EVALUATION OF ACCESSIBILITY CHALLENGES OF PUBLIC PARKS IN RESIDENTIAL AREAS OF SOUTH AFRICAN CITIES - A CASE STUDY OF BLOEMFONTEIN CITY

D DAS* and J HONIBALL

*Department of Civil Engineering, Central University of Technology, Free State,
20 President Street, Bloemfontein, South Africa, 9300
Email: ddas@cut.ac.za, Cell: 0848529260; jhoniball.cut.ac.za

ABSTRACT

Public parks and open recreational facilities are essential elements of healthy modern cities. The importance of the public parks in urban residential areas is uncontested from the health and environment point of view. Although, public parks are integral parts of the urban residential areas in most of the cities in South Africa, they are observed to be highly underutilised. Literature suggests that accessibility, environmental and social factors are some of the challenges for proper utilization of the public parks. However, the challenges of accessibility to the public parks, particularly in residential areas of cities are least explored. Therefore, using the case study of Bloemfontein this investigation identified the most important accessibility factors that deter the utilisation of public parks, and examined their level of influence on the utilisation of public parks in the residential areas of a South African city. This study was conducted by using a survey research methodology and consequent development and application of empirical models. Primary data collected through both household surveys, and physical park utilisation surveys by continuous digital photography and videography were used to explore the influential accessibility variables, and subsequent development of empirical models to examine their influence on the utilisation of public parks. It was revealed that the ratio of road network to pedestrian facilities (paved pathways) network, number of access streets to the parks, size (in area) of parks, and the level of illumination in the parks during evening periods are the major variables, which influence the utilisation of the parks to varied extent. An optimal level of number of access streets to the parks, proportionate pedestrian facilities (paved pathways) facilities on the roads providing access to parks and appreciable illumination will enable significant improvement in the utilisation of parks in the residential areas of South African cities.

Keywords: Accessibility; Public parks; Pavements; Road network, Residential areas

1. INTRODUCTION

Public parks and recreational facilities are locations which provide people opportunities for a wide range of leisure, sport and recreational activities. As such, public parks and recreational facilities are crucial for the social and economic health of cities and towns (Sallis, Frank, Saelens, & Kraft, 2004). Accordingly, there was a greater demand for creation of organized open spaces including public parks and open recreational facilities in the residential areas of the cities. These spaces have become one of the core urban functions and land uses in the city development plan. Although, a number of such public parks and recreational facilities have been developed in the South African urban areas, it has been observed that except for a few major and organized ones, the others are barely utilized. The reason of underutilization of the public parks are attributed to many factors that include lack of amenities, inappropriate location, lack of attractiveness, lack of accessibility, behavioural issues like lack of time and life style, social issues like crime or fear of crime to name a few. However, according to a Project for Public Spaces (PPS) model, the success of public parks and open recreational spaces depends on several major determinants, which include accessibility, engagement of people in related activities, image, comfort, and sociability of the space (Project for Public Spaces, 2011). Physical accessibility – in terms of availability and quality of access facilities (road communication); cost of accessibility; time distance relationship from the residential areas as well as parking and security facilities is considered as one of the most important characteristics influencing successful utilization of these public parks and open recreational facilities. Similarly, visual accessibility variables like sight distance, visibility of the parks and illumination level in and around the parks are argued to influence utilisation of the public parks.

Accessibility of public parks in the city is largely affected due to the lack of an efficient and adequate public transportation system; development of commercial and related activities engulfing their space; unavailability of quality physical communication facilities (roads, parking, pedestrian facilities, safety and security measures) and also the increase in traffic volumes resulting in traffic congestion and extended travel time. Similarly, according to PPS, the accessibility to parks is measured by characteristics such as continuity, proximity, connectedness, readability, walkability, convenience as well as vehicle and pedestrian access infrastructure and visual accessibility parameters. Thus, it is crucial to evaluate the most important determinants, which influence accessibility of public parks and recreational facilities in the residential areas of a city and then evolve planning and design guidelines to improve accessibility so that the parks and recreational areas will be more vibrant and optimally utilised.

Therefore, the objective of this investigation is to identify the most important accessibility factors that deter the utilisation of public parks, and examine their level of influence on the utilisation of public parks in the residential areas of a South African city. The study was conducted by using Bloemfontein city as a case study. A survey research method and statistical regression modelling approach were used for this purpose. Findings suggest that the ratio of road network to pedestrian facilities (paved pathways) network, number of access streets to the parks, size (in area) of parks, and the level of illumination in the parks during evening periods are the major variables, which influence the utilisation of the parks to varied extent. An optimal

level of number of access streets to the parks, proportionate pavement facilities on the roads providing access to parks and appreciable illumination will enable significant improvement in the utilisation of parks in the residential areas of South African cities.

2. LITERATURE REVIEW

Public parks and open recreational spaces have physical, social and economic, environmental contributions to the cities. Physically it creates an image of the city, which leads to other advantages like enhancement of tourism, attraction for people to live in and perhaps assist in investment in the city (Atiqul Haq, 2011; Madanipour, 2003; Sorensen, Smit, Barzetti and Williams, 1997; Van Melik, Van Aalst, Van Weesep, 2009). Environmentally, public parks supply the cities with ecosystem services ranging from maintenance of biodiversity to the regulation of urban climate (Heidt and Neef, 2008). Public parks through natural eco systems have the ability for CO_2 absorption, and research has shown that they alleviate air pollution (Bolund and Sven, 1999; Huang, Lu and Wang, 2009). Besides, people try to satisfy most of their recreational needs within the locality where they live (Nicol and Blake, 2000). Public parks and green spaces within urban areas provide a sustainable proportion of the total outdoor leisure opportunities on a daily basis or every second day (Neuvonen, Sievanen, Susan and Terhi, 2007). They serve as a near resource for relaxation; offer opportunities for wide variety of activities, and also provide emotional warmth (Grahn and Stigsdotter, 2003; Heidt and Neef, 2008; Sorensen, Smit, Barzetti and Williams, 1997)**.** Several studies also established that quality public parks impact on specific health outcomes, like community-level rates of mortality, cardiovascular disease, diabetes, and obesity (Takano, Nakamura, Watanabe, 2002). Therefore, it can be concluded that public parks offer a unique setting within the urban landscape, providing opportunities for physical activity, enjoyment of nature, social interaction, health benefits and escape (Hayward and Weitzer, 1984; McCormack, Rock, Toohey, Hignel, 2010). Thus, planning, design, and redesign of public parks and their upkeep are vitally important for population health and the society (Hayward and Weitzer, 1984).

One of the important aspects which have been emphasized in literature regarding the public parks and open recreational facilities is the access, which essentially influence their success (PPS, 2011). It is well established that access to public parks and natural settings is associated with improved physical and mental health of people (Sugiyama et al., 2008; Payne et al., 2005; Potwarka et al., 2008). Public park users are more likely to achieve good levels of physical activity and health compared with non-users (Deshpande et al., 2005) because there is evidence that lack of accessibility of parks and distance from parks are inversely associated with use and physical activity behaviour (Kaczynski and Henderson, 2007).

According to the place diagram of the PPS model, the basic park access for residential populations of a city is based on the spatial configuration of parks, the number of parks and their spatial distribution across neighbourhood areas or local regions. It is therefore a common practice to base spatial accessibility on the proximity, location and size of the parks, which contribute to the use of the parks (Zhang et al., 2014). Further, according to the PPS model, accessibility of a place is

judged by its connections to its surroundings. A successful public park needs to be easily accessed and commuted through and it can be seen from both a distance and up close. Generally, it is argued that availability of local public parks within walking distance is positively associated with park use, while the necessity of driving to reach a park often deterred its use (Wilbur et al., 2002, p. 22). Also, other park attributes like safety, and location may also influence the use of public parks. Some scholars argued that distance or walking time from home has appeared to be the single most important precondition for access and use of green spaces such as public parks (Herzele and Wiedeman, 2003). Apparently, easy access and short distance to public parks increase the number of visits; people in close proximity to a public park or green space access and use it more frequently (Atiqul Haq 2011; Herzele and Wiedeman, 2003; Neuvonen, Sievanen, Susan and Terhi, 2007). For example, a study in Helsinki, Finland found that people living close (<0.5 km) visited the parks or green spaces more frequently (>4 times per week) (Neuvonen, Sievanen, Susan and Terhi, 2007, Atiqul Haq, 2011).

Some scholars also argue that public parks should be at the centre of neighbourhood and not more than five minutes walk for most residents, public buildings or shops (Etzioni, 1998). As well as, the distance, if one uses a bi-cycles to visit parks should be adequately short and should have limited obstructions along the trip (Atiqul Haq, 2011; Etzioni, 1998).

Besides, access to specific park attributes may influence park use at local scale or neighbourhood level. For example, dog-owners looking for dog exercise areas (Cutt et al., 2008), or people wishing to use parks with pools that have specific hours of operation (Tucker et al., 2007) will access and use the public parks according to their needs. Access to public transportation was also identified as an enabler for public park access as it is always associated with some physical activity for some people in addition to providing accessibility (Day, 2008, p. 306). Also, parks and playgrounds on regularly walked routes are observed to be accessed and used more often than those located elsewhere (Ferre´ et al., 2006; McCormack, Rock, Toohey, Hignel, 2010).

Arguments have emerged that the rapid growth of vehicles has greatly affected the accessibility of public parks in the cities. The lack of bi-cycle lanes and pedestrian sidewalks connected to- and parking areas near public parks and open recreational facilities create constraints in the accessibility of the parks and open recreational areas in the cities (Nevhutanda, 2007). Similarly, pedestrian safety is a major concern with respect to accessibility to public parks. Pedestrian safety is largely reliant on the design elements of the roadway; it is just as much influenced by the design of the land use surrounding the roadway (Nambuusi, Hermans, Brijsa, & Wets, 2010). Notwithstanding of the land uses, it is argued that the design of the roadway must go hand in hand with the design of the open spaces surrounding the roadway (Nambuusi, Hermans, Brijsa, & Wets, 2010). Land use-planning should provide facilities and services that ensure continuous and safe pedestrian access, which can increase access to public parks.

Similarly, the other relevant aspects to consider regarding the accessibility to public parks and open recreational facilities are the visibility of the space from a distance, interior visibility, usability, functionality with respect to people with special needs,

availability of various modes of movement, availability of convenient transportation nodal points close to important social and civic elements such as park entrances, libraries, post offices, etc. (PPS, 2011). Besides, symbolic access to public parks is becoming more and more important in defining the full spectrum of accessibility and vibrancy of the public parks. Symbolic access to public parks can be defined by the level and quality of signs and marks that share information to prospective users on who or what is welcome and who or what is not in the areas and territories of the space. These markings and signs can also be elements like structures, landmarks, monuments, sculptures, etc. Public display areas and programs such as pavilions, galleries, and other theme objects can also be seen as features contributing to symbolic access. The visibility of users such as groups - teenagers, small children, dog walkers, etc., maintenance workers, and security staff in public parks are also contributors to the symbolic access of public parks (Sendi and Golicˇnik Marusˇic, 2012). Thus, accessibility forms a vital element for success and higher utilisation of public parks and need thorough investigation.

3. CASE STUDY: BLOEMFONTEIN

Bloemfontein City in South Africa was chosen as the study area for this investigation. Geographically Bloemfontein is situated at 29°06′S and 26°13′E at an altitude of 1395m above sea level. It is the capital city of the Free State province as well as the judicial capital of South Africa.

There are numerous organized open spaces in the city. It is found that the city has a well-distributed network of public parks in all the residential areas. There are about 202 public parks in the city, covering an area of 167 km², which means that for every square kilometer of the city there are on an average 1.2 public parks. Every residential area and neighbourhood contains a number of public parks. These public parks and open recreational areas in the residential areas, which offer free access to the public are considered for the purpose of this investigation. Although, the city has a variety of sport fields (stadiums, sport arenas, and sport facilities) that are categorized under public recreational facilities, they are not considered in the analysis because of the limited/private access these facilities provide. Besides, nature reserves, zoos and botanical gardens that require the public to pay a certain fee in order to gain access have been kept out of the scope of this study.

The City of Bloemfontein has ensured in its planning that there is a public park within 1.0 km walking distance from every residential dwelling. With such availability of public parks to the residents of the city, it is expected that these public parks to be vibrant and active, but as experienced that is not the case. However, as observed from survey, these parks are not used to their full potentials. There are a number of factors which contribute to their under utilisation among which accessibility is a major reason. Thus, it is necessary to assess and analyze the accessibility to these public parks in order to evolve plausible policy guide lines and strategic interventions for improving the use of these public parks.

4. METHODOLOGY

A survey research method followed by statistical analyses and empirical modelling approach was used in this study. Data from primary field survey was used in the analyses. Primary field survey was conducted to get first hand data at the study area level. For this purpose, out of the twenty six suburbs of the city, four suburbs such as Batho (Eastern part), Universitas (South-Western part), Langenhovenpark (Western part), and Lourier Park (Southern part) were chosen. These suburbs were selected on the basis of a set of selection criteria, such as location, population, social and demographic condition, type of accessibility through road network, location, size and availability of the public parks and open recreational areas. These suburbs are densely populated and have a number of public parks, and apparently represent the heterogeneity and diversity of the demographic and public parks characteristics of the City.

Three kinds of primary surveys- household survey, physical condition of parks survey and public park use survey were conducted in these selected areas. Household survey was conducted among 240 households by using pretested questionnaires (with one questionnaire per household). The households were selected by using systematic stratified random sampling process in each suburb. About 60-80 households were selected in each suburb proportionately based on the population size of the suburbs. The survey was conducted by the researchers and with the assistance of student research assistants through semi- structured interviews among the respondents. Out of the 240 households surveyed 208 (86.7%) have responded appropriately. However, after elimination of errors and improper responses, 200 questionnaires with proper information were used for analysis. Some of the relevant and important questions that are included in the household survey questionnaire to obtain the perception of the park users are: demographic and social attributes of the respondent, how often and how recent the respondent visit the parks, what are the purpose of visit to parks, what facility in the park he/she uses, during what period he/she uses the parks, how does he/she travel to the parks, how much distance he/she travels to reach the parks, how much time he/she takes to travel to parks, how much time does he/she spend in the parks, and his/her perceptions on the various characteristics of parks, facilities available in the parks, accessibility conditions in and around the parks, challenges faced in use of parks, and suggestions to improve the accessibility and use of parks.

Data on the physical condition of the public parks in the selected suburbs, their accessibility to users, and use were obtained by conducting physical surveys and public park use survey. Besides these information was supplemented by the up-to-date GIS data obtained from the municipality. Physical condition of parks and park use surveys were conducted by using continuous digital photography and videography. Fourteen public parks located in the four selected residential areas were identified for the physical and park user survey. For this purpose a camera was set up at each of the identified public parks, which filmed the park for 7 days non-stop to monitor the daily use of each park and various accessibility issues. The physical surveys included facilities and challenges on the traffic network systems in and around the public parks in the selected areas, parking access near the public parks; the condition and availability of pedestrian access; the public transport system servicing the selected areas and the surrounding land use.

Physical accessibility was evaluated based on the availability of pedestrian facilities and road network leading to the parks. Pedestrian facilities include properly maintained paved pathways along the roads without obstructions/barriers/encroachments/gaps. The road network includes the local roads and access streets passing through the residential areas. Access streets imply the roads that are directly leading to the parks. While analysing the accessibility factors pedestrian facilities length to road network length ratio was considered as a parameter for the convenience of analysis as both are dependent on each other. The ratio was calculated by taking the ratio of total length of pedestrian facilities without obstructions/ barriers/ encroachments/gaps along the roads leading to the parks to the total road length of the road network that provides access to the parks. The lengths of the pedestrian facilities and road network were obtained from GIS data available with the municipality. While calculating the lengths the spheres of influence of the parks in the residential area were considered and the midpoint between two parks is taken as the dividing line between the sphere of influence of different parks. For example, as shown in the Figure 1, while calculating the pedestrian facility lengths and road network lengths for public park 1, the middle dividing lines between public park 1(PP1) and public park 2 (PP2), and between public park 1(PP1) and public park) 3 (PP3) respectively were taken as the dividing lines of the sphere of influences for public park 1. The lengths of the road network and pedestrian facility network were measured from these dividing lines to the access point(s) (gates) of the park 1. The road network length includes all the roads in the network that leads to the park (shown in black colour in Figure 1). However, pedestrian facility length includes all the pedestrian facilities that run along the roads leading to the park without obstruction/ barriers/ gaps in the pedestrian facility (as shown in red colour in Figure 1).

The data collected were statistically analysed by using weighted average index method, correlation coefficients and multi-collinearity analysis to observe the causes of traffic accidents. Besides, empirical linear regression models were developed; significance tests (F distribution and t test for p values) were conducted to understand the influence of the major variables that cause accessibility challenges and their implications on the use of the public parks.

The weighted average index method was employed to find the people's perception indices of the variables regarding the accidents. The model used is given in equation 1 (Eq.q1):

Perception weighted average index= PWI $=\frac{\sum \mathrm{Pi}*\mathrm{Ni}}{\sum \mathrm{Ni}}$ ……Eq. (1)

Where, Ni = number of respondents, Pi = index values provided by the respondents in a scale of 0 to 1 as observed from household survey.

Figure 1: Pedestrian facility network to road network ratio for public parks in a residential area

5. RESULTS AND DISCUSSION

5.1 Factors influencing accessibly and consequent uses of public parks

Table 1 presents the indices of the factors influencing usability of public parks based on perceptions of people. It is revealed that walking to public parks (PI= 0.99) is the most influential factor of accessibility that influences uses of parks. People also perceive that walking distance (PI= 0.69) fairly influences the use of parks. However, it is also found that vehicular use has the least influence (PI=0.01) on the use of parks. Since most of the public parks in the residential areas are located within 1 to 2 Kms of distance from residences of people and the maximum walking time is about 13 minutes, most people prefer to walk to the parks.

According to people, afternoons and evenings (5pm-8pm) (PI= 0.75) are the most important periods of the day to make use of public parks. Some people prefer morning hours (PI=0.20). However, mid- day period (PI= 0.05) is the least preferred time to visit parks in the study area.

Since the evening and afternoon hours are the most preferred time for users to go to public parks, it was important to investigate the influence that illumination levels have on users accessing the public parks in the evenings. As found out most users are influenced by the level of illumination in the public parks (PI=0.68). Insufficient illumination of public parks during evening hours deters the people to visit the parks or stay for longer duration in the parks.

The perception index also revealed that for all the people surveyed entry fee is the least influential factors as most of the parks are accessible for free. However, it is also found that people prefer not to pay an entrance fee in order to access a public park. The pavement condition of roads and pedestrian facilities and maintained condition of the public parks have lower perception indices thus; do not influence use of parks.

Besides, people also perceive safety as a very important factor which influences use of parks in the study area. Lack of safety (PI= 0.80) is one of the most important reasons for people to not making use of the public parks. Although, it is necessary to note the importance of safety at public parks, this investigation only focussed on the accessibility aspects to public parks and safety issues are kept out of the scope of the investigation.

Table 1: Perception index of the factors influencing usability of Public Parks

Factors influencing usability of public parks	PI = (∑NiXi)/N
Walking to public parks	0.99
Use vehicle to access	0.01
Walk distance importance	0.69
Walk distance satisfaction	0.26
Quality of parks (Prefer private parks)	0.34
Safety	0.80
Period of the day (morning)	0.20
Period of the day (Mid-day)	0.05
Period of the day (Evening/afternoon)	0.75
Illumination in the parks in the evening	0.68
Pavement condition of roads and pedestrian facilities	0.43
Maintenance of parks	0.47
Entry fees	0.00

(Source: Physical and public park use survey, 2014)

Table 2 presents the correlation coefficients of various accessibility factors with the number of park users. The high correlation coefficient between the illumination of the parks at night and the average number of public parks users per month (0.84) supports the premise that the higher the illumination levels of the public parks, the higher will be the average number monthly users of those public parks. The high correlation between the average number public parks users per month and the pedestrian facility network to road network ratio (0.82) means that the more complete the pedestrian facility network in the service areas, the higher will be the average number of public parks users per month. Though variables such as number of access streets into park (0.69) and area (size) of park (0.70) have relatively lower correlation coefficients with the average number of public parks users per month, they are also significant, and thus influence the average number public park users per month in the study area. Variables with very insignificant correlation coefficients - such as the average pedestrian facility widths, and longest sight distance towards public parks, were not considered as major control variables that are influencing the users to visit public parks. Thus, the major control variables, which largely influence the average number of public parks users per month in the study area, are the road network to pavement network ratio (%); the number of access streets into the parks;

the area/size of the parks (m²) and illumination of the parks at night. Furthermore, VIF test results (Table 3) present the interdependency among the independent variables. It is observed that all the independent variables considered such as pedestrian facility network to road network ratio (%); the number of access streets into the parks; the area/size of the park (m²) and illumination of the parks at night are fairly independent and mutually exclusive of each other as the VIF factors between the independent variables are found to be less than 4.

Table 2: Correlation coefficients between parks users and accessibility variables

	Average number users per month		Pavement to road network ratio (%)	Number of access streets into park	Average pavement width (m)	Area of park (m²)	Number of parking lots	Longest sight distance (meter)	Illumination of parks in evenings measured in lumens (lux)
Average number of users per month	1								
Pavement to road network ratio (%)	0.82		1.0						
Average pavement width (m)	0.67		0.76	1.0					
Number of access streets into park	0.69		0.32	0.21	1.0				
Area of park (m²)	0.70		0.42	0.42	0.23	1.0			
Number of parking lots	0.34		0.14	0.27	0.46	1.0			
Longest sight distance (m)	0.51		0.72	0.73	0.58	0.72		1.0	
Illumination of park in evenings measured in lumens (lux)	0.84		0.42	0.43	0.45	0.32		0.78	1.0

Table 3: Variance Inverse Factors (VIF) test results on selected variables

	Number of users	Pavement network to road network ratio	Number of access streets into park	Area of park	Illumination of park in evenings measured
Number of users	13.16	-3.14	-3.42	-2.45	-3.24
Pavement network to road network ratio	-3.14	4.76	2.42	3.45	1.78
Number of access streets into park	-3.42	2.42	3.97	3.23	1.96
Area of park	-2.45	3.45	3.23	5.34	3.78
Illumination of park in evenings	-3.24	1.78	1.95	3.78	4.12

Regression and trend analyses were done to observe the influence of the accessibility variables on the usability of public parks in the study area. Table 4 provides the regression variables between the parks users and various major accessibility variables obtained from multiple regression and ANOVA analysis. It is observed that the actual F value (49.75) is much higher than the critical F value (3.63). The high r^2 value also indicates that the four major accessibility variables mentioned above significantly influence the park uses in the study area. Besides, the significance test results show that p values (both single tailed ad two tailed) for each variable are <0.05 for α <0.05. This indicates that there are significant relationships exist between all the accessibility variables such as pedestrian facility network to road network ratio, number of access streets into parks, area (size) of parks and illumination level of parks in evenings/nights with the park uses in the study area of city of Bloemfontein. Thus, pedestrian facility network to road network ratio, illumination parks in the evenings, number of access streets and area of parks are considered as the major accessibility variables which influence the usability of public parks in Bloemfontein.

Table 4: Regression variables and significance test results

Regression variables			
r^2 =			0.96
Adjusted r^2			0.98
F			*49.75 >(Critical F value 3.63) for α<0.05*
df			*13*
	t Stat	*P*-value*	*P**-value*
Pavement network to road network ratio	2.77	0.0059	0.0118
Number of access streets into park	3.55	0.0010	0.0020
Area (size) of park	-3.19	0.0019	0.0038
Illumination of park in evenings	2.96	0.0033	0.0066

*Note: *single tailed; ** two tailed*

5.2 Influence of major influential accessibility factors on users of public parks

5.2.1 Pedestrian facility network to road network ratio on the number of users of public parks in the study areas

Figure 2 shows the relation between the pavement network to road network ratio and the average number monthly users of the public parks in the study areas. The relationship is presented in the equation 2 (Eq.2).

$y_1=0.0002x_1+0.8515$ …… (Eq. 2)
$r^2 =0.72$
p=0.0059
y_1 = Number of public park users per month
x_1 = Pavement network to road network ratio

The trend analysis revealed that the average number of monthly users' increases linearly with improvement in the pedestrian facility to road network ratio, or in other words higher pedestrian facilities commensurate to road network encourages more people to use the parks. However it is also seen that the pedestrian facilities network to road network ratio ranges between 0.80-0.98, and higher number of park users are seen with a ratio more than 0.9. This indicates that although the study area has a fairly good pedestrian facility to road network ratio in the residential areas, more number of people use parks where the pedestrian facility network is more complete, i.e., the pedestrian facilities are almost provided along all the roads leading to the parks without much obstructions.

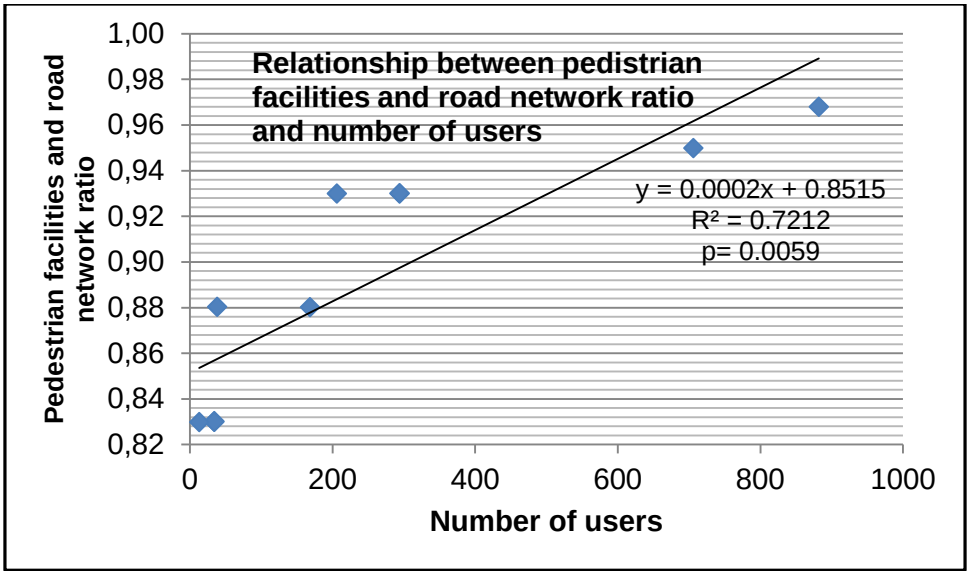

Figure 2: Influence of pedestrian facilities network to road network ratio on the number of users of public parks

5.2.2 Influence of the number of access streets leading into the public parks in the study areas

Figure 3 shows the relationship between the number of access streets leading to the public parks and the average number monthly users of the public parks in the study areas. The relationship is presented in the equation 3 (Eq.3).

$y_1=0.0086x_2+2.0026$ …… (Eq. 3)
$r^2 =0.702$
$p=0.0010$
y_1 = Number of public park users per month
x_2 = number of access streets

The relation posits that the average number of monthly users also increases along with an increase in the number of access streets leading towards the public parks. Although, the maximum number of users are found where the number of access streets are exceedingly high (9), such scenarios are exceptional. Similarly, very low number of park users is also found where the number of access streets is very low (2). However, a reasonably good number of park users are observed in the parks, which are accessible by 3 to 5 number access streets. Therefore, number of access streets has a definite relationship with park uses, and adequate number of access streets is necessary to improve the use of parks in the study area. However, it may not possible increase the number of access streets physically because of physical, land and infrastructural constraints in case of existing parks but such consideration will be useful while developing new public parks.

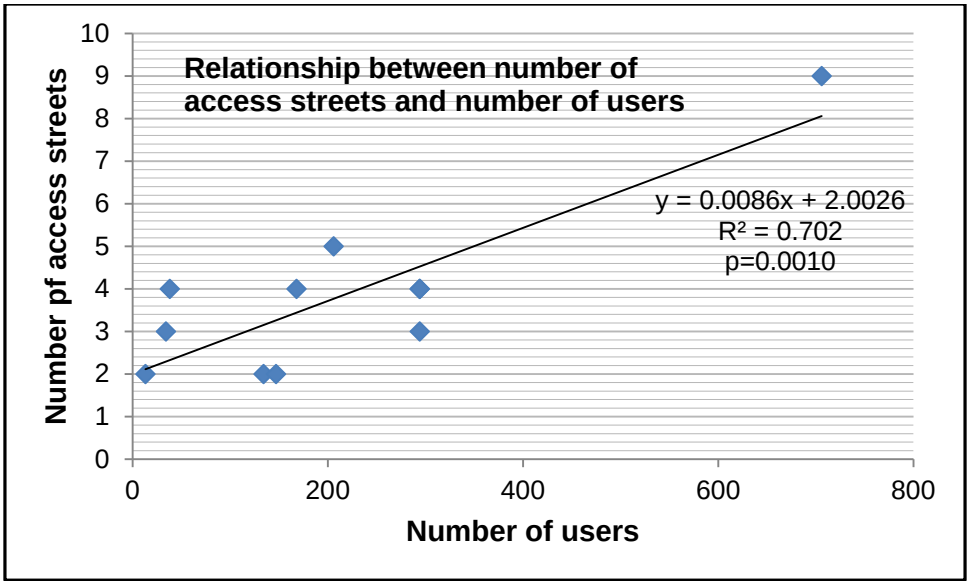

Figure 3: Influence of the number of access streets leading to the public parks on the number of users of public parks

5.2.3 Influence of the area (size) of the public park in the study areas

Figure 4 shows the relationship between the area (size) of the public parks and the average number monthly users of the public parks in the study areas. The relationship is presented in the equation 4 (Eq.4).

y_1=216.07-10979 …… (Eq. 4)
r^2 =0.66
p=0.0019
y_1 = Number of public park users per month
x_3 = Area of parks in sq.m

It is found that exceptionally large parks invite maximum number of users. However, as most of parks in the residential areas have limited size, large number users in large parks is found to be an exception. The trend analysis also revealed that the variations in the number of users do not necessarily dependent on the variation in the size of parks. For example, according to the trend analysis an increase of about 9 monthly users will be observed with every increase of 1000 m² of the area of the public parks, which may seem to be meagre. This indicates that an increase in the area of public parks may not necessarily increase the number of users significantly. However, concurrently its impact on the use of parks can not be undermined.

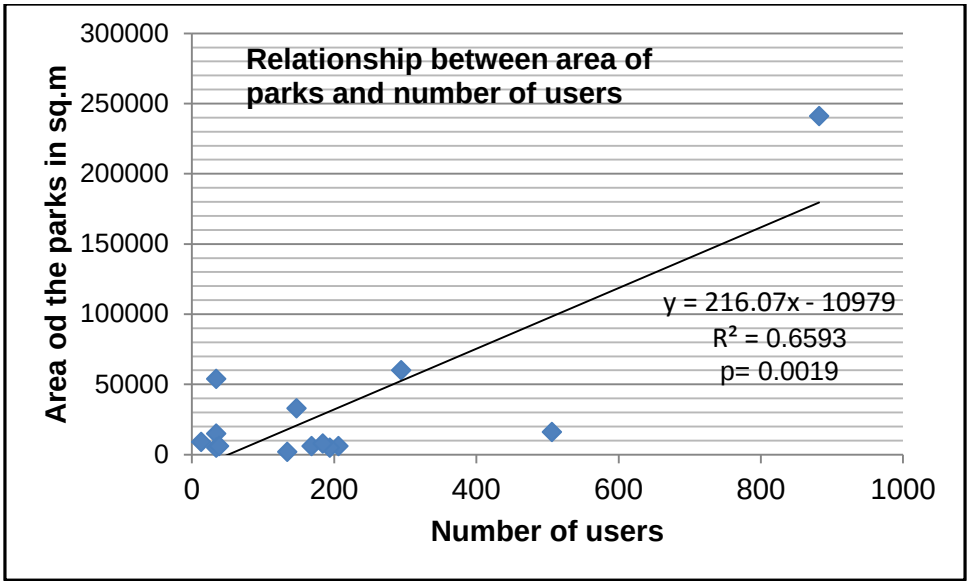

Figure 4: Influence of the area (size) of the public park on number of users of public parks

5.2.4 Influence of the level of evening illumination of public parks in the study areas

Figure 5 shows the relationship between the illumination levels in the evenings and the average number of monthly users of the public parks in the study areas. The relationship is presented in the equation 5 (Eq.5).

$y_1 = 0.0073x_4 + 2.3679$ …… (Eq. 5)
$r^2 = 0.767$
$p = 0.0033$
y_1 = Number of public park users per month
x_4 = Illumination level in parks in lux

The relationship proves that a linear relationship exists between illumination and number of park uses. Clearly it is observed that low number of park users visits parks where the average illumination level is very low (<3 lux) and more people use parks where illumination level is high (>7). However, all the parks have illumination level less than 20 lux recommended by the Encyclopedia of Occupational Health and Safety. Thus, as per the trend analysis the average number of monthly park users increases significantly along with an increase in the level of illumination of the public parks in the evenings/nights. So, significant improvement in the illumination in the public parks during evening/ nights is essential to improve the uses of public parks in the study area.

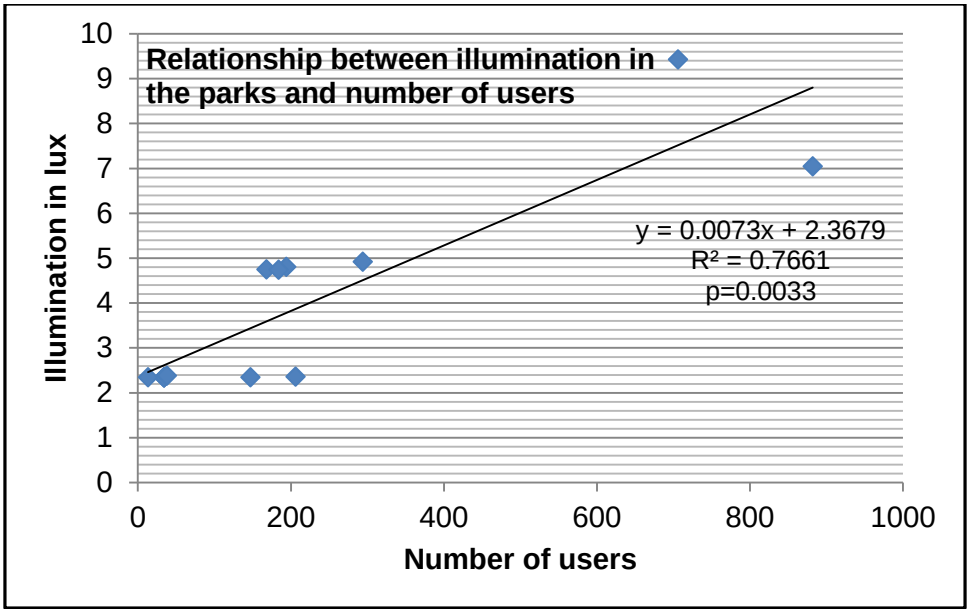

Figure 5: Influence of the Level of Evening Illumination of Public Parks on the number of users of public parks

Thus, it is essential to appropriately improve the four accessibility variables in order to improve the uses of the public parks.

6. CONCLUSION

The study explored the major accessibility parameters which largely influence the uses of public parks and examined their level of influence. For this purpose a case study was conducted by considering Bloemfontein city of South Africa. A survey research method that includes household survey, physical survey, and public parks use survey were conducted by using continuous digital photography and videography. Relevant statistical analyses including regression analyses were adopted to conduct the investigation. The relationship and causation between the number of park users and accessibility variables were established by the concurrent analyses of the perception index, correlation coefficients, VIF test, significance tests and regression analyses. The investigation revealed that pedestrian facility network to road network ratio; number of access streets to public parks, size of parks and illumination level of public parks are the major accessible parameters which influence the uses of the public parks in the study area. However, it is apparent that out of the four major variables pedestrian facility network to road network ratio; number of access streets to public parks, and illumination level of public parks have higher significance and they could be crucial to increase the use of parks in comparison to size of parks, which has relatively lesser influence. Walking to parks and walking distance also influence the park users to visit the parks. On the other hand, other accessibility parameters such as average pavement widths, longest sight distance towards public parks, and availability of parking lots have insignificant influence on the park users to visit the public parks. Lack of safety is found to be a crucial factor which deters people to visit parks, however, it is kept out of the scope of the current investigation and no further analysis was conducted.

The study has a few limitations. The major limitation is that the scope of the research was confined to the investigation of accessibility related parameters on the public park uses in the Bloemfontein City. So, explicit analyses relating to influence of socio- cultural, environmental, demographic, and behavioural and safety related parameters were kept out of the scope of the investigation. Further research is also needed to extend the study to these aspects of the study. Besides, studies also need to be conducted by considering other cities of the country in order to generalise the research implications. However, the current research shows that such as road network ratio; number of access streets to public parks, size of parks and illumination level of public parks and size of parks are the four important accessibility parameters, which need to be considered carefully while developing policy interventions for the improvement of use of public park in residential areas of Bloemfontein city of South Africa.

REFERENCES

Atiqul Haq Shah Md. 2011. Urban Green Spaces and an Integrative Approach to Sustainable Environment, Journal of Environmental Protection, 2011, 2, p. 601-608 doi:10.4236/jep.2011.25069 Published Online July (http://www.scirp.org/journal/jep).

Bolund, P. and Sven, H. 1999. Ecological Services in Urban Areas, Ecological Economics, 29, p. 293-301. doi:10.1016/S0921-8009(99)00013-0.

Cutt, H., Giles-Corti, B., Wood, L., Knuiman, M., Burke, V. 2008. Barriers and motivators for owners walking their dog: results from qualitative research. Health Promotion Journal of Australia, 19, p.118–124.

Day, R., 2008. Local environments and older people's health: dimensions from a comparative qualitative study in Scotland, Health and Place, 14, p.299–312.

Deshpande, A.D., Baker, E.A., Lovegreen, S.L., Brownson, R.C. 2005. Environmental correlates of physical activity among individuals with diabetes in the rural Midwest, Diabetes Care, 28, p. 1012–1018.

Etzioni, A. 1998. The Essential Communitarian Reader, Rowman and Littlefield, Lanham.

Ferre´, M., Guitart,A.,Ferret,M., 2006. Children and playgrounds in Mediterranean cities, Children's Geographies, 4, p. 173–183.

Grahn P. and Stigsdotter, A. U. 2003. Landscape Planning and Stress, Urban Forest: Urban for Urban Green, 2, p. 001-018.

Heidt V. and Neef, M. 2008. Benefits of Urban Space for Improving Urban Climate, Ecology, Planning and Management of Urban Forests: International Perspective.

Herzele V. and Wiedeman T. 2003. A Monitoring Tool for the Provision for Accessible and Attractive Green Spaces, Landscape and Urban Planning, 63, 2, p. 109-126. doi:10.1016/S0169-2046(02)00192-5.

Huang, D., Lu C. C. and Wang, G. 2009. Integrated Management of Urban Green Space: The Case in Guangzhou China, 45th ISOCARP Congress.

Hayward, D., Weitzer, W. 1984. The public image of urban parks: past amenity, present ambivalence, uncertain future, Urban Ecology, 8, p. 243–268.

Kaczynski, A.T., Potwarka, L.R., Saelens, B.E. 2008. Association of park size, distance, and features with physical activity in neighborhood parks, American Journal of Public Health, 98, p. 1451–1456.

Madanipour, A. 2003. Public and Private Spaces of the City. Routledge, London

McCormack, Gavin R. Rock Melanie, Ann, Toohey M, Hignel Danica (2010) Characteristicsofurbanparksassociatedwithparkuseandphysicalactivity: A review of qualitative research, Health & Place, 16 p. 712–726.

Nambuusi, B. B., Hermans, E., Brijsa, T., & Wets, G. 2010. Sensitivity of road safety outcomes to uncertainties in the computational model for assessing the impact of policy measures at the regional level, Procedia - Social and Behavioural Sciences, 2(6), p. 7714–7715. doi:10.1016/j.sbspro.2010.05.193

Neuvonen, M.. Sievanen, T., Susan T. and Terhi, K. 2007. Access to Green Areas and the Frequency of Visits: A Case Study in Helsinki, Elsevier: Urban Forestry and Urban Greening, 6, 4, p. 235-247.

Payne, L., Orsega-Smith, E., Roy, M., Godbey, G. 2005. Local park use and personal health among older adults: an exploratory study, Journal of Park and Recreation Administration, 23, p. 1-20.

Potwarka, L.R., Kaczynski, A.T., Flack, A.L. 2008. Places to play: association of park space and facilities with healthy weight status among children, Journal of Community Health, 33, p.344 350.

Project for Public Spaces. 2013. No Title. What Makes a Successful Place? Retrieved September 18, 2013, from https://www.pps.org/reference/grplacefeat

Sallis, J. F., Frank, L. D., Saelens, B. E., & Kraft, M. K. 2004. Active transportation and physical activity: opportunities for collaboration on transportation and public health research, Transportation Research Part A: Policy and Practice, 38(4), p. 249–268. doi:10.1016/j.tra.2003.11.003.

Sendi R and Golicˇnik Marusˇic B. 2012. Neighbourhood Design: Public Spaces, p. 21–28. doi:10.1016/B978-0-08-047163-1.00541-5.

Sorensen, M. Smit, J. Barzetti V. and Williams, J. 1997. Good Practices for Urban Greening, Inter-American Development Bank,. http://www.iadb.org/sds/doc/ENV109KKeipiE.pdf.

Sugiyama, T., Leslie, E., Giles-Corti, B., Owen, N., 2008. Associations of neighbourhood greenness with physical and mental health: do walking, social coherence and local social interaction explain the relationships?, Journal of Epidemiology and Community Health, 62 - 69.

Takano T, Nakamura K, Watanabe, M. 2002. Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces, J Epidemiol Community Health, 56, p. 913–918.

Tucker, P., Gilliland, J., Irwin, J. 2007. Splash pads, swings, and shade: parents' preferences for neighbourhood parks. Canadian Journal of Public Health, 98, p. 198–202.

Van Melik, R, Van Aalst, I and Van Weesep, J. 2007 Fear and fantasy in the public domain: the development of secured and themed public space, Journal of Urban Design, 12(1), p. 25–42.

Wilbur, J., Chandler, P., Dancy, B., Choi, J., Plonczynski, D. 2002. Environmental, policy, and cultural factors related to physical activity in urban, African– American women. Women and Health, 36, p. 17–28.