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Multi-Criteria Decision Making in Hotel Site Selection

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Abstract : *In the Multi Criteria Decision-Making (MCDM) context, the selection is facilitated by evaluating each choice on the set of criteria. The criteria must be measurable and their outcomes must be measured for every decision alternative. In This Paper the decision making process frame work was developed to provide Hotel site suitability map. Road, river , built up areas n and the Available area were prepared as layers in ArcGIS 10.2 to create suitability model for development area. The results of this analysis indicated that 41% of the study area is considered as the most suitable place for hotel site selection, 33% of the area as moderately suitable and 21% percent as marginally suitable. A portion of 5% was found to be not suitable areas for hotel site selection.*

Keywords: *GIS, Site Selection. Decision. Suitability, Criteria*

I. Introduction

Multi-Criteria Decision Making (MCDM) issue in a GIS environment. Determination of optimum landuse type for an area involves integration of data from various sources. All these datasets can be considered as criteria. Every criterion will contribute towards the suitability at different degrees. Relative importance of these parameters should be well evaluated to determine the suitability by multi criteria evaluation techniques [1]. Site selection can be considered as a multiple criteria decision making or multiple MCDM problems involve a set of alternatives that are evaluated on the basis of spatial planning [2].

GIS-based MADM is used in a wide range of site selection decision [3, 4, 5]. A large number of tourists are oriented to hotel seeking sun and river [6]. Therefore river, road , built-up area will be used as the main four criteria for site selection. A number of procedures were followed in compiling the geographic and tabular data such as digitizing, ranking and weightage overlayed. The subjective numbers in the weights and the values of the criteria can be changed according to the study area characteristics and experts opinions. This map can give planners the tool for assessing and minimizing uncertainly for the decision choice risk.

II. Method

This paper considered study area (Subset of Selangor) as mask layer. The roads is important factor to determined the easy and fast access and communicates with particular areas. The road was evaluated by buffering process. The nearest areas from the road network got the high potential rank (ranking value = 8). Road Buffering was ranked and reclassified to four classes as I indicated in Fig. 1.

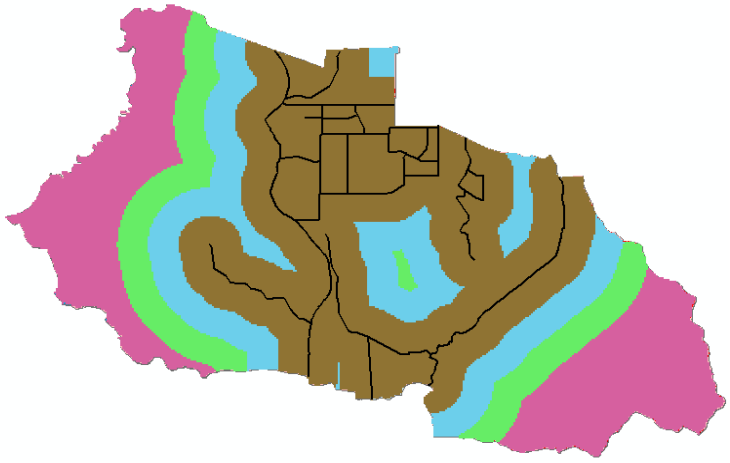

Fig. 1: The Road four classes (brown is most important, blue, green and pink respectively less)

River view consider as important factor for hotel site selection. The nearest area is the most potential area (rank value =8) see Fig. 2.

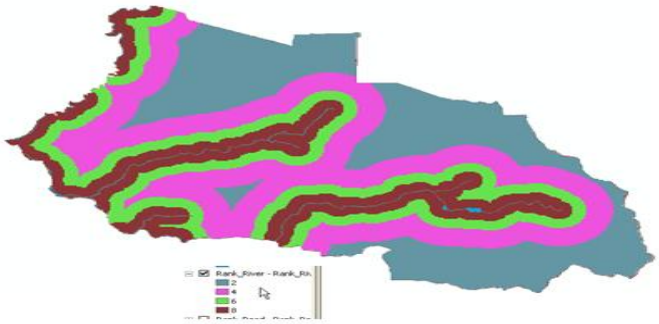

Fig. 2: The River four classes

In addition the slope layer was ranked and classified the lowest slope area got the highest potential rank. All the layers were ranked and transformed to raster layers. The built up Area buffered and classified to four classes, depending on the distant factor, the nearest area to built up area got the high potential value see Fig. 3

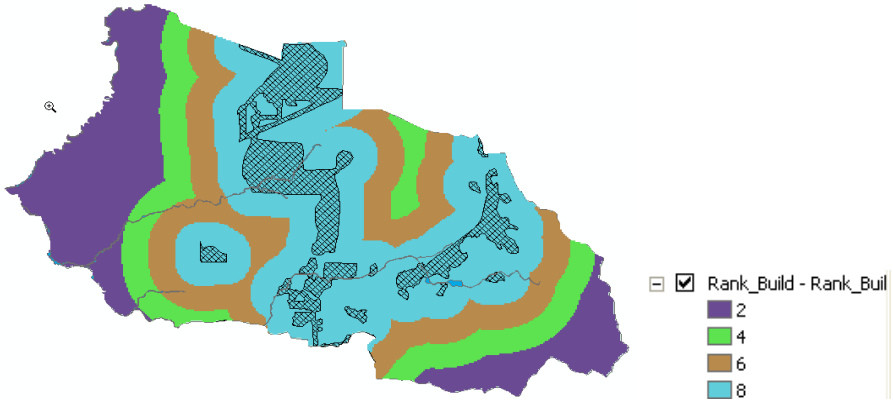

Fig. 4: The built-up areas four classes

Saaty (1980) proposed the pair wise compression method. This method was developed in the context of the Analytic Hierarchy Process (AHP). The AHP has been employed into the GIS-based site suitability procedures [7]. Most of the previous studies in land suitability analysis create the pairwise comparison matrix based on expert's opinions [8, 9, 10 , 11, 12]. After reclassifying and ranking all layers, the weightings must be calculated for each layer, the method was used here is pairwise comparison technique, the calculation was computed using Microsoft Excel software see Fig. 5. After getting the weights, the Raster Calculator overlay was used to produce final suitability map by multiplying each layer with its weight value.

Calculate weights

Step 1: Complete matrix calculating reciprocal values

	Slope	River	Road	Builtup
Slope	1	4	2	1
River	**0.250**	1	**0.333**	**0.333**
Road	**0.500**	3	1	**0.250**
Builtup	**1.000**	3	4	1

Step 2: Sum column values

	Slope	River	Road	Builtup
Slope	1	4	2	1
River	0.25	1	0.333333	0.333333
Road	0.5	3	1	0.25
Builtup	1	3	4	1
	2.750	**11.000**	**7.333**	**2.583**

Step 3: Divide matrix values by column sums

	Slope	River	Road	Builtup
Slope	**0.36**	**0.36**	**0.27**	**0.39**
River	**0.09**	**0.09**	**0.05**	**0.13**
Road	**0.18**	**0.27**	**0.14**	**0.10**
Builtup	**0.36**	**0.27**	**0.55**	**0.39**
	1.00	1.00	1.00	1.00

Step 4: Sum row values

	Slope	River	Road	Builtup	Sum	Average Weightage
Slope	0.36	0.36	0.27	0.39	**1.39**	**0.35**
River	0.09	0.09	0.05	0.13	**0.36**	**0.09**
Road	0.18	0.27	0.14	0.10	**0.69**	**0.17**
Builtup	0.36	0.27	0.55	0.39	**1.57**	**0.39**
	1.00	1.00	1.00	1.00		
				Min=	0.36	

Step 5a											
0	Slope	River	Road	Builtup							Weightage sum vecto
Slope	1	4	2	1	X	0.35	0.09	0.17	0.39	"="	0.818579
River	0.25	1	0.333333	0.333333							2.317937
Road	0.5	3	1	0.25							3.048387
Builtup	1	3	4	1							0.826521
Step 5b											
	0.8185789		0.35		2.360553						
	2.3179374	÷	0.09	"="	26.02195						
	3.0483871		0.17		17.73134						
	0.8265213		0.39		2.107243						
Step 5c			Average=		12.05527						
Step 5d			CI=		2.685091						
Step 5e			CR=		2.983434						

Fig. 5 Calculating weightage for each criteria

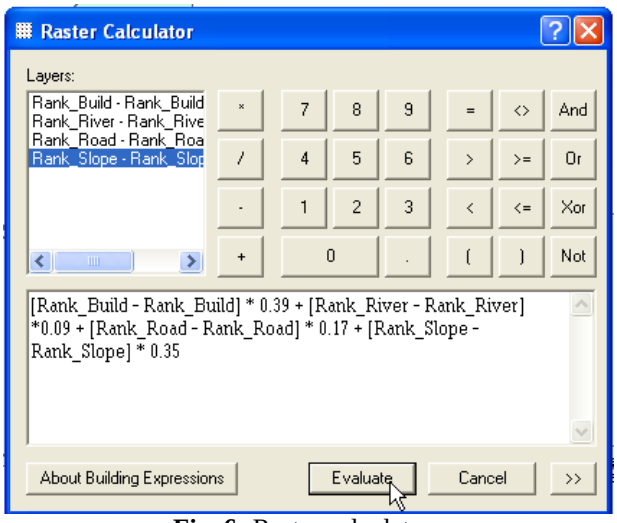

Fig. 6: Raster calculator.

The final step the project Clipped the result calculated map by the Available Area Layer, the last map is the real classification of the available areas only on the case study, without subtracting the unavailable areas the result will not be significant:

III. Result And Discusion

Multi criteria analysis is applied and integrates with the spatial data in order to produce suitability map for hotel site selection. In this study, the suitability areas were first produced by numerically overlaying road, river, slope and buildup layers. All criteria are combined by logical operators such as intersection (AND. First, ranking method was used, where every criterion was ranked in the order of the decision maker's preference. Each factor was weighted according to the estimated significance for hotel site selection. Factor of 8 is the most important factor and rank 2 is the least important. After that, pairwise comparison method was used to determine the weight of each criterion. The individual judgment, was measured by using Consistency Ratio (CR), indicating the probability that the matrix ratings were randomly generated. The rule of thumb is that a CR less than or equal to 0.1 indicates reciprocal matrix is accepted, while a ratio over 0.1 indicates that the reciprocal matrix should be revised.

Project found that the weights for layers is (0.39, 0.09, 0.17, 0.35) for built area, river, road, slopes respectively. The CR equals to 2.98. This high value indicates low level of consistence in comparison layers process, due to lack experience on the relation evaluation process between layers. The project calculates the areas and found that the most suitable area equals to 41.19% (Green color) from the total available area. The high moderately suitable area equals to 33.11% , the medium suitability area equal to 21.64% , and the low suitability area equals to 4.06% from the total available area as indicated in Fig. 6.

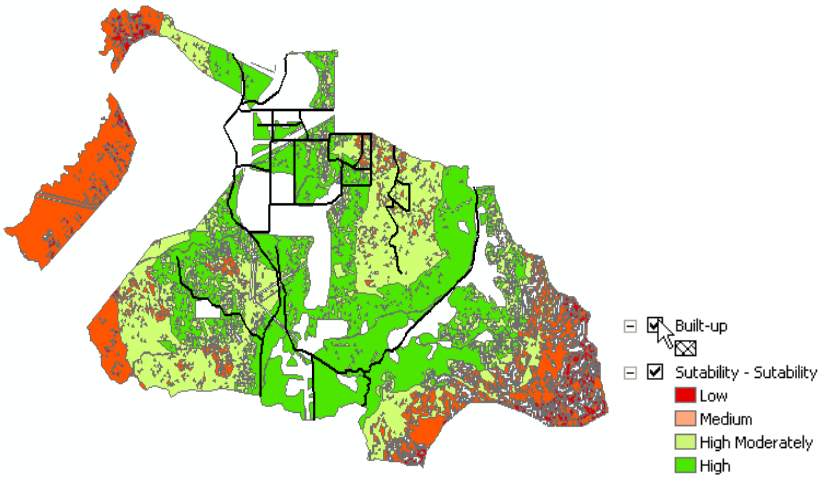

Fig. 6: The Suitability map of the hotel site selection.

The highest percentage for the suitable area is due to the wide network roads covered the area, and also the distribution of the built up areas.

IV. Conclusion

The hotel site suitability map was produced using the GIS and AHP method. Four layers (road, buildup, river, and slope) were overlaid and ranking based on significant of site selection. The subjective numbers in the weights and the values of the criteria can be changed according to the study area characteristics and experts opinions. This map can give planners the tool for assessing and minimizing uncertainly for the decision choice risk.

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