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Spatial Distribution Analysis of Urban Inner Parks with Emphasis on Sustainable Development using AHP Model & GIS (Case Study – District 4, City of Kabul)

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Abstract

Cities, being hubs of human activity, are forced to adapt to the way natural systems affect their form and function in order to maintain sustainability. On the other hand, being a vital component of cities, urban green areas are crucial to their expansion and development, and their absence can seriously disrupt city life. The fourth district of Kabul city is one of the key areas of the city, which has a population of 350,000 people, with a low per capita number of urban inner parks, and the reason for this is the increase in population, excessive growth of construction, and lack of proper management of urban inner parks. The purpose of this research is to analyze the spatial distribution of urban inner parks based on social justice, how to optimally distribute parks with an emphasis on sustainable development, and to provide a suitable and comprehensive model for locating this type of land use in other areas of Kabul. For this purpose, field research was used to investigate urban inner parks at the district level. Later, a questionnaire was distributed to check the level of people's satisfaction with the spatial distribution of urban inner parks at the level of the fourth district. In this regard, after determining the influential indicators in the location of urban inner parks, weighting them using the AHP model and integrating the weighted indicators in the GIS environment has been done and suitable areas for the construction of new parks in the area of study were obtained.

Keywords: Urban inner parks, Spatial distribution analysis, AHP model, GIS

* Corresponding Author

1. Introduction

Urbanization results in an increasing proportion of the population living in cities. Urban living limits access to nature and can increase exposure to certain environmental hazards, such as air and noise pollution. Many urban areas face increasing pressure from expanding populations, limited resources and growing impacts of climate change.These challenges must be addressed in order for cities to provide healthy and sustainable living environments[1].

Therefore, revitalizing urban nature requires special consideration in today's cities. Because of the extent, combination, and distribution of nature in the city, it is required and sufficient for sustainable development. Due to this, allocating land to different urban land uses is one of the crucial jobs of urban and district planners. Land use planning actually refers to the efficient distribution of available land (land uses, as elements of the city's spatial structure, have a big impact on the formation and appeal of this structure)[2]. Due to the unorganized distribution of land uses in the city and the heterogeneous and unbalanced spatial structure caused by the lack of an optimal location that is appropriate to the land use characteristics and functional characteristics as well as the characteristics of the studied urban environment at any functional scale, chaos in the spatial structure occurs[2]. Therefore, the optimal location of inner-city parks according to ecological and social functions, which are functional at different scales, is based on the problem-solving logic of planning.

In this research, available sources, including books, articles, thesis, detailed and comprehensive plans, existing documents, and maps of the city and district, have been studied to identify the location of existance parks. Then a questionnaire was distributed among the visitors to the parks. Further, it has been tried to identify the most effective criteria for the spatial distribution of parks at each functional level (neighborhood, local, district, and region), and using the analytic hierarchy process (AHP), each criterion has been weighted. Recently, the AHP results have been integrated into the GIS environment, and the findings demonstrate the spatial distribution of urban inner parks in the fourth district of Kabul city.

2. Research Questions

The objectives of the current study are to provide responses to the following question:

1. What is the function of urban inner parks, and are the parks that currently exist in ?the ۴th district suitable for the current population
2. ?Are the urban parks optimally distributed in terms of location
3. ?Which model and strategy can be used to optimally distribute the urban parks

3. Literature review

Considering the importance of parks and green spaces in sustainable urban development and the quality of life of city dwellers, this issue is investigated from different aspects by researchers. The field of study on green spaces, although it has a relatively good history in the world, but in Afghanistan, less attention has been done about this issue. Here, for .instance, we're referring to an article on urban parks "Upgrading recreational spaces with the redesign approach of urban park furniture (Kabul New City Park). The purpose of this

research is to identify the effective factors in the field of improving recreational spaces with the approach of redesigning the furniture of city parks and responding to the needs and preferences of citizens in the urban area when using urban spaces and parks[13]. This research has focused on the improvement of recreational spaces (city parks) and not on the spatial analysis of parks. In general, in the last few decades, due to the issues of rapid urbanization and the expansion of cities, this issue somehow has been taken into account. In this study, residential, access, educational, and gathering place criteriahave been employed to do a spatial analysis of the urban inner parks. But there are different criteria that have been utilized, such as population criteria, economic criteria, natural criteria, physical criteria, and pollution criteria too that can be taken in account in different purposes regarding to the urban greeneriesParizadi Taher, Shaikhi Hojat, and) (Ibrahimpoor Mariam, ۲۰۱۳ [3].

,In this studythe AHP modelhas been utilized for spatially analysis ofthe urban inner parks, but there aresome other models and approaches for this purpose too,such as: TOPSIS (Technique for other of presence by similarity to ideal solution), SWOT (Strength, weakness, opportunity, and threats), ANP (Analytic network process). Analytic heirarchy process (AHP), is oneof the comperhensive models for choosing ,multiple criterias. Analytic network process (ANP)the model which is used in the geographic information system. This model is used to analyze the current situation of the spatial distribution of services or uses and to check the radius of their operation and to determine the areas that are outside of the radius of their coverage (Dr. Q. Hamed, D. Shaida Kashifi, Q. Jamil, D. Diman Kashifi, 2015)[4].

In the context of Afghanistan, there has only done some limited studies in the form of dissertations and publications on theissue of locating urban inner parks utilizing spatial analysis approaches such as the AHP (Analytical Hierarchy Process) model, TOPSIS (Technique for order of presence by similarity to ideal solution), SWOT (strength, weakness, opportunity, and threat) model, and geographic information system (GIS(. All these studies mostly focused on spatial distribution of urban parks only by using GIS. ,Furthermorein these studies, the parkshave not beencategorized ; instead, in this study, the parks have been categorized into (neighborhood, local, district, and regional) and assigned accordingly because every type of park has its own criteria and standardsto be spatially distributed. In addition, inthese studies the authors ,have utilized population criteria, economic criteria, natural criteria, physical criteria, and pollution criteria, butin this study proximity to the residential areas ,distance from the accessnetworks, proximity to theeducational centers and ,proximity to the gathering centerscriteria have been utilized, because the purpose isto analyze the spatial distribution of urban parks based on the access of urban inhabitants to theparks. So, this study has mainly focused on and utilized the AHP model because the aim is to weigh the criteria and rank the options based on them for reasonable decision makingand it is not possible to do this with any , .other approaches

4. Research Hypotheses

Bassed on the spatial distribution of the urban inner parks examination and analyzation, the research hypotheses are as follow:

- All land uses [Residential centers, access networks, educational centers, and gathering centers] have been placed accurately pertaining to the inner-urban parks.
- By using spatial analysis methods (AHP model) and geographic information system (GIS), it is possible to determine the most suitable place to establish a park in the studied area.

5. Research Methodology

The current research is an applied research and the research method is descriptive-analytical. The method of collecting information in this research is based on two library methods and field studies [The libraryapproachegathers relevant things by consulting books, journals, and scientific research, Furthermore, the field study approach involves going to the target region to assess the strengths, weaknesses, opportunities, and threats.]. In the first stage available sources including books, articles, thesis, detailed and comprehensive plans, existing documents and maps of the city and district have been studied to identify the location of existance park. In the field method, the questionnaire was distributed among the visitors to the parks, in the library method, the research on urban inner parks and the identification of the influencing criteria on the analysis of the spatial distribution of the park, which correspond to the real needs of the city, were done. Next, the AHP model was used to weight the criteria and finally the results were integrated in the GIS environment.

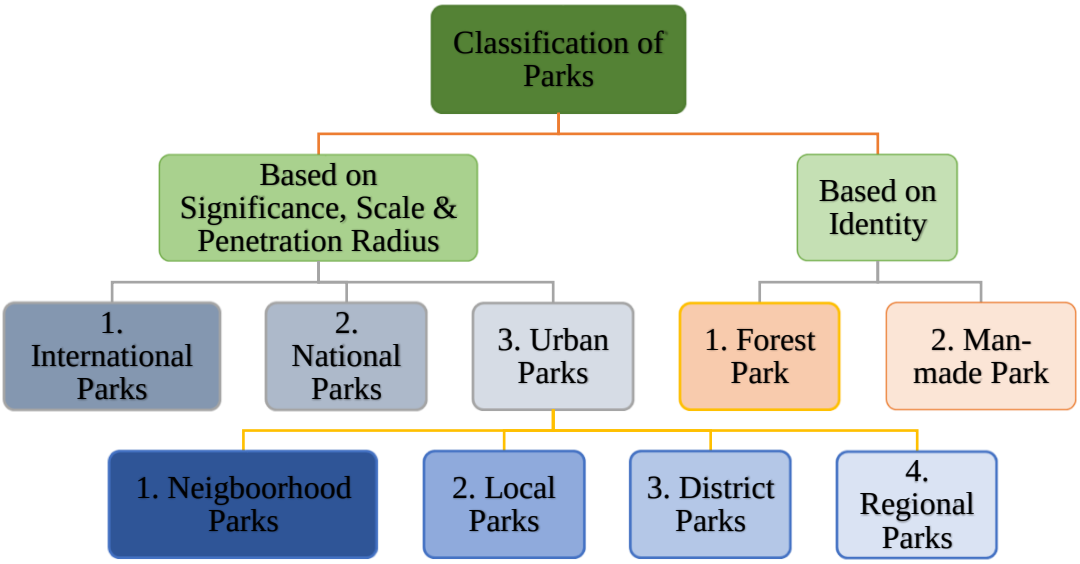
The purpose of the analytic hierarchy process technique is to select the best option based on various criteria through pairwise comparison. This technique is also used for weighting criteria. Decision criteria are typically broken down into sub-criteria since the rise in the number of elements in each cluster makes pairwise comparison challenging[8].

6. Parks

Park is a designed green space that is owned by the public and is considered as a part of urban spaces. These spaces are covered by plants and trees and are maintained or established based on human supervision and management[5].

6.1 Classification of parks based on identity

The classification of chart is summarized in the diagram bellow:



.Diagram 1: Park classification [8]

7. Study Area

7.1 Fourth District of Kabul City

The 4th district of Kabul city is one of the key and most populated districts of Kabul city, which has 350,000 people and an area of 11.626117 square kilometers or 1162.611653 hectares. and it is bounded by District 11, 15 in the North, District 10 in the East, District 17 in the West and District 2 in the South (Figure 1).

7.2 Population Density

According to Kabul Urban Design Framework (KUDF), population density in the 4th district of Kabul city divided into 10 section, the lowest density is 0-26 people and the highest density is 640-357 people per hectare[9] (figure 2).

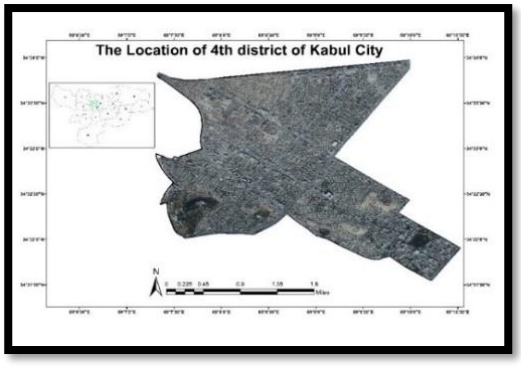


Figure 1: Kabul city, 4th district

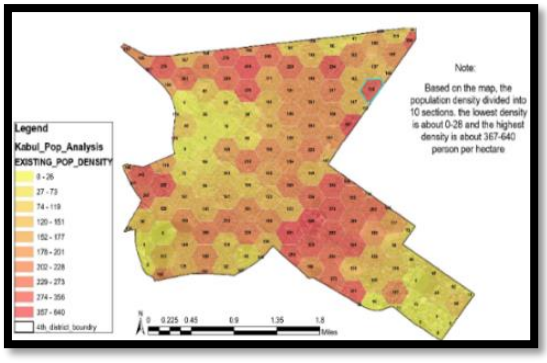


Figure 2: Population Density, 4th district

7.3 Fourth district Parks

park is a designed green space that is owned by the public and is considered a part of urban spaces. These spaces are covered by plants and trees and are maintained or constructed based on human supervision and management[5].

In the fourth district of Kabul, the parks that exist in terms of their importance, scale, and radius of penetration are among urban parks, and these parks are divided into neighborhood, local, district, and regional parks. There are a total of ١٧ parks in the fourth district of Kabul, of which 4 parks are planed to be built in the future by the government.

Table 1: 4th district parks [11]

No	Name	Statue	Category	Area(m2)
1	Bagh-eBala	Complete & Access	Regional	319504.6
2	Kolola Poshta Hill	Vacant land	Regional	1205.28
3	Qale Fathullah Hill	Vacant Land	Regional	118026.12
٤	Shar-e-naw	Complete & open to public	District	92347.9
٥	Qalamuddin	Complete & open to public	Local	7883.8
٦	Taimani	Complete & open to public	Neighborhood	2177.2
٧	Sharid-Hakim Naser Khesraw Balkhi school	Complete & open to public	Local	6903.6
٨	Sharid-Wazir Abad	Complete & open to public	Local	17880.3
٩	Sharid-Lab Jar	Complete & open to public	Local	11681.4
١٠	Block Sharwali	Complete & open to public	Local	11971.7
١١	sharid-taimani-2nd Rd	Complete & open to public	Local	7416.1
١٢	Sharid-Taimani-2nd Rd 2	Complete & open to public	Neighborhood	1505.9
١٣	Shahr Ara	Complete & open to public	Local	27266.9
١٤	Sharid-Mosa Kalimullah mosque	Vacant Land	Neighborhood	4491.5
١٥	East Sahrid-Wazir Abad	Vacant Land	Local	7678.2
١٦	West Sharid-Wazir Abad	Vacant Land	Neighborhood	3588.8
١٧	Sharid-Tajwar sultana School	Vacant Land	Neighborhood	4570.1

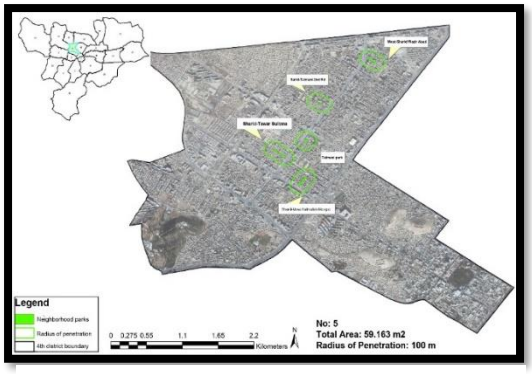


Figure 3: Neighborhood Parks(Authors)

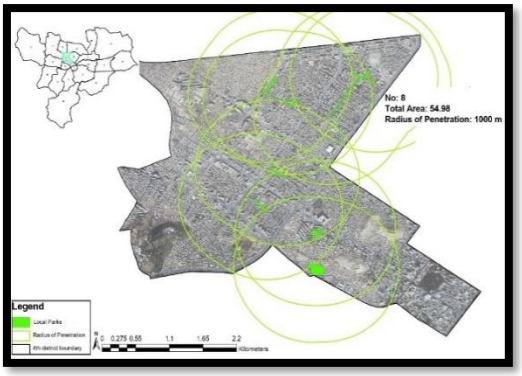


Figure 4: Local Parks(Authors)

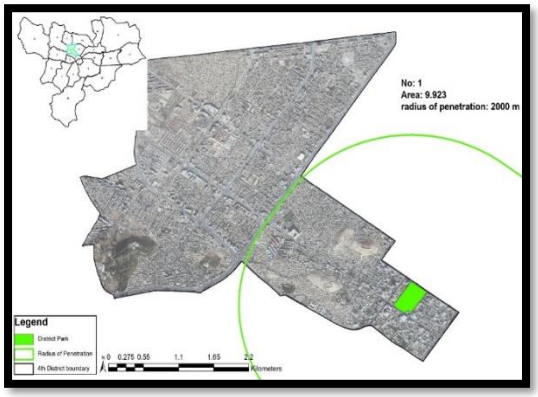


Figure 5: District Park(Authors)

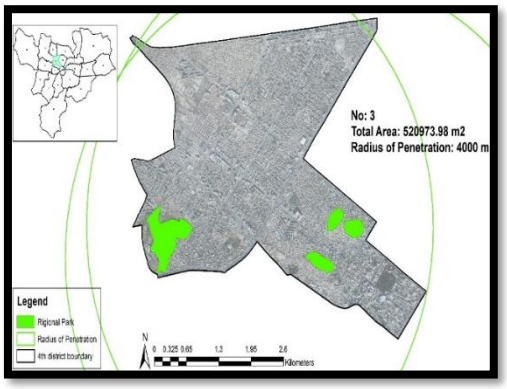


Figure 6: Rigional Parks(Authors)

8. Analysis of the parks' spatial distribution in Kabul's fourth district

Today, following the expansion of urbanization and the increasing population, cities are dealing with a number of issues, including the lack of proportional benefit of all citizens from city services. Parks as one of the important Land uses that a significant population deals with and occupy significant levels of urban space, they frequently face issues like scarcity, improper distribution based on population demands, non-compliance with neighborhoods etc.

Studying and analyzing the spatial distribution of parks is a complex process that not only require technical abilities, but also economic, social, environmental, political, and Physical spatial needs. Such complexity requires the usage of multiple decision-making tools, such as geographic information system (GIS) and multi-criteria decision analysis methods such as the utilize of analysis hierarchy process (AHP). The main focus of this study is to examine the study area based on five criteria (proximity to residential centers, proximity to the main access network, proximity to education centers and proximity to gathering centers) and to utilize (GIS) software and analysis hierarchy process (AHP).

9. Spatial division of Kabul's fourth district

Based on the literature review related to spatial division, we divided our study area into three different scales.

- Gozar (Neighborhood)
- Local
- District

9.1 **Gozar (Neighborhood):** Gozar is a part of the district whose area is determined by the relevant district and has a minimum of 1000 residential units and a maximum of 1250 residential units[10]. The 4th district of Kabul city has 21 Gozars (figure 7).

9.2 **Local:** It is part of the district that includes 3 to 7 gozars; these divisions are considered according to the neighborhood park's penetration radius. According to the Kabul City Design Framework (KUDF), local parks should be 2 to 4 kilometers apart[9]. So, the study area was divided into five parts (figure 8).



Figure 7: Division of 4th district into Gozars[14]

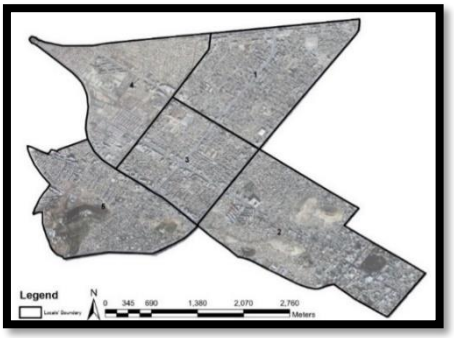


Figure 8: Division of 4th district into Glocals[14]

District: A part of a city with multiple locales that is organized as a type of municipal administrative entity with an independent department for each district. There are 22 districts in Kabul[8].

10. Spatial Distribution analysis of neighborhood parks

There are five neighborhood parks in the fourth district of Kabul city, and each of them is located in a different Gozar. In order to analyze the spatial distribution of neighborhood parks, first the criteria for locating the parks are determined, and then each criterion is weighted using the Analytical Hierarchy Process (AHP).

10.1 Spatial Distribution Criteria for Neighborhood Parks

To analyze the spatial distribution of parks at the neighborhood level, we consider four criteria [6].

- Proximity to the residential centers
- Distance from the main access network
- Proximity to the educational centers
- Proximity to the gathering centers

Note: there is another important criteria called “population density” which can be taken in account in compact or vertical developed cities. As the Kabul city has developed horizontally and the population density is low or midium, so in this study the mentioned criteria has not been analyzed for the spatial distribution of the inner parks.

10.2 Analytic Hierarchy Process

The purpose of the analytic hierarchy process (AHP) technique is to select the best option based on various criteria through pairwise comparison. This technique is also used for weighting criteria. Decision criteria are typically broken down into sub-criteria since the rise in the number of elements in each cluster makes pairwise comparison challenging[9]. The steps in the analytic hierarchy process are shown in the table bellow:

Table 2: Analytic Hierarchy Process (Authors)

Criteria	Proximity to Residential Centers	Proximity to Access Network	Proximity to Educational Centres	Proximity to Gathering Centers	Geo-Mean	Criteria weight	Precentage
Proximity to Residential Centers	1.00	2.00	3.00	5.00	2.340	0.483	48
Proximity to Access Network	0.50	1.00	2.00	3.00	1.316	0.271	27
Proximity to Educational Centres	0.33	0.50	1.00	2.00	0.759	0.156	16
Proximity to Gathering Centers	0.20	0.33	0.50	1.00	0.427	0.088	9
Total					4.843	1	100

10.3 Integration of AHP model results into a GIS environment

To integrate the AHP model's outputs in the GIS environment, do the following:

- Finding thepositioning criteria
- Getting the correct distance using Euclidean distance in a GIS environment
- Classification of Euclidean distances using Reclassify in a GIS environment
- Layer overlay using weighted overlay in a GIS environment.

Conclusion: In light of the foregoing, we can say that the neighborhood park in the 1st , 5th and, 10th Gozars is located in a very appropriate location based on the existing criteria (figures 9, 10, 11 & 12).

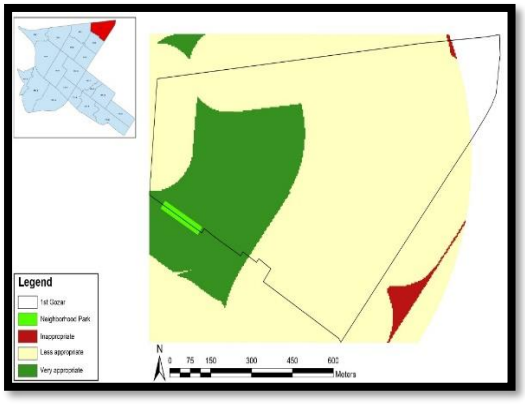


Figure 9: Find the best location for the neighborhood park in 1st Gozar(Authors)

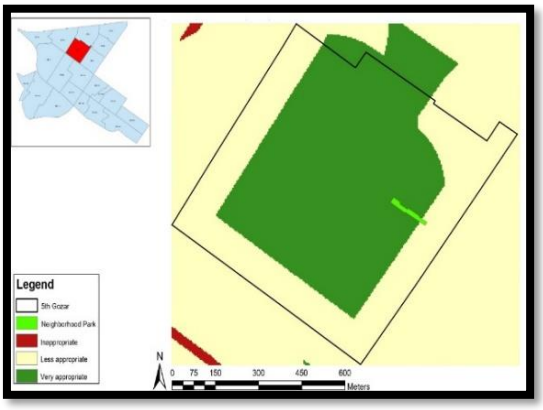


Figure 10: Find the best location for the neighborhood park in 5th Gozar(Authors)

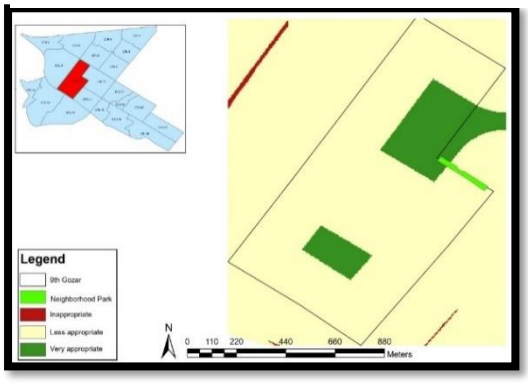


Figure 11: Find the best location for the neighborhood park in 10th Gozar(Authors)

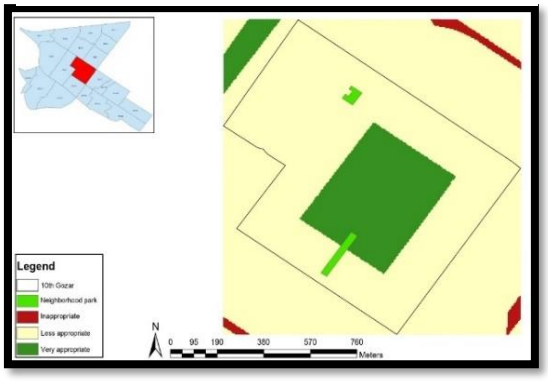


Figure 12: Find the best location for the neighborhood park in 10th Gozar(Authors)

The outcomes of the spatial distribution analysis of neighborhood parks are shown in the table bellow:

Table 3: The outcomes of the spatial distribution analysis of neighborhood parks(Authors)

4th district, Neighborhood parks of Kabul City					
No	Name	Category	Gozar	Area m^2	Spatial Distribution
1	Taimani	Complete & Access	10	2177.2	less appropriate
2	Sharid-Taimani 2nd Rd (2)	Complete & Access	5	1497.4	very appropriate
3	West Sharid-Wazir Abad	Vacant Land	1	3588.8	very appropriate
4	Sharid-Tajwar Sultana School	Vacant Land	9	4570.1	less appropriate
5	Sharid-Mosa Kalimullah Mosque	Vacant Land	10	4491.5	less appropriate

11. Spatial Distribution analysis of Local parks

There are eight local parks in the fourth district of Kabul city, and each of them is located in a different local. In order to analyze the spatial distribution of local parks, first we devide the 4^{th} district into locals then the criteria for locating the parks are determined, and then each criterion is weighted using the Analytical Hierarchy Process (AHP).

11.1 Spatial Distribution Criteria for Local Parks

To analyze the spatial distribution of parks at the local level, first, we consider four criteria, then we consider another criteria (Distance from existing green space) [6].

- Proximity to residential centers
- Distance from main access network
- Proximity to educational centers
- Proximity gathering centers

11.2 Analytic Hierarchy Process

The steps in the analytic hierarchy process are shown in the table bellow:

Table 4: Analytic Hierarchy Process (Authors)

Criteria	Proximity to Residential Centers	Proximity to Access Network	Proximity to Educational Centres	Proximity to Gathering Centers	Geo-Mean	Criteria weight	Precentage
Proximity to Residential Centers	1.00	2.00	3.00	5.00	2.340	0.483	48
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Proximity to Educational Centres	0.33	0.50	1.00	2.00	0.759	0.156	16
Proximity to Gathering Centers	0.20	0.33	0.50	1.00	0.427	0.088	9
Total					4.843	1	100

11.3 Integration of AHP model results into a GIS environment

To integrate the AHP model's outputs in the GIS environment, do the following:

- Finding the positioning criteria
- Getting the correct distance using Euclidean distance in a GIS environment
- Classification of Euclidean distances using Reclassify in a GIS environment
- Layer overlay using weighted overlay in a GIS environment

11.4 Spatial distribution of parks in the First local.

There are three local parks located in the first locality of the fourth district of Kabul city, and we will analyze their spatial distribution (figure 13).

The next step involves locating the distance to other parks from the reference local park that is situated in an appropriate location for spatial distribution. The distance between two local parks is assessed to be 2000 meters since, in accordance with the definition of local parks, these parks have a radius of penetration of 1000 meters. So, we measure the distance between the reference park and the 2000-meter maximum, Then, we will classify it so that the farther the parks are from one another, the more points they will receive, and finally, based on five criteria (proximity to residential centers, distance from the access network, proximity to educational centers, proximity to gathering centers, and distance from existing green spaces), we will determine the best location for the distribution of local parks at the level of the first local (Figure 14).

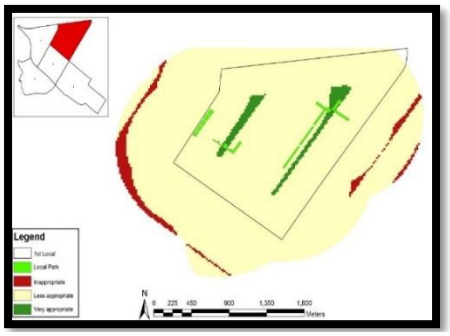


Figure 13: Best location for the local park based of 4 criteria in 1st local(Authors)

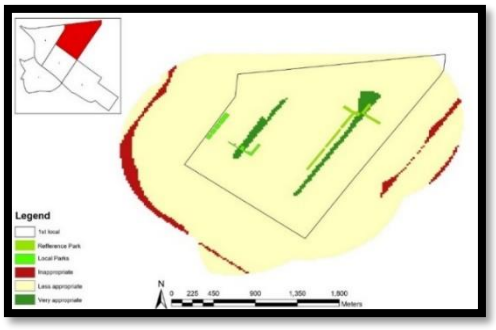


Figure 14: Best location for the local park based on 5 criteria in 1st local(Authors)

Conclusion: Based on the above map, the existing parks at the level of the first local, which are local parks in terms of spatial distribution based on 5 criteria (proximity to residential centers, distance from the access network, proximity to educational centers, proximity to gathering centers, and distance from the existing green space), are located in a less appropriate area.

11.5 Spatial distribution of parks in the second local.

There are two local parks located in the second locality of the fourth district of Kabul city, and we will analyze their spatial distribution (Figure 15).

The next step involves locating the distance to other parks from the reference local park that is situated in an appropriate location for spatial distribution. The distance between two local parks is assessed to be 2000 meters since, in accordance with the definition of local parks, these parks have a radius of penetration of 1000 meters. So, we measure the distance between the reference park and the 2000-meter maximum, Then, we will classify it so that the farther the parks are from one another, the more points they will receive, and finally, based on five criteria (proximity to residential centers, distance from the access network, proximity to educational centers, proximity to gathering centers, and distance from existing green spaces), we will determine the best location for the distribution of local parks at the level of the first local (figure 16).

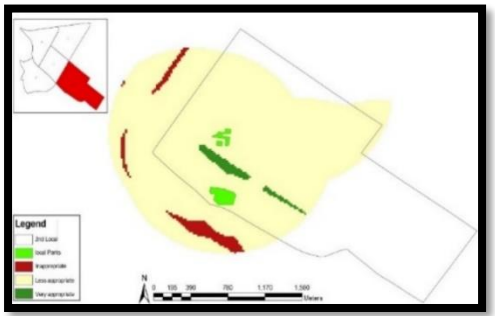


Figure 15: Best location for the local park based of 4 criteria in 2nd local(Authors)

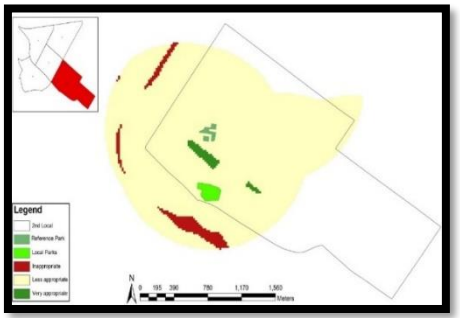


Figure 16: Best location for the local park based of 5 criteria in 2nd local(Authors)

Conclusion: Based on the above map, the existing parks at the level of the first local, which are local parks in terms of spatial distribution based on 5 criteria (proximity to residential centers, distance from the access network, proximity to educational centers, proximity to gathering centers, and distance from the existing green space), are located in a less appropriate area.

11.6 Spatial distribution of parks in the third local.

There are two local parks located in the third locality of the fourth district of Kabul city, and we will analyze their spatial distribution (Figure 17).

The next step involves locating the distance to other parks from the reference local park that is situated in an appropriate location for spatial distribution. The distance between two local parks is assessed to be 2000 meters since, in accordance with the definition of local parks, these parks have a radius of penetration of 1000 meters. So, we measure the distance between the reference park and the 2000-meter maximum, Then, we will classify it so that the farther the parks are from one another, the more points they will receive, and finally, based on five criteria (proximity to residential centers, distance from the access network, proximity to educational centers, proximity to gathering centers, and distance from existing green spaces), we will determine the best location for the distribution of local parks at the level of the first local (Figure 18).

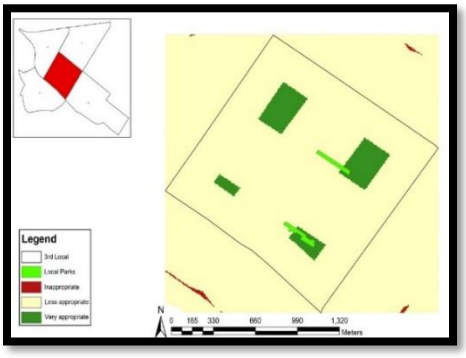


Figure 17: Best location for the local park based of 4 criteria in 3rd local(Authors)

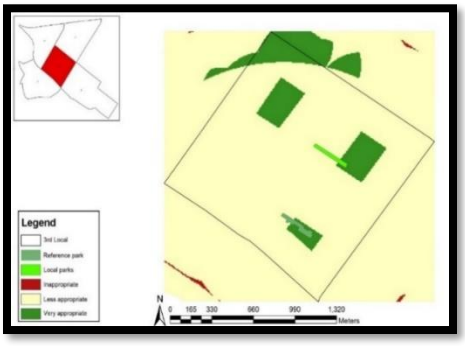


Figure 18: Best location for the local park based on 5 criteria in 2nd local(Authors)

Table 5: The outcomes of the spatial distribution analysis of local parks(Authors)

4th District, Local parks					
NO	Name	Category	Local	Area m2	Spatial Distribution
1	Shahr Ara	Complete & Access	2	27266.9	Less appropriate
2	Sharid-Wazir Abad	Complete & Access	1	17880.3	Less appropriate
3	Block Sharwali	Complete & Access	2	11971.7	Less appropriate
4	Sharid-Lab Jar	Complete & Access	1	11090.9	Less appropriate
5	Qalamuddin	Complete & Access	3	7883.8	more appropriate
6	East sharid-Wazir Abad	Vacant land	1	7678.2	Less appropriate
7	Sharid-Taimani 2nd Rd	Complete & Access	1	7416.1	Less appropriate
8	Sharid-Naser Khesraw Balkhi School	Complete & Access	3	6903.6	Less appropriate

Conclusion: Based on the above map, the existing parks at the level of the first local, which are local parks in terms of spatial distribution based on 5 criteria (proximity to residential centers, distance from the access network, proximity to educational centers, proximity to gathering centers, and distance from the existing green space), are located in a less appropriate area and a more appropriate area.

11.7 Spatial Distribution analysis of District parks

There is one district park in the fourth district of Kabul city. In order to analyze the spatial distribution of district parks, first the criteria for locating the parks are determined, and then each criterion is weighted using the Analytical Hierarchy Process (AHP).

11.8 Spatial Distribution Criteria for District Parks

To analyze the spatial distribution of parks at the district level, we consider five criteria to find out whether the existing parks are correct in terms of location at the district level or not[6].

- Proximity to residential centers
- Proximity to access network

- Proximity to commercial centers
- Proximity to edicational centers
- Proximity to gathering centers

11.9 Analytic Hierarchy Process

The steps in the analytic hierarchy process are as follows.

- Create a hierarchy process.
- Pairwise comparison of criteria
- Convert fractional numbers to decimal numbers.
- Get the geometric mean of numbers.
- Normalization or standardization of numbers
- Find the inconsistency rates.

Table 6: Analytic Hierarchy Process (Authors)

Criteria	Proximity to Residential Centers	Proximity to Access Network	Proximity to Commercial centers	Proximity to Educational Centres	Proximity to Gathering Centers	Criteria weight	Precentage
Proximity to Residential Centers	1.00	2.00	3.00	4.00	5.00	0.417	42
Proximity to Access Network	0.50	1.00	2.00	3.00	4.00	0.263	26
Proximity to Commercial centers	0.33	0.50	1.00	2.00	3.00	0.160	16
Proximity to Educational Centres	0.25	0.33	0.50	1.00	2.00	0.097	10
Proximity to Gathering Centers	0.20	0.25	0.33	0.50	1.00	0.061	6
Total						1	100

Integration of AHP model results into a GIS environment

To integrate the AHP model's outputs in the GIS environment, do the following:

- Finding the positioning criteria
- Getting the correct distance using Euclidean distance in a GIS environment
- Classification of Euclidean distances using Reclassify in a GIS environment
- Layer overlay using weighted overlay in a GIS environment

The fourth district of Kabul City has been classified into three locations (more appropriate, less appropriate, and inappropriate) for the construction of a park, as shown on the above map.

Conclusion: There is 1 district park located in the fourth district of Kabul city. Based on spatial distribution analysis considering location criteria (proximity to residential areas, proximity to access networks, proximity to commercial centers, proximity to educational centers, and proximity to gathering centers), the existing park is outside the scope, which means that the existing park is not located in the appropriate area in terms of spatial distribution considering the mentioned criteria.

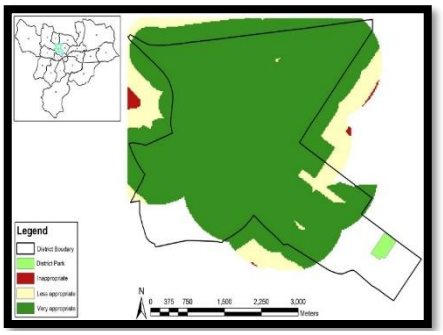


Figure 19: Best location for the district park(Authors)

Table 7: The outcomes of the spatial distribution analysis of neighborhood parks(Authors)

4th district of Kabul city parks					
No	Name	Category	District	Area m2	Spatial Distribution
1	Shahr-e-naw	Complete & Access	4	92347.9	Inappropriate

12. Spatial Distribution analysis of Regional parks

Based on the Kabul urban design framework, the hills around Kabul, which are uninhabitable, are suitable for regional parks if they are close to the main access network. As a consequence, we can conclude that Bagh Bala, Qale Fatehullah Hill, and Kolola Pashta Hill are situated in the right geographic location in terms of spatial distribution, being adjacent to the main access network and situated in the uninhabitable slope area. The ability to stop the city from growing excessively and to enhance the amount of urban green space are two benefits of building regional parks in hills with uninhabitable slopes [7].

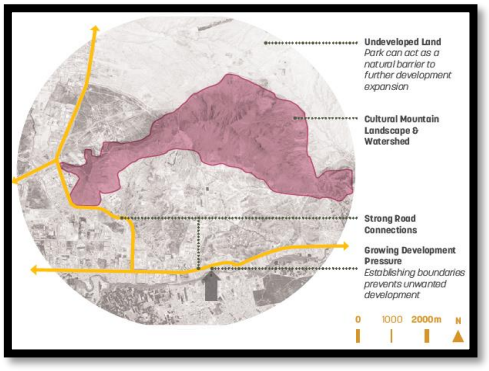


Figure 20: Best location for the district park(Authors)

Table 8: The outcomes of the spatial distribution analysis of neighborhood parks(Authors)

4th district of Kabul city regional parks					
No	**Name**	**Category**	**District**	**Area m2**	**Spatial Distribution**
1	**Bagh-e-Bala**	**Complete & Access**	**4**	**319504.6**	**more appropriate**
2	**Qale Fatehullah Hill**	**Vacant Land**	**4**	**118026.12**	**more appropriate**
3	**Kolola Poshta Hill**	**Vacant Land**	**4**	**1205.285531**	**more appropriate**

13. Conclusion

- An urban park, as a part of natural infrastructure and an influential component in the urban landscape, is the place of communication between an urban dweller and nature—someone who has become alienated from nature with the rapid development of industrial and technological advances.
- In the first step, we studied the parks at the level of the fourth district, and there are 17 parks in the fourth district, such as neighborhood, local, district, and regional parks.
- After studying the parks in Kabul's fourth district, we looked at how they were distributed spatially. This included neighborhood parks, all of which were located in both more and less appropriate areas. All of the local parks were located in more or less appropriate areas based on the "sustainable development goals", "accessibility", and "spatially located in accordance to the mentioned criteria". At the level of the fourth district, there is one district park, which is located in an inappropriate area in terms of spatial distribution. The regional parks that are located in the area, considering the Kabul Urban Design Framework (KUDF), are located in more appropriate areas.
- After analyzing the spatial distribution of parks in the fourth district of Kabul city, we came to the conclusion that in the fourth district of Kabul, the district park, which has a radius of penetration over one district, is available in the fourth district, and there is no need for more district parks. We do have regional parks whose radius of penetration is greater than one district. Building local parks in local areas without access to parks is our suggestion for increasing park access in Kabul's fourth district because neighborhood parks serve a larger population and have more amenities available to them. And yet, there isn't enough vacant land in Kabul's fourth district to set aside for the creation of a park.

Recommendations

- In keeping with social justice and the Kabul Urban Design Framework, our recommendation is to construct local parks in local areas that lack access to parks in order to ensure that everyone has equal access to urban inner parks.
- The Kabul Urban Design Framework is designed in such a way that every person should have access to one of the urban inner parks within 10 minutes.
- In order for people to have equal access to the park, the locals who do not have access to the park were first identified, followed by the selection of the influential criteria for the spatial distribution of the local parks. Finally, using the AHP model, weight was applied to the mentioned criteria, and we were able to determine the level of influence of each criterion. The results were then integrated into the GIS environment.
    - Identifying areas that do not have access to the park (Figure 22)
    - According to the above map, among the five local areas in the 4th district of Kabul city, the fourth local does not have access to urban inner parks, and the people of this area have to go through the main access network to reach the park and spend more than 25 minutes getting to the local parks, district parks, or regional parks (Figure 23).
    - As a result, the locations highlighted in green color on the figure 23 are the best (more appropriate) places to build a park at the level of the fourth local. There should be local parks having an area of more than 5000 square meters and less than 50,000 square meters.
- According to the Kabul Urban Design Framework, the best locations for regional parks are the hills that are present inside and outside of Kabul city that are uninhabitable and adjacent to the main access networks. The hills (Koluleh Pashteh and Qale Fathullah) in Kabul City's fourth district are ideal locations for regional parks. These hills should be made active and adjusted so that they can be used to establish a public area and a conspicuous location for public viewing. The hilltop road may require construction work. This path has to be fixed so that it functions as a sidewalk with seating areas, informative signs, illumination for pedestrians, and views of the city. The castle itself should be illuminated at night and be visible from the nearby area[7].



Figure 21:identying locals that do access to the parks (Authors)

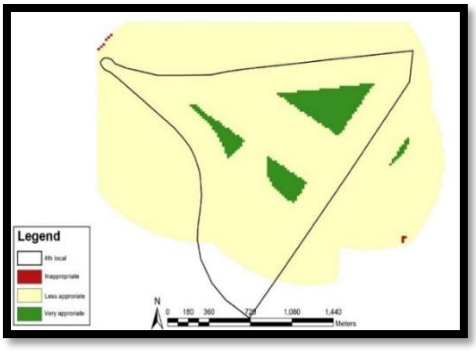


Figure 22: Best location for the local park in the 4th district (Authors)

Conflicts of interest
All authors declare that they have no conflicts of interest to disclose.

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