Azadi |
| 155 | Bawari | 4177 | Azadi |
| 156 | Niza | 4816 | Azadi |
| 157 | Xoshi | 7647 | Azadi |
| 158 | Rwan | 9280 | Azadi |
| 159 | Bezhan | 4047 | Azadi |
| 160 | Ravist | 2033 | Azadi |
| 161 | Hataw | 5771 | Azadi |
| 162 | Wafayee1 | 3142 | Andazyaran |
| 163 | Wafayee2 | 5342 | Andazyaran |
| 164 | Andazyaran | 7816 | Andazyaran |
| 165 | Karokh | 7409 | Zanko1 |
| 166 | Lava | 3989 | Zanko1 |
| 167 | Shayan | 3483 | Zanko1 |
| 168 | Babus | 2034 | Zanko2 |
| 169 | Hazho | 3847 | Rzgari2 |
| 170 | Shkir fatah | 4251 | Rzgari2 |
| 171 | Heshw | 7000 | Shadi |
| 172 | Gew | 4022 | Shadi |
| 173 | Mukryani | 11761 | Shadi |
| 174 | Rzgari | 3408 | Rzgari1 |
| 175 | Zaytun | 3674 | Rzgari1 |
| 176 | Haryad3 | 3792 | Sarbasti |
| 177 | Sarkarez | 7070 | Sarkarez |

Table 3.4. Neighborhood parks of Erbil city with areas and quarters located (continued)

| No. | Name | Area (m2) | Location quarter |
|-----|------------|-----------|------------------|
| 178 | Fenk | 7299 | Shadi |
| 179 | Bahari new | 8487 | Shadi |
| 180 | Bandaw | 11112 | Shadi |
| 178 | Fenk | 7299 | Shadi |
| 179 | Bahari new | 8487 | Shadi |
| 180 | Bandaw | 11112 | Shadi |
| 181 | Kawna | 4283 | Shadi |
| 182 | Shapal | 3757 | Kurdistan |
| 183 | Kurdayati | 7556 | Bahar |
| 184 | Mergaswr | 7350 | Nawroz |
| 185 | Brwa | 2051 | Nawroz |
| 186 | Marina | 10000 | Nawroz |
| 187 | Hayat | 3961 | Nawroz |
| 188 | Garmyan | 23174 | Nishtiman |
| 189 | Qandil | 2063 | Eskan |

Table 3. 5 Mini green areas of Erbil city with their area and quarters located

| No. | Name | Area (m2) | Location quarter |
|-----|--------------|-----------|------------------|
| 1 | Bazyan | 892 | Mstawfi |
| 2 | Dalan | 405 | Tayrawa |
| 3 | Kner | 1619 | Tayrawa |
| 4 | Hunar | 1538 | Taajeel |
| 5 | Shaveen | 844 | Zanyari |
| 6 | Chra | 1695 | Zanyari |
| 7 | Avrast | 1626 | Zanyari |
| 8 | Kawyar | 1434 | Setaqan |
| 9 | Otism | 562 | Setaqan |
| 10 | Tomar | 1983 | Arab |
| 11 | Derin | 1383 | Arab |
| 12 | Peshang | 1226 | Arab |
| 13 | Arisha | 519 | Minara |
| 14 | Mazi | 900 | Minara |
| 15 | Kotri Salam | 754 | Bazar |
| 16 | Gazino antar | 1158 | Bazar |
| 17 | Parezga | 1386 | Bazar |
| 18 | Kani askakan | 714 | Bazar |
| 19 | Rondik | 1600 | Bakhtyari |
| 20 | Hardi | 1340 | Shorsh |
| 21 | Nalee | 1166 | Shorsh |
| 22 | Havin | 1732 | Kwestan |
| 23 | Astar | 1965 | Raparin |
| 24 | Raparin | 1771 | Raparin |
| 25 | Saya | 1695 | Raparin |
| 26 | Vinus | 1782 | Raparin |
| 27 | Pari | 1520 | Safin |
| 28 | Lanya | 1200 | Gulan |
| 29 | Graw | 1796 | Gulan |
| 27 | Pari | 1520 | Safin |
| 28 | Lanya | 1200 | Gulan |
| 29 | Graw | 1796 | Gulan |
| 30 | Razhan | 1949 | Gulan |
| 31 | Lana1 | 1239 | Chwarchra |
| 32 | Ala | 1055 | Khebat |
| 33 | Shawbo | 1468 | Mamostayan |
| 34 | Shanaz | 1469 | Mamostayan |
| 35 | Shokhan1 | 1894 | Mamostayan |
| 35 | Lanja | 1810 | Mufti |
| 36 | Xuncha | 1467 | Mufti |

Table 3.5. Mini green areas of Erbil city with their area and quarters located (continued)

| No. | Name | Area (m2) | Location quarter |
|-----|-----------|-----------|------------------|
| 37 | Chwarchra | 807 | Havalan |
| 38 | Jezhwan | 1315 | Eskan |
| 39 | Hazhan | 1777 | Eskan |
| 40 | Halo | 1760 | Eskan |
| 41 | Qashqa | 1230 | Mantikawa` |
| 42 | Mzgawt | 1247 | Azadi |
| 43 | Nazan | 1434 | Andazyaran |
| 44 | Ronyar | 1303 | Zanko1 |
| 45 | Parlin | 1417 | Zanko2 |
| 46 | Rebwar | 1380 | Rzgari |
| 47 | Lawzha | 1468 | Sarbasti |
| 48 | Haryad2 | 1735 | Sarbasti |
| 49 | Kaywan | 1815 | Kurdistan |
| 50 | Berivan1 | 929 | Kurdistan |
| 51 | Zharo | 972 | Kurdistan |
| 52 | Dyako | 1330 | Kurdistan |
| 53 | Berivan2 | 1373 | Bahar |
| 54 | Sivar | 1294 | Nawroz |
| 55 | Nawroz | 1836 | Nawroz |
| 54 | Sivar | 1294 | Nawroz |
| 55 | Nawroz | 1836 | Nawroz |

Table 3. 6 Forest of Erbil city with areas and quarters located

| No. | Name | Area (m2) | Location quarter |
|-----|----------------|-----------|------------------|
| 1 | Mukhtar | 159436 | Hasarok 5 |
| 2 | Kaliptos | 68629 | Hasarok 5 |
| 3 | 159 Gulan | 136357 | Gulan |
| 4 | Darstani bakur | 1239000 | Kwestan |
| 5 | Darstan kuran | 81824 | Zanyari |
| 6 | Alar | 17433 | Zanko2 |
| 7 | Mashxa1 | 13124 | Zanko2 |
| 8 | Mashxa2 | 5000 | Zanko2 |
| 9 | Mashxa3 | 29202 | Zanko2 |
| 10 | Mashxa6 | 38000 | Zanko2 |
| 11 | Haryad1 | 5559 | Sarbasti |
| 12 | Halsho | 29497 | Shadi |
| 13 | Shwenawar | 5280 | Shadi |
| 14 | Shalyar | 7939 | Shadi |

Table 3. 7 Green belts of Erbil city with areas and quarters located.

| No. | Name | Area (m2) | Location quarter |
|-----|---------|-----------|------------------|
| 1 | Dalya | 14445 | Nwsaran |
| 2 | Gala | 7350 | Waziran |
| 3 | Rwdaw | 12455 | UN office |
| 4 | Kazhaw | 1124 | Raparin |
| 5 | Zagros | 12259 | Safin |
| 6 | Tarin | 4911 | Safin |
| 7 | Pirmam | 7820 | Safin |
| 8 | Banaz | 2899 | Rasti |
| 9 | Aland | 57902 | Sarbasti |
| 10 | Sartka1 | 4791 | Sarbasti |
| 11 | Sartka2 | 4249 | Sarbasti |
| 12 | Sartka3 | 3780 | Sarbasti |
| 13 | Honyar | 9080 | Shadi |
| 14 | Tasaw | 38947 | Shadi |
| 15 | Rawen | 9,000 | kwran |
| 16 | Mawlawi | 44186 | Karezan |
| 17 | Sartka2 | 4249 | Sarbasti |
| 18 | Sanaw1 | 15281 | Sharawani |
| 19 | Sanaw1 | 3360 | Sharawani |

3.2.3. Processing of data

1. Digitize all access (roads and streets) which classified according to speed limitation to the public green areas manually which created with AutoCAD polygons and then converted to GIS Network Analyst tool.
2. Integrate the demographic population layer and quarter's border of Erbil city by utilizing tabulate intersection in Network analyst tool.
3. Create green areas of Erbil city polygons by AutoCAD tool and then converted to GIS.

3.3. Network Analysis

We have to calculate cost, this cost could be in different units it could be time, money or land this study used time cost that means temporal needs to pass each line segments.

In this study quarters border layer in GIS Environment by using quarter's border layer in Auto CAD then by using joint tool of equipped software we can integrate tabular population data with polygons quarters border layer.

In this study green areas border (line) generated then lines converted to polygons then converted to the point which is the format of needed data form in network analysts too.





4. RESULTS

This study analyzes green areas of the Erbil city and measures the accessibility of green spaces with environmental justice in Erbil city with regard to public green areas. The study shows the relationship between different quarters of Erbil city and public green areas accessibility. The idea of this research study derived from (So-Shuk-Wai, 2013 and Comber et al., 2008), and the methodology is originating from (Sister et al., 2007 and Hass, 2009). In this study AutoCAD tools like polygon, line and layer were used and then converted to Network Analyst within GIS were utilized the main tool in this research. This study utilizes this methodology mentioned above to answer questions

1. How accessible are public green areas for different populations within 300m, 600m and 900m distance or 5minute, 10minute and 15minute walking for mini parks and neighborhood parks and driving for community parks and district parks?
2. Which areas of Erbil city need to have new public green areas and increased accessibility to public green areas?

By two main steps

1. Identify and classify all green areas of Erbil city by polygons and classify all roads with speed limitations to the green areas.
2. integrating the demographic data of the city of Erbil and the city's quarters to obtain the population accounts for which the services of the green areas reach.

4.1. Analysis and Results

Measuring the accessibility of public urban green areas for different quarters of Erbil city and calculating of the population. Select the areas that do not have enough green areas and need new green areas.

4.1.1. Community parks

There are 10 community parks accessibility measured by GIS Network analysis for 5, 10 and 15 minutes for driving as shown in table (4.1), (4.2) and (4.3), the results show that for 5 minutes driving the %68 of population have accessibility to green areas and %32 of population don't have accessibility to green areas, for 10 minutes of driving there are accessibility for %99 of population, %1 of population don't have accessibility to green areas. For 15 minutes driving there is accessibility for %100 of population to public Community parks.

4.1.2. District parks

There are 10 District parks accessibility measured by GIS Network analysis for 5, 10 and 15 minutes for driving as shown in table (4.4), (4.5) and (4.6), the results show that for 5 minutes driving %70 of Erbil city population have accessibility and %30 of population don't have easy access to District parks. For 10minutes driving there is accessibility for %96 of Erbil residents to District parks. For 15 minutes driving there is %100 accessibility to district parks.

4.1.3. Neighborhood parks

There are 189 Neighborhood parks, accessibility measured by GIS Network analysis for 5, 10 and 15 minutes walking as explained in table (4.7), (4.8) and (4.9), the results show that for 5 minutes walking %43 of Erbil city population have accessibility and %57 of population don't have easy access to Neighborhood parks. For 10minutes walking there is accessibility for %71 of Erbil residents to District parks. For 15 minutes walking %80 of Erbil city have accessibility to Neighborhood parks.

4.1.4. Mini parks

There are 55 Mini parks in Erbil city which their areas less than 2000m², accessibility measured by GIS Network analysis for 5, 10 and 15 minutes walking as

explained in table (4.10), (4.11) and (4.12), the results show that for 5 minutes walking %22 of Erbil city population have accessibility and %78 of population don't have easy access to Mini parks. For 10minutes walking there is accessibility for %52 of Erbil residents to Mini parks. For 15 minutes walking %70 of Erbil city have accessibility to Mini parks.



Table 4. 1 Accessibility results of community parks for 5 minutes driving

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-----------------|---------------|------------|-------------------|--------------------|------------------------|
| Ainkawa | 34 | 0 | 66 | 0 | 0 |
| Andazyaran | 100 | 18376 | 0 | 18376 | 0 |
| Arab | 100 | 115 | 0 | 115 | 0 |
| Ari | 100 | 17976 | 0 | 17976 | 0 |
| Azadi1 | 69 | 15127 | 31 | 10435 | 4692 |
| Azadi2 | 100 | 4490 | 0 | 4490 | 0 |
| Badawa | 54 | 16526 | 46 | 8880 | 7646 |
| Bahar | 58 | 18753 | 42 | 10878 | 7875 |
| Bahrka | 74 | 17987 | 26 | 13395 | 4592 |
| Bakhtyari1 | 42 | 6789 | 58 | 2822 | 3967 |
| Bakhtyari2 | 27 | 17404 | 73 | 4769 | 12635 |
| Bazar | 100 | 2659 | 0 | 2659 | 0 |
| Berkot | 100 | 750 | 0 | 750 | 0 |
| Betwatae nwe | 9 | 3456 | 91 | 295 | 3161 |
| Brayati | 100 | 25865 | 0 | 25794 | 71 |
| Chinar | 34 | 14717 | 66 | 4998 | 9719 |
| Chwarchra | 8 | 28707 | 92 | 2170 | 26537 |
| Darstani bakur | 65 | 0 | 35 | 0 | 0 |
| Drem city | 6 | 8450 | 94 | 549 | 7901 |
| Empire | 44 | 0 | 56 | 0 | 0 |
| English village | 48 | 4350 | 52 | 2090 | 2260 |
| Eskan | 100 | 7936 | 0 | 7936 | 0 |
| Ganjan city | 46 | 4567 | 54 | 2122 | 2445 |
| Gorstani bakur | 41 | 300 | 59 | 122 | 178 |

Table 4.1. Accessibility results of community parks for 5 minutes driving (Continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-----------------|---------------|------------|-------------------|--------------------|------------------------|
| Gulan | 83 | 16157 | 17 | 13442 | 2715 |
| Hamrin | 79 | 11198 | 21 | 8897 | 2301 |
| Havalan | 98 | 16930 | 2 | 16553 | 377 |
| Italian village | 51 | 21896 | 49 | 11261 | 10635 |
| Kani | 100 | 23762 | 0 | 23762 | 0 |
| Karezan | 5 | 24603 | 95 | 1259 | 23344 |
| Khanaqa | 100 | 6673 | 0 | 6673 | 0 |
| Khanzad | 100 | 19517 | 0 | 19517 | 0 |
| Khebat | 99 | 25424 | 1 | 25142 | 282 |
| Komari | 100 | 3893 | 0 | 3893 | 0 |
| kurani aynkawa | 100 | 14376 | 0 | 14359 | 17 |
| Kurdistan | 27 | 35172 | 73 | 9547 | 25625 |
| Kwestan | 100 | 13502 | 0 | 13502 | 0 |
| Mahabad | 67 | 11428 | 33 | 7602 | 3826 |
| Majidawa | 42 | 2180 | 58 | 905 | 1275 |
| Mamostayan1 | 95 | 13402 | 5 | 12677 | 725 |
| Mamostayan2 | 96 | 9820 | 4 | 9404 | 416 |
| Mantikawa | 93 | 8525 | 7 | 7946 | 579 |
| Minara | 100 | 6960 | 0 | 6960 | 0 |
| Mstawfi | 100 | 8147 | 0 | 8147 | 0 |
| Mufti | 100 | 13645 | 0 | 13645 | 0 |
| Nawroz | 12 | 39105 | 88 | 4593 | 34512 |
| Naz | 4 | 3000 | 96 | 132 | 2868 |
| Nishtiman | 94 | 14269 | 6 | 13387 | 882 |

Table 4.1. Accessibility results of community parks for 5 minutes driving (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|---------------------------|---------------|------------|-------------------|--------------------|------------------------|
| Nwsaran | 94 | 17700 | 6 | 16593 | 1107 |
| Peeshasazi bashur | 1 | 1290 | 99 | 16 | 1274 |
| Qalat | 54 | 0 | 46 | 0 | 0 |
| Raparin | 99 | 12096 | 1 | 12029 | 67 |
| Rastee | 3 | 9863 | 97 | 288 | 9575 |
| Runaki | 100 | 4867 | 0 | 4867 | 0 |
| Rzgari | 100 | 30146 | 0 | 30146 | 0 |
| Safeen2& pishasazi bashur | 37 | 939 | 63 | 351 | 588 |
| Safin1 | 100 | 3621 | 0 | 3621 | 0 |
| Safin3 | 10 | 1513 | 90 | 158 | 1355 |
| Salahaddin1 | 100 | 24056 | 0 | 24056 | 0 |
| Salahaddin2 | 100 | 7057 | 0 | 7057 | 0 |
| Sami abdulrahman | 99 | 579 | 1 | 572 | 7 |
| Sarwaran | 89 | 5542 | 11 | 4936 | 606 |
| Saydawa | 100 | 14360 | 0 | 14360 | 0 |
| Setaqan | 100 | 12809 | 0 | 12809 | 0 |
| Shadi | 1 | 17695 | 99 | 212 | 17483 |
| Sharawani | 6 | 5942 | 94 | 339 | 5603 |
| Shorsh | 100 | 15595 | 0 | 15595 | 0 |
| Taajeel | 98 | 3859 | 2 | 3781 | 78 |
| Tayrawa | 95 | 19159 | 5 | 18191 | 968 |
| Waziran | 53 | 4700 | 47 | 2473 | 2227 |
| Zanko1 | 51 | 16777 | 49 | 8613 | 8164 |
| Zanko2 | 1 | 4519 | 99 | 51 | 4468 |
| Zanyari | 100 | 5470 | 0 | 5470 | 0 |
| Zilan | 2 | 3231 | 98 | 77 | 3154 |

Table 4. 2 Accessibility results of community parks for 10 minutes driving

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-----------------|---------------|------------|-------------------|--------------------|------------------------|
| Andazyaran | 100 | 18376 | 0 | 18376 | 0 |
| Arab | 100 | 115 | 0 | 115 | 0 |
| Ari | 100 | 17976 | 0 | 17976 | 0 |
| Azadi1 | 100 | 15127 | 0 | 15127 | 0 |
| Azadi2 | 100 | 4490 | 0 | 4490 | 0 |
| Badawa | 99 | 16526 | 1 | 16412 | 114 |
| Bahar | 100 | 18753 | 0 | 18753 | 0 |
| Bahrka | 100 | 17987 | 0 | 17987 | 0 |
| Bakhtyari1 | 98 | 6789 | 2 | 6672 | 117 |
| Bakhtyari2 | 100 | 17404 | 0 | 17404 | 0 |
| Bazar | 100 | 2659 | 0 | 2659 | 0 |
| Berkot | 100 | 750 | 0 | 750 | 0 |
| Betwatae new | 100 | 3456 | 0 | 3456 | 0 |
| Brayati | 100 | 25865 | 0 | 25828 | 37 |
| Chinar | 100 | 14717 | 0 | 14717 | 0 |
| Chwarchra | 86 | 28707 | 14 | 24747 | 3960 |
| Darstani bakur | 100 | 0 | 0 | 0 | 0 |
| Drem city | 100 | 8450 | 0 | 8450 | 0 |
| Empire | 100 | 0 | 0 | 0 | 0 |
| English village | 100 | 4350 | 0 | 4350 | 0 |
| Eskan | 100 | 7936 | 0 | 7936 | 0 |
| Ganjan city | 100 | 4567 | 0 | 4567 | 0 |
| Gorstani bakur | 100 | 300 | 0 | 300 | 0 |
| Gulan | 100 | 16157 | 0 | 16109 | 48 |
| Hamrin | 100 | 11198 | 0 | 11198 | 0 |
| Hana city | 45 | 4567 | 55 | 2059 | 2508 |

Table 4. 2 Accessibility results of community parks for 10 minutes driving (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-------------------|---------------|------------|-------------------|--------------------|------------------------|
| Havalan | 100 | 16930 | 0 | 16930 | 0 |
| Hawleri new | 73 | 21896 | 27 | 16017 | 5879 |
| Italian village | 99 | 3570 | 1 | 3530 | 40 |
| Kani | 100 | 23762 | 0 | 23762 | 0 |
| Karezan | 98 | 24603 | 2 | 24081 | 522 |
| Khanaqa | 100 | 6673 | 0 | 6673 | 0 |
| Khanzad | 100 | 19517 | 0 | 19517 | 0 |
| Khebat | 100 | 25424 | 0 | 25424 | 0 |
| Komari | 100 | 3893 | 0 | 3893 | 0 |
| Kurani aynkawa | 100 | 14376 | 0 | 14376 | 0 |
| Kurdistan | 100 | 35172 | 0 | 35172 | 0 |
| Kwestan | 100 | 13502 | 0 | 13502 | 0 |
| Mahabad | 100 | 11428 | 0 | 11428 | 0 |
| Majidawa | 100 | 2180 | 0 | 2180 | 0 |
| Mamostayan1 | 98 | 13402 | 2 | 13121 | 281 |
| Mamostayan2 | 100 | 9820 | 0 | 9820 | 0 |
| Mantikawa | 100 | 8525 | 0 | 8525 | 0 |
| Minara | 100 | 6960 | 0 | 6960 | 0 |
| Mstawfi | 100 | 8147 | 0 | 8147 | 0 |
| Mufti | 100 | 13645 | 0 | 13645 | 0 |
| Nawroz | 100 | 39105 | 0 | 39058 | 47 |
| Naz | 100 | 3000 | 0 | 3000 | 0 |
| Nishtiman | 100 | 14269 | 0 | 14269 | 0 |
| Nwsaran | 100 | 17700 | 0 | 17700 | 0 |
| Peeshasazi bashur | 100 | 1290 | 0 | 1290 | 0 |
| Qalat | 98 | 0 | 2 | 0 | 0 |

Table 4. 2 Accessibility results of community parks for 10 minutes driving (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|--------------------------|---------------|------------|-------------------|--------------------|------------------------|
| Raparin | 100 | 12096 | 0 | 12096 | 0 |
| Rastee | 100 | 9863 | 0 | 9863 | 0 |
| Runaki | 100 | 4867 | 0 | 4867 | 0 |
| Rzgari | 100 | 30146 | 0 | 30146 | 0 |
| Safeen2& pishasazi bakur | 100 | 939 | 0 | 939 | 0 |
| Safin1 | 100 | 3621 | 0 | 3621 | 0 |
| Safin3 | 100 | 1513 | 0 | 1513 | 0 |
| Salahaddin1 | 100 | 24056 | 0 | 24056 | 0 |
| Salahaddin2 | 100 | 7057 | 0 | 7057 | 0 |
| Sami abdulrahman | 99 | 579 | 1 | 576 | 3 |
| Sarbasti | 100 | 25670 | 0 | 25629 | 41 |
| Sarwaran | 100 | 5542 | 0 | 5542 | 0 |
| Saydawa | 100 | 14360 | 0 | 14360 | 0 |
| Setaqan | 100 | 12809 | 0 | 12809 | 0 |
| Shadi | 100 | 17695 | 0 | 17651 | 44 |
| Sharawani | 100 | 5942 | 0 | 5942 | 0 |
| Shorsh | 100 | 15595 | 0 | 15595 | 0 |
| Taajeel | 99 | 3859 | 1 | 3818 | 41 |
| Tayrawa | 97 | 19159 | 3 | 18554 | 605 |
| Twraq | 100 | 5870 | 0 | 5870 | 0 |
| Waziran | 100 | 4700 | 0 | 4700 | 0 |
| Zanayan | 0 | 17670 | 100 | 0 | 17670 |
| Zanko1 | 100 | 16777 | 0 | 16777 | 0 |
| Zanko2 | 100 | 4519 | 0 | 4513 | 6 |
| Zanyari | 100 | 5470 | 0 | 5470 | 0 |
| Zilan | 99 | 3231 | 1 | 3198 | 33 |

Table 4. 3 Accessibility results of community parks for 15 minutes driving

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-----------------|---------------|------------|-------------------|--------------------|------------------------|
| Andazyaran | 100 | 18376 | 0 | 18376 | 0 |
| Arab | 100 | 115 | 0 | 115 | 0 |
| Ari | 100 | 17976 | 0 | 17976 | 0 |
| Azadi1 | 100 | 15127 | 0 | 15127 | 0 |
| Azadi2 | 100 | 4490 | 0 | 4490 | 0 |
| Badawa | 100 | 16526 | 0 | 16514 | 12 |
| Bahar | 100 | 18753 | 0 | 18753 | 0 |
| Bahrka | 100 | 17987 | 0 | 17987 | 0 |
| Bakhtyari1 | 99 | 6789 | 1 | 6747 | 42 |
| Bakhtyari2 | 100 | 17404 | 0 | 17404 | 0 |
| Bazar | 100 | 2659 | 0 | 2659 | 0 |
| Berkot | 100 | 750 | 0 | 750 | 0 |
| Betwatae new | 100 | 3456 | 0 | 3456 | 0 |
| Brayati | 100 | 25865 | 0 | 25854 | 11 |
| Chinar | 100 | 14717 | 0 | 14717 | 0 |
| Chwarchra | 100 | 28707 | 0 | 28687 | 20 |
| Darstani bakur | 100 | 0 | 0 | 0 | 0 |
| Drem city | 100 | 8450 | 0 | 8450 | 0 |
| Empire | 100 | 0 | 0 | 0 | 0 |
| English village | 100 | 4350 | 0 | 4350 | 0 |
| Eskan | 100 | 7936 | 0 | 7936 | 0 |
| Ganjan city | 100 | 4567 | 0 | 4567 | 0 |
| Gorstani bakur | 100 | 300 | 0 | 300 | 0 |
| Gulan | 100 | 16157 | 0 | 16140 | 17 |
| Hamrin | 100 | 11198 | 0 | 11198 | 0 |
| Hana city | 100 | 4567 | 0 | 4550 | 17 |

Table 4. 3 Accessibility results of community parks for 15 minutes driving (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-------------------|---------------|------------|-------------------|--------------------|------------------------|
| Havalan | 100 | 16930 | 0 | 16930 | 0 |
| Hawleri new | 100 | 21896 | 0 | 21896 | 0 |
| Italian village | 100 | 3570 | 0 | 3555 | 15 |
| Kani | 100 | 23762 | 0 | 23762 | 0 |
| Karezan | 100 | 24603 | 0 | 24598 | 5 |
| Khanaqa | 100 | 6673 | 0 | 6673 | 0 |
| Khanzad | 100 | 19517 | 0 | 19517 | 0 |
| Khebat | 100 | 25424 | 0 | 25424 | 0 |
| Komari | 100 | 3893 | 0 | 3893 | 0 |
| Kurani aynkawa | 100 | 14376 | 0 | 14376 | 0 |
| Kurdistan | 100 | 35172 | 0 | 35172 | 0 |
| Kwestan | 100 | 13502 | 0 | 13502 | 0 |
| Mahabad | 100 | 11428 | 0 | 11428 | 0 |
| Majidawa | 100 | 2180 | 0 | 2180 | 0 |
| Mamostayan1 | 99 | 13402 | 1 | 13322 | 80 |
| Mamostayan2 | 100 | 9820 | 0 | 9820 | 0 |
| Mantikawa | 100 | 8525 | 0 | 8525 | 0 |
| Minara | 100 | 6960 | 0 | 6960 | 0 |
| Mstawfi | 100 | 8147 | 0 | 8147 | 0 |
| Mufti | 100 | 13645 | 0 | 13645 | 0 |
| Nawroz | 100 | 39105 | 0 | 39087 | 18 |
| Naz | 100 | 3000 | 0 | 3000 | 0 |
| Nishtiman | 100 | 14269 | 0 | 14269 | 0 |
| Nwsaran | 100 | 17700 | 0 | 17700 | 0 |
| Peeshasazi bashur | 100 | 1290 | 0 | 1290 | 0 |
| Qalat | 99 | 0 | 1 | 0 | 0 |

Table 4. 3 Accessibility results of community parks for 15 minutes driving (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|---------------------------|---------------|------------|-------------------|--------------------|------------------------|
| Raparin | 100 | 12096 | 0 | 12096 | 0 |
| Rastee | 100 | 9863 | 0 | 9863 | 0 |
| Runaki | 100 | 4867 | 0 | 4867 | 0 |
| Rzgari | 100 | 30146 | 0 | 30146 | 0 |
| Safeen2& pishasazi bashur | 100 | 939 | 0 | 939 | 0 |
| Safin1 | 100 | 3621 | 0 | 3621 | 0 |
| Safin3 | 100 | 1513 | 0 | 1513 | 0 |
| Salahaddin1 | 100 | 24056 | 0 | 24056 | 0 |
| Salahaddin2 | 100 | 7057 | 0 | 7057 | 0 |
| Sami abdulrahman | 100 | 579 | 0 | 578 | 1 |
| Sarbasti | 100 | 25670 | 0 | 25666 | 4 |
| Sarwaran | 100 | 5542 | 0 | 5542 | 0 |
| Saydawa | 100 | 14360 | 0 | 14360 | 0 |
| Setaqan | 100 | 12809 | 0 | 12809 | 0 |
| Shadi | 100 | 17695 | 0 | 17670 | 25 |
| Sharawani | 100 | 5942 | 0 | 5942 | 0 |
| Shorsh | 100 | 15595 | 0 | 15595 | 0 |
| Taajeel | 100 | 3859 | 0 | 3847 | 12 |
| Tayrawa | 98 | 19159 | 2 | 18849 | 310 |
| Twraq | 100 | 5870 | 0 | 5870 | 0 |
| Waziran | 100 | 4700 | 0 | 4700 | 0 |
| Zanayan | 0 | 17670 | 100 | 0 | 17670 |
| Zanko1 | 100 | 16777 | 0 | 16777 | 0 |
| Zanko2 | 100 | 4519 | 0 | 4517 | 2 |
| Zanyari | 100 | 5470 | 0 | 5470 | 0 |
| Zilan | 100 | 3231 | 0 | 3231 | 0 |

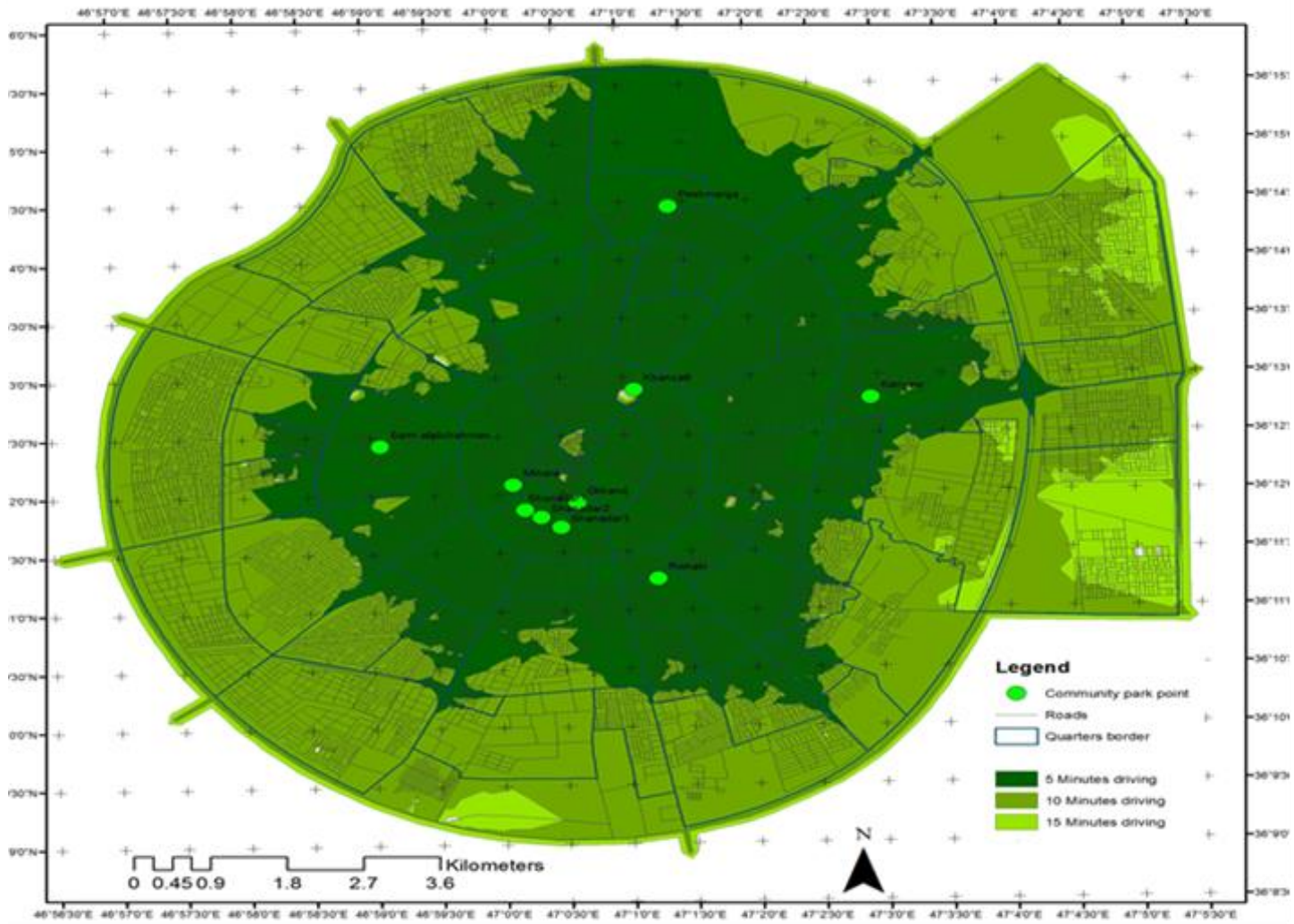


Figure 4. 1 Community parks accessibility for 5, 10 and 15 minutes.

Table 4. 4 Accessibility results of district parks for 5 minutes driving

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-----------------|---------------|------------|-------------------|--------------------|------------------------|
| Andazyaran | 100 | 18376 | 0 | 18376 | 0 |
| Arab | 100 | 115 | 0 | 115 | 0 |
| Azadi1 | 100 | 15127 | 0 | 15127 | 0 |
| Azadi2 | 100 | 4490 | 0 | 4490 | 0 |
| Badawa | 99 | 16526 | 1 | 16392 | 134 |
| Bahar | 100 | 18753 | 0 | 18753 | 0 |
| Bakhtyari1 | 33 | 6789 | 67 | 2260 | 4529 |
| Bakhtyari2 | 0 | 17404 | 100 | 20 | 17384 |
| Bazar | 100 | 2659 | 0 | 2659 | 0 |
| Betwatae nwe | 100 | 3456 | 0 | 3456 | 0 |
| Brayati | 41 | 25865 | 59 | 10680 | 15185 |
| Chinar | 100 | 14717 | 0 | 14717 | 0 |
| Chwarchra | 6 | 28707 | 94 | 1800 | 26907 |
| Drem city | 4 | 8450 | 96 | 303 | 8147 |
| Empire | 21 | 0 | 79 | 0 | 0 |
| English village | 24 | 4350 | 76 | 1047 | 3303 |
| Eskan | 100 | 7936 | 0 | 7936 | 0 |
| Gorstani bakur | 7 | 300 | 93 | 22 | 278 |
| Gulan | 25 | 16157 | 75 | 4093 | 12064 |
| Hamrin | 100 | 11198 | 0 | 11198 | 0 |
| Hana city | 28 | 4567 | 72 | 1277 | 3290 |
| Havalan | 89 | 16930 | 11 | 15018 | 1912 |
| Hawleri new | 34 | 21896 | 66 | 7448 | 14448 |
| Italian village | 76 | 3570 | 24 | 2707 | 863 |
| Karezan | 88 | 24603 | 12 | 21570 | 3033 |
| Khanaqa | 100 | 6673 | 0 | 6673 | 0 |

Table 4.4. Accessibility results of district parks for 5 minutes driving (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|---------------------------|---------------|------------|-------------------|--------------------|------------------------|
| Khanzad | 4 | 19517 | 96 | 840 | 18677 |
| Khebat | 97 | 25424 | 3 | 24745 | 679 |
| Komari | 100 | 3893 | 0 | 3893 | 0 |
| Kurdistan | 100 | 35172 | 0 | 35172 | 0 |
| Mahabad | 100 | 11428 | 0 | 11428 | 0 |
| Majidawa | 100 | 2180 | 0 | 2180 | 0 |
| Mamostayan1 | 96 | 13402 | 4 | 12848 | 554 |
| Mamostayan2 | 100 | 9820 | 0 | 9820 | 0 |
| Mantikawa | 100 | 8525 | 0 | 8525 | 0 |
| Minara | 100 | 6960 | 0 | 6944 | 16 |
| Mstawfi | 100 | 8147 | 0 | 8134 | 13 |
| Mufti | 100 | 13645 | 0 | 13645 | 0 |
| Nawroz | 85 | 39105 | 15 | 33353 | 5752 |
| Nishtiman | 100 | 14269 | 0 | 14266 | 3 |
| Nwsaran | 1 | 17700 | 99 | 200 | 17500 |
| Peeshasazi bashur | 51 | 1290 | 49 | 661 | 629 |
| Qalat | 97 | 0 | 3 | 0 | 0 |
| Rastee | 88 | 9863 | 12 | 8713 | 1150 |
| Runaki | 100 | 4867 | 0 | 4867 | 0 |
| Rzgari | 100 | 30146 | 0 | 30146 | 0 |
| Safeen2& pishasazi bashur | 0 | 939 | 100 | 3 | 936 |
| Salahaddin1 | 13 | 24056 | 87 | 3208 | 20848 |
| Sami abdulrahman | 65 | 579 | 35 | 377 | 202 |
| Sarbasti | 7 | 25670 | 93 | 1704 | 23966 |
| Sarwaran | 26 | 5542 | 74 | 1448 | 4094 |
| Saydawa | 100 | 14360 | 0 | 14360 | 0 |

Table 4.4. Accessibility results of district parks for 5 minutes driving (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-----------|---------------|------------|-------------------|--------------------|------------------------|
| Setaqan | 96 | 12809 | 4 | 12344 | 465 |
| Shadi | 40 | 17695 | 60 | 7031 | 10664 |
| Sharawani | 75 | 5942 | 25 | 4447 | 1495 |
| Shorsh | 5 | 15595 | 95 | 765 | 14830 |
| Taajeel | 98 | 3859 | 2 | 3792 | 67 |
| Tayrawa | 57 | 19159 | 43 | 10879 | 8280 |
| Twraq | 28 | 5870 | 72 | 1635 | 4235 |
| Waziran | 63 | 4700 | 37 | 2938 | 1762 |
| Zanko1 | 100 | 17670 | 0 | 17586 | 84 |
| Zanko2 | 89 | 16777 | 11 | 15013 | 1764 |
| Zanyari | 100 | 5470 | 0 | 5470 | 0 |
| Zilan | 93 | 3231 | 7 | 2993 | 238 |

Table 4. 5 Accessibility results of district parks for 10 minutes driving

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-----------------|---------------|------------|-------------------|--------------------|------------------------|
| Andazyaran | 100 | 18376 | 0 | 18376 | 0 |
| Arab | 100 | 115 | 0 | 115 | 0 |
| Ari | 100 | 17976 | 0 | 17976 | 0 |
| Azadi1 | 100 | 15127 | 0 | 15127 | 0 |
| Azadi2 | 100 | 4490 | 0 | 4490 | 0 |
| Badawa | 100 | 16526 | 0 | 16480 | 46 |
| Bahar | 100 | 18753 | 0 | 18753 | 0 |
| Bahrka | 48 | 17987 | 52 | 8575 | 9412 |
| Bakhtyari1 | 98 | 6789 | 2 | 6677 | 112 |
| Bakhtyari2 | 100 | 17404 | 0 | 17404 | 0 |
| Bazar | 100 | 2659 | 0 | 2659 | 0 |
| Berkot | 100 | 750 | 0 | 750 | 0 |
| Betwatae new | 100 | 3456 | 0 | 3456 | 0 |
| Brayati | 100 | 25865 | 0 | 25770 | 95 |
| Chinar | 100 | 14717 | 0 | 14717 | 0 |
| Chwarchra | 89 | 28707 | 11 | 25634 | 3073 |
| Darstani bakur | 46 | 0 | 54 | 0 | 0 |
| Drem city | 100 | 8450 | 0 | 8450 | 0 |
| Empire | 100 | 0 | 0 | 0 | 0 |
| English village | 100 | 4350 | 0 | 4350 | 0 |
| Eskan | 100 | 7936 | 0 | 7936 | 0 |
| Ganjan city | 88 | 4567 | 12 | 3999 | 568 |
| Gorstani bakur | 100 | 300 | 0 | 300 | 0 |
| Gulan | 100 | 16157 | 0 | 16104 | 53 |
| Hamrin | 100 | 11198 | 0 | 11198 | 0 |
| Hana city | 99 | 4567 | 1 | 4543 | 24 |

Table 4.5. Accessibility results of district parks for 10 minutes driving (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|------------------|---------------|------------|-------------------|--------------------|------------------------|
| Havalan | 100 | 16930 | 0 | 16930 | 0 |
| Hawleri new | 96 | 21896 | 4 | 21114 | 782 |
| Italian village | 99 | 3570 | 1 | 3531 | 39 |
| Kani | 100 | 23762 | 0 | 23762 | 0 |
| Karezan | 99 | 24603 | 1 | 24389 | 214 |
| Khanaqa | 100 | 6673 | 0 | 6673 | 0 |
| Khanzad | 100 | 19517 | 0 | 19517 | 0 |
| Khebat | 100 | 25424 | 0 | 25424 | 0 |
| Komari | 100 | 3893 | 0 | 3893 | 0 |
| kurani aynkawa | 100 | 14376 | 0 | 14376 | 0 |
| Kurdistan | 100 | 35172 | 0 | 35172 | 0 |
| Kwestan | 100 | 13502 | 0 | 13502 | 0 |
| Mahabad | 100 | 11428 | 0 | 11428 | 0 |
| Majidawa | 100 | 2180 | 0 | 2180 | 0 |
| Mamostayan1 | 98 | 13402 | 2 | 13127 | 275 |
| Mamostayan2 | 100 | 9820 | 0 | 9820 | 0 |
| Mantikawa | 100 | 8525 | 0 | 8525 | 0 |
| Minara | 100 | 6960 | 0 | 6955 | 5 |
| Mstawfi | 100 | 8147 | 0 | 8147 | 0 |
| Mufti | 100 | 13645 | 0 | 13645 | 0 |
| Nawroz | 100 | 39105 | 0 | 39068 | 37 |
| Naz | 85 | 3000 | 15 | 2553 | 447 |
| Nishtiman | 100 | 14269 | 0 | 14269 | 0 |
| Nwsaran | 100 | 17700 | 0 | 17700 | 0 |
| Peeshasazi bakur | 100 | 1290 | 0 | 1290 | 0 |
| Qalat | 98 | 0 | 2 | 0 | 0 |

Table 4.5. Accessibility results of district parks for 10 minutes driving (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|------------------------------|---------------|------------|-------------------|--------------------|------------------------|
| Raparin | 100 | 12096 | 0 | 12096 | 0 |
| Rastee | 100 | 9863 | 0 | 9863 | 0 |
| Runaki | 100 | 4867 | 0 | 4867 | 0 |
| Rzgari | 100 | 30146 | 0 | 30146 | 0 |
| Safeen2& pishasazi bashur | 99 | 939 | 1 | 934 | 5 |
| Safin1 | 100 | 3621 | 0 | 3621 | 0 |
| Safin3 | 100 | 1513 | 0 | 1513 | 0 |
| Salahaddin1 | 100 | 24056 | 0 | 24056 | 0 |
| Salahaddin2 | 85 | 7057 | 15 | 5971 | 1086 |
| Sami abdulrahman | 99 | 579 | 1 | 575 | 4 |
| Sarbasti | 100 | 25670 | 0 | 25661 | 9 |
| Sarwaran | 100 | 5542 | 0 | 5542 | 0 |
| Saydawa | 100 | 14360 | 0 | 14360 | 0 |
| Setaqan | 100 | 12809 | 0 | 12809 | 0 |
| Shadi | 100 | 17695 | 0 | 17667 | 28 |
| Sharawani | 100 | 5942 | 0 | 5942 | 0 |
| Shorsh | 100 | 15595 | 0 | 15595 | 0 |
| Taajeel | 99 | 3859 | 1 | 3823 | 36 |
| Tayrawa | 96 | 19159 | 4 | 18478 | 681 |
| Twraq | 100 | 5870 | 0 | 5870 | 0 |
| Waziran | 100 | 4700 | 0 | 4700 | 0 |
| Zanayan | 0 | 17670 | 100 | 0 | 17670 |
| Zanko1 | 100 | 16777 | 0 | 16760 | 17 |
| Zanko2 | 100 | 4519 | 0 | 4514 | 5 |
| Zanyari | 100 | 5470 | 0 | 5470 | 0 |
| Zilan | 100 | 3231 | 0 | 3231 | 0 |

Table 4. 6 Accessibility results of district parks for 15 minutes driving

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-----------------|---------------|------------|-------------------|--------------------|------------------------|
| Ainkawa | 100 | 0 | 0 | 0 | 0 |
| Andazyaran | 100 | 18376 | 0 | 18376 | 0 |
| Arab | 100 | 115 | 0 | 115 | 0 |
| Ari | 100 | 17976 | 0 | 17976 | 0 |
| Azadi1 | 100 | 15127 | 0 | 15127 | 0 |
| Azadi2 | 100 | 4490 | 0 | 4490 | 0 |
| Badawa | 100 | 16526 | 0 | 16522 | 4 |
| Bahar | 100 | 18753 | 0 | 18753 | 0 |
| Bahrka | 100 | 17987 | 0 | 17987 | 0 |
| Bakhtyari1 | 99 | 6789 | 1 | 6749 | 40 |
| Bakhtyari2 | 100 | 17404 | 0 | 17404 | 0 |
| Bazar | 100 | 2659 | 0 | 2659 | 0 |
| Berkot | 100 | 750 | 0 | 750 | 0 |
| Betwatae new | 100 | 3456 | 0 | 3456 | 0 |
| Brayati | 100 | 25865 | 0 | 25832 | 33 |
| Chinar | 100 | 14717 | 0 | 14717 | 0 |
| Chwarchra | 100 | 28707 | 0 | 28707 | 0 |
| Darstani bakur | 100 | 0 | 0 | 0 | 0 |
| Drem city | 100 | 8450 | 0 | 8450 | 0 |
| Empire | 100 | 0 | 0 | 0 | 0 |
| English village | 100 | 4350 | 0 | 4350 | 0 |
| Eskan | 100 | 7936 | 0 | 7936 | 0 |
| Ganjan city | 100 | 4567 | 0 | 4567 | 0 |
| Gorstani bakur | 100 | 300 | 0 | 300 | 0 |
| Gulan | 100 | 16157 | 0 | 16138 | 19 |
| Hamrin | 100 | 11198 | 0 | 11198 | 0 |

Table 4.6. Accessibility results of district parks for 15 minutes driving (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-------------------|---------------|------------|-------------------|--------------------|------------------------|
| Hana city | 100 | 4567 | 0 | 4555 | 12 |
| Havalan | 100 | 16930 | 0 | 16930 | 0 |
| Hawleri new | 100 | 21896 | 0 | 21896 | 0 |
| Italian village | 100 | 3570 | 0 | 3556 | 14 |
| Kani | 100 | 23762 | 0 | 23762 | 0 |
| Karezan | 100 | 24603 | 0 | 24599 | 4 |
| Khanaqa | 100 | 6673 | 0 | 6673 | 0 |
| Khanzad | 100 | 19517 | 0 | 19517 | 0 |
| Khebat | 100 | 25424 | 0 | 25424 | 0 |
| Komari | 100 | 3893 | 0 | 3893 | 0 |
| kurani aynkawa | 100 | 14376 | 0 | 14376 | 0 |
| Kurdistan | 100 | 35172 | 0 | 35172 | 0 |
| Kwestan | 100 | 13502 | 0 | 13502 | 0 |
| Mahabad | 100 | 11428 | 0 | 11428 | 0 |
| Majidawa | 100 | 2180 | 0 | 2180 | 0 |
| Mamostayan1 | 99 | 13402 | 1 | 13323 | 79 |
| Mamostayan2 | 100 | 9820 | 0 | 9820 | 0 |
| Mantikawa | 100 | 8525 | 0 | 8525 | 0 |
| Minara | 100 | 6960 | 0 | 6960 | 0 |
| Mstawfi | 100 | 8147 | 0 | 8147 | 0 |
| Mufti | 100 | 13645 | 0 | 13645 | 0 |
| Nawroz | 100 | 39105 | 0 | 39092 | 13 |
| Naz | 100 | 3000 | 0 | 3000 | 0 |
| Nishtiman | 100 | 14269 | 0 | 14269 | 0 |
| Nwsaran | 100 | 17700 | 0 | 17700 | 0 |
| Peeshasazi bashur | 100 | 1290 | 0 | 1290 | 0 |

Table 4.6. Accessibility results of district parks for 15 minutes driving (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|---------------------------|---------------|------------|-------------------|--------------------|------------------------|
| Qalat | 99 | 0 | 1 | 0 | 0 |
| Raparin | 100 | 12096 | 0 | 12096 | 0 |
| Rastee | 100 | 9863 | 0 | 9863 | 0 |
| Runaki | 100 | 4867 | 0 | 4867 | 0 |
| Rzgari | 100 | 30146 | 0 | 30146 | 0 |
| Safeen2& pishasazi bashur | 100 | 939 | 0 | 939 | 0 |
| Safin1 | 100 | 3621 | 0 | 3621 | 0 |
| Safin3 | 100 | 1513 | 0 | 1513 | 0 |
| Salahaddin1 | 100 | 24056 | 0 | 24056 | 0 |
| Salahaddin2 | 100 | 7057 | 0 | 7057 | 0 |
| Sami abdulrahman | 100 | 579 | 0 | 578 | 1 |
| Sarbasti | 100 | 25670 | 0 | 25666 | 4 |
| Sarwaran | 100 | 5542 | 0 | 5542 | 0 |
| Saydawa | 100 | 14360 | 0 | 14360 | 0 |
| Setaqan | 100 | 12809 | 0 | 12809 | 0 |
| Shadi | 100 | 17695 | 0 | 17670 | 25 |
| Sharawani | 100 | 5942 | 0 | 5942 | 0 |
| Shorsh | 100 | 15595 | 0 | 15595 | 0 |
| Taajeel | 100 | 3859 | 0 | 3848 | 11 |
| Tayrawa | 98 | 19159 | 2 | 18825 | 334 |
| Twraq | 100 | 5870 | 0 | 5870 | 0 |
| Waziran | 100 | 4700 | 0 | 4700 | 0 |
| Anayan | 0 | 17670 | 100 | 0 | 17670 |
| Zanko1 | 100 | 16777 | 0 | 16777 | 0 |
| Zanko2 | 100 | 4519 | 0 | 4518 | 1 |
| Zanyari | 100 | 5470 | 0 | 5470 | 0 |
| Zilan | 100 | 3231 | 0 | 3231 | 0 |

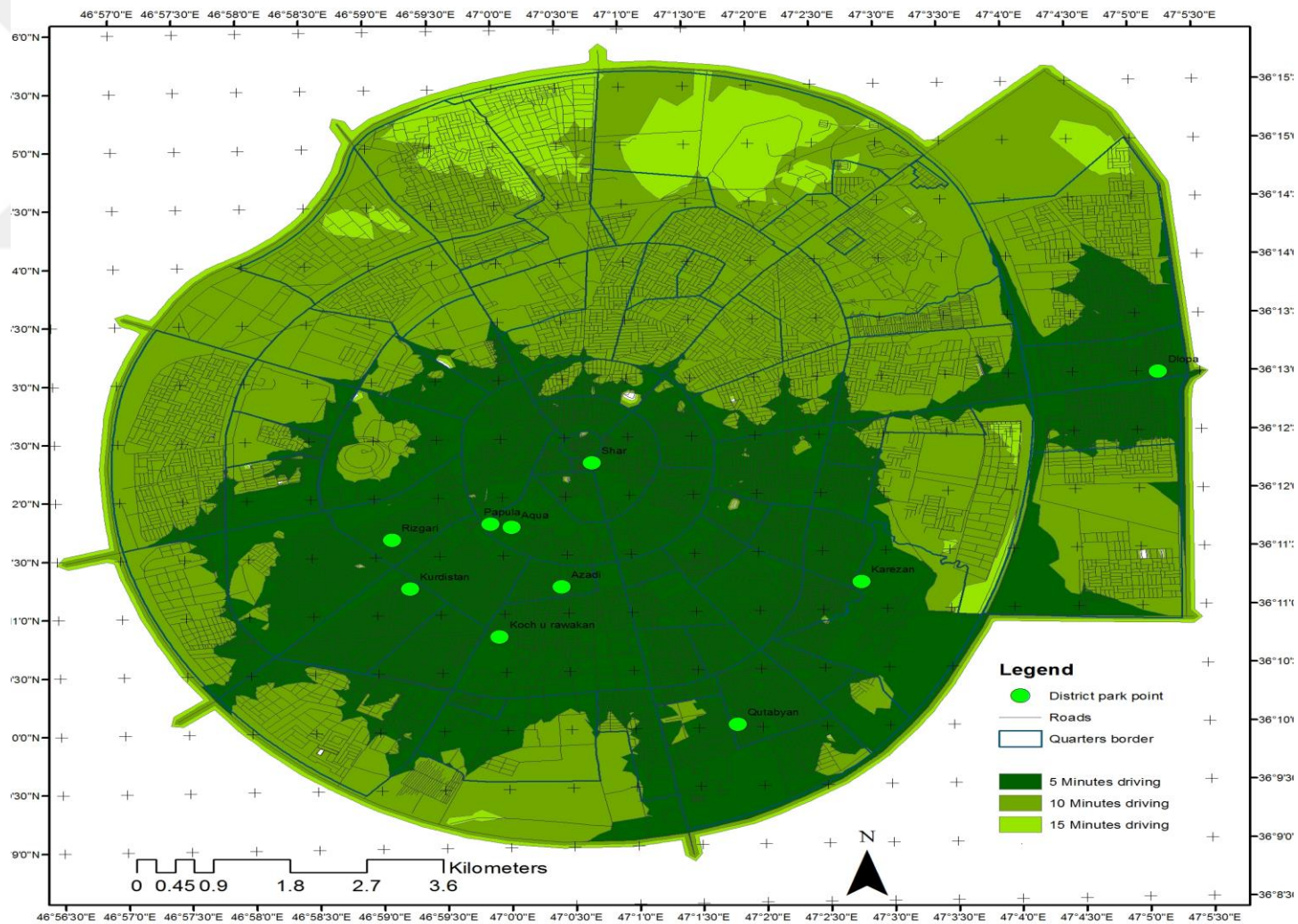


Figure 4. 2 District parks accessibility for 5, 10 and 15 minutes.

Table 4. 7 Accessibility results of neighborhood parks for 5 minutes walking

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|----------------|---------------|------------|-------------------|--------------------|------------------------|
| Andazyaran | 67 | 18376 | 33 | 12321 | 6055 |
| Arab | 22 | 115 | 78 | 26 | 89 |
| Ari | 72 | 17976 | 28 | 12856 | 5120 |
| Azadi1 | 51 | 15127 | 49 | 7747 | 7380 |
| Azadi2 | 37 | 4490 | 63 | 1640 | 2850 |
| Badawa | 18 | 16526 | 82 | 2971 | 13555 |
| Bahar | 28 | 18753 | 72 | 5202 | 13551 |
| Bahrka | 0 | 17987 | 100 | 50 | 17937 |
| Bakhtyari1 | 79 | 6789 | 21 | 5388 | 1401 |
| Bakhtyari2 | 5 | 17404 | 95 | 818 | 16586 |
| Bazar | 38 | 2659 | 62 | 1024 | 1635 |
| Berkot | 3 | 750 | 97 | 22 | 728 |
| Brayati | 74 | 25865 | 26 | 19097 | 6768 |
| Chinar | 49 | 14717 | 51 | 7193 | 7524 |
| Chwarchra | 23 | 28707 | 77 | 6517 | 22190 |
| Darstani bakur | 2 | 0 | 98 | 0 | 0 |
| Drem city | 9 | 8450 | 91 | 778 | 7672 |
| Eskan | 63 | 7936 | 37 | 5009 | 2927 |
| Gorstani bakur | 8 | 300 | 92 | 25 | 275 |
| Gulan | 34 | 16157 | 66 | 5487 | 10670 |
| Hamrin | 42 | 11198 | 58 | 4718 | 6480 |
| Havalan | 89 | 16930 | 11 | 14999 | 1931 |
| Hawleri new | 5 | 21896 | 95 | 1141 | 20755 |
| Kani | 100 | 23762 | 0 | 23762 | 0 |
| Karezan | 3 | 24603 | 97 | 715 | 23888 |
| Khanaqa | 26 | 6673 | 74 | 1725 | 4948 |

Table 4.7. Accessibility results of neighborhood parks for 5 minutes walking (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|--------------------------|---------------|------------|-------------------|--------------------|------------------------|
| Khanzad | 73 | 19517 | 27 | 14199 | 5318 |
| Khebat | 73 | 25424 | 27 | 18571 | 6853 |
| Komari | 9 | 3893 | 91 | 356 | 3537 |
| Kurdistan | 16 | 35172 | 84 | 5575 | 29597 |
| Kwestan | 68 | 13502 | 32 | 9204 | 4298 |
| Mahabad | 54 | 11428 | 46 | 6157 | 5271 |
| Majidawa | 39 | 2180 | 61 | 854 | 1326 |
| Mamostayan1 | 87 | 13402 | 13 | 11667 | 1735 |
| Mamostayan2 | 63 | 9820 | 37 | 6234 | 3586 |
| Mantikawa | 74 | 8525 | 26 | 6294 | 2231 |
| Minara | 43 | 6960 | 57 | 3017 | 3943 |
| Mstawfi | 38 | 8147 | 62 | 3104 | 5043 |
| Mufti | 93 | 13645 | 7 | 12721 | 924 |
| Nawroz | 30 | 39105 | 70 | 11638 | 27467 |
| Naz | 1 | 3000 | 99 | 40 | 2960 |
| Nishtiman | 21 | 14269 | 79 | 3015 | 11254 |
| Nwsaran | 32 | 17700 | 68 | 5709 | 11991 |
| Peeshasazi bashur | 9 | 1290 | 91 | 111 | 1179 |
| Qalat | 5 | 0 | 95 | 0 | 0 |
| Raparin | 94 | 12096 | 6 | 11423 | 673 |
| Rastee | 83 | 9863 | 17 | 8191 | 1672 |
| Runaki | 91 | 4867 | 9 | 4414 | 453 |
| Rzgari | 56 | 30146 | 44 | 16936 | 13210 |
| Safeen2& pishasazi bakur | 8 | 939 | 92 | 72 | 867 |
| Safin3 | 91 | 1513 | 9 | 1372 | 141 |
| Salahaddin1 | 56 | 24056 | 44 | 13353 | 10703 |
| Sami abdulrahman | 0 | 579 | 100 | 1 | 578 |

Table 4.7. Accessibility results of neighborhood parks for 5 minutes walking (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-----------|---------------|------------|-------------------|--------------------|------------------------|
| Sarbasti | 7 | 25670 | 93 | 1875 | 23795 |
| Sarwaran | 81 | 5542 | 19 | 4474 | 1068 |
| Saydawa | 50 | 14360 | 50 | 7232 | 7128 |
| Setaqan | 73 | 12809 | 27 | 9386 | 3423 |
| Shadi | 31 | 17695 | 69 | 5515 | 12180 |
| Sharawani | 32 | 5942 | 68 | 1889 | 4053 |
| Shorsh | 89 | 15595 | 11 | 13876 | 1719 |
| Taajeel | 36 | 3859 | 64 | 1376 | 2483 |
| Tayrawa | 54 | 19159 | 46 | 10256 | 8903 |
| Twraq | 1 | 5870 | 99 | 63 | 5807 |
| Waziran | 54 | 4700 | 46 | 2535 | 2165 |
| Zanko1 | 45 | 16777 | 55 | 7536 | 9241 |
| Zanko2 | 17 | 4519 | 83 | 764 | 3755 |
| Zanyari | 43 | 5470 | 57 | 2345 | 3125 |

Table 4. 8 Accessibility results of neighborhood parks for 10 minutes walking

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|----------------|---------------|------------|-------------------|--------------------|------------------------|
| Andazyaran | 100 | 18376 | 0 | 18376 | 0 |
| Arab | 97 | 115 | 3 | 112 | 3 |
| Ari | 100 | 17976 | 0 | 17976 | 0 |
| Azadi1 | 96 | 15127 | 4 | 14459 | 668 |
| Azadi2 | 100 | 4490 | 0 | 4490 | 0 |
| Badawa | 79 | 16526 | 21 | 13036 | 3490 |
| Bahar | 98 | 18753 | 2 | 18307 | 446 |
| Bahrka | 11 | 17987 | 89 | 2033 | 15954 |
| Bakhtyari1 | 97 | 6789 | 3 | 6557 | 232 |
| Bakhtyari2 | 31 | 17404 | 69 | 5402 | 12002 |
| Bazar | 100 | 2659 | 0 | 2659 | 0 |
| Berkot | 22 | 750 | 78 | 162 | 588 |
| Betwatae new | 4 | 3456 | 96 | 132 | 3324 |
| Brayati | 100 | 25865 | 0 | 25805 | 60 |
| Chinar | 92 | 14717 | 8 | 13580 | 1137 |
| Chwarchra | 49 | 28707 | 51 | 14081 | 14626 |
| Darstani bakur | 8 | 0 | 92 | 0 | 0 |
| Drem city | 38 | 8450 | 62 | 3216 | 5234 |
| Empire | 0 | 0 | 100 | 0 | 0 |
| Eskan | 100 | 7936 | 0 | 7936 | 0 |
| Ganjan city | 19 | 4567 | 81 | 847 | 3720 |
| Gorstani bakur | 24 | 300 | 76 | 71 | 229 |
| Gulan | 78 | 16157 | 22 | 12616 | 3541 |
| Hamrin | 100 | 11198 | 0 | 11198 | 0 |
| Havalan | 96 | 16930 | 4 | 16328 | 602 |
| Hawleri new | 18 | 21896 | 82 | 3892 | 18004 |

Table 4.8. Accessibility results of neighborhood parks for 10 minutes walking (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-------------------|---------------|------------|-------------------|--------------------|------------------------|
| Italian village | 3 | 3570 | 97 | 106 | 3464 |
| Kani | 100 | 23762 | 0 | 23762 | 0 |
| Karezan | 16 | 24603 | 84 | 3970 | 20633 |
| Khanaqa | 100 | 6673 | 0 | 6673 | 0 |
| Khanzad | 100 | 19517 | 0 | 19517 | 0 |
| Khebat | 100 | 25424 | 0 | 25424 | 0 |
| Komari | 95 | 3893 | 5 | 3693 | 200 |
| Kurdistan | 74 | 35172 | 26 | 25881 | 9291 |
| Kwestan | 97 | 13502 | 3 | 13075 | 427 |
| Mahabad | 100 | 11428 | 0 | 11428 | 0 |
| Majidawa | 100 | 2180 | 0 | 2180 | 0 |
| Mamostayan1 | 98 | 13402 | 2 | 13169 | 233 |
| Mamostayan2 | 100 | 9820 | 0 | 9820 | 0 |
| Mantikawa | 100 | 8525 | 0 | 8525 | 0 |
| Minara | 90 | 6960 | 10 | 6266 | 694 |
| Mstawfi | 95 | 8147 | 5 | 7712 | 435 |
| Mufti | 100 | 13645 | 0 | 13645 | 0 |
| Nawroz | 72 | 39105 | 28 | 28193 | 10912 |
| Naz | 10 | 3000 | 90 | 290 | 2710 |
| Nishtiman | 59 | 14269 | 41 | 8429 | 5840 |
| Nwsaran | 89 | 17700 | 11 | 15718 | 1982 |
| Peeshasazi bashur | 35 | 1290 | 65 | 448 | 842 |
| Qalat | 75 | 0 | 25 | 0 | 0 |
| Raparin | 100 | 12096 | 0 | 12096 | 0 |
| Rastee | 100 | 9863 | 0 | 9863 | 0 |
| Runaki | 100 | 4867 | 0 | 4867 | 0 |

Table 4.8. Accessibility results of neighborhood parks for 10 minutes walking (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|--------------------------|---------------|------------|-------------------|--------------------|------------------------|
| Rzgari | 100 | 30146 | 0 | 30000 | 146 |
| Safeen2& pishasazi bakur | 26 | 939 | 74 | 242 | 697 |
| Safin1 | 30 | 3621 | 70 | 1098 | 2523 |
| Safin3 | 100 | 1513 | 0 | 1513 | 0 |
| Salahaddin1 | 100 | 24056 | 0 | 24010 | 46 |
| Salahaddin2 | 4 | 7057 | 96 | 252 | 6805 |
| Sami abdulrahman | 13 | 579 | 87 | 74 | 505 |
| Sarbasti | 23 | 25670 | 77 | 5869 | 19801 |
| Sarwaran | 100 | 5542 | 0 | 5538 | 4 |
| Saydawa | 100 | 14360 | 0 | 14315 | 45 |
| Setaqan | 100 | 12809 | 0 | 12809 | 0 |
| Shadi | 79 | 17695 | 21 | 14011 | 3684 |
| Sharawani | 40 | 5942 | 60 | 2406 | 3536 |
| Shorsh | 99 | 15595 | 1 | 15504 | 91 |
| Taajeel | 99 | 3859 | 1 | 3805 | 54 |
| Tayrawa | 96 | 19159 | 4 | 18329 | 830 |
| Twraq | 10 | 5870 | 90 | 601 | 5269 |
| Waziran | 99 | 4700 | 1 | 4670 | 30 |
| Zanko1 | 99 | 16777 | 1 | 16628 | 149 |
| Zanko2 | 58 | 4519 | 42 | 2630 | 1889 |
| Zanyari | 93 | 5470 | 7 | 5081 | 389 |
| Zilan | 1 | 3231 | 99 | 28 | 3203 |

Table 4. 9 Accessibility results of neighborhood parks for 15 minutes walking

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-----------------|---------------|------------|-------------------|--------------------|------------------------|
| Andazyaran | 100 | 18376 | 0 | 18376 | 0 |
| Arab | 100 | 115 | 0 | 115 | 0 |
| Ari | 100 | 17976 | 0 | 17976 | 0 |
| Azadi1 | 100 | 15127 | 0 | 15127 | 0 |
| Azadi2 | 100 | 4490 | 0 | 4490 | 0 |
| Badawa | 100 | 16526 | 0 | 16502 | 24 |
| Bahar | 100 | 18753 | 0 | 18753 | 0 |
| Bahrka | 25 | 17987 | 75 | 4541 | 13446 |
| Bakhtyari1 | 100 | 6789 | 0 | 6759 | 30 |
| Bakhtyari2 | 62 | 17404 | 38 | 10819 | 6585 |
| Bazar | 100 | 2659 | 0 | 2659 | 0 |
| Berkot | 70 | 750 | 30 | 524 | 226 |
| Betwatae new | 19 | 3456 | 81 | 659 | 2797 |
| Brayati | 100 | 25865 | 0 | 25840 | 25 |
| Chinar | 100 | 14717 | 0 | 14717 | 0 |
| Chwarchra | 70 | 28707 | 30 | 20157 | 8550 |
| Darstani bakur | 16 | 0 | 84 | 0 | 0 |
| Drem city | 79 | 8450 | 21 | 6660 | 1790 |
| Empire | 12 | 0 | 88 | 0 | 0 |
| English village | 2 | 4350 | 98 | 88 | 4262 |
| Eskan | 100 | 7936 | 0 | 7936 | 0 |
| Ganjan city | 62 | 4567 | 38 | 2816 | 1751 |
| Gorstani bakur | 42 | 300 | 58 | 127 | 173 |
| Gulan | 98 | 16157 | 2 | 15841 | 316 |
| Hamrin | 100 | 11198 | 0 | 11198 | 0 |
| Havalan | 99 | 16930 | 1 | 16702 | 228 |

Table 4.9. Accessibility results of neighborhood parks for 15 minutes walking (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-------------------|---------------|------------|-------------------|--------------------|------------------------|
| Hawleri new | 39 | 21896 | 61 | 8482 | 13414 |
| Italian village | 15 | 3570 | 85 | 553 | 3017 |
| Kani | 100 | 23762 | 0 | 23762 | 0 |
| Karezan | 41 | 24603 | 59 | 10201 | 14402 |
| Khanaqa | 100 | 6673 | 0 | 6673 | 0 |
| Khanzad | 100 | 19517 | 0 | 19517 | 0 |
| Khebat | 100 | 25424 | 0 | 25424 | 0 |
| Komari | 100 | 3893 | 0 | 3893 | 0 |
| kurani ayinkawa | 20 | 14376 | 80 | 2873 | 11503 |
| Kurdistan | 99 | 35172 | 1 | 34877 | 295 |
| Kwestan | 100 | 13502 | 0 | 13502 | 0 |
| Mahabad | 100 | 11428 | 0 | 11428 | 0 |
| Majidawa | 100 | 2180 | 0 | 2180 | 0 |
| Mamostayan1 | 99 | 13402 | 1 | 13333 | 69 |
| Mamostayan2 | 100 | 9820 | 0 | 9820 | 0 |
| Mantikawa | 100 | 8525 | 0 | 8525 | 0 |
| Minara | 99 | 6960 | 1 | 6923 | 37 |
| Mstawfi | 100 | 8147 | 0 | 8147 | 0 |
| Mufti | 100 | 13645 | 0 | 13645 | 0 |
| Nawroz | 94 | 39105 | 6 | 36835 | 2270 |
| Naz | 27 | 3000 | 73 | 808 | 2192 |
| Nishtiman | 86 | 14269 | 14 | 12203 | 2066 |
| Nwsaran | 100 | 17700 | 0 | 17700 | 0 |
| Peeshasazi bashur | 67 | 1290 | 33 | 862 | 428 |
| Qalat | 99 | 0 | 1 | 0 | 0 |
| Raparin | 100 | 12096 | 0 | 12096 | 0 |

Table 4.9. Accessibility results of neighborhood parks for 15 minutes walking (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|------------------------------|---------------|------------|-------------------|--------------------|------------------------|
| Rastee | 100 | 9863 | 0 | 9863 | 0 |
| Runaki | 100 | 4867 | 0 | 4867 | 0 |
| Rzgari | 100 | 30146 | 0 | 30146 | 0 |
| Safeen2& pishasazi bashur | 53 | 939 | 47 | 501 | 438 |
| Safin1 | 100 | 3621 | 0 | 3621 | 0 |
| Safin3 | 100 | 1513 | 0 | 1513 | 0 |
| Salahaddin1 | 100 | 24056 | 0 | 24056 | 0 |
| Salahaddin2 | 38 | 7057 | 62 | 2648 | 4409 |
| Sami abdulrahman | 46 | 579 | 54 | 268 | 311 |
| Sarbasti | 37 | 25670 | 63 | 9545 | 16125 |
| Sarwaran | 100 | 5542 | 0 | 5542 | 0 |
| Saydawa | 100 | 14360 | 0 | 14354 | 6 |
| Setaqan | 100 | 12809 | 0 | 12809 | 0 |
| Shadi | 96 | 17695 | 4 | 16958 | 737 |
| Sharawani | 52 | 5942 | 48 | 3069 | 2873 |
| Shorsh | 100 | 15595 | 0 | 15575 | 20 |
| Taajeel | 100 | 3859 | 0 | 3842 | 17 |
| Tayrawa | 98 | 19159 | 2 | 18791 | 368 |
| Twraq | 31 | 5870 | 69 | 1824 | 4046 |
| Waziran | 100 | 4700 | 0 | 4700 | 0 |
| Zanko1 | 100 | 16777 | 0 | 16777 | 0 |
| Zanko2 | 78 | 4519 | 22 | 3544 | 975 |
| Zanyari | 100 | 5470 | 0 | 5470 | 0 |
| Zilan | 6 | 3231 | 94 | 187 | 3044 |

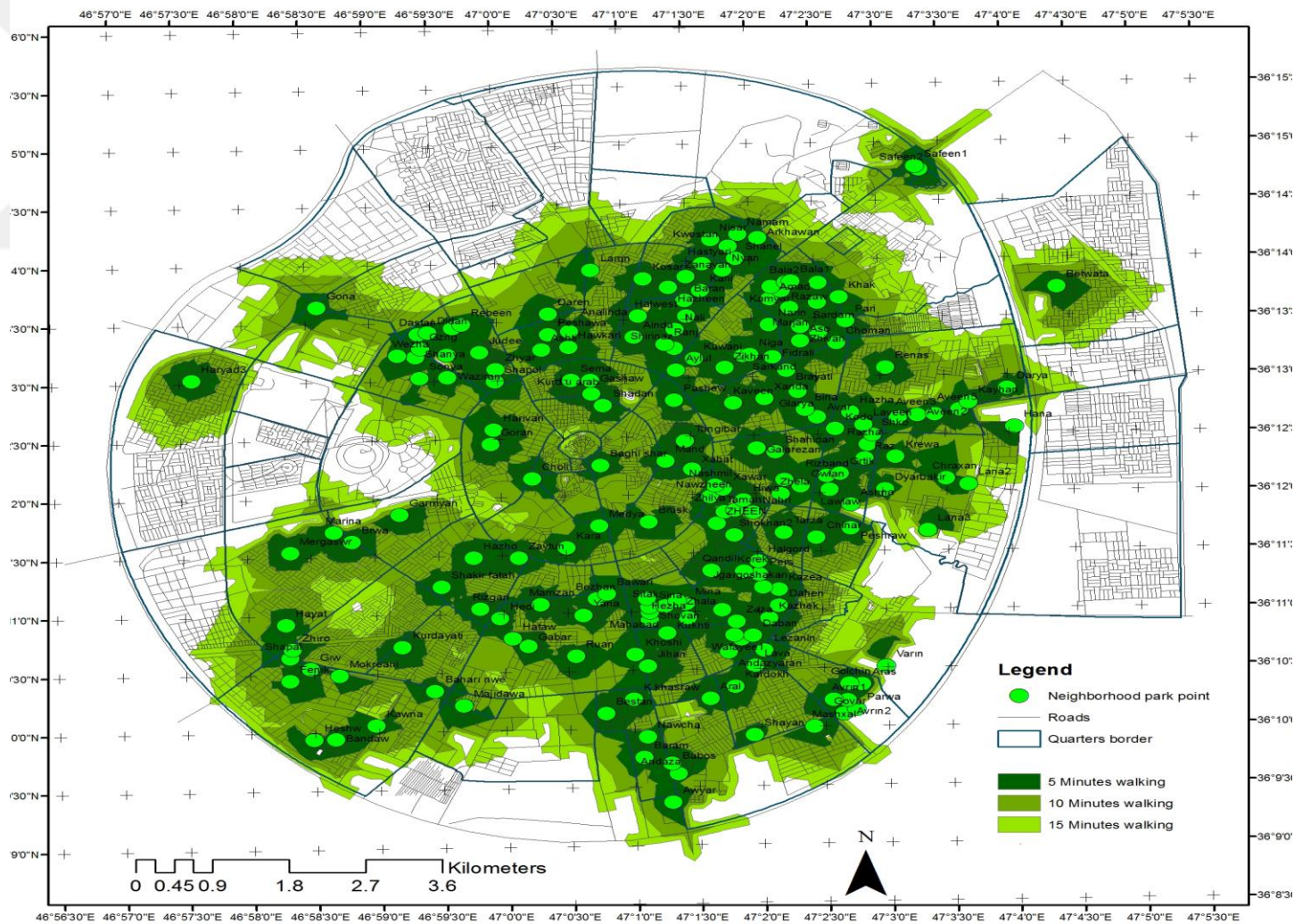


Figure 4. 3 Accessibility of neighborhood parks for 5, 10 and 15 minutes.

Table 4. 10 Accessibility results of mini parks for 5 minutes walking

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-----------------|---------------|------------|-------------------|--------------------|------------------------|
| Andazyaran | 49 | 18376 | 51 | 9034 | 9342 |
| Arab | 76 | 115 | 24 | 88 | 27 |
| Ari | 22 | 17976 | 78 | 3942 | 14034 |
| Azadi1 | 8 | 15127 | 92 | 1144 | 13983 |
| Azadi2 | 17 | 4490 | 83 | 783 | 3707 |
| Bahar | 20 | 18753 | 80 | 3811 | 14942 |
| Bakhtyari1 | 8 | 6789 | 92 | 541 | 6248 |
| Bakhtyari2 | 0 | 17404 | 100 | 21 | 17383 |
| Bazar | 1 | 2659 | 99 | 23 | 2636 |
| Berkot | 3 | 750 | 97 | 23 | 727 |
| Brayati | 12 | 25865 | 88 | 3093 | 22772 |
| Chinar | 0 | 14717 | 100 | 11 | 14706 |
| Chwarchra | 1 | 28707 | 99 | 387 | 28320 |
| English village | 3 | 4350 | 97 | 142 | 4208 |
| Eskan | 68 | 7936 | 32 | 5383 | 2553 |
| Gorstani bakur | 1 | 300 | 99 | 2 | 298 |
| Gulan | 23 | 16157 | 77 | 3684 | 12473 |
| Hamrin | 1 | 11198 | 99 | 102 | 11096 |
| Havalan | 10 | 16930 | 90 | 1680 | 15250 |
| Italian village | 3 | 3570 | 97 | 122 | 3448 |
| Kani | 8 | 23762 | 92 | 1949 | 21813 |
| Khanaqa | 8 | 6673 | 92 | 530 | 6143 |
| Khanzad | 12 | 19517 | 88 | 2248 | 17269 |
| Khebat | 10 | 25424 | 90 | 2578 | 22846 |
| Komari | 34 | 3893 | 66 | 1321 | 2572 |
| Kurdistan | 48 | 35172 | 52 | 16971 | 18201 |

Table 4.10. Accessibility results of mini parks for 5 minutes walking (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|--------------------------|---------------|------------|-------------------|--------------------|------------------------|
| Kwestan | 18 | 13502 | 82 | 2386 | 11116 |
| Mahabad | 36 | 11428 | 64 | 4095 | 7333 |
| Mamostayan1 | 72 | 13402 | 28 | 9708 | 3694 |
| Mamostayan2 | 37 | 9820 | 63 | 3600 | 6220 |
| Mantikawa | 44 | 8525 | 56 | 3789 | 4736 |
| Minara | 39 | 6960 | 61 | 2726 | 4234 |
| Mstawfi | 50 | 8147 | 50 | 4050 | 4097 |
| Mufti | 38 | 13645 | 62 | 5200 | 8445 |
| Nawroz | 19 | 39105 | 81 | 7478 | 31627 |
| Nishtiman | 4 | 14269 | 96 | 600 | 13669 |
| Qalat | 4 | 0 | 96 | 0 | 0 |
| Raparin | 44 | 12096 | 56 | 5337 | 6759 |
| Runaki | 9 | 4867 | 91 | 418 | 4449 |
| Rzgari | 14 | 30146 | 86 | 4159 | 25987 |
| Safeen2& pishasazi bakur | 2 | 939 | 98 | 19 | 920 |
| Salahaddin1 | 0 | 24056 | 100 | 3 | 24053 |
| Sarbasti | 11 | 25670 | 89 | 2946 | 22724 |
| Sarwaran | 15 | 5542 | 85 | 857 | 4685 |
| Saydawa | 3 | 14360 | 97 | 378 | 13982 |
| Setaqan | 52 | 12809 | 48 | 6720 | 6089 |
| Shorsh | 38 | 15595 | 62 | 5893 | 9702 |
| Taajeel | 21 | 3859 | 79 | 830 | 3029 |
| Tayrawa | 33 | 19159 | 67 | 6356 | 12803 |
| Zanko1 | 17 | 16777 | 83 | 2823 | 13954 |
| Zanko2 | 11 | 4519 | 89 | 504 | 4015 |
| Zanyari | 59 | 5470 | 41 | 3214 | 2256 |

Table 4. 11 Accessibility results of mini parks for 10 minutes walking

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-----------------|---------------|------------|-------------------|--------------------|------------------------|
| Andazyaran | 100 | 18376 | 0 | 18376 | 0 |
| Arab | 100 | 115 | 0 | 115 | 0 |
| Ari | 77 | 17976 | 23 | 13847 | 4129 |
| Azadi1 | 34 | 15127 | 66 | 5168 | 9959 |
| Azadi2 | 89 | 4490 | 11 | 3996 | 494 |
| Badawa | 36 | 16526 | 64 | 5890 | 10636 |
| Bahar | 60 | 18753 | 40 | 11223 | 7530 |
| Bahrka | 0 | 17987 | 100 | 0 | 17987 |
| Bakhtyari1 | 48 | 6789 | 52 | 3258 | 3531 |
| Bakhtyari2 | 0 | 17404 | 100 | 84 | 17320 |
| Bazar | 100 | 2659 | 0 | 2659 | 0 |
| Berkot | 34 | 750 | 66 | 251 | 499 |
| Betwatae new | 3 | 3456 | 97 | 87 | 3369 |
| Brayati | 60 | 25865 | 40 | 15615 | 10250 |
| Chinar | 15 | 14717 | 85 | 2208 | 12509 |
| Chwarchra | 8 | 28707 | 92 | 2271 | 26436 |
| Darstani bakur | 0 | 0 | 100 | 0 | 0 |
| English village | 15 | 4350 | 85 | 667 | 3683 |
| Eskan | 100 | 7936 | 0 | 7936 | 0 |
| Gorstani bakur | 15 | 300 | 85 | 44 | 256 |
| Gulan | 63 | 16157 | 37 | 10225 | 5932 |
| Hamrin | 23 | 11198 | 77 | 2533 | 8665 |
| Havalan | 43 | 16930 | 57 | 7350 | 9580 |
| Italian village | 23 | 3570 | 77 | 835 | 2735 |
| Kani | 70 | 23762 | 30 | 16654 | 7108 |
| Karezan | 1 | 24603 | 99 | 173 | 24430 |

Table 4.11. Accessibility results of mini parks for 10 minutes walking (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-----------------------------|---------------|------------|-------------------|--------------------|------------------------|
| Khanaqa | 56 | 6673 | 44 | 3719 | 2954 |
| Khanzad | 73 | 19517 | 27 | 14314 | 5203 |
| Khebat | 47 | 25424 | 53 | 12063 | 13361 |
| Komari | 100 | 3893 | 0 | 3893 | 0 |
| Kurdistan | 97 | 35172 | 3 | 34068 | 1104 |
| Kwestan | 73 | 13502 | 27 | 9831 | 3671 |
| Mahabad | 91 | 11428 | 9 | 10398 | 1030 |
| Mamostayan1 | 98 | 13402 | 2 | 13163 | 239 |
| Mamostayan2 | 95 | 9820 | 5 | 9367 | 453 |
| Mantikawa | 99 | 8525 | 1 | 8478 | 47 |
| Minara | 88 | 6960 | 12 | 6153 | 807 |
| Mstawfi | 94 | 8147 | 6 | 7675 | 472 |
| Mufti | 99 | 13645 | 1 | 13527 | 118 |
| Nawroz | 53 | 39105 | 47 | 20764 | 18341 |
| Nishtiman | 48 | 14269 | 52 | 6872 | 7397 |
| Nwsaran | 1 | 17700 | 99 | 139 | 17561 |
| Qalat | 28 | 0 | 72 | 0 | 0 |
| Raparin | 95 | 12096 | 5 | 11477 | 619 |
| Rastee | 10 | 9863 | 90 | 1006 | 8857 |
| Runaki | 64 | 4867 | 36 | 3110 | 1757 |
| Rzgari | 77 | 30146 | 23 | 23272 | 6874 |
| Safeen2& pishasazi bakur | 13 | 939 | 87 | 125 | 814 |
| Safin1 | 8 | 3621 | 92 | 283 | 3338 |
| Salahaddin1 | 25 | 24056 | 75 | 6000 | 18056 |
| Salahaddin2 | 7 | 7057 | 93 | 484 | 6573 |
| Sarbasti | 35 | 25670 | 65 | 8992 | 16678 |

Table 4.11. Accessibility results of mini parks for 10 minutes walking (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|----------|---------------|------------|-------------------|--------------------|------------------------|
| Sarwaran | 89 | 5542 | 11 | 4911 | 631 |
| Saydawa | 62 | 14360 | 38 | 8927 | 5433 |
| Setaqan | 98 | 12809 | 2 | 12514 | 295 |
| Shadi | 2 | 17695 | 98 | 435 | 17260 |
| Shorsh | 98 | 15595 | 2 | 15345 | 250 |
| Taajeel | 88 | 3859 | 12 | 3384 | 475 |
| Tayrawa | 78 | 19159 | 22 | 14936 | 4223 |
| Twraq | 3 | 5870 | 97 | 173 | 5697 |
| Waziran | 2 | 4700 | 98 | 101 | 4599 |
| Zanko1 | 58 | 16777 | 42 | 9726 | 7051 |
| Zanko2 | 25 | 4519 | 75 | 1139 | 3380 |
| Zanyari | 99 | 5470 | 1 | 5402 | 68 |
| Zilan | 1 | 3231 | 99 | 19 | 3212 |

Table 4. 12 Accessibility results of mini parks for 15 minutes walking

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|-----------------|---------------|------------|-------------------|--------------------|------------------------|
| Andazyaran | 100 | 18,376 | 0 | 18,376 | 0 |
| Arab | 100 | 115 | 0 | 115 | 0 |
| Ari | 100 | 17,976 | 0 | 17,976 | 0 |
| Azadi1 | 65 | 15,127 | 35 | 9,770 | 5,357 |
| Azadi2 | 100 | 4,490 | 0 | 4,490 | 0 |
| Badawa | 90 | 16,526 | 10 | 14,838 | 1,688 |
| Bahar | 95 | 18,753 | 5 | 17,859 | 894 |
| Bahrka | 2 | 17,987 | 98 | 419 | 17,568 |
| Bakhtyari1 | 87 | 6,789 | 13 | 5,928 | 861 |
| Bakhtyari2 | 5 | 17,404 | 95 | 954 | 16,450 |
| Bazar | 100 | 2,659 | 0 | 2,659 | 0 |
| Berkot | 73 | 750 | 27 | 550 | 200 |
| Betwatae new | 15 | 3,456 | 85 | 526 | 2,930 |
| Brayati | 97 | 25,865 | 3 | 25,000 | 865 |
| Chinar | 61 | 14,717 | 39 | 8,975 | 5,742 |
| Chwarchra | 25 | 28,707 | 75 | 7,192 | 21,515 |
| Darstani bakur | 3 | 0 | 97 | 0 | 0 |
| Drem city | 5 | 8,450 | 95 | 459 | 7,991 |
| Empire | 4 | 0 | 96 | 0 | 0 |
| English village | 30 | 4,350 | 70 | 1,308 | 3,042 |
| Eskan | 100 | 7,936 | 0 | 7,936 | 0 |
| Gorstani bakur | 32 | 300 | 68 | 95 | 205 |
| Gulan | 94 | 16,157 | 6 | 15,201 | 956 |
| Hamrin | 61 | 11,198 | 39 | 6,854 | 4,344 |
| Havalan | 94 | 16,930 | 6 | 15,872 | 1,058 |
| Hawleri new | 0 | 21,896 | 100 | 3 | 21,893 |

Table 4.12. Accessibility results of mini parks for 15 minutes walking (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|---------------------------|---------------|------------|-------------------|--------------------|------------------------|
| Italian village | 54 | 3,570 | 46 | 1,913 | 1,657 |
| Kani | 100 | 23,762 | 0 | 23,762 | 0 |
| Karezan | 6 | 24,603 | 94 | 1,530 | 23,073 |
| Khanaqa | 100 | 6,673 | 0 | 6,673 | 0 |
| Khanzad | 100 | 19,517 | 0 | 19,517 | 0 |
| Khebat | 90 | 25,424 | 10 | 22,959 | 2,465 |
| Komari | 100 | 3,893 | 0 | 3,893 | 0 |
| Kurdistan | 100 | 35,172 | 0 | 35,172 | 0 |
| Kwestan | 100 | 13,502 | 0 | 13,501 | 1 |
| Mahabad | 100 | 11,428 | 0 | 11,428 | 0 |
| Mamostayan1 | 99 | 13,402 | 1 | 13,332 | 70 |
| Mamostayan2 | 100 | 9,820 | 0 | 9,820 | 0 |
| Mantikawa | 100 | 8,525 | 0 | 8,525 | 0 |
| Minara | 100 | 6,960 | 0 | 6,930 | 30 |
| Mstawfi | 100 | 8,147 | 0 | 8,147 | 0 |
| Mufti | 100 | 13,645 | 0 | 13,645 | 0 |
| Nawroz | 79 | 39,105 | 21 | 31,066 | 8,039 |
| Nishtiman | 83 | 14,269 | 17 | 11,781 | 2,488 |
| Nwsaran | 18 | 17,700 | 82 | 3,136 | 14,564 |
| Qalat | 89 | 0 | 11 | 0 | 0 |
| Raparin | 100 | 12,096 | 0 | 12,096 | 0 |
| Rastee | 59 | 9,863 | 41 | 5,789 | 4,074 |
| Runaki | 100 | 4,867 | 0 | 4,867 | 0 |
| Rzgari | 100 | 30,146 | 0 | 30,146 | 0 |
| Safeen2& pishasazi bashur | 28 | 939 | 72 | 264 | 675 |
| Safin1 | 100 | 3,621 | 0 | 3,621 | 0 |

Table 4.12. Accessibility results of mini parks for 15 minutes walking (continued)

| Name | %Area covered | Population | %Area not covered | People get service | People not get service |
|------------------|---------------|------------|-------------------|--------------------|------------------------|
| Salahaddin1 | 80 | 24,056 | 20 | 19,311 | 4,745 |
| Salahaddin2 | 25 | 7,057 | 75 | 1,756 | 5,301 |
| Sami abdulrahman | 5 | 579 | 95 | 28 | 551 |
| Sarbasti | 60 | 25,670 | 40 | 15,386 | 10,284 |
| Sarwaran | 100 | 5,542 | 0 | 5,528 | 14 |
| Saydawa | 98 | 14,360 | 2 | 14,141 | 219 |
| Setaqan | 100 | 12,809 | 0 | 12,809 | 0 |
| Shadi | 12 | 17,695 | 88 | 2,041 | 15,654 |
| Shorsh | 100 | 15,595 | 0 | 15,595 | 0 |
| Taajeel | 99 | 3,859 | 1 | 3,839 | 20 |
| Tayrawa | 98 | 19,159 | 2 | 18,703 | 456 |
| Twraq | 16 | 5,870 | 84 | 952 | 4,918 |
| Waziran | 37 | 4,700 | 63 | 1,749 | 2,951 |
| Zanko1 | 87 | 16,777 | 13 | 14,584 | 2,193 |
| Zanko2 | 43 | 4,519 | 57 | 1,936 | 2,583 |
| Zanyari | 100 | 5,470 | 0 | 5,470 | 0 |
| Zilan | 5 | 3,231 | 95 | 177 | 3,054 |

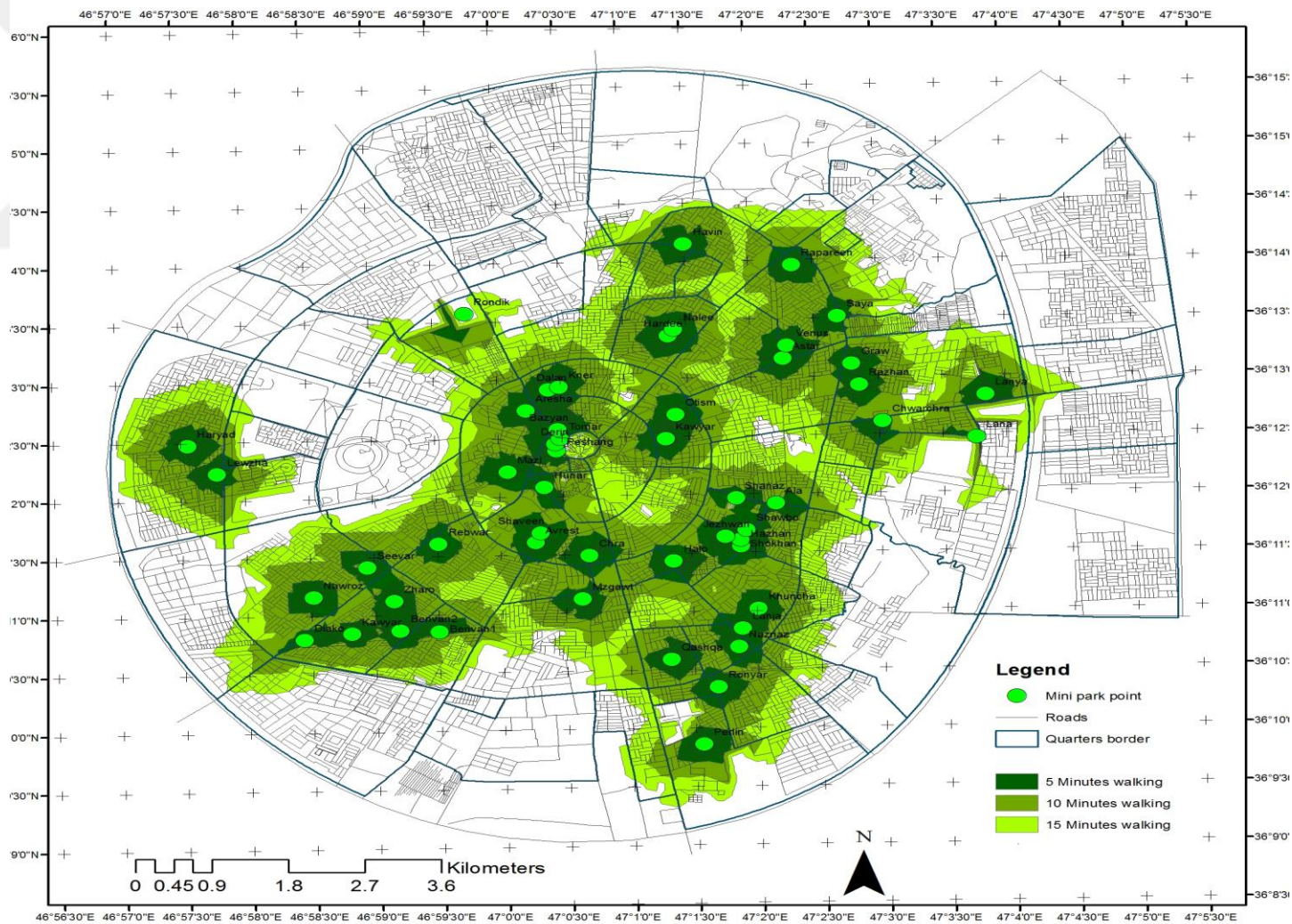


Figure 4. 4 Accessibility to Mini parks for 5, 10 and 15 minutes.

5. DISCUSSION AND CONCLUSION

The goal of this study in the Erbil city in Iraq is to determine the general status of public green areas and measuring the accessibility of green areas in the Erbil city, the cost of time access to the green areas and compare the city's public green spaces access with international standards, and to know which places of city need new parks.

There are many green areas in Erbil city distributed around the city which classified in in to active and passive according to their daily using by people this study focused only on the active types because they represent the most important part of the public green spaces in the metropolitan area in other hand roads classified in to four groups according to speed limitation.

There is no known work about accessibility of green area in order to evaluate general situation of Erbil city public green areas. The study that carried out in this context is the first known study in the sense of accessibility of public green areas in the Erbil city.

Network analysts tool within environmental GIS were used to determine time cost access to public green areas, green areas divided in to two groups small parks and large parks small parks include Neighborhood parks and Mini parks counted time cost for walking 300m, 600m and 900m means 5minutes, 10minutes and 15minutes, results for Neighborhood parks access show %43 of population have access, for 10minutes %71of population have accessibility and for 15minutes walking %80 of population have accessibility. Access to Mini parks for 5minutes walking %22 of population have services, for 10minutes walking %52 of residents have access and for 15minutes walking there is %70 of populations has access to Mini parks. And access to large parks Community parks and District parks counted for 5minutes, 10minutes and 15minutes driving, community parks with 5minutes driving %68 of population have access, for 10minutes driving %99 of residents have access and for 15minutes driving %100 of population have access to Community parks. Network analysts counted for District parks with 5minutes with driving %70 of residents have access, for 10minutes driving %96 of population have access and for 15minutes driving %100 of residents of Erbil city have access to District parks.

A United Kingdom provides a set of regulations called accessible natural green space standards to control the provision of and access to green areas. Everyone should have access to neighborhood parks and mini parks with 300m or 5minutes walking. Everyone should have access to District parks with 2000m. Everyone should have access to District parks with 5000m. This standard not suitable for all cities in Iraq because there are no green areas as in United Kingdom and some of green areas not accessible, in USA each city has its special regulations and standards 400m distance that residents are desire to walk to reach a public green area, (Kuta et al., 2014) studied urban green area accessibility for different socio-economic groups in the UK as well and they found that socio-economically deprived group lack access to green space within 300m from the residence but in Erbil city most of population didn't have access within 300m to green areas. (Sotoudehnia and Comber, 2011) studied perceived and physical accessibility to urban green areas in the UK, and they explained that only 15% of the Leicester's population meets the physical access up to 300m if we compare the results we can find that the Erbil city has higher range of accessibility than Leicester city. (Eom et al., 2008 and Eom and Lee, 2009) explained that spaces within a linear distance of 700m from green areas composed 98.6% of the all areas city of Seoul, and so the provision of open green areas was judged to get more than adequate but this ratio of accessibility compare with erbil city is very high therefore Erbil city need more new green areas to raise the ratio of accessibility. (Boone et al., 2009) found that more African Americans in Baltimore, Maryland have access to green areas within 400 meters walking distance while White people have access to more green spaces in less than 400 meters' distance, given the results of this study, we can see that there are no such problems among the society in Erbil. a research in Helsinki city capital of Finland found that inhabitants living close less than 500m visited the green areas more frequently more than 4 times per week (Neuvonen et al., 2007). (Etzioni, 1998) also explained that public green areas must be at the neighborhoods center and not more than 5 minutes' walk for residents but in the case of Erbil city access to Mini parks for 5minutes walking %22 of population have services, for neighborhood parks %43 of population of Erbil city have accessibility and for big parks such as community parks with 5minute driving there are accessibility for %70 of population, for District park %68 of population have accessibility.

There is no standard for Erbil city, in this study small parks like Mini parks and Neighborhood parks should be in a distance which accessible in a 5minute walking. Other green areas like community and district parks should be in a distance which accessible in 5, 10 and 15 minutes driving. This time costs are defined by using international standards and literatures.

There are many obstacles to this study, including the difficulty of obtaining data sets from government agencies because of Security concerns they couldn't give data sets easily. And all data sets are primary data manually generated to use in this study, there is a problem of data projection by using reference points we convert the position of the Auto CAD data to the correct UTM position.

Data is ready to for other studies, other urban facilities like Hospitals, schools and other government services could be conducted by using this infrastructures data.

About the future directions that kind of study should conduct for other critical urban facilities, services like health, firefighting, police station, and average speeds for this accessibility analysis real time speed data can improve the accuracy of the results.

That kind of study is not static changes on green areas quality and quantities and although changes about road networks could update or differentiate the accessibility results, so the data used for the analysis should be updated in the future studies.



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**EXTENDED TURKISH SUMMARY
(GENİŞLETİLMİŞ TÜRKÇE ÖZET)**

**CBS AĞ ANALİZİ KULLANILARAK YEŞİL ALANLARDA
ERİŞİLEBİLİRLİK: ERBİL ŞEHİRİ ÖRNEĞİ**

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ÖZ

Bu çalışma, 2017- 2019 yıllarında, Erbil kentinde CBS ortamında, ağ analizleri kullanılarak yeşil alanların erişilebilirliğinin ölçülmesi amacıyla yapılmıştır. İlk olarak, Auto CAD yazılımı ile elle sayısallaştırılan tüm yeşil alan poligonları, aktif ve pasif yeşil alanlar olarak iki kategoride sınıflandırılmıştır. Pasif yeşil alanlar: orman alanları ve yeşil kuşaklar olarak iki alt gruba; Aktif yeşil alanlar ise alan büyüklükleri ve fonksiyonlarına göre 10 topluluk parkı, 10 bölge parkı, 189 mahalle parkı ve 55 mini park olmak üzere dört alt gruba ayrılmıştır. Bunun yanı sıra, çalışma alandaki tüm yollar, 15km / saat, 25km / saat, 45km / saat ve 70km / saat olmak üzere ortalama hız bilCBSine göre dört kategoride incelenmiştir. Mahallenin nüfusu ve sınırları, yeşil alan hizmetinin ulaştığı sakin sayısını hesaplamak için sayısallaştırıldı. Sonra, tüm veri kümeleri farklı popülasyonlarda, yeşil alanların erişilebilirliğini ve ne kadar erişilebilir olduklarını ölçmek üzere 300, 600 ve 900 metre mesafedeki veya 5, 10 ve 15 dakika mesafedeki mini parklar ve Mahalle parkları ile 5, 10 ve 15 dakikalık sürüşle topluluk ve bölge parkları polygon ve noktalar olarak; yollar ise çizgi olarak bileşke tablolaştırma (tabulate intersection) aracıyla CBS ağ analizi formatına dönüştürüldü. Sonuçlar, topluluk parklarına 5 dakika sürüş mesafesinde nüfusun %68'inin erişebildiğini, % 32'sinin ise erişemediğini; buna karşın, nüfusun % 99'unun 10 dk. sürüş mesafesinde erişebildiğini, % 1inin ise erişemediğini; 15 dk sürüş mesafesinde ise nüfusun tamamının topluluk parklarına erişebildiğini göstermiştir. Bölge parklarında ise; 5 dk. lık sürüş mesafesinde nüfusun % 70'i parka erişebilirken % 30'u erişememektedir. 10 dk sürüş mesafesindeki erişilebilirlik % 96, 15 dk sürüş mesafesindeki erişilebilirlik ise % 100 olarak sonuç vermiştir. Sonuçlarda yürüme

mesafelerine bakıldığında ise; Erbil nüfusunun % 22'si küçük parklara 5 dk yürüme mesafesinde erişebilmektedir. Nüfusun % 78 i ise kolay erişim sağlayamamaktadır. 10 dk yürüme mesafesinde nüfusun % 52'si; 15 dk yürüme mesafesinde ise nüfusun % 70'ı küçük parklara erişebilmektedir. Komşuluk ünitesi parklarına erişime baktığımızda, nüfusun % 43 5dk yürüme mesafesiyle, % 71'i 10 dk yürüyüş mesafesiyle, % 80'i ise 15 dk yürüyüş mesafesiyle erişimini sağlayabilmektedir.

1. GİRİŞ

Kentsel yeşil alanlar, insanlara çeşitli boş zaman aktiviteleri, eğlence, spor ve rekreasyonel aktiviteler sunan yerlerdir. Kamusal yeşil alanlar ve dinlenme tesisleri şehirlerin, kasabaların sağlığı ve sosyo-ekonomik yapıları için önemlidir (Sallis, 2004). Bu nedenle, kasaba ve şehirlerin yerleşim alanlarında halka açık parklar ve açık spor tesisleri gibi kamusal yeşil alanların yaratılması için büyük bir eğilim vardır ve bu kentsel yeşil alanlar, kentsel gelişim planında önemli bir kullanım-fonksiyon haline gelmişlerdir.

Erişim olanaklarının kalitesi ve mevcudiyeti gibi fiziksel erişilebilirlik olanakları, erişilebilirlik maliyeti, zamansal mesafe, yerleşim yerleriyle olan bağlantı, park etme ve güvenlik gibi faktörler kentsel yeşil alanların başarılı bir şekilde kullanılmasını etkileyen en önemli özelliklerden bazıları olarak kabul edilir. Benzer bir şekilde, görüş mesafesi, parkların görünürlüğü gibi görsel erişilebilirlik değişkenlerinin kentsel yeşil alanların kullanımını etkilediği iddia edilmektedir.

Genel olarak kentteki kentsel yeşil alanların erişilebilirliği, verimli ve yeterli toplu taşıma sisteminin olmamasından etkilenmektedir; ayrıca, bu alanlardaki ticari ve ilgili faaliyetlerin artması; yollar, yaya fonksiyonları, güvenlik, otopark ve trafik yavaşlatma gibi fiziksel iletişim türlerinin kullanılmaması trafik sıkışıklığına ve uzun seyahat süresine yol açan trafik hacimlerinde artmaya sebep olmaktadır. Benzer şekilde, kentsel yeşil alanlara erişilebilirlik; süreklilik, yakınlık, bağlanabilirlik, yürünebilirlik, kolaylık, yaya ve araç erişim altyapısı ve görsel erişilebilirlik parametreleri gibi özelliklerle ölçülmektedir. Bu nedenle, kentin yerleşim alanlarındaki kamusal yeşil alanların erişilebilirliğini etkileyen en önemli belirleyicileri değerlendirmek ve daha

sonra kentsel yeşil alanların daha canlı ve uygun şekilde kullanılması için planlama ve tasarım kılavuzları geliştirmek çok önemlidir.

Çalışmanın amacı, Erbil şehrinin yerleşim bölgelerinde yeşil alanların kullanımına etki eden ve alanlarının kullanımını engelleyen en önemli erişilebilirlik faktörlerini tespit etmek ve etki düzeylerini incelemektir. Çalışmalar, yol ağları ve yaya fonksiyon ağları arasındaki ilişkinin, yeşil alanlara erişilebilen sokakların sayısının, yeşil alanların büyüklüğünün, kentsel yeşil alanların kullanımını çeşitli boyutlarda etkilediğini açıkladı. Yeşil alanlara en uygun erişim, kentsel yeşil alanlara erişim sağlayan yollardaki orantılı kaldırımlarla mümkün olacaktır ve Erbil ilinin yerleşim bölgelerinde yeşil alanların kullanımında önemli iyileşmeler sağlayacaktır. (Das, ve Honiball, 2016).

1.1. Kentsel Yeşil Alanlar

Kentsel yeşil alanlar, genel olarak kamusal veya özel olabilen, bitki örtüsü ile kaplı kentsel alanlardaki açık alanlardır (Baycan-Leven ve ark, 2002) Kentsel yeşil alan, parkları, topluluk bahçelerini, ormanları ve doğal rezervleri içerebilir. Bu çalışmada, yalnızca kamusal yeşil alanlar üzerinde çalışılmaktadır çünkü kamusal yeşil alanlar ücretsizdir ve çoğu nüfus özel yeşil alanlara erişememektedir.

Kavram olarak yeşil alanlar, genel olarak tamamen veya kısmen canlı bitki örtüsü veya ağaçlarıyla kaplı ve halkın ücretsiz olarak erişebileceği; ekolojik, sosyal ve ekonomik yararları olan toprakla kaplı bir alanı ifade eder. (Henderson ve Wall, 1979).

1.2. Yeşil Alanlara Erişim

Kamusal yeşil alanlara ve kamusal rekreasyon olanaklarına ilişkin literatürde vurgulanan önemli konulardan biri erişimdir (PPS, 2013). Kamusal yeşil alanlara erişim, bireylerin fiziksel ve zihinsel sağlığının iyileştirilmesiyle ilişkilidir (Sugiyama ve ark., 2008; Payne ve ark., 2005; Potwarka ve ark., 2008). Yeşil alan kullanıcıları daha sağlıklı ve fiziksel aktivite açısından daha güçlü olmaktadır. Çünkü yeşil alan kullanımından yoksunluk ve bu alanlara uzaklık, fiziksel aktivite davranışları ve kamusal yararlarla ters orantılıdır.

Başarılı bir kamusal yeşil alana erişilebilirlik zor olmamalıdır ve işleyen bir sisteminin olması, hem uzaktan hem de yakından görülebilir olması gerekmektedir. Genel olarak, yürüme mesafesindeki yerel halka açık yeşil alanların mevcudiyeti, yeşil alanların kullanımıyla olumlu yönde ilişkiliyken, parka ulaşmak için araç kullanma ihtiyacı genellikle kullanımını sınırlamaktadır (Wilbur ark., 2002). Ayrıca, yer ve güvenlik gibi konular kamusal yeşil alanların kullanımını etkileyebilir. Bazı araştırmacılar, yeşil alanların erişim ve kullanımının en önemli koşulu olarak evden yürüme süresi veya evden uzaklığı olduğunu açıklamıştır (Herzele ve Wiedeman, 2003). Kısa mesafeli ve yeşil alanlara kolay erişim, yeşil alanlara yapılan ziyaret sayısını arttırmakta ve yakın olan sakinler de bu alanları daha sık kullanmaktadır (Atiqul Haq 2011; Herzele ve Wiedeman, 2003). Örneğin, Finlandiya'nın Helsinki şehir başkentinde yapılan bir araştırma (0,50 km'den daha az) yaşayanların haftada 4 kereden daha fazla yeşil alanları ziyaret ettiğini tespit etti (Neuvonen ve ark., 2007, Atiqul Haq, 2011). Araştırmacılar ayrıca, halka açık yeşil alanların mahallelerin merkezinde olması gerektiğini ve yürüyerek 5 dakikadan fazla sürmemesi gerektiğini açıklıyor (Etzioni, 1998).

1.3 Yeşil Alanlara Erişilebilirlik

Genel olarak erişilebilirlik terimi, belirli bir aracının belirli bir seyahat sistemi ile belirli bir ağ sistemi üzerinden belirli bir varış noktasına ulaşmadaki kolaylığını belirtmek için kullanılır. (Talen ve Anselin, 1998). Yürünebilirlik, genellikle belirli bir seyahat acentesi tarafından belli bir yerleşimde dolaşmanın kolaylığını ifade etmek için kullanılır (Inani ve Abdul, 2012). Ayrıca hareketlilik, belirli bir aracının, söz konusu araca uygulanabilir tüm seyahat modlarını göz önünde bulundurarak belirli bir ağ sisteminde hareket etme kabiliyetini göstermek için kullanılır (Litman, 2003).

Erişilebilirlik teriminin çeşitli tanımları vardır. En iyi tanımlardan biri, “insanların, ticaretin, endüstrilerin ve kamu hizmetlerinin ihtiyaçlarını içeren toplumdaki faaliyetlere ulaşmanın en kolay yolu” olarak verilebilir. Uzaklık ölçütleri en açık erişilebilirlik kıstasıdır. Ortalama mesafe, ağırlıklı alan mesafesi ya da en yakın imkânlara uzaklık olarak ölçülebilir.

1.4 Cbs Ve Yeşil Alanlar

CBS, çevre adaletinde ve yeşil alanların erişilebilirliğini analiz etmede önemli bir rol oynamaktadır. CBS ağ analizi bir yerden başka bir yere seyahat zamanını hesaplayabilmektedir. CBS ağ analizini kullanarak farklı dini grupların, etnik grupların, sosyo-ekonomik grupların kentsel yeşil alana nasıl erişildiğini açıklamak için kullanılır (Comber ve ark. 2008; Kuta ve ark. 2014). Birçok araştırmacının çevresel adalet analizini yürütmek için CBS'yi kullanmasının nedeni, olası sorunları tanıdıktan sonra farklı sosyal problemleri çözmeye yardımcı olmasıdır. Yeşil alana eşit erişimin önemi, planlamacılar tarafından dikkate alınmalıdır, çünkü şehir içinde yaşayan tüm halk, halka açık yeşil alanlara eşit erişilebilirliği hak eder.

2. KAYNAK BİLDİRİŞLERİ

Giderek artan bir şekilde, araştırmacılar ve kentsel analistler, kentsel ortamlardaki yeşil alanların erişilebilirliğinin dağıtımına odaklanmaya başlamıştır. Ann (1991), erişilebilirliği nehirler, yeşil bantlar ve su kütleleri de dâhil olmak üzere açık yeşil alanlardan yerleşim alanlarına düz hat mesafesi olarak ölçmek için CBS'yi kullanmıştır (Ann, 1991).

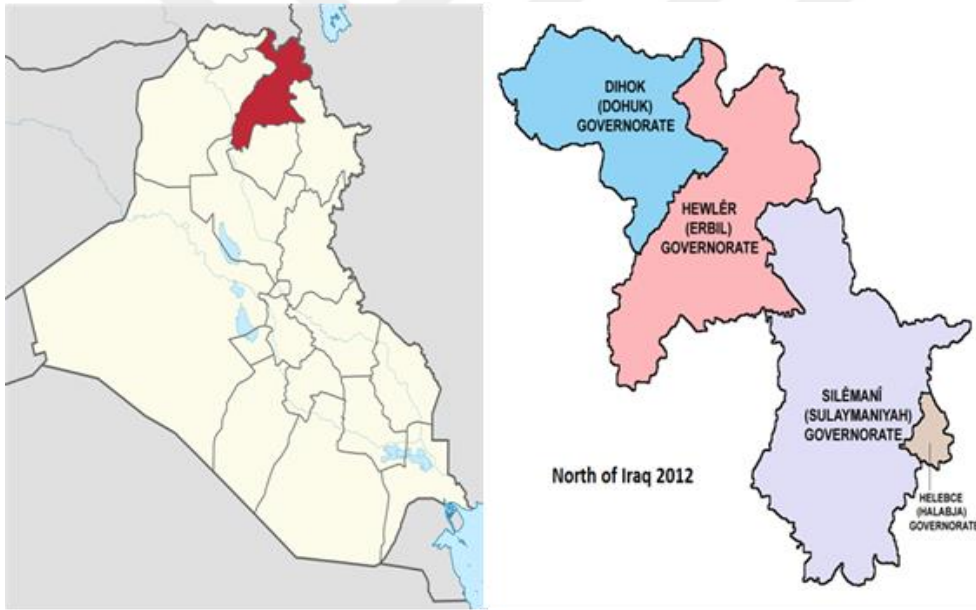
Talen (1998), Pueblo, Colorado'daki yeşil alanlara erişilebilirliği araştırmak için yeşil alan planlama standartlarından ve planlama politikası dokümanlarından elde edilen özkaynak haritalama yönteminden ve ihtiyaç temelli bir ölçümden faydalanmıştır ve İspanyol nüfusunun bölgelerinin erişilebilirliğinin düşük olduğunu bulmuştur. Nicholls (2001), Bryan County, Texas'taki halka açık yeşil alanların dağılım eşitliği ve SPSS'deki CBS ve Mann-Whitney U test prosedürünü kullanarak erişilebilirliği incelemiştir ve sonuçlar eşitsizliğin bulunmadığını göstermektedir. Lindsay ve Maraj (2001), Indianapolis, Indiana'da araştırma çalışmaları yaptı; erişilebilirliğin eşitliğini belirlemek için nüfus sayımı ve yakınlığın basit bir CBS analizi ve erişilebilirliğin bir ölçütü olarak kullanıldı. Sonuçlar, azınlıklar ve düşük gelirli çoğunlukların açık alanlara erişiminin kısıtlı olduğunu gösterdi. Gaussian merkezli 2SFCA yaklaşımı, Gürcistan'daki yeşil alanların erişilebilirliğini tahmin etmek için kullanıldı (Dai, 2011) ve sonuçlar, sayım yollarının çoğunun, en yakın yeşil alana yürünebilecek mesafenin ötesinde olduğunu

gösterdi. Kuta ve ark. (2014), Birleşik Krallık'taki farklı sosyo-ekonomik grupların kentsel yeşil alan erişilebilirliğini de inceledi ve sosyoekonomik açıdan mahrum olan grubun, ikamet yerinden 300 metre uzaklıktaki yeşil alana erişimi olmadığını buldu. Kuta ve ark. (2014) sosyo-ekonomik açıdan mahrum gruplar için yeşil alana erişilebilirliği tahmin etmek için ağ analizi yaklaşımını uyguladı.

3. MATERYAL VE YÖNTEM

3.1 Materyal

Bu çalışma Kuzey Irak'ın Erbil Vilayeti 2017-2019 yıllarında yürütülmüştür.

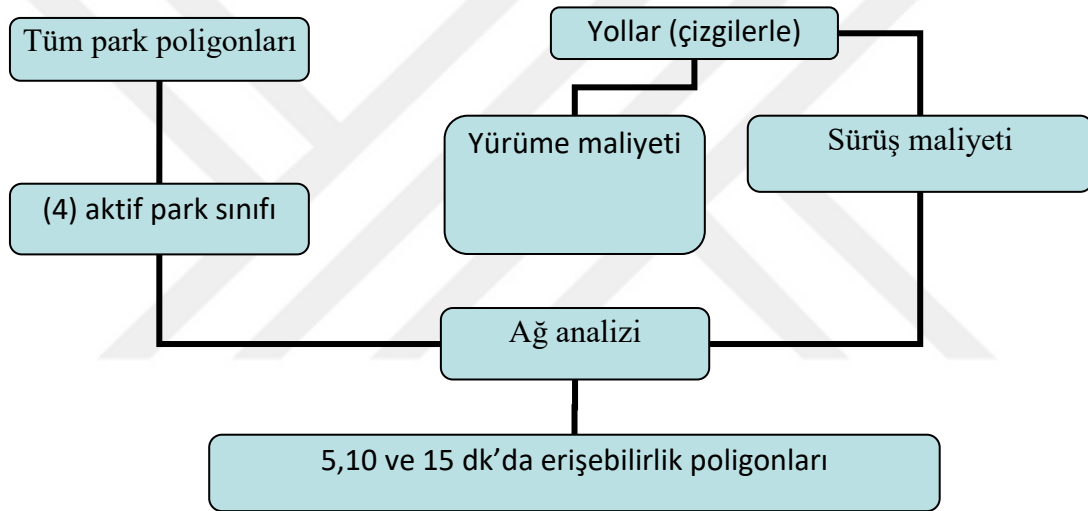


3.2 Çalışma Alanının Coğrafi Karakteristiği

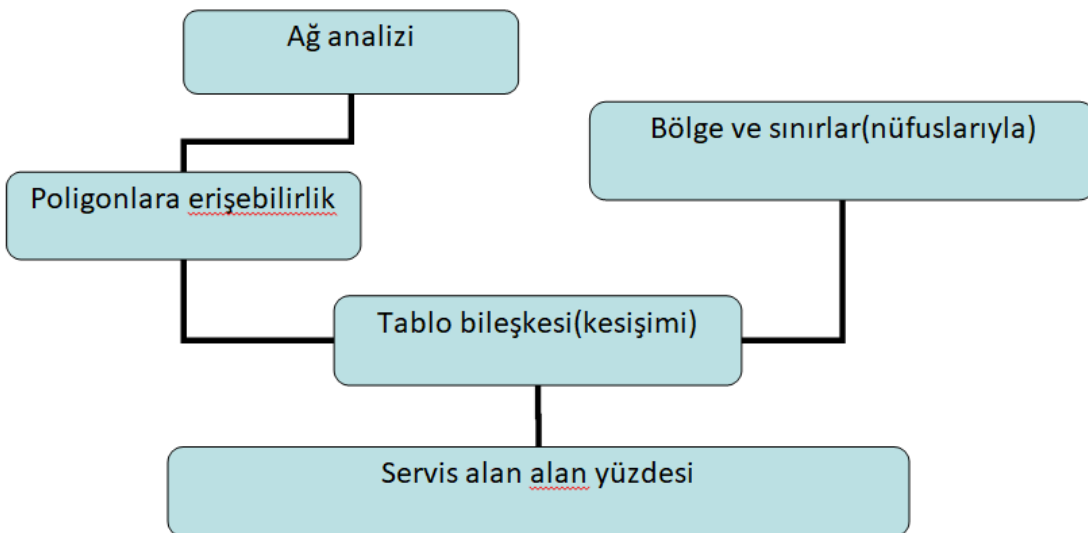
Bu çalışma 2016-2019 yılları arasında Irak'ın kuzeyinde bulunan Erbil kentinde yapılmıştır. Kentin coğrafi koordinatları: Enlem: 36 ° 11'33.25 "K ve boylam: 44 ° 0'38.23" E. Erbil şehrinin deniz seviyesinden yüksekliği 429,00 m.'dir.

3.3 YÖNTEM

Bu çalışmadaki yöntem, yeşil alanların seçilerek aktif ve pasif olarak olarak sınıflandırılmasıdır. Büyüklük ve fonksiyonlarına göre aktif yeşil alanlar 4, pasif yeşil alanlar 2 gruba ayrılmıştır. Erbil şehrinin tüm bölgeleri, nüfuslarıyla beraber seçilmiştir. Bunun yanısıra, tüm yollar ve caddeler hız sınırlamalarına göre sınıflandırıldı, daha sonra Auto CAD ortamında hazırlanan tüm bu veri kümeleri daha sonra yeşil alanlara ve kamusal yeşil alanın kapsadığı alana erişim zamanını analiz etmek ve hesaplamak için CBS'e çevrildi. Hizmetler ve hizmetin ulaştığı bölge sakinlerinin sayısı (3.1) ve (3.2) numaralı şemalarda açıklandığı gibidir (Kemec ve ark., 2015).



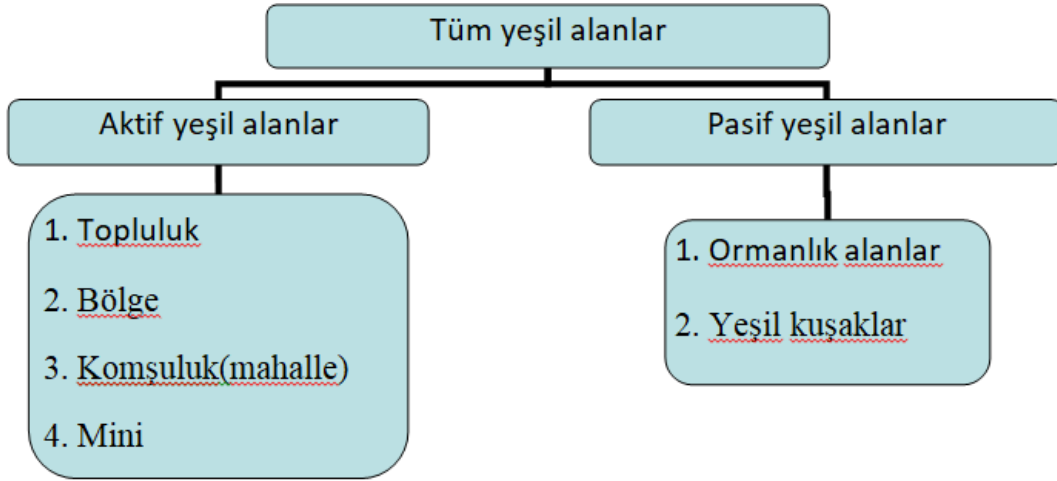
Diyagram 3. 1 CBS Ağı analiz aracında analiz yöntemleri



Diyagram 3. 1 Hizmetlerin kapsadığı alan ve nüfus hesaplama yöntemleri.

ERBİL YEŞİL ALANLARININ SINIFLANDIRILMASI

Şema (3.3) 'de açıklandığı gibi, Erbil kentinde, yeşil alanların kullanılabilirliğine göre iki kategoriye ayrılan altı tür yeşil alan bulunmaktadır.



Diyagram 3. 2 Yeşil alanların sınıflandırılması.

3.3.1 Verilerin İşlenmesi

1. Hız sınırına göre sınıflandırılan tüm yol ve sokaklar ile Autocad ortamında oluşturulan poligonlarından CBS Ağ Analist aracına dönüştürülen tüm yeşil alanlar sayısallaştırıldı.
2. Ağ analisti aracındaki tablo kesişimini kullanarak mahalle nüfus katmanı ve Erbil şehrinin sınırı birleştirildi.
3. Auto CAD aracıyla Erbil şehri çokgenlerinin yeşil alanları oluşturuldu ve daha sonra CBS'e dönüştürüldü.

3.3.2 Ağ Analizi

1. Maliyet hesaplanmalıdır ve bu maliyet zamansal, mekansal ya da parasal maliyet olabilir. Çalışmada zamansal maliyet hesaplaması yapılmıştır.

2. Bu çalışmada Auto CAD bölge sınırları kullanılarak CBS bölge sınır katmanları oluşturulmuştur daha sonra yazılımın ortak aracını kullanarak çizelge popülasyonu verileri polygon bölge sınırları katmanlarıyla birleştirilmiştir.
3. Çalışmada yeşil alanlar sınır (çizgi) oluşturulmuş, daha sonra çizgiler çokgenlere dönüştürülmüş, daha sonra ağ analistlerinde de gerekli veri biçiminin olduğu noktaya dönüştürülmüştür.

4. BULGULAR

Bu çalışma Erbil ilinin yeşil alanlarını analiz etmekte ve Erbil kentindeki yeşil alanların erişilebilirliğini çevre adaleti ve kamu yararını gözetmek amacıyla ölçmektedir. Çalışma Erbil ilçesinin farklı mahalleleri ile yeşil alanların erişilebilirliği arasındaki ilişkiyi göstermektedir. Bu araştırma çalışmasının fikri, So-Shuk-Wai (2013), Comber ve ark. (2008) den ve yöntem Sister ve ark. (2007), Hass (2009) dan derlenmiştir. Çalışmada çokgen, çizgi ve tabaka gibi Auto CAD araçları kullanılmış ve daha sonra bu çalışmada ana araç CBS ortamındaki ağ analistine çevrilmiştir. Çalışma yöntemi aşağıdaki soruları cevaplayabilmek adına uygulanmıştır:

1. 300m, 600m ve 900m mesafedeki ya da 5, 10 ve 15 dk yürüme mesafesindeki mini parklar ve komşuluk üniteleri parkları ile 5, 10 ve 15 dk sürüş mesafesindeki topluluk ve bölge parkları farklı topluluklar için ne kadar erişilebilirdir?
2. Erbil şehrinin hangi alanlarının yeni kamusal yeşil alanlar ihtiyacı vardır ve ortak yeşil alanlara daha fazla erişime ihtiyacı var?

İki ana adımda

1. Erbil şehrinin tüm yeşil alanları poligonlar ile belirlendi ve sınıflandırın ve tüm yolları yeşil alanlara sınırlandırıldı.
2. Yeşil alanların hizmetlerinin ulaştığı nüfus hesaplarını elde etmek için Erbil şehri ve kent merkezinin demografik verileri bütünleştirildi.

4.1. Analiz Ve Sonular

Kentsel yeřil alanların, Erbil ilinin farklı mahallelerinde erişilebilirliğinin ölçülmesi ve nüfusun hesaplanması. Yeterince yeřil alana sahip olmayan ve yeni yeřil alanlara ihtiyaç duyan alanların analiz edilmesi.

4.1.1. Topluluk Parkı

10 Topluluk parkının erişilebilirliği CBS Ağ analizi ile ölçülmüřtür. Sonular, topluluk parklarına 5 dakika sürüş mesafesinde nüfusun %68'inin erişebildiğini, %32'sinin ise erişemediğini; buna karşın, nüfusun %99'unun 10 dk sürüş mesafesinde erişebildiğini, %1'inin ise erişemediğini; 15 dk sürüş mesafesinde ise nüfusun tamamının topluluk parklarına erişebildiğini göstermiştir.

4.1.2. Bölge Parkları

10 bölge parkının erişilebilirliği CBS Ağ analizi ile ölçülmüřtür. Bölge parklarında, 5 dk lık sürüş mesafesinde nüfusun %70'i parka erişebilirken %30'u erişememektedir. 10 dk sürüş mesafesindeki erişilebilirlik %96, 15dk sürüş mesafesindeki erişilebilirlik ise %100 olarak sonu vermiştir.

4.1.3. KOMŞULUK ÜNİTESİ PARKLARI

189 komşuluk ünitesi(mahalle)'nin yürüme mesafesindeki erişilebilirliği CBS Ağ analizi ile ölçülmüřtür. Komşuluk ünitesi parklarına erişime baktığımızda, nüfusun %43 5dk yürüme mesafesiyle, %71'i 10 dk yürüyüş mesafesiyle, %80'i ise 15 dk yürüyüş mesafesiyle erişimini sağlayabilmektedir.

4.1.4. MİNİ PARKLAR

2000m²'den küçük olan 55 mini parkın yürüme mesafesindeki erişilebilirliği CBS Ağ analizi ile ölçülmüřtür. Erbil nüfusunun %22'si Küçük parklara 5 dk yürüme mesafesinde erişebilmektedir. Nüfusun %78 i ise kolay erişim sağlayamamaktadır. 10

dk yürüme mesafesinde nüfusun % 52'si; 15dk yürüme mesafesinde ise nüfusun %70'i küçük parklara erişebilmektedir.

5. TARTIŞMA VE SONUÇ

Irak'ını Erbil kenti için yapılan bu çalışmanın amacı, Erbil kentinde yeşil alanların genel durumunu belirlemek ve yeşil alanların erişilebilirliğini, yeşil alanlara erişim zamanının maliyetini ölçmek, uluslararası standartlara göre kentin yeşil alanlarına erişimini karşılaştırmak ve nerelerin yeni parklara ihtiyacı olduğunu saptamaktır.

Erbil'de, şehir çevresinde dağılmış birçok yeşil alan bulunmaktadır. İnsanların günlük kullarımlarına göre aktif ve pasif olarak sınıflandırılmışlardır. Çalışmada sadece aktif türlere odaklanmıştır, çünkü kentde halka açık yeşil alanların en önemli bölümünü aktif yeşil alanlar temsil etmektedir.

Erbil ilinin halka açık yeşil alanlarının genel durumunu değerlendirmek için yeşil alanın erişilebilirliği konusunda bilinen bir çalışma yoktur. Bu bağlamda yapılan çalışma Erbil kentinde halka açık yeşil alanların erişilebilirliği anlamında bilinen ilk çalışmadır.

CBS Ağ analiz aracıyla yeşil alanların zaman maliyetli erişimi analiz edilmiştir ve yeşil alanlar küçük ve büyük parklar olmak üzere değerlendirilmiştir. Mahalle parkları ve mini parkların zaman maliyeti yürüme mesafesine göre değerlendirilmiştir. Nüfusunun %22'si Küçük parklara 5 dk yürüme mesafesinde erişebilmektedir. Nüfusun %78 i ise kolay erişim sağlayamamaktadır. 10 dk yürüme mesafesinde nüfusun % 52'si; 15dk yürüme mesafesinde ise nüfusun %70'i küçük parklara erişebilmektedir. Komşuluk ünitesi parklarına erişime baktığımızda, nüfusun %43 5dk yürüme mesafesiyle, %71'i 10 dk yürüyüş mesafesiyle, %80'i ise 15 dk yürüyüş mesafesiyle erişimini sağlayabilmektedir. Bölge topluluk parklarına erişim ise sürüş mesafesine göre değerlendirilmiştir. Bölge parklarında, 5 dk lık sürüş mesafesinde nüfusun %70'i parka erişebilirken %30'u erişememektedir. 10 dk sürüş mesafesindeki erişilebilirlik %96, 15dk sürüş mesafesindeki erişilebilirlik ise %100 olarak sonuç vermiştir. Topluluk parklarında ise 5 dakika sürüş mesafesinde nüfusun %68'inin erişebildiğini, %32'sinin ise erişemediğini; buna karşın, nüfusun %99'unun 10 dk sürüş mesafesinde

erişebildiğini, %1inin ise erişemediğini; 15 dk sürüş mesafesinde ise nüfusun tamamının topluluk parklarına erişebildiğini göstermiştir.

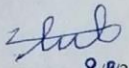
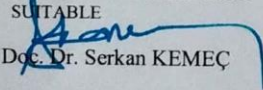

Birleşik krallık, yeşil alanların teminini ve erişimini kontrol etmek için erişilebilir doğal yeşil alan standartları olarak adlandırılan bir dizi düzenleme sağlamaktadır (Combers ark., 2008) Herkes, 300 m veya 5 dakikalık yürüme mesafesindeki mahalle parklarına ve mini parklara ve 2000m ile bölge parklarına erişebilmelidir. Bu standart Irak'taki tüm şehirler için uygun değildir, çünkü Birleşik Krallık'taki kadar fazla ve büyük ölçekli yeşil alanlar bulunmamaktadır. Aynı şekilde, ABD'nin her bir şehir sakininin açık yeşil bir alana ulaşmak için yürüdüğü 400m mesafedeki özel düzenlemeleri ve standartları vardır. Erbil şehri için bir standart düzenleme yoktur, bu çalışma mini parklar ve mahalle parkları gibi küçük parklara 5 dakikalık bir yürüyüşle ulaşılabilecek mesafeyi önermektedir. Topluluk ve semt parkları gibi diğer yeşil alanlarda ise arabayla 5, 10 ve 15 dakika içinde ulaşılabilecek mesafede olmalıdır. Bu süre, uluslararası standartlar ve konuya ilişkin akademik yazın kullanılarak belirlenmiştir.

Bu çalışma, devlet kurumlarından veri setleri elde etmenin zorluğu, güvenlik nedeniyle veri setlerini kolaylıkla veremedikleri endişesi dâhil olmak üzere pek çok engel altında hazırlanmıştır. Tüm veri kümeleri bu çalışmada kullanılmak üzere manuel olarak oluşturulan birincil verilerdir, referans noktalarını kullanarak Auto CAD verilerinin konumunu UTM konumuna dönüştürdüğümüzde veri projeksiyonuyla ilgili problemler oluşmuştur.

Veriler diğer çalışmalara hazırdır, bu verileri kullanılarak hastaneler, okullar ve diğer devlet hizmetleri gibi diğer kentsel tesisler projelendirilmesinde kullanılabilir. Bu tür bir çalışma yeşil alanların niteliği ve miktarlarındaki statik değişiklikler değildir ve yol ağlarındaki değişiklikler erişilebilirlik sonuçlarını güncelleyebilmekte veya farklılaştırabilmesine rağmen, analiz için kullanılan veriler gelecekteki çalışmalarda güncellenmelidir.

CURRICULUM VITAE

Salar hassan ABDALKARIM, was born in 1987 in Chamchamal-Iraq, and started to his education in Bestuni Mala Omar Primary School, then finished the Secondary School in Runaki secondary school, after that he entered to his higher education and completed his degree of Bachelor of Science (B.Sc.) for engineering in the College of Engineering Department of Architecture at Salahaddin University/Erbil-Iraq in 2011. Then he started a degree of Master of Science (M.Sc.) for Landscape Architecture currently a M.Sc. student under the supervision of Assoc. Prof. Dr. Serkan KEMEÇ. in the Department of Landscape Architecture at the Institute of Natural and Applied Science, in Van Yuzuncu Yil University. Van Turkey.

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