Assessing the Spatial Distribution of Parks in Khulna City

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Abstract

Park is an important feature of urban area that not only provides better living environment in urban life but also helps to maintain ecological balance. This study aims to investigate the spatial distribution of existing parks as well as identify served, unserved and over served area of these parks of Khulna City. A reconnaissance survey was done to find out the location of the parks, then analysis was done by GIS (Network analysis tool). It was found that 20 wards have no access to parks. Then comparing with standards, it was evident that grossly parks are adequate for Khulna City but in the real life scenario, they are not distributed properly over the area. Through the study it was found that wards e.g. ward no. 14, ward no. 22, ward no. 25 etc. has no access to parks, whereas some wards e.g. ward no. 20, ward no. 23, ward no. 27 etc. are under more than one parks service area. So proper planning is required and hence proposed sites for the parks in Khulna City can be developed by further study. Reasons behind the clustering of the parks were explained by previous case studies and land use type of the area. Most of the parks are situated either in the proximity to residential area or beside near to CBD (Dakbangla). With the passage of time population density increased over the whole city but new parks were not established for the new encroachment of the city expansion.
Keywords: *Demand; Adequacy; Service area; Spatial Analysis; Park; Khulna City; Network Analysis.*

1 Introduction

Khulna is one of the most important cities in Bangladesh. According to (BBS, 2011), the city is situated between 22°12′ and 23°59′ north latitudes and between 89°14′ and 89°45′ east longitudes having total area of 4389.11 sq. km. Form field survey it was found that there are 8 parks in Khulna City. To deliver better living condition as well as maintaining ecological balance park and open space is an exigent component in urban life (Islam, Mahmud, & Islam, 2015), (Unal et al., 2016). Open green space i.e. parks are salient features in urban areas, because it contributes to recreation, amenities and property values as well as public health, through its location, accessibility, proximity and serviceability (Yi, 2013). To ensure a better living condition in an urban area, park plays a vital role. In a city whether the existing parks are adequate to serve the local people evenly over the area or not is a major concern for the residents' health; recreation etc. A significantly revolutionary development in park sector in Bangladesh has been seen in the last two decades besides establishment and development of such park had introduced a new dimension of entertainment for the people of Khulna also (Afroj, 2012). Either this parks are adequate and accessible or not is a matter of great concern now. The first amusement park inside KCC is "Wonder Land" situated at Khalishpur that started at June 7, 1996. G.M.M Rahman is the owner of this park and with the cooperation of Khulna City the park started and KCC leased the total land for the park for 20 years with a charge of 0.25 million for first 10 years and 0.35 million for the next 10 years (Afroj, 2012). Slowly other parks were built. Till 2011 there were 6 parks in KCC according to (BBS, 2011).

The main objective of this paper was to assess the spatial distribution of the existing parks in KCC. Moreover, served; unserved and over served areas in KCC were identified and clustering of park in one place is discovered in Khulna City. Relation between land use and establishment of park was investigated here. Areas with more residential units are prone to have parks as well as new expansion of city from higher population growth had not been considered while creating Detail Area Plan (DAP) found in this study. Amount of parks needed for a certain amount of population and density is fixed, besides the accessibility to those parks are a matter of concern in case of adequacy of park. Parks have to fulfill some spatial need that was determined by comparing with standard for park and open space in this study.

2 Literature Review

According to World Health Organization per city dwellers there should be at least 9 square meters of green space to ensure better life in a city. Any city requires 25% open space or park for enough fresh air and sustainable ecosystem (Islam, Mahmud, & Islam, 2015). Adequacy of the parks means whether the existing parks provide accessible, interesting and good service to the city people along with an equal distribution of the influence radius over the city. So here comes a factor that is service area of a park; that is related with served area; over served and unserved area with network analysis. This work can be done by service area analysis of the parks by buffer, multiple ring buffer, network analysis too with GIS.
Numerous studies had been conducted over time on spatial distribution of park using GIS. Among them some of relevant studies are shown in a chronological order here. With the ideas of accessibility and access chance (Bach, 1980) made the location-allocation model that targeted on following the reduction of collective friction of area. (Lucy, 1981) additionally, highlighted equity in locating public facilities and conferred a few sub-concepts that embrace equality, need, demand, preference, and willingness-to-pay. With regard to equality but, a correct limit of distance is required as a result of a strict or good equality of distance to physical facilities is not possible to realize (Lucy, 1981). (Talen & Anselin, 1998) had assessed spatial equity in their study. (Nicholls, 2001) conducted network analysis in GIS. Since neighborhood park is within the walking distance he used a small radius distance and actual travel distance had been calculated along the streets to local park. (Oh & Jeong, 2007) evaluated the spatial distribution of parks in the five sub-regions of Seoul in terms of serviceability indices i.e. service area ratio, service population ratio, and service floor area ratio. Study results indicated that, the total service area of the urban parks identified by network analysis was 249 square km, which was approximately half of the service area analyzed by the conventional simple buffering method (Oh & Jeong, 2007).
In another study in recent year by (Unal et al., 2016), it was shown that the Cukurova district form shows uneven distribution of neighborhood parks in terms of park spatial sufficiency and accessibility potentials. Service area of 500 m for neighborhood parks is required, but there is no attention given to the minimum field size with respect to population density (Unal et al., 2016). In this paper GIS based analysis has been done along with a reconnaissance survey. The existing parks of Khulna City was under consideration.

3 Methodology

3.1 Study Area

In this study, Khulna city was defined as study area to assess the spatial distribution of parks. A reconnaissance survey was performed to find out the locations of parks within Khulna city due to unavailability of data. The existing parks within Khulna city with their location is enlisted below:

Table 1. Location name and name of the existing parks in Khulna City; Source: Author,2018

Name of the Park	Location
1.Wonder Land Park	Khalishpur
2. Khulna Navy Colony Children Park	Refugee Colony
3. S.S. World Amusement Park	Outer Bypass Road, Khulna
4. Solar Park	Sonadanga R/A
5. Shahid Hadis Park	DakBangla Mor
6. Jatishongha Park	Shantidham More
7. Lenear Park	Gollamari
8. Golokmoni Park	Khulna Press Club

3.2 Network Analysis

Network analysis is basically used in analyzing of water distribution, stream flows, and traffic flows where centers, links, nodes and impedance are key issue in analysis (Oh & Jeong, 2007). To assess spatial distribution, it is must to connect traffic flow with that feature. In this regard, network analysis tool is very useful and realistic approach to determine the spatial distribution of parks.

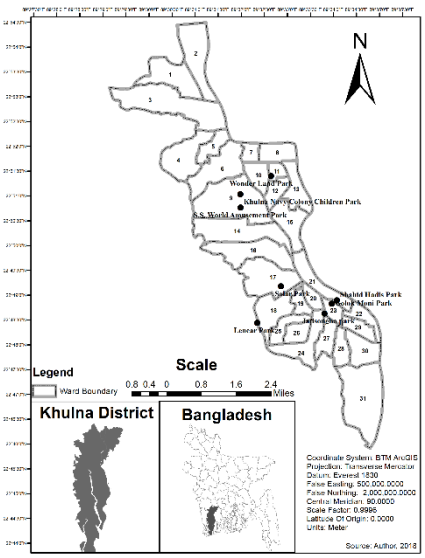

Figure 1. Study area map; Source: Author, 2018.

3.2.1 Maximum Distance

There are number of standards used for maximum distance to access a nearby park. According to (Lucy, 1981), (Perry, 1966), parks and playground should be within a 400m radius surrounding a primary school as the center. According to the recommendation of NRPA, maximum distance for park accessibility is 0.5 mile (Gold, 1973). In this study, maximum distance was set at 0.5 mile.

3.2.2. Working Procedure

After setting maximum distance, network analysis was initiated to find out the spatial distribution of parks. A network dataset was created from existing road line features of Khulna city using network analyst tool in ArcGIS 10.5. After that the network dataset was solved by loading location of parks as well as setting tolerance distance of 0.5 mile from which the service area of each parks were found out. Each service area polygon was defined as both served and over served areas. To find out which wards of Khulna city were served, over served and unserved, overlay tool was used to segregate each polygons on basis of spatial status. Finally, ward-wise spatial distribution was found out from intersecting ward boundary with identified three polygons (Served Areas, Overserved Areas, Unserved Areas).

3.3 Analysis Standard and estimation indices

To find out the efficiency of park service, service area ratio was calculated which is the percentage of service area within the area of analysis excluding park areas. High service area ratio indicates good accessibility to parks as well as good services of parks and low service area indicates less accessibility to parks as well as poor services of parks for a specific location. A formula is used to calculate service area ratio which is below:

Service area ratio (%) = (Service area by Parks) / (Total Area-Park area) *100

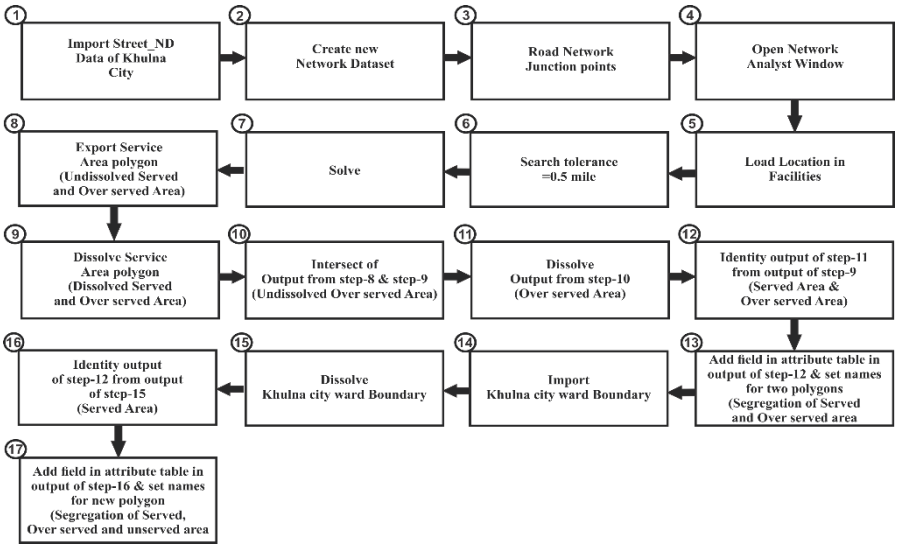

Figure 2. Working Procedure of Network Analysis; Source: Author, 2018.

4 Results and Discussion

Subsection Service areas of existing parks were analyzed by employing the network analysis method.

4.1. Service Area Analysis

Total Khulna city area was about 46.05 sq.km and service area of parks was found about 2.52 sq.km. which is about 5.55% of total area.

Table 2. Served, over served and Unserved Area of Khulna City; Source: Author, 2018.

Spatial Status	Area
Served (sq. m)	2103702.184198
Over Served (sq. m)	205684.662268
Unserved (Sq. m)	42785343.930575

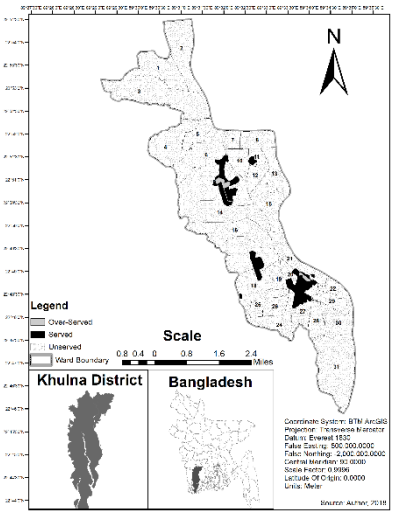

Figure 3. Spatial Distribution of Parks; Source: Author, 2018

From figure-03 it was evident that overserved area was very negligible which was about 0.45% of total area shown in figure 04, indicates that parks are located keeping a distance from one to another. It was a matter of concern that 94.45% of total area of Khulna city was remain unserved on perspective of park services.

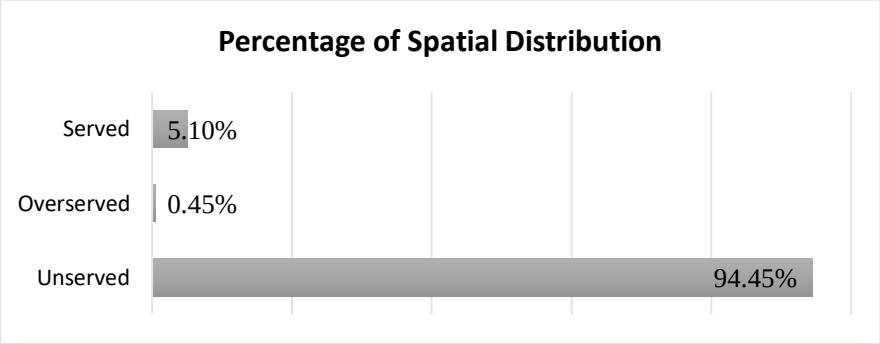

Figure 4. Spatial Distribution of Parks of Khulna City; Source: Author, 2018.

4.2 Service Area Ratio

The service area ratio was found about 4.57% which indicates that parks were not well provided. Park area ratio, park area per capita was also calculated besides service area which was interpreted in table 03.

Table 3. Service Area Ratio; Source: Author, 2018.

Region	Area	Population	Number of Parks	Park Area (km^2)	Park Area Ratio (%)	Park Area Per Capita (m^2)	Service Area ratio (%)
KCC	46.05	884445	8	0.11	0.24	0.12	4.57

4.3 Comparison between Standard and Result

According to World Health Organization (WHO), minimum nine square meters of open green space per urban dweller is mandatory. Besides, by comparison, per capita 20 square meters is the minimum suggested by Leadership in Energy and Environmental Design for Neighborhood Design (Govindarajulu, 2014). According to Bangladesh Population Census 2001, Bangladesh Bureau of Statistics, total Population of KCC is 884445 that indicates 1.44 sq. km per inhabitant. Though it seems like there is enough park in KCC but there is no proper distribution of these parks. Some wards have no park where some have access to 2 or 3 parks. No proximal park was found (Distance estimated=0.5 mile) at several wards which were ward no: 1, 2, 3, 4, 5, 6, 7, 8, 13, 14, 15, 16, 22, 25, 26, 27, 28, 29, 30, 31. It is evident that there was improper distribution of parks in KCC.

4.4 Land uses and urban park locations classification

Khulna city is one of the third largest city of Bangladesh. Due to rapid urbanization population density was increasing day by day which consequences the decrease in open spaces and park areas. From figure-05 The major land uses in Khulna city were commercial activity, community services, government services, manufacturing and processing activity, residential and service activity where residential occupied the most, about 75.20%.

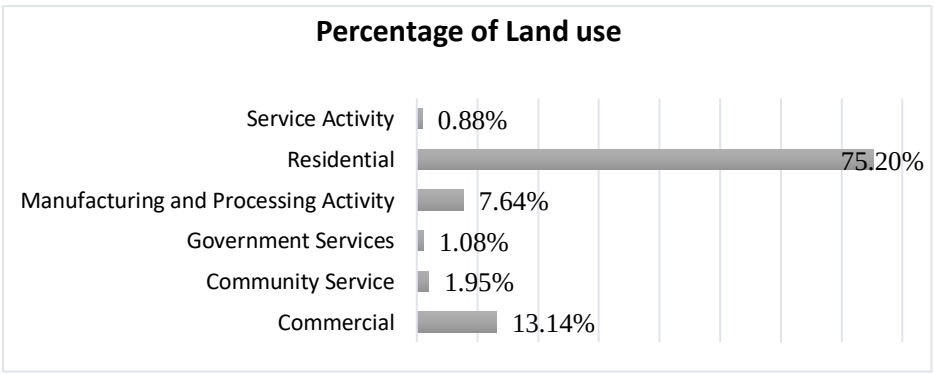

Figure 5. Major land uses of Khulna City; Source: Author, 2018.

As a result, the orientation of infrastructure services mostly depended on residential activity. From figure-06, it is evident that the distribution of parks was influenced by residential activity. Most of the areas adjacent to parks were seen to be residential. Moreover, other areas where there is no park have less density of residential units. So proper distribution of parks in the study area is essential in the existing scenario of KCC.

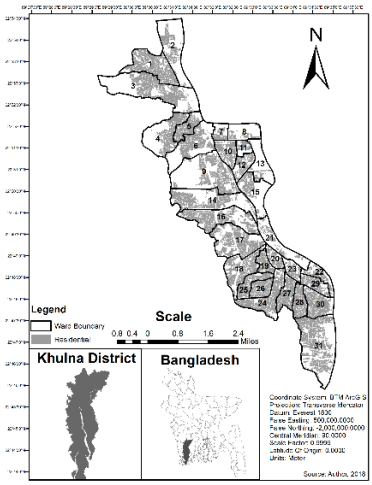

Figure 6. Service Area of Parks in terms of Residential uses; Source: Author, 2018.

5 Conclusion and Recommendation

The study was conducted for identifying spatial distribution of parks in Khulna. Among 31 wards (Census, 2011) of Khulna 20 wards have no parks found in our study. Parks are clustered in developed areas with high density residential units. Khulna Master Plan of 2001 recommended 2 acres of open space for every 1000 population. Khulna city area has 751.23 thousand populations according to census, 2011. So it is vivid that parks are in adequate number for Khulna city. But proper distribution is absent in Khulna city. Khulna Master Plan provided some guidelines but those guidelines are not specific. So no standard has been maintained while preparing the DAP for this city (Khan, 2014). Concerned authority should provide appropriate guidelines for proper distribution of park, so that the rest 10572.5 acre found in our study of Khulna city should not remain unserved by park facility.

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