EFFECTS OF THE PEDESTRIAN PAVEMENT NETWORK AND ILLUMINATION ON ACCESSIBILITY ON PUBLIC PARKS IN SOUTH AFRICAN CITIES

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Abstract: Public parks are integral elements of residential areas of cities. It is well established that public parks have a positive influence on the social and physical health of the people who have access to them. The public parks despite being seemingly planned according to urban planning guidelines and are located appropriately in the neighbourhoods of the cities of South Africa, they are observed to be highly underutilised. Many social and physical factors that include location, accessibility, crime or fear of crime, life style, and lack of time are generally attributed for such a scenario. However, explicit studies on the factors that influence- and their relationships with the use of public parks by people, particularly in the residential areas of cities are limited. Therore, the objective of this study is to explore how pedestian movement network in the neighbourhoods and illumination levels in the public parks influence the utilization of public parks in the residential areas of South African cities. Blomefontein city of South Africa was taken as a case study, and a survey research method for data collection, subsequent statistical analyses and development of empirical models were follwed. Data were collected through park user survey conducted by using random sampling process, and household survey through startified random sampling by using pre tested questionaires. Besides, physical park utlisation survey was conducted by using continous time lapse digital photography and videograpgy of the public parks. The study revealed that more people use the public parks during evening hours. Higher artificial illumination and availability of quality pedestrian pavement netwoks are the two important factors, which influence public park use, although they do not necessarily influence each other. However, the combination of availability of both factors would enhance the utlisation of public parks significantly.

Keywords: accessibility, illumination, public parks, pavements, road network, residential areas.

1. Introduction

Public parks (PPs) and recreational facilities (RFs) offer people the opportunities for a wide range of leisure, sport and recreational activities. They are crucial for the social and economic health of the cities and towns (Sallis, Frank, Saelens, & Kraft, 2004). It is observed that the habitation areas including residential areas of South Africa in general and in the cities in particular have been going through transformations since the establishment of its new constitution in the year 1994. In the process transformations in urban functions and consequent land uses are observed in many cities of the country. Consequently a hierarchical change in the pattern of residential areas in urban areas has been experienced (Spocter, 2004). For instance, the residential areas have been expanded to develop suburban areas. The suburban areas, which were essentially started for residential purposes, gradually incorporated other urban functions such as commercial, civic and recreational activities. Besides, a stress was laid upon to create organized open spaces including public parks and open recreational facilities in the residential areas of the cities. They become one of the core land uses in the city development plan offering urban social and recreational functions. Although, a number of such public parks and recreational facilities have been developed in most of the South African cities, it is observed that except a few major and organized ones, majority of the public parks in residential areas scarcely utilized. The reason of underutilization these public parks are attributed to many factors that includes 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, accessibility to public parks particularly in sub urban residential areas is a crucial challenge. Therefore, the objective of the of study is to explore how two imporatnt accessibility parameters such as illumination levels in the public parks and pedestraian network facilitiess (with respect to road network facilities) influence the accessibility and consequent utilisation of public parks in the residential areas of South African cities. However, other social, cultural, and other physical, visual and symbolic accessibility factors have been kept out of the scope of the paper as they also warrant specific investigation.
The study was conducted by using Bloemfontein city of South Africa as a case study. A survey research method and empirical modelling were used for the purpose. Two hypotheses that (1) availability of improved level of artificial illumination in the public parks; and (2) complete pedestrian facilities along the road networks in residential areas of cities, will improve the utilisation of public parks" are tested. Findings suggest that majority of the people use the parks during evening hours. Artificial illumination is one of the most important factors that influences accessibility of the public parks, and utilisation of the public parks increases with higher level of artificial illumination. Besides, it is also found that more complete the pedestrain facilitiy network along the roads leading to public parks, higher is the urtilisation of the parks.

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2. Literature review

2.1. Role and indicators of success of public parks

Public parks have crucial roles to play in cities. Some of the important roles they play are that they offer open recreational facilities to people, bring people together, increases social bonding, make intergenerational interaction, develop contact with nature (especially if it is natural green spaces), compliment the architectural articulation of the surrounding built areas, improve the value and desirability of the surrounding residential areas, and create an area for people to orientate themselves with the greater part of the city or town (Dempsey, 2012). Public parks have many design aspects, which positively contribute to the well-being and value of the surrounding spaces. Properly planned and designed open green spaces (OGSs) and public parks greatly add to the aesthetic quality of the surrounding areas and satisfaction inhabitants around them. Also, they create a restorative environment, which cannot be neglected as they positively influence the inhabitant's well-being and health (Ariane, Bedimo-Rung, Andrew, Mowen, Deborah, Cohen, 2005).
The project for public spaces (PPS, 2011) evaluated thousands of public spaces around the world and has found that successful public parks and recreational facilities have four key qualities. Firstly, they are accessible; secondly, people are engaged in activities there; thirdly, the space is comfortable and has a good image; and lastly, it is a sociable place where people meet each other and take people with them when they come to visit (PPS, 2011). Based on such studies, a tool called "The Place Diagram (Figure 1)" was developed to aid people to judge whether any public place is good or bad. One of the important aspects, which have been emphasized in it is the access and linkages of parks and recreational facilities, which essentially influence the success of the public parks and open recreational areas PPS, 2011).

Fig. 1.
The Place diagram for public parks
Source: Project for Public Spaces (2011)

2.2. Forms of accessibility to public parks

The accessibility of public parks is related to the ability of people to reach the space by means of public transport, private transport or pedestrian infrastructures. Accessibility is often considered as a crucial factor to make a public park function as purposed. For instance, a public park that is set on a busy road may draw more people that are passing by as well as people using services and facilities that are nearby (Dempsey, 2012). Although, there is no unanimity on the definition of accessibility of public parks because of the various roles it plays and its effect on the vibrancy and usefulness of public parks, it can be categorized into three forms such as, physical access, visual access, and symbolic access (Sendi and Golicˇnik Marusˇic, 2012).

2.2.1. Physical access

Physical access to public parks requires the space to have proper linkage from neigbouring spaces as well as no barriers preventing pedestrians to enter the space. According to Sendi and Golicˇnik Marusˇic, (2012) physical access to public parks should be easy for children and elderly people to make use of. Houses and residential areas next to the public parks should also have relatively easy access to the space. Physical access is hampered by vehicular movements around the public parks. Also, the type, quality and continuity of the pavements of the pedestrian facilities are factors that encourage or discourage people to visit the parks at the neighbourhood or residential area level (Dell'Acqua, Mario, Russo, 2012; Žilionienė, Mario, Russo, 2013). The physical accessibility of parks is also influenced by the density of the neighbourhood which surrounds it, and perhaps by the shape of the park. Besides, convenient access for physically challenged people is an essential element of the physical access of the public parks (Dempsey, 2012).

2.2.2. Visual access

The visual access of a public park refers to the visual connection a user would have with the park they are heading towards. Visual access contributes to the safety of the user due to the proper visibility needed to safely navigate to the park. Not only must a public park be easily visible to its users, it must also ensure that the users are visible when accessing as well as when using the parks (Sendi and Golicˇnik Marusˇic, 2012). According to Peña-García, Hurtado, & Aguilar-Luzón, (2015), artificial illumination of a public park is a key element in making sure that the visual access of a public park is adequate.

2.2.3. Symbolic access

Symbolic access to public parks is becoming more and more important in defining the full accessibility and vibrancy of the public parks. Symbolic access 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. Users such as groups (teenagers, small children, dog walkers, etc.), maintenance workers, and security staff visible in the public parks are also contributors to the symbolic access of the public parks (Sendi and Golicˇnik Marusˇic, 2012).

2.3. Issues of accessibility and use of public parks

The issue of accessibility to the public parks is becoming more and more debated with regards to sustainable urban planning. Accessibility to the public parks is essential for the health, well-being and cultural equality of the societies. This awareness can mainly be attributed to the awareness about the health and well-being benefits that are gained from the successful use of the public parks (Thomson, Aspinall, & Roe, 2014). Access to the public parks is particularly useful to children, lower socioeconomic group, and people with physical/mental disabilities (La Rosa, 2014).

Challenges of accessibility to public parks vary according to the different access needs people. If accessibility to the public parks is considered as the degree of ease at which a user can reach their destination, then fully determining the factors and variables affecting the accessibility of public parks should be a pre- requisite for further analysis on planning for vibrant and sufficient public parks (La Rosa, 2014; Sendi and Golicˇnik Marusˇic, 2012).

In addition to the spatial accessibility of public parks, Weiss et al., (2011) suggests that there are many other variables of the environment that might negatively affect the use and accessibility of the public parks. In this regard, the research conducted in the perspective of environmental justice highlights the linkage between the inequalities in the spatial distribution of public parks and natural hazards in the environment. For example communities with less or limited accessibility to public parks face exposure to environmental ailments such as air pollutions (Evcil, 2012). Besides, it is also found that fear of crime or concerns for personal safety limits the accessibility of the parks as it discourages the users to make use of the available modes of access to the public parks. For instance, these fears and concerns may lead users to rather seek out other recreational facilities, which are perceived to be safer to access (Weiss et al., 2011). However, Painter (1996) observed that adequate levels of illumination in public parks are often a deterrent for crime and inadequate levels of illumination in the parks are often a deterrent for potential users of the parks.

Evidence from the literature suggests that most of the researches on the accessibility to public parks that have been carried out until now are mostly on industrialized nations, which have well-established infrastructure. However, on the contrary very little is known about accessibility of public parks, particularly the influence of illumination level in the parks and availability of pedestrian facility network on the park use, in fast growing cities of developing countries (Wright, Zarger, & Mihelcic, 2012). Therefore, an effort has been made in this study to understand the relationship between illumination and pedestrian facility network leading to the parks and the use of public parks in a city of a developing country.

3. Study Area

Bloemfontein city of South Africa is used as a case study for this investigation. It is comprised of 35 suburban residential areas. The city has an adequate number of hierarchical public parks and recreational facilities, which includes central park and stadiums at the city level, public parks at the neighbourhood level and residential area level. However, most of the parks in the residential areas are observed to be lacking in vibrancy and more so found to be underutilized. Accessibility, perception of safety, actual safety, lack of entertainment amenities, lack of maintenance, and lack of comfort are some of the suggested factors, which discourage the higher use of these parks. Therefore, it was felt relevant to explore the relevant accessibility factors such as illumination and pedestrian facilities that influence the utilisation of the public parks in the city.

4. Research methodology

The investigation followed a survey research methodology and development of empirical models. Data was collected through household survey and physical and park use surveys. The surveys were conducted in four representative suburbs of the city such as Universitas (South-Western part of Bloemfontein), Langenhovenpark (Western part of Bloemfontein), Batho (Eastern part of Bloemfontein), and Lourier Park (Southern part of Bloemfontein). The suburbs were selected on the basis of a set of selection criteria such as, geographic location, population, social demographic condition, availability of number and type public parks, type of accessibility through road network, and size. These selected suburban residential areas vary from each other in terms of its diverse demographics, size, location, and accessibility via road networks. Household survey with a sample size of 208 was conducted by using systematic stratified random sampling process through semi-structured interviews. Physical and park use survey were conducted by using continuous digital photography and videography. Twenty four 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 parks and various accessibility issues.
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. While analysing the accessibility factors with regards to pedestrian facilities the ratio of length pedestrian facilities to length road network was considered as the relevant parameter for the convenience of analysis as both are dependent on each other. Similarly lighting facilities and their intensity in lux in the evening times was taken as the level of illumination in the parks. The analysis was conducted by use of statistical methods such as correlation, significance tests and trend analysis by developing empirical models.

5. Findings and discussion

Table 1 presents the correlation coefficients between parks use and illumination level, and park use and pedestrian facility network leading to the parks as well as significance test results between park use and accessibility parameters. A correlation between the average number of users and recorded level of illumination was conducted and it is found that illumination level in parks and use of parks are highly correlated (cc=0.84). The high correlation coefficient suggests that higher the illumination levels of the public parks, the higher will be the average number monthly users of the public parks. The high correlation between the average number public parks users per month and the pedestrian facility network to road network ratio (cc=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. Besides, the significance test results show that p values (both single tailed ad two tailed) for each variable are <0.05 for $\alpha < 0.05$. This establishes that there are significant relationships exist between the accessibility variables such as pedestrian facility network to road network ratio, and illumination level of parks in evenings with the park uses in Bloemfontein, thus establishing the two hypotheses envisaged that (1) availability of improved level of artificial illumination in the public parks; and (2) complete pedestrian facilities along the road networks in residential areas of cities, will improve the utilisation of public parks.

Table 1
Correlation and significance test results

Accessibility Parameter	Decadent parameter	Correlation coefficient (cc)	r^2	T value	df	p*	p**
Illumination level of parks in the evening	Park use	0.84	0.92	6.82	40	0.0000003	0.0000006
Pedestrian facility network to road network ratio	Park use	0.82	0.92	7.40	32	0.00000001	0.00000002

*Note: *single tailed; ** two tailed p values for α <0.05*

5.1. Influence of the level of illumination in public parks in the evenings on the number of users of public parks in the study area

Figure 2 presents the relationship between the illumination levels in the evenings and the average number of monthly users of the public parks in the study area. The relationship is presented in the equation 1 (Eq.1).

$$Y_1 = 37.585X_1 + 89.75 \quad (1)$$

$r^2 = 0.92$

Y_1 = Number of public park users per month; X_1= Illumination level in parks in lux

The relationship proves that a linear relationship exists between illumination level and number of park uses. It is observed that parks with very low illumination (<3 lux) experience very few visitors and more people use parks where illumination level is high (>10 lux). However, majority of the parks have illumination level less than 20lux 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. So, significant improvement in the illumination in the public parks during evening is essential to improve the uses of public parks in the study area.

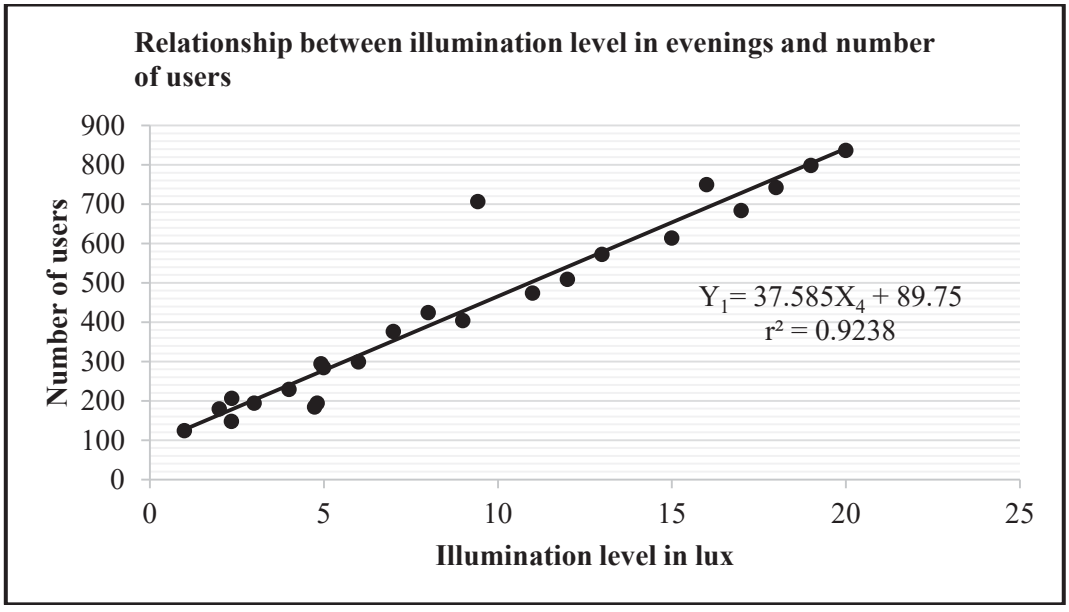

Fig. 2.
Influence of the level of illumination in public parks in the evening on the number of users of public parks

5.2. Influence of pedestrian facility network to road network ratio on the number of users of public parks in the study area

Figure 3 shows the relation between the pedestrian pavement network to road network ratio and the average number monthly users of the public parks in the study area. The relationship is presented in the equation 2 (Eq.2).

$$Y_1 = 2.032e^{5.9542X_1} \quad (2)$$

r^2 =0.92
Y_1 = Number of public park users per month; X_1= Pavement network to road network ratio

The trend analysis from Figure 3 revealed that the average number of monthly users increases gradually (non-linearly) as the pedestrian facility to road network ratio increases up to 0.85; however, it increases exponentially as the ratio improves beyond 0.85. This indicates that if the pedestrian facilities are not available commensurate to the road network, it will act as a barrier for the people to use the parks, however, more number of people use parks where the pedestrian facility network is more complete, i.e., if the pedestrian facilities are almost provided along all the roads leading to the parks without much obstructions.

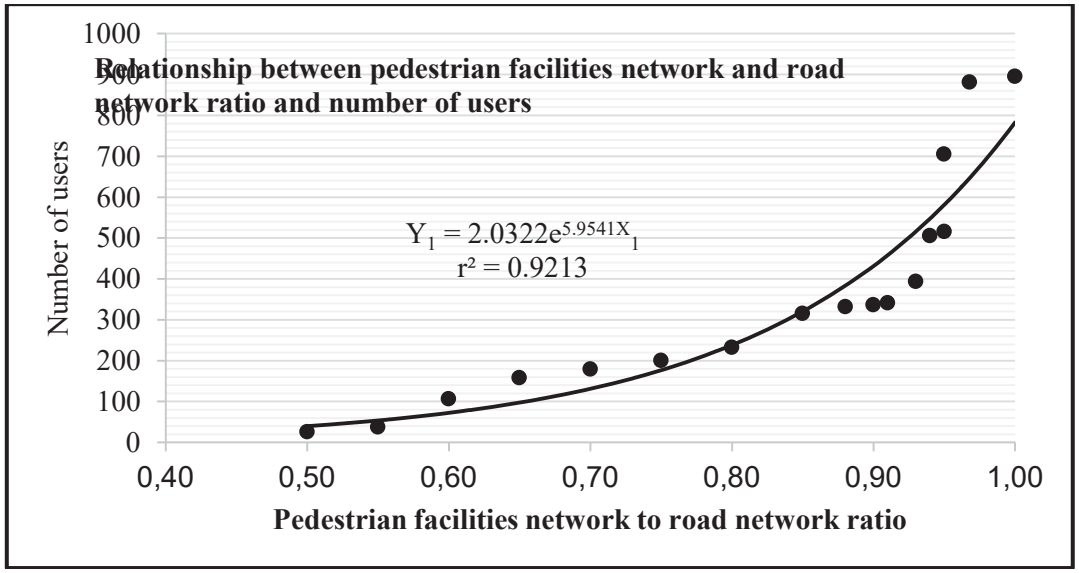

Fig. 3.
Influence of pedestrian facilities network to road network ratio on the number of users of public parks

6. Conclusion and further research

Accessibility of public parks in residential areas in the South Africa cities is a challenge. This study revealed that illumination and pedestrian facility network along the roads leading to the public parks are two major parameters, which influence the accessibility and consequent use of the parks. The relationship between the illumination and use of parks, and pedestrian facility network and use of public parks, are established by empirical models as well as by significance tests. It is found that number of users of the public pars increases with the increase in illumination and pedestrian facility. However, there are various other factors, such as physical access, social and cultural issues, which also influence use of public parks, which is the further scope of the research. Nevertheless, at its current state, it is revealed that there is a need to improve the artificial lighting infrastructure in the public parks and to make provision for complete pedestrian facilities along the roads leading to the public parks in residential of Bloemfontein city in order to improve their use.

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