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**AHP based Weightage Analysis of Criteria for
Optimal Locations of Urban Green Spaces**

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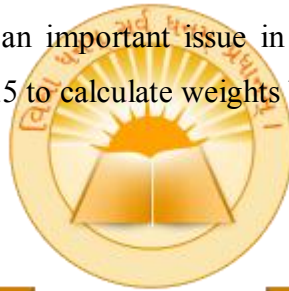
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ABSTRACT

Urban green spaces such as parks, gardens, green roofs, streams and playgrounds are to give the basic ecological community management of urban green space. For environmental adjustment and human strength have a very important significance, the city green space to achieve multi-level capabilities, to the local people a huge advantage. So far, through the use of geographic data framework (GIS) and multi-standard methods, the Diagnostic Progressive System Approach (AHP) has been shown to be divorced from the most important land rationality inspection methods. The convergence of geographic information system conditions and the analytic hierarchy process is a powerful tool for urban development to adapt to future arrangements. This paper aims to review the GIS-based AHP as a multi-standard assessment / evaluation system for Outer Ring Road, Surat city. At this point, the links between the different variables are capable. The best place for urban green space is an important issue in urban planning. Use the decision support system software called expert selection 11.5 to calculate weights based on different alternatives.



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KEY WORDS:

Urban Green Space, Reaction survey, Suitability analysis, AHP, Optimal Locations, URDPFI guidelines, GTPUDA (1976).



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INTRODUCTION

In the past few decades, especially in the creation of the country, the loss of urban green space has become a major pattern. One of the real concerns is that, despite the different conduct and regulations, in order to ensure, manage and improve the urban green space, although all the major urban areas in the creation of the country have been reduced. Urban greenbelt is one of the most important factors in any urban ecosystem because of its ecosystem dynamics and its important contribution to human well-being.

Keeping in mind the ultimate goal of establishing a sound urban economy and national well-being, urban green space is seen as a basis. Urban green spaces constitute the necessities of any urban area, and the number and nature of UGS are sympathetic to both the organizer and the city manager. Green space and the site for the biological adjustment and human strength are of extraordinary significance. Urban greenbelt is considered a green lung of the city and usually has key capabilities, including preserving water and contaminants.

Analytical Hierarchy Process (AHP) is a multi-standard decision-making approach introduced by Saaty (1977 and 1994). AHP is a decision support tool that can be used to solve complex decision problems. It uses a multi-layered hierarchical structure of goals, standards, secondary standards, and alternatives.

The aim of this literature study is to find out criteria which are responsible for suitable locations of green spaces. Furthermore, to find out weightage of each criteria and sub-criteria using AHP online calculator based on 20 experts including urban planners, planning assistant, planning consultants, town planning officer, etc.

CRITICAL LITERATURE REVIEW

The literature review is based on the prior art literature. Here, academic literature is a critical assessment of articles, books, research papers, reports and other sources, such as sites and GIS applications related to the location of residential plots in suitability analysis.



Functions of Urban green space

- Guide the mixed climate to clear the neighborhood air;
- Control the continuous operation and flooding
- Guide the hydrological cycle;
- Support the natural qualities of the city
- Maintain soil decomposition and silt;
- Guide the surrounding and global atmosphere;
- Monitor the vitality of the city by controlling small-scale climate change;
- Help recreation and tourism to coordinate city people and nature;
- Restore groundwater level.

Table 1:-Detailed of reservation of land as per GTPUD Act 1976

Reservation of land to the extent of	Purpose
10%	Housing accommodation to the members of S.E.W.S
15%	Roads
5%	Parks, playground, garden and open space
5%	Social infrastructure such as schools, dispensary, fire brigade, public utility place
15%	For sale by appropriate authority for residential, commercial, or industrial use depending upon nature of development

(Source: GTPUDA, 1976)

Arrive utilize appropriateness investigation coordinating Geological Data Frameworks (GIS) and multi-criteria choice examination to assess the capability of changing over current land use to urban advancement as indicated by unique prerequisite is a standout amongst the most helpful applications for reasonable urban improvement and arranging by limiting negative effect of urban improvement on the land framework.

STUDY AREA PROFILE

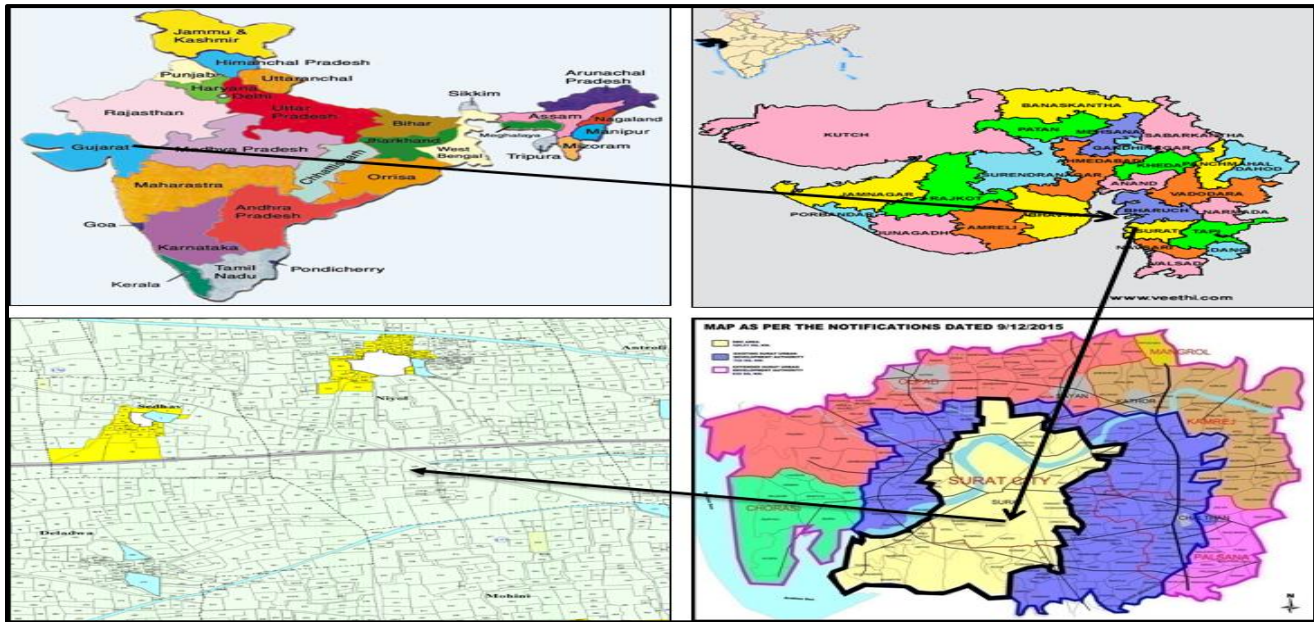


Figure 1:- Location of Study Area

(Source: SUDA, 2016))

Outer Ring Road of Surat city is selected as study area. Surat is located in the ancient city of Gujarat in the western Indian city. Surat is Gujarat's largest city after Ahmedabad, also known as the economic capital of Gujarat, has been actively planning the future. Surat population in 2011 census is about 434 million people, the density of 13680 people/ square kilometers. Surat has seven districts.

Analytic Hierarchy Process (AHP):

AHP is a multi-standard selection technology that uses a variety of hierarchical structures to solve problems, and then creates selection requirements based on customer judgment (Saaty,1980). Saaty has shown that through a variety of hierarchical organizations and pairs of exams, you can successfully manage weightlifting of multi-standard basic leadership forces. The combination of shrewd exams depends on the determination of the framework between the two specific components, rather than the organization of a whole component (Saaty, 1980). The size of the AHP of the joint mental examination is as follows.



Table 2:- Scale for pair wise comparison

Intensity of importance	Definition
1	Equal importance
2	Equal to moderately 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	Extreme importance

(Source: Saaty (1987))

Based on this AHP method, design a spreadsheet package called EXPERT CHOICE and it is used in calculating weight for each layer. It has an ability to calculate weights, for multiple criteria with pair wise comparisons.

Table 3:-Town Planning Schemes of Outer Ring Road

Sr. No.	Town Planning Scheme	Area (In ha.)
1.	51 (Kosmada, Khadsad, Pilodra, Simada)	165.17
2.	52 (SaniaHemad, Kosmada, Chhedchha)	186.13
3.	53 (Vedchha, Chhedchha, Sabargam, SaniaHemad)	186.20
4.	54 (Niyol, Sedhav)	195.52
5.	55 (Niyol, Deladva, Mohini)	204.97
6.	56 (Kharvasa, Khambhasala, SaniaKanade)	225.16
7.	57 (Kharvasa, Eklera)	136.47
8.	58 (Valak)	66.60
9.	83 (Variav-Kosad)	199.75
10.	84 (Kosad-Bharthana-Kosad-Motavaraccha-Abrama)	268.06
11.	85 (Sarhana)	103.48



(Source: SUDA, 2016)

Surat City Development Bureau is also a growth in the city of Surat, carried out a prepared urban planning program. At this stage, about 68 city planning programs are being considered here. South West has 15 T.P drafts, of which 4 T.P was chosen for my study.

These plans are around 6348Ha. Area. There are different bookings nearby. According to the Kyoto Protocol, the urban planning program may arrange for the retention of land to prepare for the matter.

METHODOLOGY

According to the literature review, the urban green space in the urban areas of Surat city was analyzed and the study area was selected. With a primary and secondary data collection, a brief survey of urban green space. In the study of the main data details of the area map, the green space social survey and spatial and non-spatial data are used for secondary data. In spatial data, land use images and road maps are digitized. In non-spatial data, population density is performed.

Data collection, the use of GIS and AHP integration for data analysis. The suitability analysis results clearly show the appropriate location of the green space in the study area, which will directly help to generate the scene.

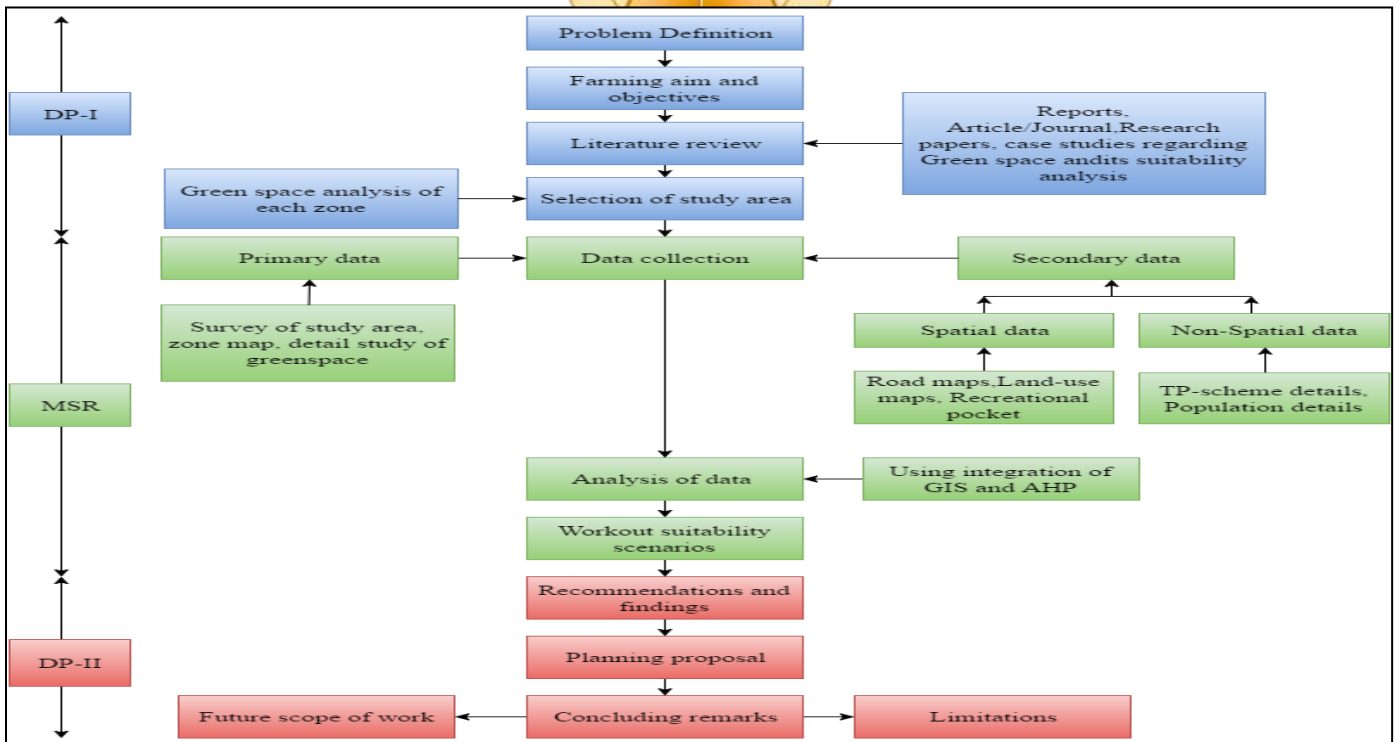


Figure 2:- Methodology



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Saaty (2008) proposed the importance of the relevant judgments, an overview of AHP has four steps:

1. Define the problem to be solved.
2. Create a decision hierarchy.
3. Construct a pair of pairs of comparison matrices for the criteria related to research questions.
4. Use the previous steps to obtain the priority, weighted comparison criteria.

AHP uses a basic scale from 1 to 9, 1 represents two equally important activities or standards, and 9 represents the strongest difference between the two criteria / activities in the assessment. The most important steps of this method are: (1) select the criteria and prepare the spatial database; (2) use AHP to determine the weight value of each standard; and (3) evaluate the applicability in the GIS environment.

- 1 •Defining the decision problem
- 2 •Define threshold levels;
- 3 •Setting up the decision hierarchy;
- 4 •Define criteria and acceptable alternatives;
- 5 •Compare criteria pair wise;
- 6 •Compare alternative pair wise;
- 7 •Calculate overall priorities of alternatives;
- 8 •Sensitivity Analysis;
- 9 •Calculating the degree of consistency;
- 10 •Calculating the mean relative weight.

Selection of Criteria

In the AHP process, the selection criteria and their sub-criteria are critical stages. Because the choice of standards by a standard and other standards are separated to affect the judge, pay more attention to other standards.

This study selected a number of factors and criteria by synthesizing the number of literature reviews, local contexts and expert advice. According to the importance or preference of different levels, the standard is further divided into several factor scores (Classes). Factors, standards and ratings are shown in the table below.



Table 4:- Criteria & Sub criteria for Suitable Locations of Urban Green Space

<i>Criteria/Factors</i>	<i>Sub-Criteria(Parameters)</i>
<i>Land Availability</i>	Public
	Private
<i>Size of Land Parcel (In sq.m.)</i>	<5000
	5000 – 15000
	>15000
<i>Population Density (in ppha)</i>	High (>340)
	Medium (195 – 340)
	Low (<195)
<i>Accessibility</i>	<18 m
	18 – 30 m
	>30 m
<i>Land Value</i>	High
	Medium
	Low

Preparing Comparison Matrix

A useful step in AHP is to create a comparison matrix. The comparison matrix is compared by pairs. A pairwise comparison, assuming that A is more important than B, is compared with the recommendation of Saaty (1980) with a 9-degree preference scale. It is more important to show at a higher level than the previous low level (table).

Size of Land Parcel	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Accessibility to Major Road



(Source: Saaty, 1987)

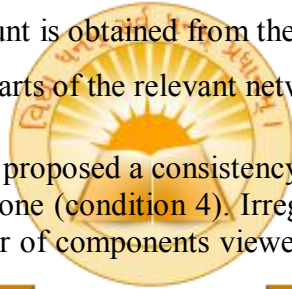
Determining Weight Values in AHP

At this stage the real scientific operation of the AHP was carried out. Here, first, the conclusions of individual experts were studied. Using Saaty's 1-9 scale (Saaty 1980; Saaty and Vargas 2001), experts were asked to assess their propensity for elements and standards.

Each portion of each test matrix is added. Divide each component of the grid from the sum of its segments. Here we get the normalized relative weight, where the sum of each segment is 1. The normalized top feature vector is obtained by averaging on the line. This is normalized along which the sum of the components of the demand vector is 1. The weight of each demand vector indicates its relative standard relative weight. For example, the relative weight of the land area

The bundle is 43.90%. As far as possible, check the tilt consistency before completing this relative weight. By taking a few stages of setting the formula to check the consistency. To check for consistency, first determine the rule feature Esteem. The count is obtained from the sum of the items between each component of the required vector and the sum of the parts of the relevant network.

In order to do the last check, Saaty (1980) proposed a consistency ratio (CR), which is a correlation between CI and any consistent list (RI), a suitable one (condition 4). Irregular files (RIs) are randomly created pairs of related grids. RI depends on the number of components viewed (ie, the size of the pair check frame) and is opposite to the attached quality:



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Table 5:- Values of Random Index Saaty (1987)

n	1	2	3	4	5	6	7	8	9
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Thus, we get the final weight of all the factors and standards at the first and second levels. At the end of this phase, we get the overall weight by multiplying the weight of the first level with the weight of the secondary. Saaty (1980) suggests whether CR is less than or equal to 10%, then inconsistency is acceptable.

$$CI = \frac{\lambda_{max} - n}{n - 1} \text{ ----- Equation (3)}$$

$$CR = \frac{CI}{RI} \text{ ----- Equation (4)}$$

In this study, the geometric mean of individual priorities is taken into account. That is, the geometric mean of the principal eigenvector (PEV) of all individual experts of a particular standard is calculated. Then, the geometric mean of all the criteria is normalized with their sum to minimize the difference.

DATA COLLECTION

For the suitability analysis of urban green Space, the data collected from the existing literature review are collected and the data is not available through the questionnaire.

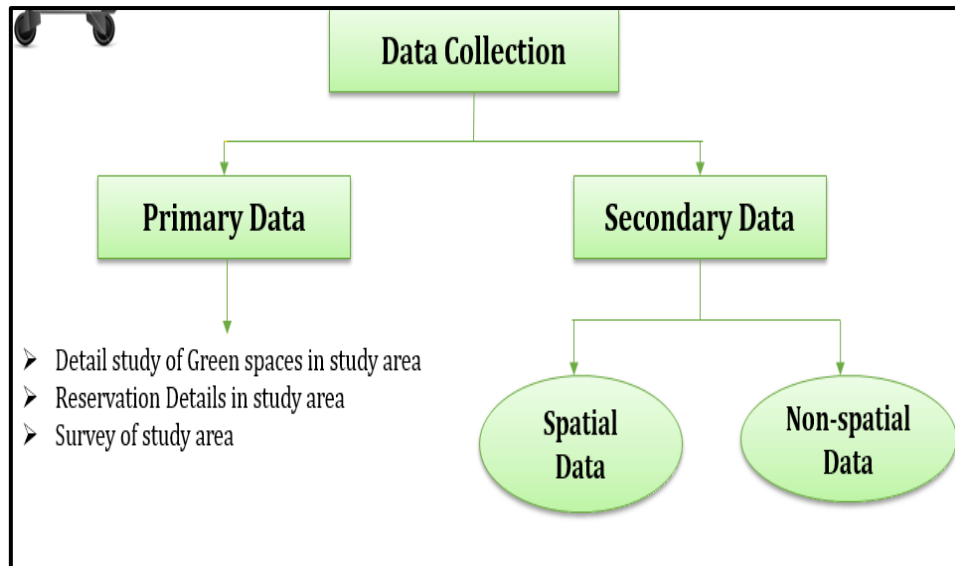
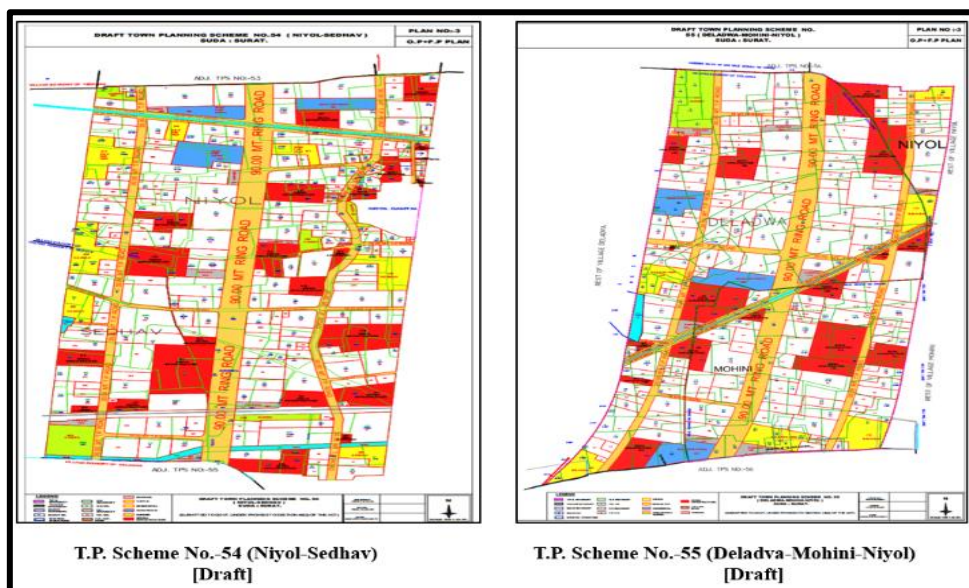


Figure 3:- T.P Scheme selected for Suitability Analysis



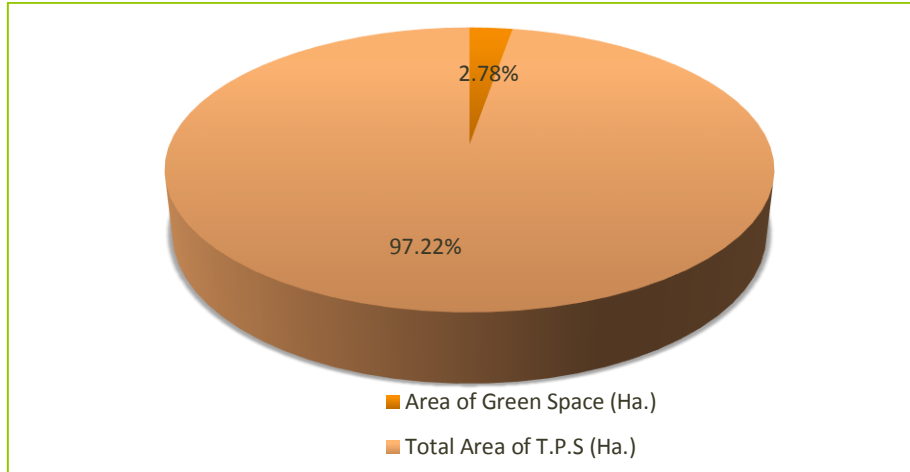


Figure 4:-Percentage of Urban Green space in T.P. Scheme
54 (Niyol-Sedhay)

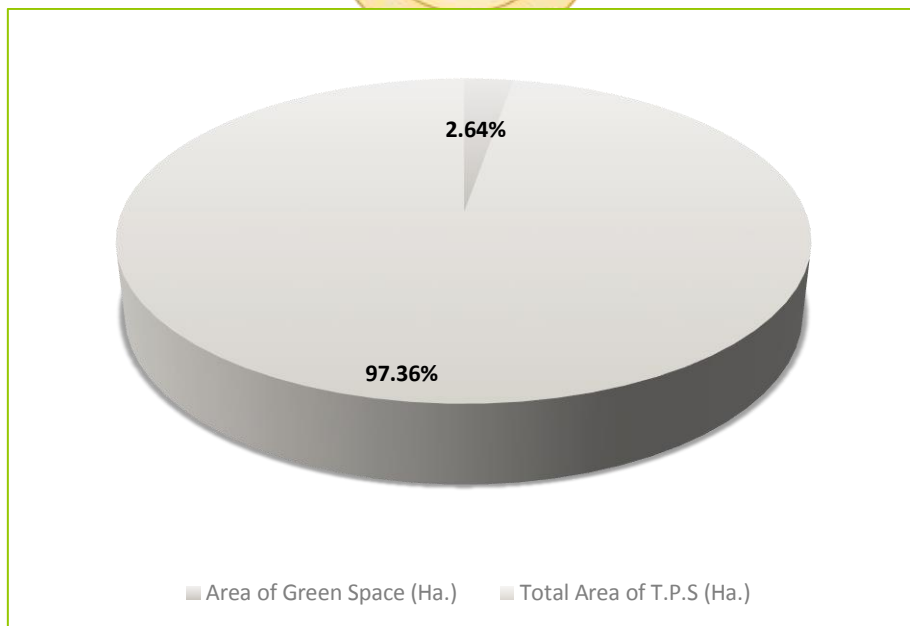


Figure 5:-Percentage of Urban Green space in T.P. Scheme
55 (Delwada-Mohini-Niyol)



Table 6:-Relative Composite Weights & Rankings of Land Suitability Criteria & Sub criteria using AHP

Criteria/ Factors	Weight (W1)	Sub- criteria (Paramete rs)	Weight (W2)	Weight W1XW2	Rank
Population Density (in ppha)	0.200	High (>340)	0.581	0.116	3
		Medium (195-340)	0.306	0.061	
		Low (<195)	0.113	0.023	
Size of land parcel (in sq. m)	0.279	<5000	0.129	0.036	2
		5000- 15000	0.620	0.173	
		>15000	0.251	0.070	
Accessibility (Major Roads)	0.131	< 18 m	0.290	0.038	4
		18 – 30 m	0.609	0.080	
		> 30 m	0.101	0.013	
Land Availability	0.349	Public Land	0.746	0.260	1
		Private Land	0.254	0.089	
Land Value	0.041	High	0.129	0.005	5
		Medium	0.332	0.014	
		Low	0.538	0.022	
		Total		1.000	

Survey Form

The two forms of the questionnaire are filled by the city planning experts.

Reaction survey from Experts

Social data is obtained through the questionnaire through the online Google questionnaire. 50 academicians, urban planners, urban planners, planning assistants, doctoral students and planning consultants and other experts to respond. Each respondent requires a maximum of 20 queries to evaluate the appropriate location of the residential space.



Expert’s opinion survey form on AHP

In order to find the right residential space position with the help of the AHP process, it is first necessary to determine the factors that affect the proper location of the residential space. To this end, a major discussion of sub-criteria related to the criteria for the finalization of different experts and the appropriate location of the dwelling space has been made. Thus, we get the composite weight of all the elements, and the sum must be 1. At the end of this phase, we get all the standard rankings.

Sample Size for survey

For any type of survey, the sample size is very important to get the correct result. To determine the sample size, the formulas used are Hogg and Tannis 2009.

N, m, and N = constrained, borderless, and accessible people

$$n = \frac{m}{[1 + (m - 1) \div N]}$$

P = Estimated population range estimate = 0.5

E = point sampling error = 0.05

For Surat, the population (expert) is 120 people.



Table 7:- Value of z

Confidence interval	Z value
99%	2.576
98%	2.327
95%	1.96
90%	1.645
88%	1.55
85%	1.44



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CONCLUSION

Urban green space may constitute an important part of the importance of urban open health. In order to recognize the country's prime green land, AHP is one of the best models. This model occupies an important position with different models and the use of Arc GIS in addressing options and guiding future development. Cyclic segment GIS programming is widely used in making databases, creating yields and different GIS analyzes from start to finish. MEPA as a MCDA in GIS-based land applicability survey methods may be valuable for determining reasonable land in urban improvement. The principle of arrangement of the ideal field is not the only fundamental idea of the procedure, but also the separation between the office and the individual.

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