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# An Approach Using the Analytical Hierarchy Process for Assessing Child-Friendly Environment in Planned Neighbourhood Parks

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**Abstract**

The parks and open spaces of planned neighbourhood are generally underutilized in cities due to the lack of a Child-Friendly Environment (CFE). The quality of parks and open spaces can be elevated by addressing and improving the deficiencies identified in their conditions. There is a need to identify the parameters for rating neighbourhood parks and open spaces. This research aims to understand the level of CFEin the planned neighbourhood parks of a metropolitan city. The research considers three parks as case study areas, Gandhi Park, Maharanapratap Park, and Balmiki Park in the city of Lucknow, the state capital of Uttar Pradesh, India's most populous state. The research employed the Analytical Hierarchy Process (AHP) method to rate the parks with the use of a nine-point weighting scale. The research identified various dimensions under five major parameters of CFE, namely: perception, physical, social, cognitive, and emotional. The cognitive and perception parameters are observed to play the most significant role in generating CFE. The research result could be used in planning and developing CFE parks and open spaces in neighbourhoods by incorporating the critical dimensions and key elements of the identified parameters in policy guidelines, norms and standards.

**Keywords:** analytic hierarchy process (AHP); child-friendly environment (CFE); urban open spaces; neighbourhood parks

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## 1. Introduction

It is projected that by 2030, 60% of the global population will reside in cities, with majority of these residents under the age of 18. As children are fundamental to societal advancement and growth, they must be viewed not merely as incidental to development, but as both the agents and beneficiaries of progress [1]. Currently, millions of children face conditions that hinder their physical and mental potential—a tragedy that perpetuates cycles of social stagnation. The World Health Organization revealed that 10% of children have a mental illness, and it also states that one in every seven children, ten to nineteen years old, has a mental disorder. Lancet Global Health, in 2018, stated that 52.9 million children aged below five years had issues relate to development. It was also found that one in every hundred children has autism [2]. Consequently, establishing child-friendly environments (CFE) aligned with the UN Convention on the Rights of the Child is essential. Various stakeholders, including governments, NGOs, and the private sector, are now actively promoting these initiatives to foster more inclusive urban spaces [2–5]. Child-friendly city

projects reinforce the idea of children as active stakeholders in cities and ensure that the design and planning of cities are governed by their needs and aspirations, and their rights to the city. This study examines the development of urban environments tailored to the unique needs of children. By analyzing the elements of urban policy, planning, and design that shape daily experiences, it underscores the city's role in fostering holistic child development. However, the critical nexus between a child's health and development and the physical configuration of the built environment often remains insufficiently examined [6,7]. The concept of child-friendly cities (CFC) is one of the most important strategies for building a developed country by creating a CFE, from a small neighbourhood to a large city. If an environment is designed to be child friendly, it will benefit everyone [8]. Planned neighbourhood spaces typically comprise road networks, open spaces/outdoor play areas, commercial and residential areas, parks, and other amenities and facilities. It is also found that external play spaces are vital for children's well-being and for developing a sense of personal empathy [9].

The first objective of this research is to identify the factors responsible for CFEs. Then, it proceeds though its second objective to rank these identified parameters according to their impact on CFEs. Then, it moves further with the third objective to understand the level of CFE in parks and open spaces. This research ends with suggesting guidelines for enhancing CFE in neighbourhood parks. It also seeks to draw the attention of society, the government, and relevant stakeholders to build an educational and communal ecosystem that is equitable, wellness-oriented, welcoming, safe, and grounded in fundamental human rights.

## 2. Literature Review

The literature covers the understanding of CFE, its parameters and neighbourhood concepts. It further proceeds to underline the importance of parks and open spaces for CFE. The literature also mentions the details of the AHP to rank the parameters of the CFE.

### *2.1. Child-Friendly Environment*

Environmental Child-Friendliness (ECF) is a complex concept that is difficult to measure or tap directly; a group of researchers designed a cluster of studies to find out the scope and potential criteria of ECF, as well as its relationship with participatory planning and governance [10,11]. The design of the study cluster on the CFE was twofold. It comprised an analysis of the relevant literature and research on general theories and concepts of good environments, including a content analysis of the international bibliography on child-friendly cities provided by UNICEF [12]. Furthermore, this research examined several comparative and empirical studies to assess both intuitive and articulated dimensions of good environments across diverse contexts, thereby defining a conceptual framework of child-friendly urbanism.

CFE is mainly characterized by solidarity, stability, independence, equity, a conflict-free environment, and a commitment to physical, mental, and emotional well-being [13]. NIUA suggests that CFE indicators are mainly categorized into subcategories/indicators, such as baseline indicators, built environment indicators, service and facility indicators, safety [14,15] and mobility indicators [16,17], ambient environment indicators, and disaster management indicators [6]. According to UNICEF, the parameters of CFEs encompass purpose; scope; concept; the dynamics of theory in practice; location; design and construction; community as a protective environment; costs and benefits; monitoring and evaluation; and mainstreaming child-friendly concepts. The conceptual scope of a CFE encompasses a comprehensive set of ten normative pillars, including housing conditions, essential services (encompassing health, education, and safe transportation), civic participation, security,

and safety. It also integrates social support systems (family and community network), urban environmental quality, ecology, resource equity, sense of place, and children-centric governance [18]. According to [19], the design and planning of children's environments require consideration, as knowledge of childhood cognitive growth and development is crucial. Children prefer more challenging environments, flexible spaces, and locations that offer opportunities to meet new friends. The literature also states that children demonstrate a strong affinity towards natural and gently sloped topographical features in their play areas [20,21]. A CFE emphasises the planning, provision, and equitable access to physical, social, and recreational infrastructure, which ensures that children can take advantage of well-distributed facilities. It not only prioritizes the availability and accessibility of diverse playful and green spaces but also recognizes their importance for children's overall growth and well-being. This reinforces inclusive recreational civic spaces that are welcoming to children and their families from all economic, social and cultural backgrounds. The central perspective of this concept is to promote a child-focused planning process in which they develop their own environment by involving themselves exclusively. Additionally, it calls for a secure and safe built environment designed through a thoughtful process to enhance comfort and protection [21]. The physical indicator of a CFE encompasses children's travel, particularly for safe walking trips, by engaging children in play within the spheres of ecological transactions between parents and the environment [14].

A child's social development encompasses three key components: learning how to behave, assuming approved social roles, and forming social attitudes [22]. In the early stages of childhood, three emotions dominate children's experience: delight, anger, and fear. Further, as a child grows over twelve months, fear differentiates into feelings of anxiety and shame, while anger divides further into envy, disappointment, and pristineness. In addition to this, their delight grows into hope and joy. During their childhood, they develop mental units of concepts, symbols, rules, and images by perceiving, remembering, reasoning, and judging various objects [23,24]. Ref. [25] studied 67 child-friendly indicators based on the Child-Mesra Net System, which were further classified into seven major indicators, namely (a) utility and infrastructure, (b) demographics, (c) environment, (d) sociology and social impact, (e) transportation and accessibility, (f) recreation and public facility, and (g) the land use sector. These indicators recommended that a CFE can be created with a special focus on (a) residential areas, (b) recreational parks, and (c) neighbourhood movement. Refs. [26,27] highlight how their independent mobility connects them to civic parks and open spaces and promotes their health and well-being in the context of their activities. However, more care is required in measuring and linking their independent mobility by exploring diversified activities for developing CFEs.

The research by various scholars highlights the key broad factors of a CFE as physical [28,29], social [28,30], emotional [13,31,32], cognitive [33,34] and perception [35–37]. The literature also suggests that parks play a crucial role in the development of children. Parks are an integral part of neighbourhoods; therefore, this study focused on understanding neighbourhood planning and considerations related to parks and children [25,38,39].

### 2.2. Neighbourhood Planning

The neighbourhood planning concept evolved approximately a hundred years ago to rebuild the congested settlements of poor immigrants. The Garden City concept, presented by Sir Ebenezer Howard in 1898, states that city design must ensure healthy living and working conditions, and should also allow for a fully developed social life. Planners James Ford in 1916 and Benamin C. Marsh in 1909 proposed some variations in the Garden City concept by decentralizing the working class, reducing congestion, and improving the neighbourhood, city and region [40].

Perry's neighbourhood plan (1929) addressed congestion and promoted social uniformity by incorporating residential and recreational spaces, local schools, and commercial shops, while also providing separation between vehicular and pedestrian traffic [40]. Clarence Perry's Neighbourhood Unit concept, used between 1929 and 1969, shows that the Neighbourhood Unit concept is a boundary object that communicates knowledge among professional fields and acts as a catalyst to fast-track new planning practices, regulatory frameworks, mindsets, and paradigm shifts. Stein and Wright, in 1929, also presented the Radburn concept, which suggested separate pedestrian and vehicular movement through 'Cul-de-sac' roads. These roads were also suggested to exclude through traffic for residential streets [41]. The neighbourhood park was its backbone. N.L. Englehardt in 1943 grouped neighbourhoods in relation to the school facilities at various at distances of a quarter and half a mile for nursery and elementary levels [42]. All the theorists suggested that parks or open spaces, recreational facilities, schools, and shops are an important part of neighbourhoods, which should be surrounded by residential areas and should be accessible by walking. Residential areas should be free from vehicular traffic. The main purpose of all the theories is to create such an environment that provides safety, security, and comfort to the residents and to develop socialization among them by collective activities. The key components defining various neighbour scales, like blocks, residential areas, institutional zones and communities, encompass spatial extent, population, boundary features and vital facilities [43].

Ref. [44] talks about three subjects—(a) 'how' the neighbourhood affects the development of the children; (b) 'where', i.e., the place-based effect of the neighbourhood; and (c) 'for whom' development is important. For 'how', the paper suggests that social inequalities among neighbourhoods are responsible for differences in early childhood growth. These are reconciled through social interactive tools such as safety or the participation of the community. Also, family level variables (parenting and learning environment at home) showed a strong association between neighbourhoods and children's development. These are also the basic principles of CFEs. Table 1 also relates the neighbourhood concept with basic factors of CFEs.

**Table 1.** Basic principles of neighbourhood concept and elements of CFEs.

| Neighbourhood Concept | Elements of Child Environment |
| --- | --- |
| Elementary school in the centre and less than one-quarter mile away | Safety and security; Walkability; Promotion for activities after school; Closer to home; Sense of security to the children; Accessibility |
| Discourage through traffic | No accidents; Safety and security; Free movement; Play variety on streets |
| More small parks and open spaces | Play varieties; Biotic attributes; Sense of belonging; Social interaction; Amenities and facilities |
| Local shops on the periphery of the neighbourhood | Safety and security; Walkability; Free movement; Accessibility; Sense of belonging; Amenities and Facilities |
| Boundaries formed by arterial streets | Discourage through heavy traffic; Sense of neighbourhood; Boundary; Safety and security; Social interaction; Accessibility |

### 2.3. Importance of Parks for Child-Friendly Environments

Child-friendly cities are concepts that respect children's civil rights, are secure, have play spaces, safe and clean streets, clean air, are friendly, foster nurturing environments for children, and include children in the processes of urban policy-making and design [45]. Such concepts need to be implemented to directly relate to and influence children and young people's use of outdoor play spaces in their communities. They should act as support for children and encourage active participation in the community's development of outdoor play spaces [9,46–48]. The importance of outdoor play, safety, and public green spaces is well emphasized by [49,50]. The research highlights the social, physical, and cognitive development of children in outdoor urban areas. Further emphasis is laid on three major domains: streets, play areas, and green areas. The concepts of the co-creative design of public spaces with children and guardians, and bottom-up neighbourhood design initiatives (child-friendly routes) are also discussed by their research [49,50]. Parks are important places where children can explore, be active, relax, socialize, play, and learn in a natural environment [51]. They affect child health, welfare, and development, and broaden and enrich the lives of our young people. Parks are also an invaluable tool in developing strong, thriving communities. The reasons why we require child-friendly parks are mainly expressed as: to make children feel welcome and safe; to have access to a range of facilities and amenities that appeal to children; and to provide opportunities for children to participate in community life with respect and dignity [52]. Early childhood educators perceive playgrounds as the most conducive outdoors for achieving educational outcomes, specifically for unstructured opportunities for play [53].

When evaluating CFEs in various parks, the multi-criteria decision-making (MCDM) approach has been adopted by researchers to identify the preferences of multiple parameters, as it determines the best alternative among various criteria [54,55]. Thus, the research proceeds to further investigate the Analytical Hierarchy Process (AHP) for MCDM, as shown below.

### 2.4. Analytical Hierarchy Process (AHP)

In this complex world, making the right decisions is a challenging task for decision-makers and policymakers. There are various methods to tackle decision-making, like the AHP, Multi-Criteria Decision Analysis (MCDA) and machine learning approaches. The AHP is simple, balanced, transparent and it has a structured framework for complex decision-making. It is also effective in resource-constrained environments and accessible to non-experts. The AHP is a methodology for relative measurement that derives ratio scales from continuous and discrete paired comparisons to prioritize and rank options for alternatives and selection. It is used in multi-criteria decision-making, resource allocation, planning, and conflict resolution. It employs a nonlinear framework for inductive/deductive thinking, considering multiple factors and utilizing feedback as numerical trade-offs to arrive at a conclusion. The AHP can be applied to a multitude of decision-making problems involving a finite number of alternatives (refer to Figure 1). Relative measurements simplify analysis when the attributes of alternatives are intangible. The ultimate scope of the AHP is that of using pairwise comparisons between alternatives as inputs to produce a rating of alternatives as a theory of relative measurement [56–59].

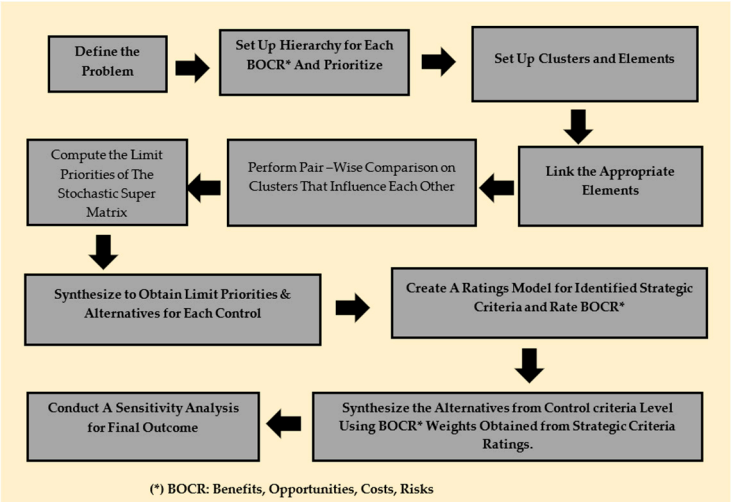



**Figure 1.** AHP. Source: Authors.

Ref. [60] assessed the architectural design by providing a novel approach based on the Analytic Hierarchy Process (AHP). He chose this method because it supports an effective comparative analysis among the alternative projects based on determined criteria. Ref. [61] explained the application of the AHP. According to him, the Analytic Hierarchy Process (AHP) is widely used as a multi-criteria decision-making tool to tackle multi-attribute decision-making problems in real-world situations. It represents a powerful technique for solving complicated and unstructured problems that may have interactions and correlations among different objectives and goals. The AHP helps decision-makers to organize the critical aspects of a problem into a hierarchical structure similar to a family tree. This method relies on experts' judgements derived via pairwise comparisons, where experts are interviewed and similar criteria are compared systematically to generate comprehensive priority weights to rank the options.

## 3. Research Methodology

The AHP is used in this research to calculate the weightage value of different child-friendly parameters to rate the park in terms of child-friendliness. The literature study is used to determine the key parameters for a CFE, whereas the AHP is used to assign weights to these parameters. A subsequent survey is conducted in the selected case study area to calculate the weightage value of different child-friendly parameters, thereby rating the park in terms of child-friendliness.

The parameters derived from the literature were validated by a Delphi panel of 30 experts from fields relevant to the built environment, including sociologists (5), psychologists (5), pediatricians (5), urban planners (5), urban designers (5), and architects (5). All the panel experts had at least 10 years of experience in their respective fields. The parameters identified through the Delphi panellists were categorized into 5 groups: perceptional, emotional, cognitive, physical, and social [22,38]. Further, to understand children's views about their neighbourhood parks, an interview cum questionnaire sample survey method was carried out. The parameter weights were determined using the AHP method. Based on the identified parameters, a site survey questionnaire was administered, and a total of 150 responses were received from children, 50 from each of the selected three parks of Lucknow city. The results of the surveys were analyzed and the extent of the CFE was obtained with the help of the mean value of each parameter and the AHP approach (refer to Figure 2). The research also included an observational analysis of the mentioned parks to determine the extent of the CFE.

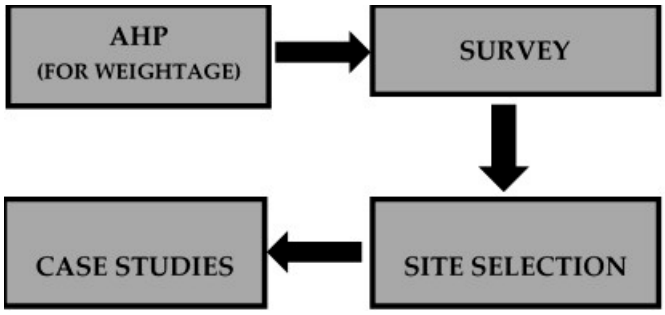



**Figure 2.** Tools used in the research. Source: Authors.

### 3.1. Prioritizing Criteria Based on AHP

Regarding the AHP, ref. [56] proposed a four-step methodology comprising modelling, valuation, assigning priorities, and synthesis. Satty derived a ratio scale that prioritizes the various chosen factors, which are compared with each other on the scale of their importance at the time of modelling; all the criteria, sub-criteria, alternatives, and attributes are included. A hierarchy table is made with the 'objective of the problem' at the top of the hierarchy and factors such as the 'criteria, sub-criteria, alternatives and attributes' following it. In the AHP, weights for these factors are provided in the hierarchy tables used in multi-criteria decision-making. Finally, the AHP gives importance to factors according to their assigned weights. Table 2 below demonstrates the extent of importance among the parameters for their pairwise comparison matrix [62].

**Table 2.** Intensity of importance as per pairwise comparison. Source: [62].

| Intensity | Definition |
|---|---|
| 1 | Equal importance |
| 2 | Equal to moderate importance |
| 3 | Moderate importance |
| 4 | Moderate to strong importance |
| 5 | Strong importance |
| 6 | Strong to very strong importance |
| 7 | Very strong importance |
| 8 | Very to extremely strong importance |
| 9 | Extremely importance |

### 3.2. Matrix for Pairwise Comparison

For assigning weights to the defined parameters, a pairwise comparison matrix is used. This matrix focuses on the comparison of just two criteria at once, which are assessed and compared with each other according to their importance value as per Saaty's importance scale [56,63]. The self-comparison value of the parameters is always 1. Hence, the diagonal cells have 1 (unitary) as the only value (to be exact, with n criteria, there are $n \times (n-1)/2$ comparisons).

In the case of two parameters A and B, if both parameters have the same importance level, then the pair obtains an index of 1 in the pairwise comparison matrix. If criteria A has more importance than B, then the index value in the pairwise matrix is 9. These weight values were assigned by consent of the Delphi panellists and the authors. Tables 3 and 4 below shows the comparison matrix of the pairs.

**Table 3.** Pairwise comparison between the parameter of the CFE. Source: Authors.

| | Cognitive | Perceptional | Emotional | Physical | Social |
|---|---|---|---|---|---|
| Cognitive | 1 | 3 | 5 | 7 | 9 |
| Perceptional | 1/3 | 1 | 3 | 5 | 7 |
| Emotional | 1/5 | 1/3 | 1 | 3 | 5 |
| Physical | 1/7 | 1/5 | 1/3 | 1 | 3 |
| Social | 1/9 | 1/7 | 1/5 | 1/3 | 1 |

**Table 4.** Pairwise comparison between parameters of CFE.

| | Cognitive | Perceptional | Emotional | Physical | Social |
|---|---|---|---|---|---|
| Cognitive | 1.00 | 3.00 | 5.00 | 7.00 | 9.00 |
| Perceptional | 0.33 | 1.00 | 3.00 | 5.00 | 7.00 |
| Emotional | 0.20 | 0.33 | 1.00 | 3.00 | 5.00 |
| Physical | 0.14 | 0.20 | 0.33 | 1.00 | 3.00 |
| Social | 0.11 | 0.14 | 0.20 | 0.33 | 1.00 |
| Sum | 1.78 | 4.67 | 9.53 | 16.33 | 25.00 |

Source: Authors.

### *3.3. Calculating the Weight of the Criteria*

After the pairwise comparison, weights for individual parameters are calculated. The first step to this is the creation of a normalized comparison matrix. Each value in the matrix is divided by the sum of values in the column. The final weights of each parameter are calculated by the mean value of each row of the matrix. As these weights are already normalized in the pairwise comparison matrix, their sum is taken as 1. Table 5 below shows the weights of the parameters.

**Table 5.** Standard deviation and weights of parameters. Source: Authors.

| | C | P | E | Ph | S | Criteria Weight | Weightage |
|---|---|---|---|---|---|---|---|
| C | 0.56 | 0.64 | 0.52 | 0.43 | 0.36 | 0.50 | 50.28 |
| P | 0.19 | 0.21 | 0.31 | 0.31 | 0.28 | 0.26 | 26.02 |
| E | 0.11 | 0.07 | 0.10 | 0.18 | 0.2 | 0.13 | 13.44 |
| Ph | 0.08 | 0.04 | 0.03 | 0.06 | 0.12 | 0.06 | 6.78 |
| S | 0.06 | 0.03 | 0.02 | 0.02 | 0.04 | 0.03 | 3.48 |

Cognitive: C, perception: P, emotional: E, physical: Ph, social interaction: S.

Table 5 above shows that the value of a CFE depends upon cognitive indicators. The perception and emotional indicators are ranked two and three, respectively.

To check if the weights assigned in Table 5 are statistically reliable, the consistency of the resulting weights is examined. The consistency ratio is verified for the chosen criteria and their weights assigned; if it comes to <0.1, then the weights assigned can be said to be statiscally reliable. The formula is given as follows:

$$\lambda max = \sum_{n=1}^{\alpha} \lambda n / n$$

If $n$ = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, the respective value of 'R.I.' against the corresponding value of '$n$' will be R.I.= 0, 0, 0.525, 0.882, 1.115, 1.252, 1.341, 1.404, 1.452, 1.484.

| n | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| R.I. | 0 | 0 | 0.525 | 0.882 | 1.115 | 1.252 | 1.341 | 1.404 | 1.452 | 1.484 |

$$C.I.(\text{Consistency index value}) = (\lambda max - \text{n})/(\text{n} - 1)$$

$\lambda max$ is the average value of λ, as given in Table 6 for each of the five parameters. The AHP valued criterion the consistency index value should be less than the Random Index value (C.I < R.I.) for the acceptable range of consistency.

$$\text{C.I.} = (5.242 - 5)/(5 - 1)$$
$$= 0.2426/4 = 0.0605$$

The ratio of the consistency index to the Random Index is to be less than 0.1. The ratio obtained is = 0.060652/1.12 = 0.054153.

The ratio value is less than 0.1, which is acceptable to us. This shows that the generated weights are validated. Thus, the value of a CFE can be calculated from the weights of various indicators responsible for the overall development of children. Various parks can be assessed through Table 5, and the value of a friendly environment can be calculated. The study further moved towards finding the value of a CFE in different parks in Lucknow, and this value was also validated by observing the environment of parks.

**Table 6.** Consistency matrix assessment.

| | **C** | **P** | **E** | **Ph** | **S** | **Weighted Sum Value** | **λ** |
|---|---|---|---|---|---|---|---|
| C | 0.50 | 0.78 | 0.67 | 0.47 | 0.31 | 2.74 | 5.46 |
| P | 0.17 | 0.26 | 0.40 | 0.33 | 0.24 | 1.41 | 5.43 |
| E | 0.10 | 0.09 | 0.13 | 0.20 | 0.17 | 0.69 | 5.20 |
| Ph | 0.07 | 0.05 | 0.04 | 0.07 | 0.10 | 0.34 | 5.03 |
| S | 0.05 | 0.04 | 0.03 | 0.02 | 0.04 | 0.18 | 5.09 |

Cognitive: C, perception: P, emotional: E, physical: Ph, social interaction: S. Source: Authors.

### *3.4. Case Studies of Parks in Planned Neighbourhood of Lucknow*

Lucknow, the capital city of Uttar Pradesh (Refer Figure 3), is selected for the research, as it can be used as a standard for other state capitals of the same scale. The researchers are familiar with the city and analyzed the factors of CFEs. The city is spread over an area of 350 sq. km; the population of the Lucknow Municipal Corporation (LMC) is 28.17 lakh (2.817 million), with a density of 8049 persons/sq.km (Census 2011).

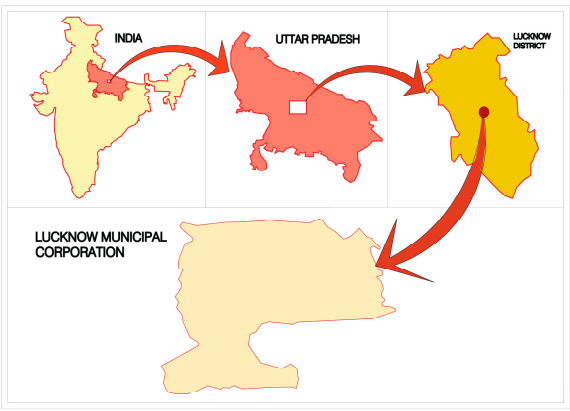



**Figure 3.** Locational map of Lucknow. Source: Authors.

This research studied three parks of Zone 4, all having an area more than 5000 $m^2$, which are Gandhi Park, Maharanpratap Park, and Balmiki Park. These parks were selected because these are in planned neighbourhoods and were developed in recent years.

Lucknow is divided between the eight zones as per the Master Plan 2011 (refer to Figure 4). The rationale for the selection of Zone 4 was based on the planned neighbourhoods that were developed in recent years. The rationale of the park's selection was based on the hierarchy of the planned neighbourhoods in terms of old, intermediate, and latest developments. Zones 1, 2, 5, and 6 were excluded from this study as they are old settlements. Zones 7 and 8 were also excluded due to undeveloped settlements in the city fringe area. The study has also not covered Zone 3, as it has older settlements compared to Zone 4.

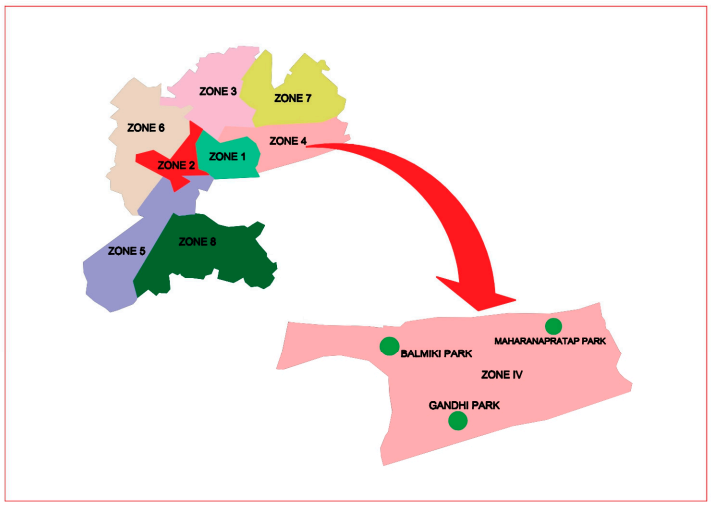



**Figure 4.** Zonal map of Lucknow and location of selected parks. Source: (Author).

3.4.1. Case Study 1—Gandhi Park

Gandhi Park is situated in the well-developed neighbourhood of Vipulkhand, Gomtinagar, Lucknow. It has access from all four sides. The surrounding roads of the park are of the tertiary category, which has low traffic. The paved walkway along the periphery and within the park divides the park into sections through a central pathway (Refer to Table 7).

**Table 7.** Details of Gandhi Park.

| Indicators | Observations |
| --- | --- |
| Physical | The plant and shrub beds are randomly placed in the park, which hinders the openness of the park. It was also observed that the trimming and planting of plants, furniture maintenance, and even surfacing of the ground are practices that are only taken care of there.<br>No dumping spaces were found there. Toilets and drinking water facilities were also not found in the park. |
| Cognitive | The park is deprived of play varieties. No slides and swings were seen. There was no space for adventure and exploration play. Children were observed only doing activities like running and throwing balls, etc. |
| Emotional | Uneven green surfaces, broken pathways at some points, placing of transformers inside the park, and open electrical panels are the major safety issues. Children's free movement was restricted due to lack of maintenance, wrong planning of plant beds, and animals like dogs. The whole environment of the park was found to be very static, which was not liked by the children of the neighbourhood. |
| Perceptional | Surface diversity was observed: plain ground—20%, pathway of grey-coloured interlocking tiles—8% of the area, green open space covered with grass and plant beds—57%, and others—15%. Plants and trees of various varieties were found in the park. However, no energetic and pleasing colour scheme was there. No structure with attracting form and shape was present in the park. |

**Table 7.** *Cont.*

| Indicators | Observations |
| --- | --- |
| Social | Some common activities among various age groups of children were organized but not on a regular basis. |
| Observations | Most of the furniture of the park was damaged. The park's environment was unpleasant due to unhygienic conditions occurring due to water logging. Dampness, structural distress and microbiological growth were observed on the boundary wall due to open storm drains and water logging on the approach roads. The park does not have dedicated parking spaces. |

Source: Authors.

#### 3.4.2. Case Study 2—Maharanapratap Park

Maharanapratap Park is situated in VijayantKhand—the two areas of Gomtinagar Lucknow Park can be accessed from three of its sides. The surrounding roads of the park are of the tertiary category, which has low traffic. The park is designed in the radial landscape pattern of walkways for circulation. An internal paved walkway divides the park into four smaller pockets, making it suitable for children of all age groups to play together (Refer to Table 8).

**Table 8.** Details of Maharanapratap Park.

| Indicators | Observations |
| --- | --- |
| Physical | The first pocket is for swings, the next two pockets are for open green spaces, and the fourth pocket is for the sitting area. The maintenance level of the park was observed to be 90%, as regular planting and trimming of plants, cleaning of the park, and maintenance of the furniture, slides and swings were conducted on regular basis. Toilets and drinking water facilities were not found in the park. |
| Cognitive | The park is deprived of play varieties There was also no space for adventure and exploration. Children were observed playing, activities like running and balling. Children also played in the space, having swings and slides. |
| Emotional | The park was safe for the children. Electrical wires were exposed in some places, which was a major safety issue. Children were freely moving from one place to another within the park. The overall environment of the park was impressive and dynamic, which was liked by the children of the neighbourhood. Children had a sense of belonging and regard for the park environment. |
| Perceptional | Surface diversity was observed: plain ground—10%, pathways with red interlocking tiles—25% area, green open space covered with grass and plant beds—60%, and others—5%. Plants and trees of various varieties were found in the park. However, no energetic and pleasing colour scheme was there. Not much structure with attractive form and shape was present in the park except for some colourful slides. |
| Social | Some common activities among various age groups of children were organized on a regular basis by society. |
| Observations | The planning layout of the park is organic in shape, which is different from many parks. The transformer area is enclosed by a shed, which is open from the top. The hand pump is in a non-working condition. The front edges of the park are covered by an illegal shed. The swings are in good condition. Vegetation is also pruned and maintained regularly. Open drains were observed in and around the park. The approaching roads to the park were maintained and it has footpaths to access the park. |

Source: Authors.

#### 3.4.3. Case Study 3—Balmiki Park

Balmiki Park is situated in Balmiki Nagar, Lucknow, and is in proximity to the paper mill colony and metro city. The park has been divided into paved and green zones using a paved pathway that moves around the edge of the park (Refer to Table 9).

**Table 9.** Details of Balmiki Park.

| Indicators | Observations |
| --- | --- |
| Physical | The park features a washroom facility and a manager's cabin on site. The park has two entrances opposite to each other on the shorter side. It was observed that the access roads to the park are congested and make it difficult to approach the park due to haphazard parking, encroachments and open residential drains. The maintenance level of the park was found to be 40% due to maintenance of the ground surface, swings, slides and furniture and regular trimming and planting. The essential amenities like toilets and drinking water were available in the park. |
| Cognitive | There was no variety of play observed in the park.<br>Only a swing area is provided. Children were observed playing, with activities like running and throwing balls, etc. There was no space for adventure and exploration also. |
| Emotional | The presence of street animals like cows, dogs, etc., and dumping spaces inside the park are the major safety issues. Children were freely moving around the park to save themselves from street animals; therefore, their movements were restricted. Children had a sense of belonging and regard for the temple and animal structures present there. |
| Perceptional | The park has a lot of potential for a rich ecology. The following surface diversity was observed: pathways—5%, pathways with interlocking tiles—23%, green open space—60%, and others—12%. Plant diversity—no. No energetic and pleasing colour scheme was there. There were few structures with attractive form and shape present in the park, except for some colourful slides. |
| Social | No common activities among various age groups of children were organized on a regular basis by society. |
| Observations | The park was observed as very degraded in spite of the presence of rich green ecology due to lack of maintenance and overcrowding within the park, as well as the unplanned growth of the surrounding residential neighbourhood. There are exposed service pipes and garbage disposals in green spaces. There was incongruous vegetation and topiary was not maintained, creating an unpleasant view, encroachment, and lack of physical infrastructure inside the park. |

Source: Authors.

## 4. Analysis and Discussion

From the observations of the case studies and analysis of the primary data collected through questionnaires/interviews, mean values of various indicators were found, and through those, the value of the child-friendly environment of different parks was calculated, as seen in Table 4. The following results were obtained, as per Table 10.

**Table 10.** Value of child-friendly environment and ranking of parks. Source: Authors.

| | Ph | C | E | P | S | CFE Value | Rank |
| --- | --- | --- | --- | --- | --- | --- | --- |
| G | 3.0 | 1.6 | 2.5 | 2.8 | 2.8 | 2.2 | 2nd |
| M | 3.4 | 2.9 | 3.0 | 3.2 | 3.3 | 3.1 | 1st |
| B | 2.5 | 1.4 | 2.5 | 2.7 | 2.7 | 2.0 | 3rd |

Gandhi Park: G, Maharanapratap Park: M, Balmiki Park: B. Cognitive: C, perception: P, emotional: E, physical: Ph, social interaction: S.

The value of the CFE depends on 50.28 percent for the cognitive parameter, 26.02 percent for the perception parameter, 13.44 percent for the emotional, 6.78 percent for the physical parameter, and 3.48 for the social parameter (Ref. Table 4). This shows that cognitive, perception, and emotional parameters are the most important factors. If we consider the first two parameters while designing and planning any park, approx. 75 percent CFE can be achieved. Further, if an emotional parameter is also added, the park will have a 90 percent CFE. Moreover, Maharanapratap Park was ranked first among the three selected parks in Zone 4 of Lucknow, whereas Balmiki Park ranked third. Parameters evaluating the child-friendly environment were found to be better in Maharanapratap

Park compared to other parks. This park was ranked the best among the three mentioned parks with respect to physical parameters like amenities and facilities, location, accessibility, and maintenance [64]. When comparing the three parks, it was also found to be good for perception parameters, including esthetics, scale, and surface diversity. It also had the maximum mean value for emotional and social parameters, meaning that it had freedom of movement, a sense of safety, and social activities [65]. However, the values suggest that this park was unsuitable for cognitive parameters like types of play varieties and adventure spaces that can satisfy the needs of various age groups of children. The park has scope for improvement for greater development of cognitive factors. Balmiki Park was ranked on the lower side for all the factors—physical, cognitive, emotional, and perception. The result also shows that all the parks do not have very satisfactory mean values on the Likert Scale 5, which means that the parks are not child-friendly. All the parks need improvements. Gandhi Park is deprived of play equipment like swings, slides, etc. There should be play varieties that consider various age groups of children. Even other parks, which have such play equipment, are only for small kids. Therefore, there is a need for play types of equipment for other age groups. This play equipment encourages children to manipulate the environment and increases their physical activity during play and adds challenging novelty to the playgrounds [64,66,67]. All three parks required adventure play equipment, as children prefer adventure playgrounds to conventional playgrounds, and they also have a desire to discover and feel a wider range of settings [32]. Perception factors should be enhanced in Balmiki Park and Gandhi Park. An esthetically pleasing environment, using bright colours and adding various attractive forms and shapes, should be provided in these parks. In addition to these factors, flower gardens should also be planned in the parks, which afford the best opportunities for developing a child's esthetic and colour sensibilities [68]. There should be places like pathways and sitting and playing areas, with variety in design, diverse possibilities of use and varied textures. Emotional indicators need to be enhanced in all three parks to provide a safe, enclosed, and intimate environment [65]. Parks should incorporate safety measures like supervision, suitable separation of the space according to ages, choices of proportional play equipment, materials of the surfaces, height of the equipment and maintenance. A park should be an environment where a child should be cognitively attentive to the external world through a free movement. Parks should also incorporate spaces for social interactions that can encourage children to connect or create a sense of bonding with them. Social indicators should be enhanced by providing spaces and by organizing regular activities through which children can interact with other children and people as "children shape their surrounding environment, and the environment itself shape them also" [19].

## 5. Conclusions

The study demonstrates a relationship between various factors in evaluating a CFE. It suggests that the value of a CFE can be found by measuring and evaluating different parameters of a CFE. The research emphasizes that the cognitive parameter has maximum weightage for determining the value of a CFE, also noted in other studies [69,70]. The perception parameter emerges as the second key parameter and has a significant share in establishing a CFE [22,35]. Further, emotional parameters have also contributed to the creation of a CFE. Social and physical parameters can further enhance the qualities of a CFE [71]. These findings indicate that incorporating these parameters can enable parks to achieve CFEs, which in turn can contribute to their overall growth. Children will get a healthy environment because they spend time in the parks for play during their stages of development. Such environments are enormously significant and necessary for children to fulfil physical, social, emotional, and cognitive aspects. Hence, the nature and

type of the play spaces are extremely important. The features, amenities and facilities, as well as the quality of internal and external spaces, also impact the quality of the play atmosphere [72]. The advantages of having a healthy environment are cognitive development, perceptual development, emotional development, physical development, and social development of children. The research also suggests that parks can be ranked in terms of the value of a CFE. Previous research has emphasized the development of CFEs in neighbourhoods [31,71]. However, the ranking of parameters has not addressed the identification of which parameter(s) is/are the most valuable parameters(s). The research contributes to the identification of the most critical parameters for ranking that can be used to create an efficient and effective CFE. The research results align with the aim of enhancing CFEs in the parks of planned neighbourhoods in Lucknow city. Its output specifies children's needs in neighbourhood parks. The AHP used in this research can be applied to similar cities with similar characteristics. Hence, there is scope for other research to evaluate other components like schools, markets, shops, roads, and health facilities with respect to CFEs. The results suggest that the research can contribute to the development of a CFE in the future, satisfying the needs and expectations of children and promoting their holistic development.

This research defined the importance of a CFE for the overall growth of children. Healthy and happy children are a predictor of a country's health and wealth. The research identified the factors responsible for a CFE, which are physical, cognitive, perceptional, emotional, and social. The research also emphasizes the importance of parks in various neighbourhood planning concepts and suggests the importance of parks for developing CFEs. To enhance the quality of parks, this research assigns weights to the various defined indicators through the AHP. Further, the research evaluated the parks of planned neighbourhoods in Lucknow. In this way, one can determine which indicators are lacking in the parks, and, by upgrading those particular indicators, a child-friendly environment can be achieved. Guidelines for enhancing a child-friendly environment in planned neighbourhood parks can be incorporated into policies of local and state government documents. This will make 'creating a CFE in planned neighborhood parks' mandatory.

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