

Land Use of the Geographical Information System (GIS) and Mathematical Models in Planning Urban Parks & Green Spaces

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Key words:

SUMMARY

Motivation

Using the Geographical Information System (GIS) and Mathematical Models in urban planning can effectively help municipalities to update planning and data of existing situation and it will create the possibility of dynamic urban planning at the vast level spacially in making more effective land use.

Freeing from the chain voluminous and less usable reports which are kept in archives for years and having access to the latest information and up-to-date changes in the projects for urban planners and urban managers was an important motivation in doing this research and project.

Objective

Presenting solution for qualitative and quantitative improvement of urban parks from the view point of functional hierarchy, proper and correct distribution at the city body, estimating the real shortages of the city, locating and proper and exact planning with regard to the potentials and accessible pieces of lands in the regions and population density of each of the urban areas, through employing the GIS are among the outstanding objectives of this project and plan. The most important qualitative and quantitative performed researches:

- Complete understanding of the status quo , entering data into necessary soft wares
- Studying Iran and global standards for ideal situation and regulating optimal model
- Defining the criteria of urban hierarchy and hierarchy of urban parks and classifying the existing spaces in the city based on the area, role and location
- Entering the suggested mathematical model into soft wares and calculated regional coefficients for each region to design the domain of the parks by class and region
- Digital analyzing of data by soft ware of system, overlaying the layers and outputting the evaluated map of the city based on the rate of access to green spaces and parks
- Output of the system resulting from the coverage of the previous stage and the map of the city lands with potential of converting into urban parks

Conclusion

- Presenting simple and reliable mathematical model to determine the domain of influence of urban land use.
- Displaying the effectiveness of Geographical Information Systems in dynamic urban planning
- Establishing the possibility of correct and up-to-date decision taking and reducing the waste of capital and time as the outcome of the old planning methods.

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TS37.4 Land Use of the Geographical Information System (GIS) and Mathematical Models in Planning Urban Parks & Green Spaces

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1. INTRODUCTION

This paper is an attempt to discuss the efficiency of the Geographical Information System (GIS) in urban planning and proper distribution of the land uses in a city.

In present cities with intensive internal complexities, the old methods cannot meet demands. The fast growth and development of the cities has made us lose the past chances to do long-term projects. That means only those designs and plans that have recorded each moment of a city's changes can be reliable and can implement the respective impacts on its outputs.

Redeveloping and planning green spaces and urban parks are among the essentials of mass planning of a city. Accurate planning with the help of GIS may bring about a big step in the physical and social development of the cities. The systematic view towards the subject of city planning it still has not found its specific position in many countries. Most of our cities are designed, planned and administrated by inexpert individuals. It would be right if the skillful experts with the help of technical and scientific tools bring an end to the disordered state of most cities.

This paper is a step to fulfill the same objective and hopefully, with the help of modeling and GIS system, it could serve the quantitative and qualitative enhancement of green spaces of the cities.

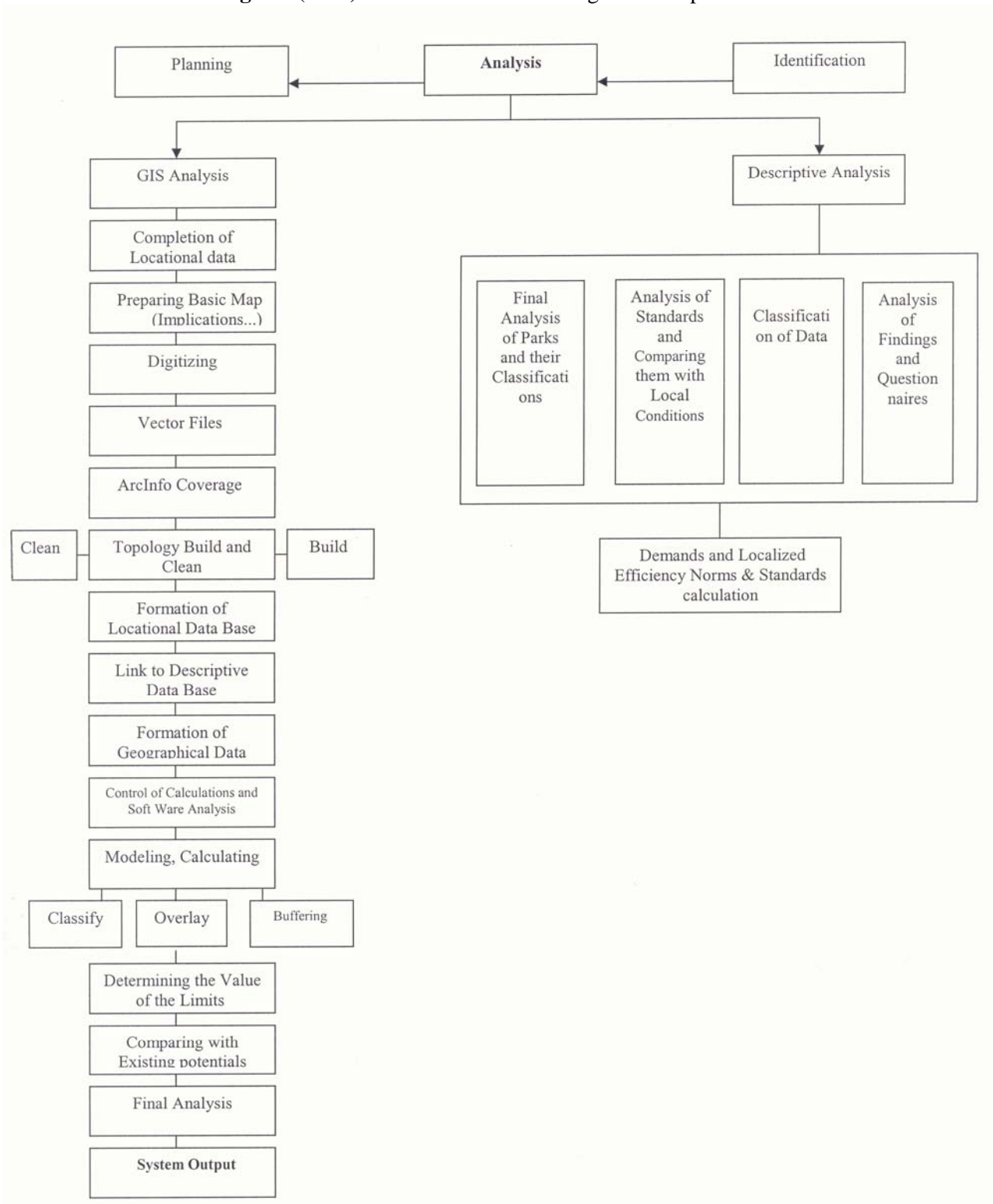
2. PAPER

The project of " Redeveloping and planning parks in Kermanshah city" (2011), was formed with the purpose of removing the deficiencies and problems of city body and aimed at improving its situation concerning the green spaces and urban parks to deal with the structural improvement (green space) of parks through correcting A) area and per capita, B) qualitative condition C) proportion in distribution and strengthening the access to them and D) establishing a functional hierarchy of parks.

To achieve this goal, the process of the duty including three main parts namely: 1) Identification, 2) Analysis and 3) Planning as shown in diagram (No.1).

The Geographical Information System (GIS) and variety of software's such as Arc View, Arch Info (Auto Cad, PhotoShop, and Ms Office) in every three stages of the process: entering the data, digital analysis, model building and taking the system output were used.

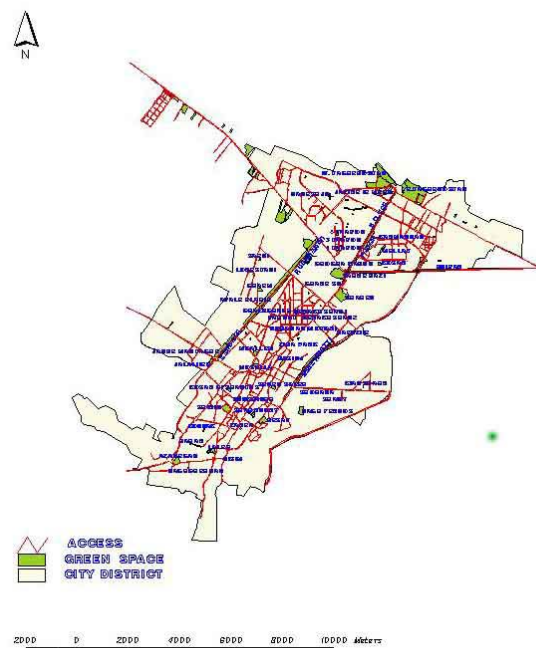
Diagram (No.1) - The Process of Planning at Urban parks



The main quantitative and qualitative researches conducted so far could be summarized as follows:

- In the first stage, complete identification of green spaces and city's parks at present and in future plans (such as Master plan of the city) was obtained through documentation, library and field studies. Then in order to know the ideal situation, the standards of Iran and international standards were reviewed. The data was entered into the system in form of digital data useable in GIS software and within the framework of plans, tables and scripts.
- From the beginning, the cities experienced an organic and spontaneous growth. Despite master urban plans in recent decades, these plans have been implemented in rather limited areas and could not be manipulated to lead the urban developments of the cities, and their land uses are in lack of a logical functional hierarchy; consequently, chaos and disorder dominate their performances. On the basis of these findings, before conducting any planning, one should define the urban hierarchy and the performance hierarchy of the city's parks and apply it on its present body and its plots may be converted into computerized data for further usage. To serve this aim, the area of the parks in this stage was the basis of action with the help of ArcView Software. Then the output of the system was subdivided into plans from different classes of city parks including: neighborhood, district, regional, area and urban. Their classification was conducted by defined standard range of the project for the areas of parks and their location in urban regions.

Plan (No.1) - Location of the Parks in Kermanshah City, Iran



- A mathematical model was designed. In the model, the goal was to determine the buffer of each park in each region of the city. In that model, the following factors were included: 1. Area of the park. 2. Rank of park in hierarchical classification of the parks (including neighborhood, district, area, regional and urban), 3. population density of the

area where the park is located (at present or in the master plans of the city), 4. The defined standard in this research has been taken from the expert assessments from the existing and suggested standards of Iran and the world (which are so different) and the local conditions and local facilities of the city under investigation of this project. The concerned standards are as follows:

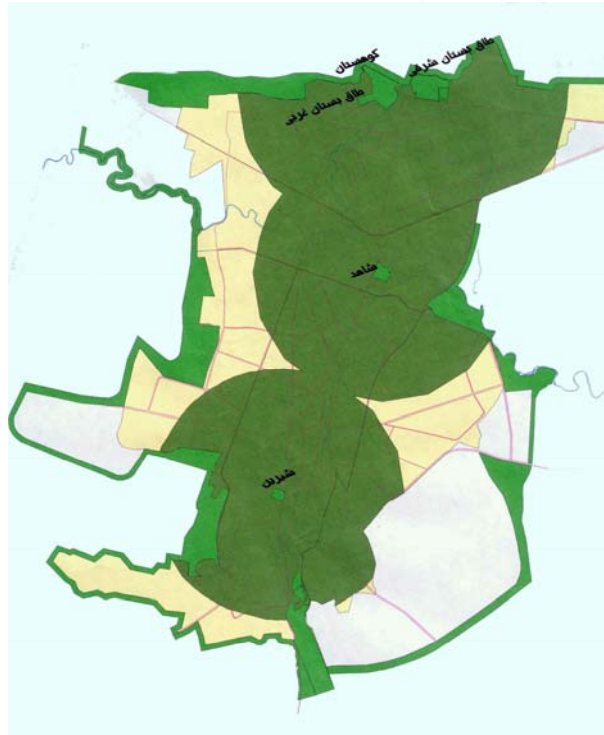
One) Standard of appropriate area for the park

Two) Standard of capacity of parks in admitting population in each class of parks

Three) Standard of ideal influence area (buffer) of each class of parks

- Using this model, the Buffer or the limits of influence around the existing parks in the city was drawn on the urban plan. According to the density of the regional population, the inhabitants residing in places inside these limits can utilize this park and the places out of that are out of the coverage of the services of this park.
- The mathematical model was entered into Software's system of (GIS) in form of formulas. For each park in each class and each region, the regional coefficient of K was calculated (by software) and by conducting mathematical operations, the area and the range of influence of each park in subdivisions was obtained by Arc View.
- The outputs of this model were used as the basis to draw Buffers that were portrayed for each individual park by subdivisions of their hierarchy in each region by software. The obtained maps divided the city into regions with the value of 0 and 1. The regions with the value of 0 had no need to have new parks established in that class and those of 1 were in need of establishing parks in the respective class. The regions had no access to more than one classes of parks had value of 2- 4.

Plan (No. 2)-The Limits of the Influence (Buffer) of Urban Parks

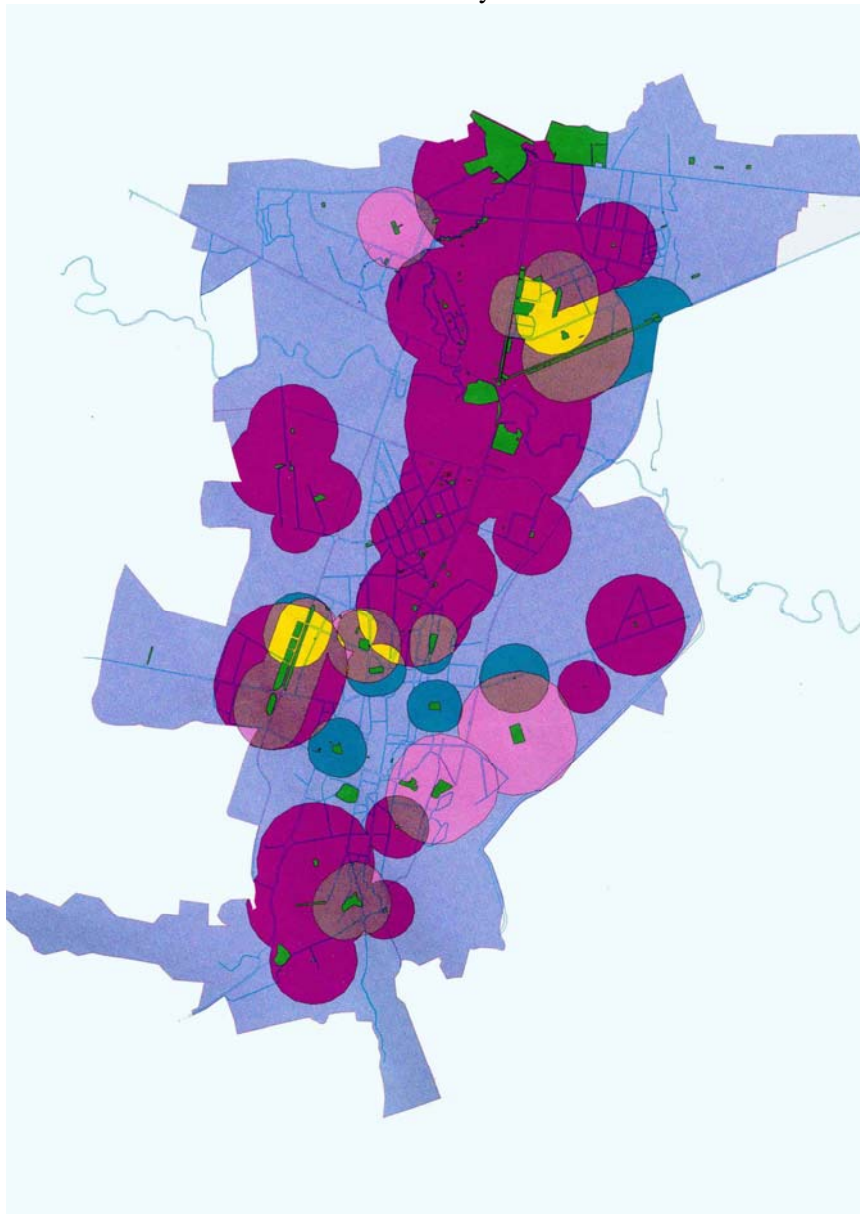


Of those plans, outputs including areas in need of parks in the above class are found which are comparable with the outputs of calculations of the planning. It shows the differences between

the figures of need on basis of per capita and figures of need on the basis of appropriate distribution.

F) In order to get the value of the urban and residential lands based on the access to the parks (in four standard classes) the GIS software was used to overlay the previous layers. Some urban plans were produced that displayed the extent of the need of urban regions to parks on the basis of colors and figures of their values.

Plan (No- 3)-Value Evaluation of Urban Lands based on the Rate of Access to the Parks and different hierarchy



In this plan, some regions have sufficient and proper access to four classes of parks, some to three classes (such as district, neighboring, and urban parks), some to two classes (for example neighboring and district), some to one class, and parts of the city were classified as those in lack of any access to any park. This very issue displays the rate of demands for any kind of parks in urban park classification in every space of the city.

Thus, the planning and administrative experts can easily review the process of locating parks in all spots of the city and could establish the future parks wherever there is a need for them. They may observe the results obtained from the changes, and by repeating this act, they are able to select the best action and in other words, the most economic location.

G) In the final stage, having compared the figures of the areas in demand with the obtained figures of the area through calculation of respective per capita, the maps of those lands which were capable of being converted into parks were prepared in order to provide lands for the establishment of parks. Then through overlaying that with the previous layer, i.e. the plan of the rate of needs of different regions of the city to parks, the proper locations for the establishment of future parks was determined and the priorities of change in land use was also specified.

The obtained plan has different values. It creates the possibility of time phasing for the planners and executives of the project. The outcome is easy usage and it enjoys a much higher accuracy as compared with the old traditional methods of planning. Furthermore there is possibility to make any changes in data and observe the changes in outputs.

3. CONCLUSION

- The suggested mathematical model in this plan is easy to use and in addition it can be used in all cities for the purpose of determining the influence limits of urban land use such as urban parks in each class.
- The efficiency of the GIS system in dynamic planning for locating and determining the limits of influences and the rate of access of all urban spaces to necessary land use was experienced. It was due to the fact that any changes in the existing situation could easily be entered into the system. The obtained results are observable and they could be used as the basis for action in the continuation of process. It also avoids excessive expenses and wasted times.
- By using the method of this research, the managers of municipalities and governor-general's will find proper and up-to-date authority to decide. It also prevents time-consuming and additional costs resulting from long-term planning. Through computerized modeling, one could be aware of the results of the decisions and planning before execution and therefore its errors can be avoided before spending any executive expenditure.

- In continuation of the existing research and project, it is suggested that in future research, the methods of inter-related multi-functional land use locating to be dealt with concurrently. In addition, the impact of some of the urban land use such as network of access on the location of the establishment of land uses, could be the subject of future research.

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