

Optimum Locations for Green Spaces Public Parks within Nawabshah City Using GIS Applications

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Abstract: When globally assessing the cities in term of attraction and aesthetics the Key features take into account is the existence of civic facilities for instance urban parks and playgrounds and accessibility to these parks accessibility in term of road, socio economic parameters, such as population density group level. In urbanized areas the importance of green spaces public parks has been gradually recognized. Cities in the world are growing and the world population is increasing day by day. In this research an Analytical Hierarchy Process (AHP) frame work was used as a Multi Criteria Conclusion approach with geographic information system (GIS) to indicate different parameters for selection suitable sites for public parks. Selection of optimal site land suitability model was applied to pick suitable land for public parks. Calculating the weight from alternative scenarios asked by different experts, computed weights were inserted into ArcGIS through Spatial Analyst tool created different land suitability maps and different sites for public parks within city boundaries. At last the findings were made and suggested suitable land for public parks.

Keywords: *Urbanization, Green spaces, Public Parks, Accessibility, MCDA, GIS. Land suitability.*

1. Introduction

It extensive recognized that green places are essential for our health and welfare. In the early days city resident pays an amazing attention to build natural sceneries in cities. Initially town designers discern that green places provide the best chance for an extensive array of societal relations and support public health and well-being. They permit people to direct interaction with nature; it can also be a significant appearance of social and ethical individuality.[1]. at present fifty percent inhabitants around the universe living in metropolitan space. Town breathing is frequently associated with poor living health standards. Inactive way of life, augmented corpulence and circulatory diseases. Anxiety associated cerebral ill-health is also increasing.

These inclinations enhance the necessity to classify alleviating reasons and contrivance viable forms of healthy town living here is the reappearance of attention for openly available urban green structure for instance parks, gardens, for human wellbeing reality is established that exactly use green spaces to encourage physical activity and mental health. Worldwide development is happening “Between 2000 to 2050” the amount of people living in town is increasing from 46.6 to 69.6%.2 about fifty percent of the world’s inhabitants live in the town.[2]. When globally assessing the cities in term of attraction and aesthetics the Key features take into account is the existence of civic facilities for instance urban parks and playgrounds.

Because green spaces and parks plays a vital role for providing basic facilities of life to urban cities both ecologically and socially [3].

In the relationship of human with nature Parks and Green spaces are essential to encourage and provide the space for physical and recreational activity, Environmental Quality and health can be improved and reduce some diseases like diabetes and coronary heart diseases. [4]. Public parks provide space for social gatherings, recreational activities and reducing mental stress and Public parks and open spaces in urban areas provide multiple and diverse function likes the contribution to the preservation of biodiversity. The rapprochement of the nature to the population, promoting this way the health and well-being.[5].

2. Resources and Techniques

2.1 Research Study Area

Nawabshah city is in the list of the oldest cities of Sindh Province. The Coordinates shows the Latitude 26°34'60.0"N+68°10'00.0"E and Longitude of Nawabshah city. Due to its geographical location District Shaheed Benazir Abad is placed in the middle of the Sindh Province the Indus River Flows on West. The District Sanghar and District Khairpur situated on East, District Hyderabad on South and District Naushahro Feroze on North side. It has large rural area and 305 Deh with a population of 1135131 having an area of 4239.4 square kilometers.

The location of District Shaheed Benazir Abad is in the middle of Sindh province it connects with other cities through airport, railway, and highways. Due to administration the District is divided into 3 Talukas namely Nawabshah, Sakrand & Kazi Ahmed. There are 51 Union councils and 327 big villages.



Figure.1:Location Map of Nawabshah city



Figure.2:Base Map of Nawabshah city

2.2 Methodology

Researchers used various techniques for accumulating data either primary or secondary sources to provide a suitable solution for land suitability for Public Park and green space. The methodology of research is discussed as follows in Fig.3.

The multi-criteria decision analysis (MCDM) technique was used in GIS land suitability analysis in this study. It permits integrating GIS-based land suitability modeling for site appropriateness [7]. It is rationally analysis the problem into smaller divisions which help to the decision maker [8].The GIS know-hows of data acquisition, stowage, reclamation, management and exploration. (ii) The MCDM abilities for merging the geographical data and the decision maker’s preferences into Multi dimension values of different decision. In GIS environment many decisions criteria rules have been applied for embark upon land use suitability problems. The decision rules can be

classified into Multi-objective and Multi attribute decision making methods [9].

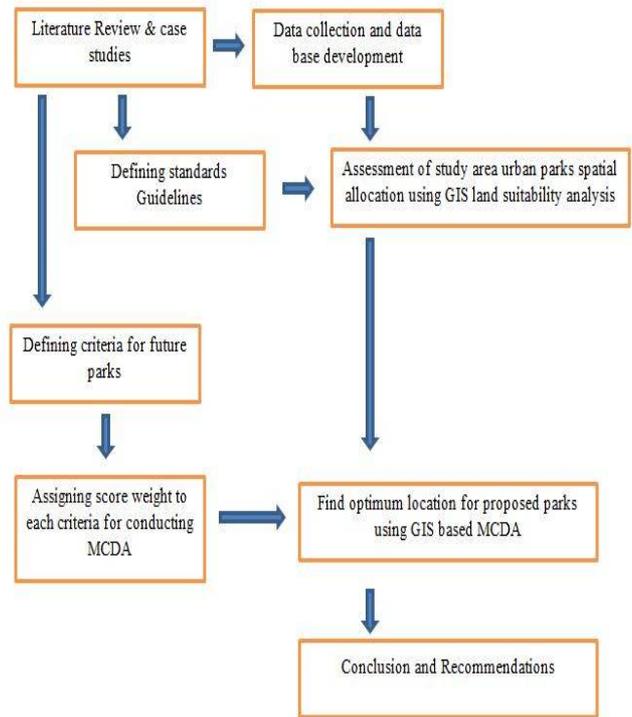


Figure.3: Research Methodology Diagram

2.3 Data Acquisition

The spatial and non-spatial data were organized from the town planning department Hyderabad and town municipal committee office Nawabshah Sindh.

2.4 GIS Database Developments

The land data were in the shape of base Map. Using software Sas. Planet the image was taken in the form of raster Image. Scan map matches with the raster image and fixed Geo Referencing to earth coordinate. After taken image the process of digitizing the base map was started using Geographic Information System (GIS) software Arc GIS version 10.2.2 .The vector format is used as a shape files to develop data layers. Different data layers were developed. The vector data transformed into a raster data format for Geo-calculation [10].The generated data sets were projected to Universal Traverse Mercator (UTM), WGS 84.

Analytical Hierarchy Process

The analytical hierarchy process (AHP) is developed by Saaty [11]. The AHP based on principle to solve problem at different levels and create hierarchies. This hierarchy permits for the assessment of the individual contribution criterion at lower levels to high level of the hierarchy.

2.5 Rating Method

AHP rating method used with various land criteria’s to weight the criteria. The rating questionnaire paper was designed for gathering the response from defendant. The Questionnaire paper was distributed to many professionals, planners, engineers and architects etc. In Questionnaire

paper predetermined scale was used from 0-100 criteria. Total 100 points distributed in all criteria's

2.6 Weighted Linear Combination/Weighted Sum

Weighted sum multiplies each weight to the multiple of raster given their own; it is essential tool of overlay in arch GIS 10.2.2 to sum them. The weighted overlay tools are usually used to adopt model. In the case of output and weight of small numbers of floating points is needed. The weighted sum tool is suitable. Weighted sum is in the specified weight, works by multiplying the value of specified field for each input raster, after that the sum in conjunction with all of the input raster. The Weighted linear procedure was used to produce the suitability map by the following mathematical expression

$$S = \sum_{i=1}^n w_i \cdot x_i \tag{1}$$

Here n is number of sum-standards, S denotes suitability land W_i is the weight of the reference (X_i), achieved based on AHP Method.

3. GIS in Land Suitability Analysis

In Planning and management the GIS application is right tool for finding the land use suitability, mapping and analysis. Spatial suitability analysis intentions to classifying the most proper spatial pattern for upcoming land uses rendering to specify requirements inclinations, or analysts of some action [12]. In Wide Variety of situations the GIS based land suitability analysis has been useful including such as ecological approaches for determining the suitable land for habitat, animal and plants species, geological favorability, suitable land for agricultural activities and landscape assessment and arrangements [13]. In this study land suitability analysis for building a green space including public park map was carried out based on existing detailed land use plan for land suitability analysis spatial analysis application tool through GIS were used identified and collected spatial data weighted with the analytic hierarchy process (AHP) integrated data analyzed through GIS and evaluated output. Hence researchers found suitable land for proposed public parks by using this process GIS [14].

3.1 Process of Land Suitability Analysis for Public Parks in Nawabshah City

In this figure the process shows the data digitizing in GIS and finding suitable land for Public Park in city. This process is used for all data layer.

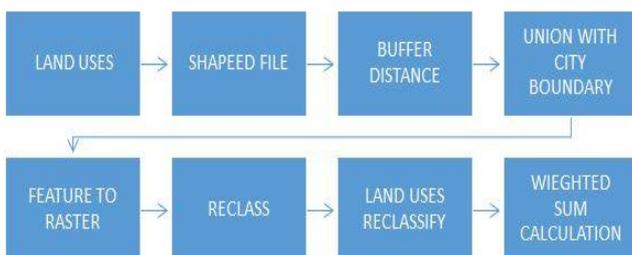


Figure. 4: Process of Land Suitability Analysis for Public Parks in Nawabshah City using GIS

Table.1.Land uses Buffer by (EPA)

S No	Land uses	Buffer
01	Recreational	200m
02	Agricultural	200m
03	Commercial	200m
04	Educational	100m
05	Health	100m
06	Secondary Roads	50m
07	River/canal	300
08	Residential	30m

Source: Environmental Protection Agency (EPA)

Later on each land use buffer was processed using GIS reclassify application and converted into raster form as to specify the high and low potentiality of land around each land use activity as pointed out[15]. At the end, while performing the land suitability analysis calculated each land use weights were inserted in GIS. The weighted -sum tool was applied through GIS and evaluated the most suitable land for public parks based on inserting weights. The buffer figure shown below:

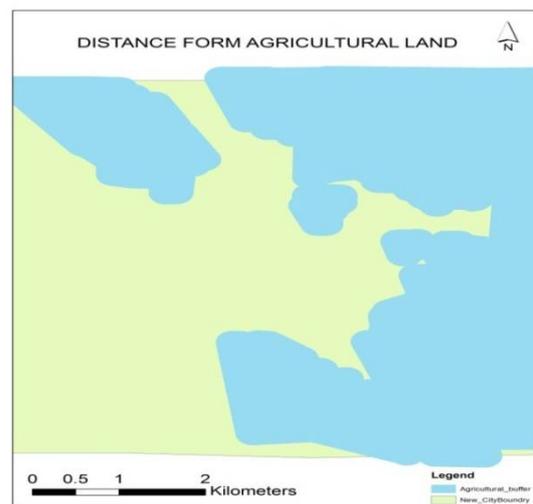


Figure 5: Agricultural buffer

Agricultural land is not suitable for Public parks according to (EPA) the standard are 200 m radius buffer space should be provided between agricultural land and Public Park.

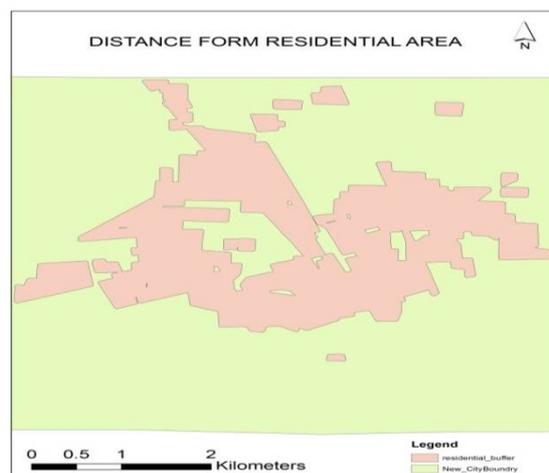


Figure. 6: Residential buffer

Parks should be provided 30m away from Residential land use according to (EPA) the standards are 30m buffer space should be provided between Residential land use, and Public parks.

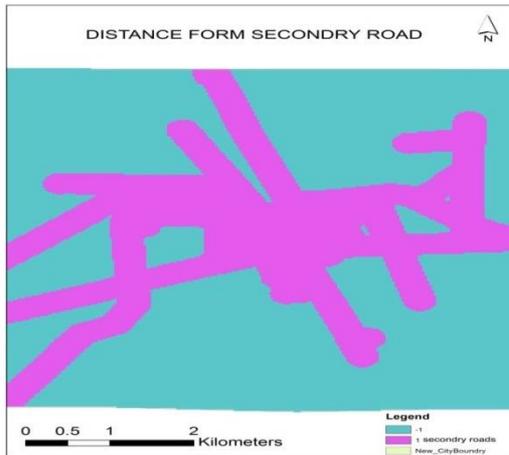


Figure.7 Secondry Roads buffer

Parks should be provided 50 m away from secondary Roads according to (EPA) the standard are 50m buffer space should be provided between secondary Roads, and Public parks.

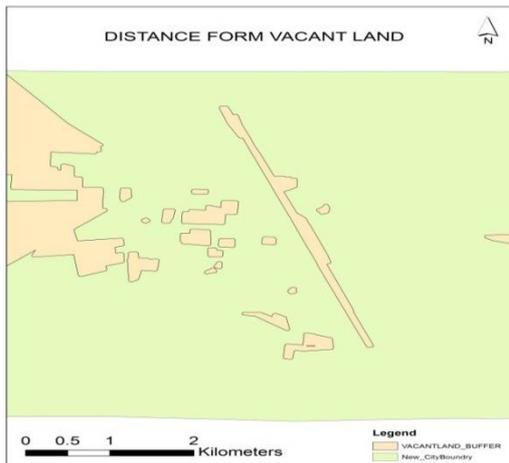


Figure 8. Vacantland buffer

Parks should be provided on vacant land considering the futuristic need.

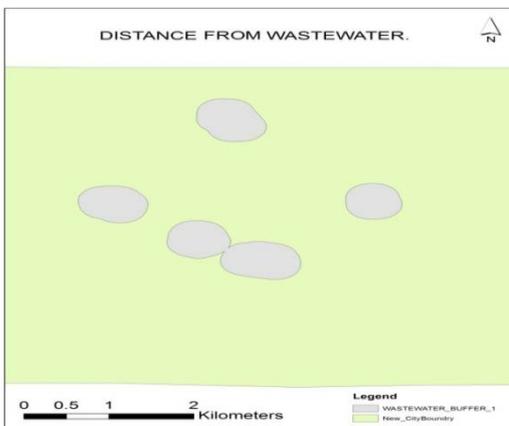


Figure.9. Wastewater buffer

Parks should be provided 300m away from Wastewater/disposal according to (EPA) the standard

is 300m buffer space should be provided between Wastewater land use and parks.

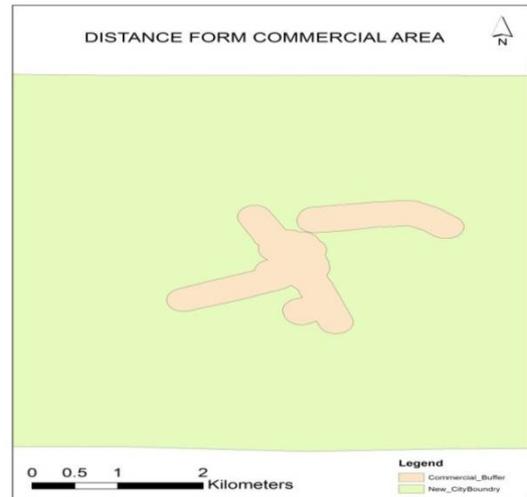


Figure10. Commercial buffer

Commercial land use is not suitable for Public parks according to (EPA) the standard are 200 m radius buffer space should be provided between Commercial land and Public Park. If the park is provided near to the commercial area it destroys the commercial activity.

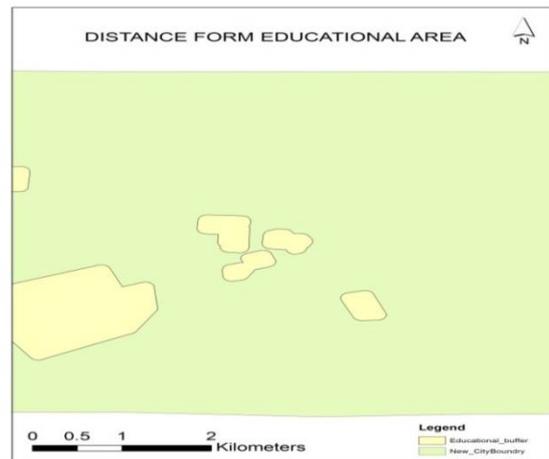


Figure 11. Educationalbuffer

Parks should be provided 100m away from Educational land use according to (EPA) the standard are 100m buffer space should be provided between Educational land use, and Public parks. Public Parks were used for leisure and other recreational activities it disturb the educational environment.

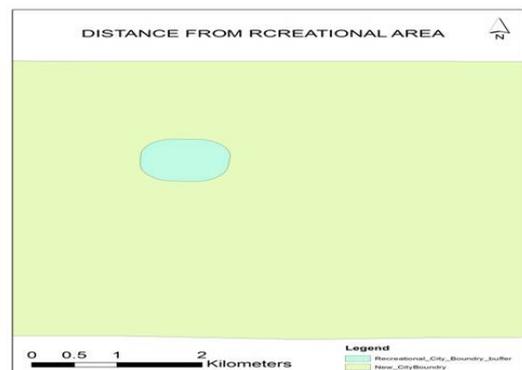


Figure12. Recreational buffer

Parks should be provided 200m away from Recreational land use according to (EPA) the standard is 200m buffer space should be provided between Recreational land uses.

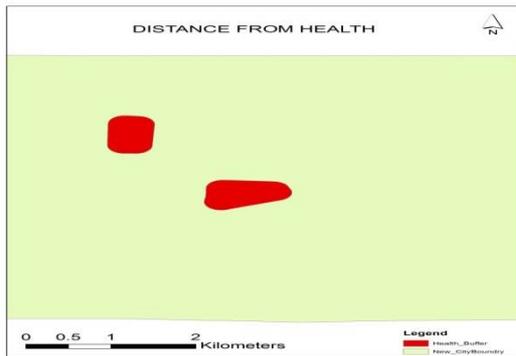


Figure13. Health buffer

Parks should be provided 100m away from Hospital and other Health land use according to (EPA) the standard are 100m buffer space should be provided between Health land use, and Public parks. Public Parks.

Experts Opinion

The land suitability opinions were taken from various relevant field experts / professionals through a sample of questionnaire.

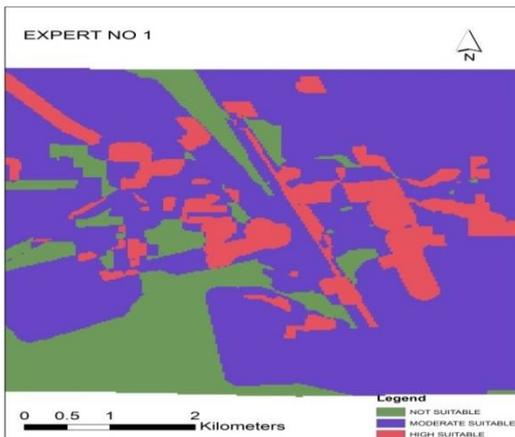


Figure 14. Criteria given by the Experts to the respective Land uses

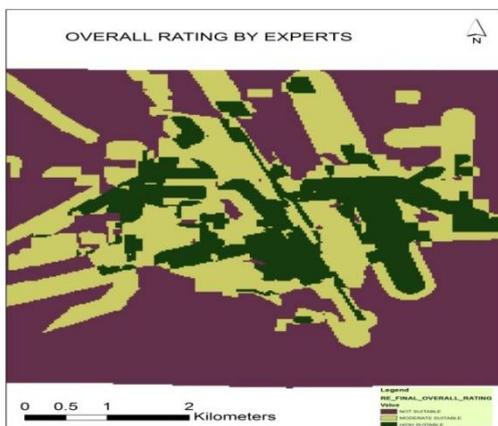


Figure 15. Final Result's shows moderate suitable, high suitable and not suitable land.

4. Result and Discussions

The research was conducted to select suitable site for public parks by applying suitability analysis approach in

the Nawabshah city. The land suitability opinions were taken from various relevant field experts / professionals through a sample of questionnaire and measured the weights of different alternatives of each factor and sub criteria the factor and sub criteria weights were evaluated using Analytical Hierarchy Process (AHP). The (AHP) method was made in Geographic Information System (GIS) and produced land suitability model through Multi-Criteria Decision Analysis (MCDM) in ArcGIS. In this study the GIS based degree of land suitability scenarios for Public Park was measured by researchers.

The criterion weighted of different land uses was calculated in GIS by applying spatial analysis tool in which 19 mean, most preferable weight was provided to residential land use, secondly to agricultural land use given 12 points means, moderate suitable then commercial, etc. Hence the composite weighted result illustrates the degree from high to low potentially of land. It is also presented in different color. The high potentially of land can be proposed for public parks in Nawabshah city it almost 1629.08095 acre and moderate suitable land were found 2976.09008 acre total 4605 acre is available for proposed public parks in city. In conclusion this study provides many suitable sites for parks. This study also helps to the policy makers for the development of parks at present as well as in the future. The findings of this research help the city planners to realize the benefits of green spaces and maintainable expansion, and also improve the quality of life of residents.

Result Pixel Count Table.2 for land suitability types

Land suitability type	Pixel count	Area in hectare	Area In Acre
Not suitable	32620	2557.408	6319.49345
Moderate suitable	15362	1204.3808	2976.09008
High suitable	8409	659.2656	1629.08095
Total	56391	4421.0544	10925.10553

Table 2 :The result table shows the pixel count for three different land suitability types. These pixels are count after reclassification. The single pixel is 27.6x27.6 m in size. Hence the size of single pixel is 761.76sqm. The area is then converted into hectare and acre. The not suitable land is found 6319.49 Acre. Moderate suitable Land were found 2976.09 and high suitable land were found 1629.08.

5. Conclusion

This study dealt with choosing the optimum site for development of public facilities specifically parks in Nawabshah city, an integrated Multi-criteria decision approach (MCDA) through analytical hierarchy process (AHP) was under taken to decide suitability site for public parks. Various factors were examined based on different criteria and sub criteria by AHP assessment and information about land suitability alternatives was taken from different field experts. Moreover assessed factors weights from alternatives scenarios were calculated. Later on ArcGIS 10.2.2 spatial analysis tool were adopted and produced land suitability model to allocate the suitable land for development of public parks in Nawabshah city.

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