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MULTI-CRITERIA EVALUATION OF QUALITY OF EXISTING URBAN PARKS IN DHAKA CITY - TOWARDS ACHIEVING LIVABLE CITY

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Abstract

Qualitative and quantitative assessment of the quality of major parks in mega city Dhaka have been conducted. Four incommensurate factors: environment, safety and security, landscape and aesthetic value have been considered to qualitatively and quantitatively assesses the quality of the parks. From qualitative analysis it is found that, some parks (located in highly classified residential area of the city) are superior in safety and security and landscape design whereas other parks (located remote from residential area) are inferior in safety and security and environmental factor. It is necessary to address factors of each park lacking behind to ensure better quality of parks. To quantitatively assess the quality of parks, we formulated a new index value calculation to rank all parks in terms of all factors. It is found that the quality of all the parks are dispersed. In addition, investigation of universal accessibility of the parks and direct park user's opinion has been accumulated to supports findings of this analysis. Based on the major findings of this study a number of recommendations have been provided for the improvement of the quality of parks in Dhaka city such as involvement of local community and establishment of office for the park authority inside the park can be helpful in the quality maintenance of the parks. The findings of this paper can enhance the existing knowledge of city planners a step forward with a-priori knowledge to ensure quality of parks in further city planning.

Keywords: Urban Parks, Multi-criteria, Environmental quality, Safety and security, Aesthetic quality

Introduction

In an urban setting, parks and open space are reserved for the purpose of formal and informal sport and recreation, preservation of natural environments, for provisions of green space and/or urban storm water management (Anonymous, 1995; Chowdhury, 2004). In any city life, parks work as lungs of the city which not only provide outdoor recreation but also provide a sense of spaciousness and scale (Nabi, 1978; Nabi, 2012). People may use the parks for visual amenity, environmental, educational, health, cultural and recreational purposes. Therefore, it is utmost important to ensure quality of parks. According to (Malek et al., 2010), "Quality" is termed as the "gestalt" attitude towards a service which has been acquired over a period of time after multiple experiences with it (Parasuraman et al., 1985). Manning as cited in (MacKay and Crompton, 1990) suggested that to ensure high quality in outdoor recreation the needs of the visitors must be met (MacKay and Crompton, 1990). To enhance the quality of parks more natural features should be included, opportunities for social interaction should be increased and level of annoyance should be reduced. This will increase the amount of outdoor activity especially among older generation. To examine visual quality of the park, a study has been carried out in Alanya County, Turkey using photographs (Ter, 2012). Ter, 2012 performed a study on Alaaddin Hill, a big tumulus place in the city of Konya which serves as an urban park, to determine what quality criteria are effective in assessment of Quality of urban parks . A study was carried out in parks of two cities of Massachusetts to identify which attributes influence park characteristics more. The total use of parks have been made dependent on four variables namely activity index, amenity index, park size and aesthetic rating (More, 1990). Presence of good quality, well maintained public spaces help to improve the physical as well as mental well being of human. These places are a powerful weapon that helps in decreasing obesity and improving ill health (Space, 2004). Lam et al., 2005 reported that lower values of pollutants were found inside urban parks and open spaces in comparison to the roadside stations in Hong Kong (Cohen and Potchter, 2010). Urban trees also assist in reducing the "heat island" effect. The USDA Forest Service estimates that every 1% increase in canopy cover results in maximum mid-day air temperature reductions of 0.07°F to 0.36°F (0.04°C to 0.2°C).

In 1981, Dhaka was a city of 2.8 million, which rapidly increased alarmingly to 5.3 million in 2001 while expansion of the city area was not substantial i.e. area increased only to 276 sq. km from 208 sq. km in the same period. It was reported that from 1989 to 1999 built up areas have increased by 20.54% and vegetation has decreased by 3.4% (Ahmed and Ahmed, 2012.). From 1999 to 2009 there have been 16.86% increase in built up area but 3.24% decrease in vegetation. There are about 54 registered parks under Dhaka City Corporation (DCC). But these parks make up only an average of 14.5% of the total land area (17% in north and central part and 12% in old town) whereas any city requires 25% for livable environment and to maintain a sustainable land ecosystem. At present the local planning experts recommend that there should be at least 1 acre of parks or open spaces per 1000 population for cities of Bangladesh. If, this standard is to be adopted in Dhaka, then the city needs approximately 6 sq.

miles of area for recreation purpose (Chowdhury, 2004). Most of the areas of Dhaka city are so unplanned that there is very little scope for creating a new park or open space to meet the needs of the growing population. In this case, it is inevitable that the existing parks need to be improved or developed. But unfortunately till now no initiatives have been taken to improve the parks of Dhaka city (Alam, 2012). DCC has failed to continue its responsibility to maintain the greenery of the city and have converted the parks or open spaces into garages, shopping malls or mosques. There are many new unauthorized housing projects that are being developed in Dhaka at present. These will shrink the greenery and wetlands to create extra and unbearable pressure on the over burdened public utility. If the prevailing conditions remain unchanged then Dhaka will definitely collapse (Hasan, 2012). Allocating more areas for new parks in Dhaka city is very difficult as Dhaka due to land scarcity. Improvement of the condition of the existing parks seem to be the only the viable solution to meet the needs of the citizens. But to improve the quality of existing parks it is necessary to identify which park is lacking behind in what factors. So that resources can be efficiently allocated to develop the quality of parks of Dhaka.

Few studies have been conducted earlier on parks and open spaces (Chowdhury, 2004; Islam, et al., 2002; Siddiqui, 1990; Nehrin, et al. 2004). But, no systematic study has been performed yet to evaluate the quality of existing parks in Dhaka city considering multiple criteria and to provide recommendations for improving the quality of urban parks. Therefore, in this research an attempt has been taken to qualitatively and quantitatively evaluate the quality of some major parks of Dhaka city with respect to environmental quality, landscape quality, safety and security quality and aesthetic quality.

The paper is organized in the following ways. First, we provide the details of multi-criteria evaluation of quality of existing urban parks in section 2. In the next section 3, we first discuss about demographic statistics of users, comparison between adjacent and distant users, and attractiveness of the Parks. In section 4, we analyze safety and security factor, environmental factors, aesthetic factor, landscape factor. Finally, in section 5, we draw some concluding remarks.

Multi-criteria evaluation of quality of urban parks

This study has focused only on the 6 major urban parks of Dhaka which are more than 5 acres in size namely Ramna park, Sohrawardy Uddyan, Osmani Uddayan, Gulshan Lake park, Gulshan Tank park and Fazle Rabbi park. For data collection, at first a reconnaissance survey and a preliminary questionnaire survey have been conducted. From this the final questionnaire and checklist have been prepared by excluding the unnecessary options and variables. Then data have been collected both from primary and secondary sources in accordance with the objective and the study area. To identify the existing features of the park a field survey has been performed by using check-list. Necessary photographs of the park features and amenities have also been taken. The quality of the parks has been identified from user's perspective. A questionnaire

survey has been conducted to get the user's opinion regarding environmental quality, landscape quality, safety and security quality and aesthetic quality.

Dhaka city's population is specific but the number of users of these parks is unknown. More over these parks are major parks of Dhaka and the area they serve or the numbers of households they cover are not identified. Again due to time and resource constraints huge amount of sample population could not be surveyed. For unknown population 384 samples are surveyed. But to maintain the authenticity 402 samples surveys have been conducted to complete the study (67 surveys per park). Park users have been the target group of the study. The Q-Sort Method is a psychometric technique. It produces reliable and valid interval measurements of people's perceptions about the visual quality of landscape as depicted in photographs. An explicit and valid assumption is inherent in the use of the Q-Sort Method. It is that the visual response to landscape photographs is consistent with visual response to actual landscapes. A panel of 5 senior architecture students has been selected to rate aesthetic features of the park using photographs of the parks. Five park users have been chosen as well to rate the photographs. Their points have been used to determine the aesthetic factor of each park using Q-sort method. Collected data from field and questionnaires have been accumulated for analysis using SPSS software. All data collected from surveys have been checked and reviewed to escape unexpected error. All data compiled from questionnaire and field survey have been analyzed by Microsoft Excel, SPSS and ArcGIS software. Parameters of the objectives have been converted into quantitative value from qualitative data. To evaluate the quality of the parks, following formula has been used to calculate the quality of the parks:

$$X = \sum_{k=1}^{q} f_k \qquad (1)$$

$$X = f_e + f_s + f_l + f_a \qquad (2)$$

where f_e, f_s, f_l and f_a respectively stands for environmental quality, safety and security quality, landscaping quality and aesthetic quality.

1. Environmental quality**:** Parks are the places which are created for providing a sense of nature in the monotonous city life. Designers always try to bring the touch of natural environment in it. A very good nature is the one where the air is pure, everything is clean and the atmosphere is calm and quiet. In a very good nature usually there is no mosquito and temperature is soothing. Most importantly natural environment is usually free from the crowdedness of the city. In this study 6 components have been considered under Environmental factor namely air quality, noise level, cleanliness, temperature, crowdedness and mosquito. The environment of a park largely depends on its maintenance and its users' behavior and sometimes even on its surrounding areas.

2. Landscape quality: Landscape Design combines nature with culture. It focuses on planning of a property with various landscape elements and plants. Selection of the elements depend on

climate, topography and orientation, site drainage and ground water recharge, soil and irrigation, human and vehicular access and circulation, recreational amenities, furnishing and lighting, native plants, property safety and other measurable conditions. For this research, at first field survey has been conducted to identify the landscape design elements that are found in almost all the 6 parks under study. After the survey 12 landscape components have been selected for quality analysis. These components are greenery, water body, seat/bench, lighting, playing instrument, kiosk/shade, paved walkway, dustbin, toilet/washroom, water tap/basin, tea/coffee shop and bridge.

3. Safety and security quality: Safety and security of the parks is very important factor for the visitors' satisfaction and participation. The parks with security guards and comparatively smaller in size have more security than larger parks without security guards or care takers. Sometimes larger parks fail to attract visitors because of the unsafe condition. Parents do not feel safe to send their children to those parks. Even adults especially women do not feel secure to visit such kind of places. Six components namely mugging, drug dealing, anti-social activity, begging, eve teasing, hawking have been observed to understand the safety and security condition.

4. Aesthetic quality: This factor has been used to rate the beauty and appearance of the park from user's perspective. A psychometric technique called the Q-Sort Method is a. It produces reliable and valid interval measurements of people's perceptions about the visual quality of landscape as depicted in photographs. An explicit and valid assumption is inherent in the use of the Q-Sort Method. It is that the visual response to landscape photographs is consistent with visual response to actual landscapes. A panel of 5 senior architecture students has been selected to rate aesthetic features of the park using photographs of the parks. Five park users have been chosen as well to rate the photographs. Their points have been used to determine the aesthetic factor of each park using Q-sort method.

To study environmental condition of the parks, six variable are considered i.e. air quality/odor, noise level, cleanliness, temperature, crowdedness and invasion of mosquito. For safety and security factor, mugging, drug dealing, anti-social activity, begging, eve teasing and hawker are considered as variables. For evaluating the landscape factor, twelve Landscape elements such as Greenery, water body, seat, lighting, playing instrument, shade, paved walkway, dustbin, toilet, water tap, tea/coffee shop, and bridge are considered. These variables are evaluated on a 5 point scale (1 = Very Bad, 2 = Bad, 3 = Moderate, 4 = Good, 5 = Very Good) according to user's opinion (Table 1). Variables are prioritized according to the user's opinion. Average value of each variable of each factor will be calculated to find out the overall index.

Table 1: Assigned scale to various categories of multi-criteria

Multi-criteria	Category	Scale
Environment	Very good environmental quality	5
	Good environmental quality	4
	Moderate environmental quality	3
	Bad environmental quality	2
	Very bad environmental quality	1
Landscape	Very good landscape quality	5
	Good landscape quality	4
	Moderate landscape quality	3
	Bad landscape quality	2
	Very bad landscape quality	1
Safety and security	Very good safety and security	5
	Good safety and security	4
	Moderate safety and security	3
	Bad safety and security	2
	Very bad safety and security	1
Aesthetic	Very good aesthetic quality	5
	Good aesthetic quality	4
	Moderate aesthetic quality	3
	Bad aesthetic quality	2
	Very bad aesthetic quality	1

Following formula are used to calculate index for environmental quality, safety and security and landscape quality:

$$C_{p_t} = \sum (U_f \times S_w) \qquad (3)$$

$$C_{p_a} = \frac{C_{p_t}}{U_{f_t}} \qquad (4)$$

$$C_w = \frac{C_{p_t}}{\sum_{k=1}^{q} C_{p_t}} \qquad (5)$$

$$C_g = \sum (C_{p_a} \times C_w) \qquad (6)$$

Where, C_{p_t} = total point of a variable, U_f = frequency of users, S_w = weight of scale level, C_{p_a} = average point of a variable, U_{f_t} = total Frequency of users, C_w = weightage of each variable, C_g = index of a factor, q = number of variables, k = 1 to q. Weightage of the variables of each factor are determined based on user's opinion. Visual appearance or attractiveness quality of the parks are evaluated by the expert's opinion. Following formula are used to determine index for aesthetic quality of a park:

$$C_\mu = \frac{\frac{\rho_s}{5} + \frac{\rho_u}{5}}{2} \quad (7)$$

There are 54 registered parks under DCC area. These parks are located in different wards of DCC and may vary in size and facilities. But for this research only 6 parks, which are more than 5 acres in size, have been selected for quality assessment. These are Ramna park, Sohrawardy Uddyan, Osmani Uddyan, Gulshan Lake park, Gulshan Tank park and Fazle Rabbi park Dhaka North City Corporation (DNCC) area and Dhaka South City Corporation (DSCC) area. The parks that fall into Dhaka North City Corporation have been listed as North Region parks and the parks falling into Dhaka South City Corporation have been listed as South Region parks.

Results and Discussion

In this study, an attempt has been taken to assess the quality of the parks on the basis of user's perspective. However, for better understanding of the analysis the park users have been categorized into 2 groups on basis of the distance between their houses and the parks they visit. These are adjacent users and distant users. Adjacent users are those who live within 2 km distance from the park under study. Distant users are those who live beyond 2 km distance from the park under study. The buffer zones of adjacent and distance user's residence from parks are shown in Fig. 1(a) and Fig. 1(b) Among the surveyed population 70.4% users live near the parks that they use. Only 29.6% users come from distant places to use the park. It gives an indication that location of the park is an important factor. The tendency to visit the park declines with its increasing distance from the park user's residence.

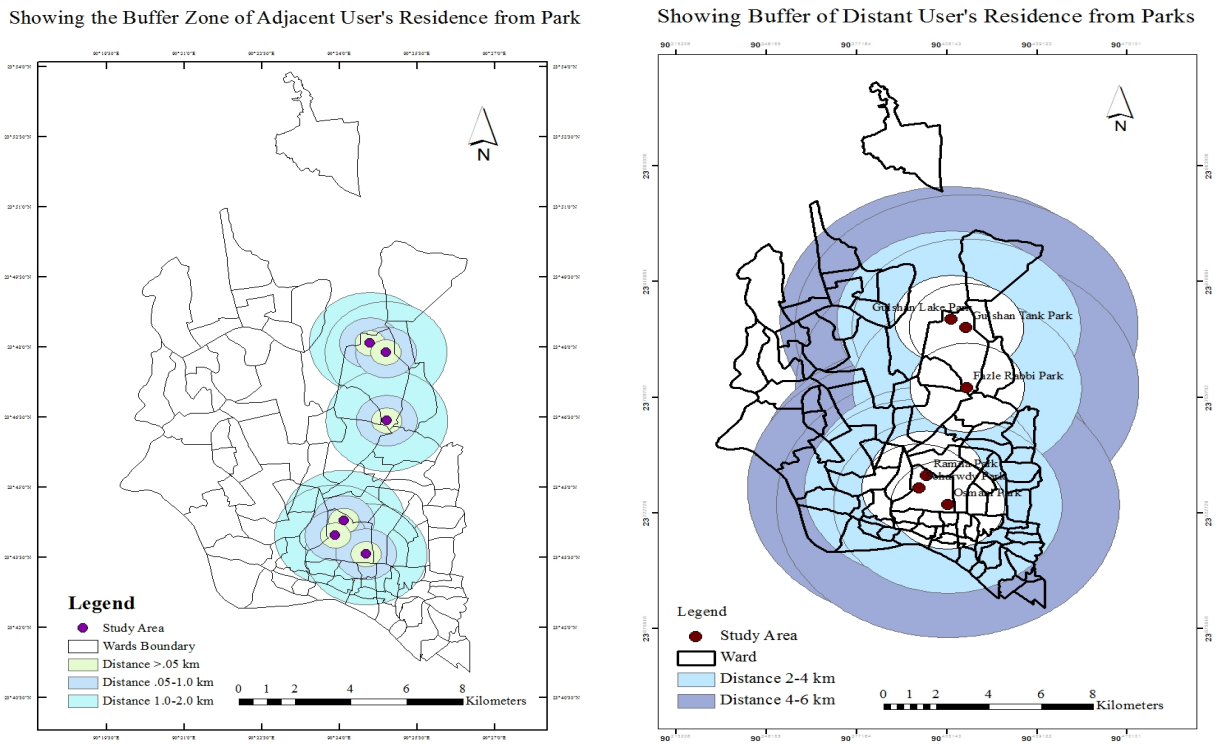

Figure 1: Buffer zone of: (a) adjacent and (b) distant user's residence from parks

Demographic statistics of users

Out of 402 surveyed population 297 are male (74%) and 105 are female (26%). It indicates that on an average male are dominant users of parks. It can be seen that majority of the park users fall between 21-30 years age which is 33.5% of the total surveyed population. This group consists of the young energetic people who are health conscious and tries to stay fit. But most people of this group go to park for recreation and spending leisure time. The age group of 41-50 and 51-60 are actual health conscious people who visit park for exercise and walking mostly. People above 60 years of age mainly go for walking. The frequency of park users in different age groups are analyzed. Almost half of the park users are graduates. 18% and 16% users have passed H.S.C and done post graduate respectively. It means that most of the users are educated. Only 3% illiterate users come to parks usually to spend their leisure time and to meet someone. From the analysis of distribution of education level of park users, it is found that majority of the park users are businessman (27%) followed by the private service holders (21%) who come for walking and physical exercise in the morning or evening. Housewives also come for walking or recreation but a significant portion of them come to parks to spend their leisure time while waiting for their children's school break. Compared to other parks high income users are dominant in Gulshan Lake park, Gulshan Tank park and Fazle Rabbi park.

Middle to lower income group are dominant users of the Ramna park, Sohrawardy Uddayan and Osmani Uddayan parks.

Comparison between adjacent and distant users

Comparison between adjacent and distant users may help to understand the reason why users prefer to come to distant parks. Among 402 surveyed populations 283 respondents go to the parks that are within 2 km distance from their residence (Fig. 2(a) and Fig. 2(b)). It means that most of the users feel the urge to go to the park if it is located near the house. Users seldom visit the parks that are distant from their residence. In this study it has been found that 119 users visit parks that are at least 2 km far from their house. But the only significant difference between adjacent and distant users is that distant users who stay >2 hours in the parks are 10% more in number than the adjacent users (Fig. 2(c) and Fig. 2(d)). It implies that the distant users stay in the parks for longer time. There is a significant difference in the visiting hour between the distant user and adjacent users. This implies that, in the morning period parks have more distant users and in the evening period parks have more adjacent users (Fig. 2(e) and Fig. 2(f)). In comparison between the two types of user the adjacent users are in a privileged position. Adjacent users have to travel very short distance and for which they do not have to depend on motorized transport that often. So, 40% adjacent users travel on foot while only 1% distant user travels on foot. 44 % distant users travel by bus whereas only 1% adjacent user uses bus (Fig. 3(a) and Fig. 3(b)). It indicates that distant users travel more on bus and adjacent users travel more on foot.

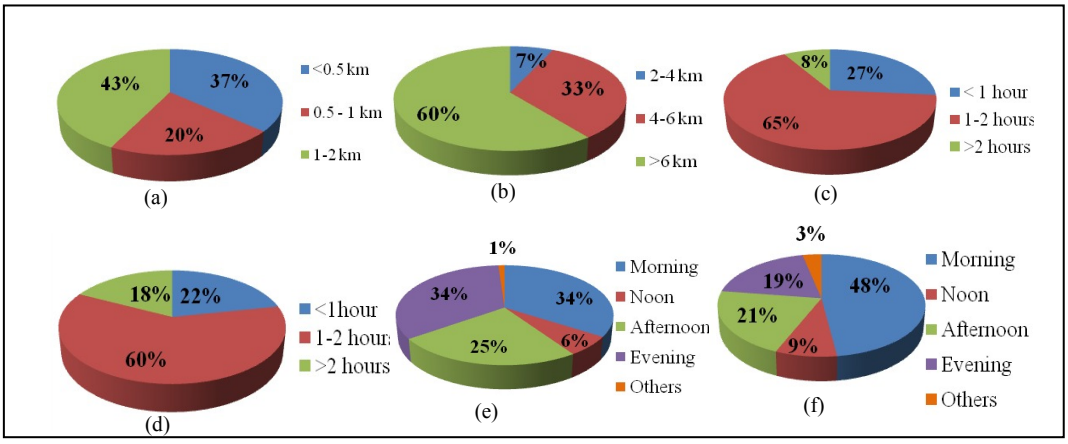

Figure 2: Percentage of users based on: (a) distance between adjacent user's house and park, (b) distance between distant user's house and park, (c) duration of visit of adjacent user, (d) duration of visit of distant user, (e) visiting hour of adjacent user, (f) visiting hour of distant user

Travel cost also varies between adjacent and distant users. Fig. 3(c) and Fig. 3(d) shows that 61% users have no cost of travel as they come by car or on foot. Only 4% users spend 5-10 taka who come by rickshaw and live within 0.5 km distance. 17% users' travel cost is above 20 taka majority of who come by rickshaw from 1-2 km distance. It is observed that most of the

distant users spend < 20 taka to visit the parks. These users come by bus or rickshaw. Only 5.9 % user spend > 100 taka to come to distant parks. They usually come by CNG or car. From the comparison it has been realized that people prefer to go to adjacent parks for walking and physical exercise rather than other purposes. But distant users choose to go to distant parks for recreation and spending leisure time rather than other purposes.

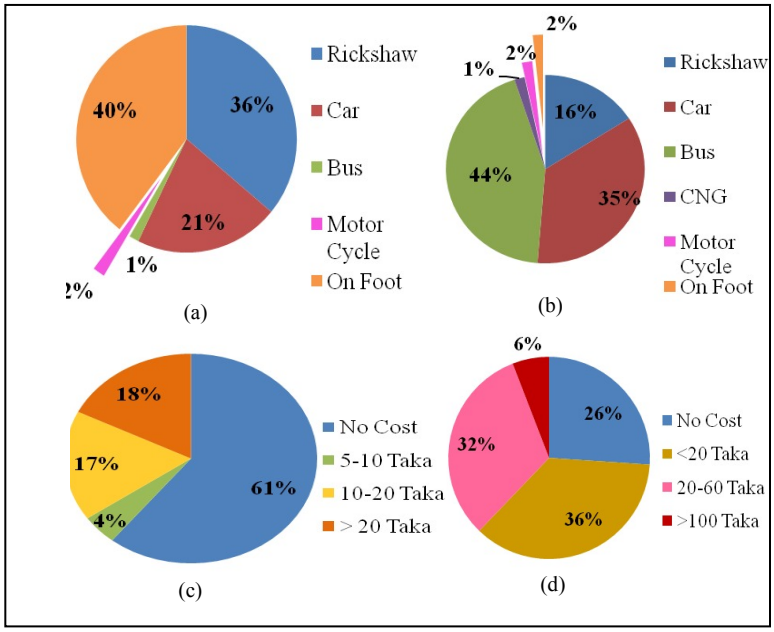

Figure 3: Percentage of users based on: (a) mode of travel of adjacent user, (b) mode of travel of distant user, (c) travel cost of adjacent user, and (d) travel cost of distant user

Attractiveness of the parks

Depending on its targeted population size, purpose and location different parks might have different attractive qualities. Its qualities also depend on its maintenance and user behavior. People usually prefer to go to their nearest park if it is well maintained. Otherwise they go to the parks that have better landscape and more open area. User might even prefer to go to distant parks if the park is accessible by better transport facilities. Openness is the dominant characteristics which attract people to visit the parks as 129 out of 402 people visit parks for openness Fig. 4. The parks under study are not attractive for the fact of being accessible by better transport facility. Around 10% people are attracted to come to the parks as these are the only place where they can meet someone or wait before going for some other works.

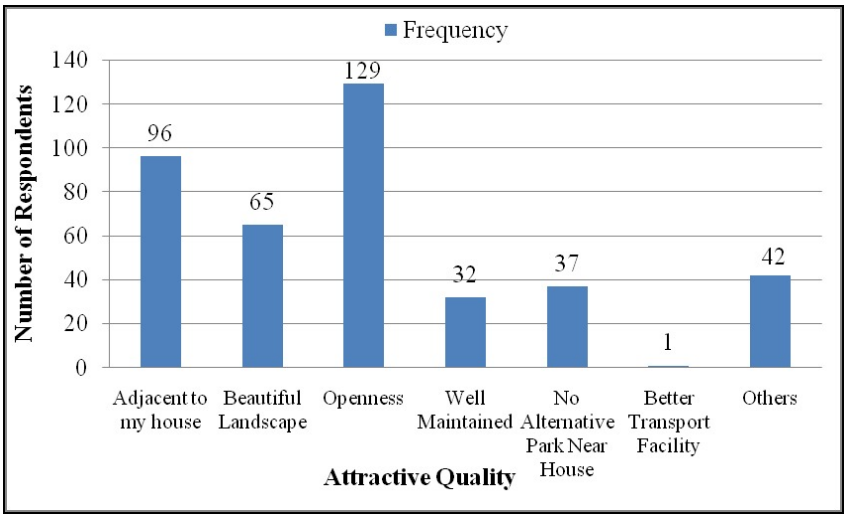

Figure 4: User's opinion regarding attractive qualities of the park

On an average majority of the users (31%) asked for more secured and safer environment. It has been followed by requirement of proper maintenance as 23% users feel that existing parks are sufficient but due to improper maintenance they are failing to attract more users. 18% user mentioned that lack of playing instruments and physical exercise equipments fail to meet the demand of the children and other users who wants to work out in the park.

Evaluation of Overall Quality of Major Parks

Index value of each of the factors are calculated using Eqns. 3 – 7. The index values have been summerized to get an overall quality of the parks. Fig. 5 shows the overall quality of major urban parks in Dhaka city. It can be understood from the figure that, among the parks under study Environmental condition of Gulshan Lake park is the best as it gets an index value of 4.166 and it is in a Good condition. Environmental condition of Osmani Uddyan is the worst among the study parks as it gets the lowest index value 2.297. It means Osmani Uddyan's overall environment is bad. In case of safety and security factor Sohrawardy Uddyan is in the worst condition as it gets an index value of 1.797. This value is less than the index number of other parks. Sohrawardy and Osmani have no security guards and mugging, drug dealing, anti-social activity, eve teasing and intrusion of hawker is severe in these parks. The parks of Gulshan and Fazle Rabbi are comparatively safer as their index values are above 4. It is because these parks have security guards and workers who ensure the safety condition. Aesthetic Factor has been calculated according to both senior architecture students who are referred to as experts and park users. It can be seen from the figure that, experts have rated Ramna park to be more attractive than the other parks as it gets the highest index compared to other parks. It is followed by Gukshan Lake and Gulshan Tank park. Experts think that Osmani Uddyan is less attractive than the other parks. According to users, Ramna park has again become more attractive that others and Osmani has become the least attractive. Among the parks Ramna park is the most attractive

and Osmani is the least attractive. So measures should be taken to increase Osmani Uddyan's aesthetic beauty. After analyzing all the components, it is found that landscape design of Gulshan Lake park is the best among the 6 parks but it is moderately satisfactory according to users. It means that none of these parks are satisfactory to the users in case of landscape design. The Gulshan Lake park is followed by the Gulshan Tank park and Ramna park which means these parks are also moderate in landscape design. Osmani Uddyan's landscaping is the worst among the parks followed by Sohrawardy and Fazle Rabbi park.

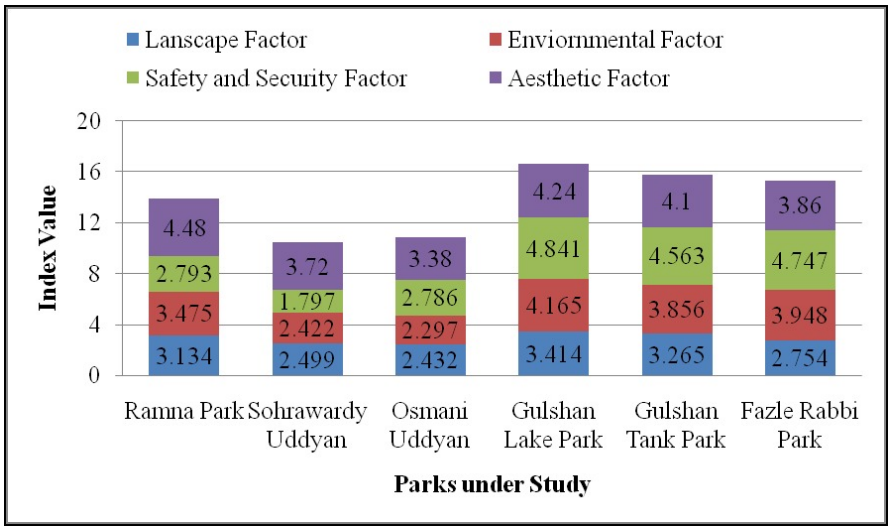

Figure 5: Overall quality assessment of the parks under study based on their index value

Index value of each of the factors has been summed to get an overall quality of the park as well as ranking of the parks Fig. 6. The overall value of Gulshan Lake park is the highest. Overall index value of Sohrawardy Uddyan and Osmani Uddyan are very much closer to one another but Sohrawardy is the worst among these six parks. It is followed by Osmani Uddyan and Ramna Park. Although Osmani Uddyan's environmental, landscape and aesthetic factor index are lower than those of Osmani but the Sohrawardy Uddyan's safety and security factor is much lower than Osmani Uddyan's. For this reason Sohrawardy has become worse than Osmani in overall quality.

In gist, it has been found that users who come to visit the parks from 2 km distance are 70.4% of the total park users. Dominant users of parks are male and most of the users age between 21-30 years. Overall safety and security condition of all parks are not satisfactory. Most of the adjacent users come daily to the park and most of them stay for 1-2 hour. Greenery and paved walkway condition of all parks are almost satisfactory as per user's opinion. Playing instruments and toilet of the most of the parks are in bad condition. Gulshan Lake Park has the highest index value in Landscape factor and environment factor and index value of Osmani Uddyan in these two factors are the lowest. In case of Safety and Security Gulshan Lake Park are

more Secured than other parks and Sohrawardy Uddyan has the worst condition in comparison to other parks. Aesthetic factor of all the parks are moderate to good but landscape factor is moderate to bad in the parks.

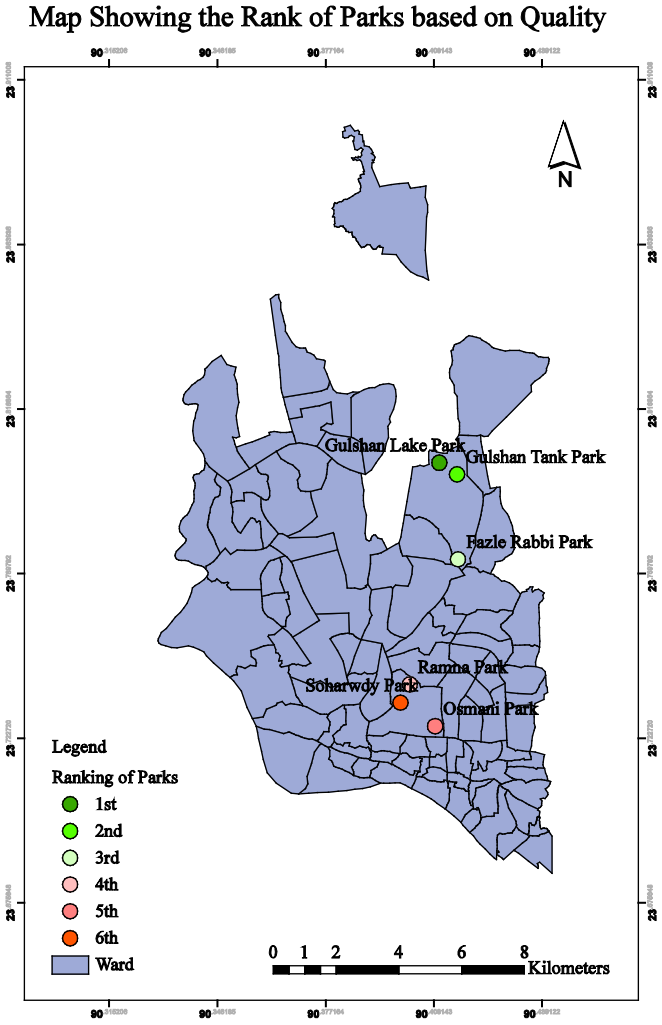

Figure 6: Ranking of major parks based on the overall quality

This study has identified the factors in which each park is weak. So to ensure better quality of park the that are lacking behind need to be improved. None of the parks under study are good in landscape design according to the user's opinion. Thus, this study recommends planning for better landscape factor should be given high priority for major parks of Dhaka. Playing instrument are absent in most of all the parks. Some parks having playing instrument but most of them are out of order. So steps should taken to repair and maintain them. Also, proper and regular maintenance of each park will ensure the environmental quality.

Conclusions

Mega city Dhaka is confronted with a big challenge to ensure good quality city life. It compromises negatively with the quality of parks thereby losing its appeal significantly. Several important factors namely environment, safety and security, landscape and aesthetic factors were considered to qualitatively and quantitatively assess the quality of the parks. It is found that in most of 54 registered parks in Dhaka city quality has not been maintained properly. The obtained overall scenario from our *qualitative* analysis showed that, some parks namely Gulshan Lake park, Tank park and Fazle Rabbi park are superior in safety and security and landscape design whereas other parks such as Ramna, Osmani and Sohrawardi Uddyan are inferior in safety and security and environmental factor. So, to ensure better quality of park the factors that are lacking behind need to be improved. Using our proposed new index formulation, this study has *quantitatively* identified the factors in which each park is weak and first time a ranking of parks is obtained from our obtained results. The results thus obtained in this study will provide very useful metrics to the responsible authority for the planning and management of parks in Dhaka city.

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