Assessing the spatial distribution of urban parks using network analysis

(Case study: Tehran, Iran)

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Introduction

Urban green spaces are the most important factor for improving the living conditions of urban communities. In addition to environmental performance such as cleaning air, reducing noise pollution, improving microclimatic conditions, it promotes the social and psychological condition of urban residents.

The accessibility to urban parks is considered as the most important factors in evaluation of parks performance. The issues of spatial equity of urban public facilities have incremented during the recent decades. Spatial equity includes the equal access of public to equipments and services.
The spatial distribution of parks in the city should be in a way that the service area of them encompasses equally the total area of the city. Few studies have been done on the spatial distribution of urban Park, and in the most of them indices such as total area of park, park area per person and Park number have been used.
This paper aims to determine the residential areas out of the pedestrian service area of parks using network analysis in Tehran city and compare the situation of different regions of the city using some related indices.

Materials and methods

Network analysis provides useful tools for solution the problems existed in water distribution, material flow and transportation networks. Links, nods centers, and impedance are key elements in this analysis (Fig. 1). In this study, centers are defined as the entrance of the urban parks on the pedestrian network access. Links are routes that connect people to the parks and Nodes are the junctions of the links. Impedance in each link indicates the speed of pedestrian movements on the network access. In this

study the average pedestrian speed of 1 m/s take into account and after modeling the network access of Tehran city service area of each park was determined.

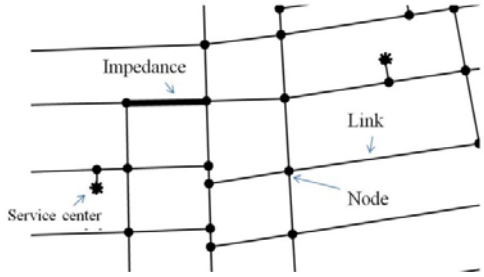

Fig. 1:Elements of a network

Since the purpose of this research is accessing the pedestrian access to nearest park, all parks have been considered as neighborhood park. Therefore the time of 15 minutes determined as the threshold of service area; means that everywhere placed in the 0 to 900 meters of the nearest park in under cover of services of that park.

To compare the regions of the city about urban park services, two indices: Service area ratio and Service population ratio as described below were used.

- Service area ratio is the percentage of service area within the interested area excluding park areas:
  Service area ratio (%) = (service area by parks / (total area – park area)) * 100
- Service population ratio indicates the percentage of service population by parks among the total population within the area of interested.
  Service population ratio (%) = (service population by parks/ total population) *100

Results

Figure 2 illustrates the service areas of urban parks for region 1 to 20 of Tehran city. Using this map and the map of residential blocks, the block located out of the service area could be determined.

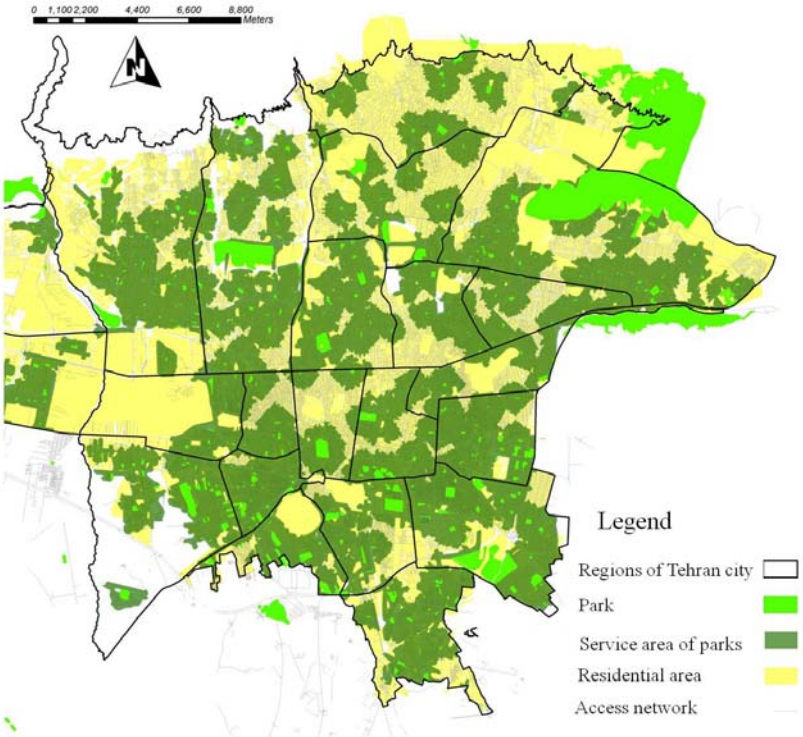

Fig. 2: Service area of urban parks in Tehran city

Based on the results, 43 percent of residential area in the area of analysis is out of park service area. Figure 3 presents the comparative situation of different regions in four indices including: Park area per capita, park area ratio, Service area ratio and Service population ratio.

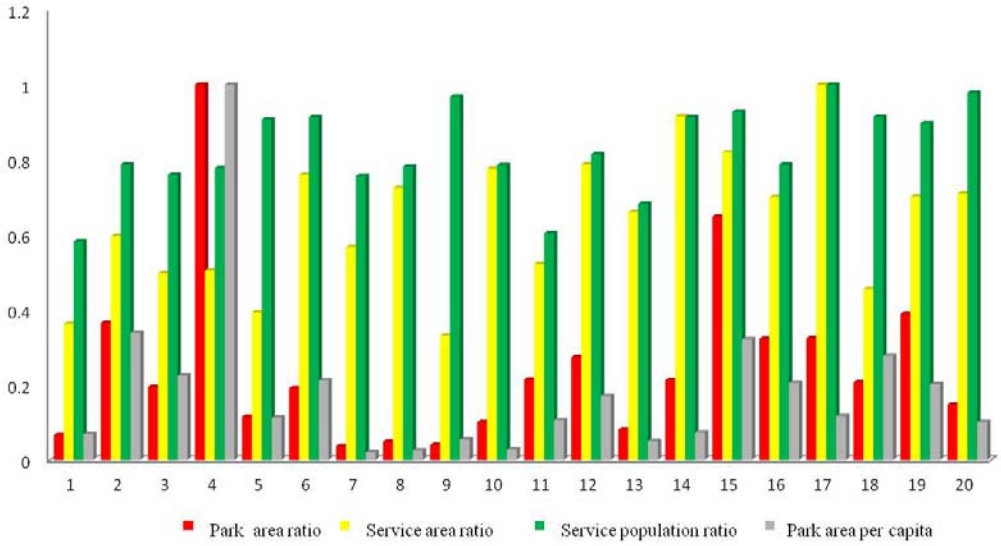

Fig.3: Comparison of standardized values of urban park service indices.

Conclusion

In the most studies that have been done about assessing the spatial distribution of urban parks, simple buffering method which has a high level of errors is used to determine the service area. Considering these problems and concepts existed in graph theory, network analysis can be usefully utilized to assessing the spatial distribution of urban parks. In this study, using accessibility network of Tehran city and defining the location of parks on it, the service area of each park was determined by network analysis.

Serviceability indices-i.e. service area ratio, service population ratio and statistical indices-i.e. park area per capita, park area ratio were evaluated and the situation of the city regions were compared. Based on the results founded in this study, 43 percent of the residual areas in the study area are placed out of the urban park serviceability. The map of these areas was prepared to use in locating and introducing new urban parks.

Keywords: Urban Parks; Service area; Network analysis, Tehran city