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EMBRACING OUR SMART WORLD WHERE THE CONTINENTS CONNECT:
ENHANCING THE GEOSPATIAL MATURITY OF SOCIETIES

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EMBRACING OUR SMART WORLD WHERE THE CONTINENTS CONNECT:
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GIS SUPPORTED DECISION MAKING MODEL TO HOUSING SUITABILITY ASSESSMENT

Dr. Bülent Bostancı, Prof. Dr. Hülya Demir, Eng. Ahmet İlvan

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Housing suitability evaluating

Housing is one of the most important investments of people and states. Researches based on housing choice are generally based on studies on housing economics. In the choices of housing, both the individual choice and the spatial structure of the housing market should be considered together and physical characteristics, environmental characteristics, transportation mode and accessibility should be evaluated together. For this reason, housing choice is not a decision as randomly

Housing suitability evaluating importance

- The implementation of planned urbanization
- Selection of residential settlements
- Comparison of the costs of internal and external connection between these regions
- Economical evaluating of the development plans
- Clarification and securing of real estate markets
- Monitoring of housing markets

Decision making

Decision making is the determination of the option or options giving the most appropriate result by evaluating of the all aspects of problems which has to be finalized against situation or events encountered in the every management level.

- AHP (Analytical Hierarchical Process)
- WLC (Weighted Linear Combination)

- **AHP (Analytical Hierarchical Process)**

  It is a multi-criteria decision making technique well known for decision support systems (Brent et al., 2007).

- **Steps of the AHP method**

  1. A binary comparison matrix is created by comparing benchmarks based on AHP importance ratings
  2. Each component of the comparison matrix is divided by the sum of the columns and a standardized comparison matrix is calculated
  3. The average of each line in the standardized comparison matrix is calculated. These mean values represent the weights of the criteria
  4. The validity of the results of the AHP methodology depends on the consistency of the binary comparison matrix

- **WLC Method (Weighted Linear Combination)**

Weighted Linear Combination is based on the weighted average concept where criteria are standardized in a common numerical range.

$$S_i = \sum Wi \,.Xi$$

APPLICATION

In this study, In order to obtain the criterial weights in the study, criteria were evaluated with AHP importance scale. By using the AHP method, a matrix of coefficients for 20 criteria was created and weights were obtained within the frame of the method steps (Table 1). Using the data on the houses, the WLC scale of each criterion and the WLC score values of 585 houses were determined on the Excel spreadsheet by the numerical and verbal conversion in Table 1.

Row No	Criteria Name	Determination Skore Value	AHP Weight
1	Housing Age	Numerical Conversion	0.0712
2	Housing front	North (0) ... South (1)	0.0908
3	Residential area	Numerical Conversion	0.0600
4	Number of rooms	1 Room (0) ... 5+ Rooms (1)	0.0415
5	Number of bathrooms	0 bathrooms (0) ... 3+ bathrooms (1)	0.0165
6	Landscape	Very poor (0) ... Very good (1)	0.0802
7	On-site status	No (0.50) ... yes (1)	0.0535
8	Condition of parking area	None (0) ... parking garage (1)	0.0362
9	Safety system status	Unsafe (0) ... Very safe (1)	0.0369
10	Building entry path width	Numerical Conversion	0.0362
11	Floors in housing	Numerical Conversion	0.0645
12	Distance to school	Numerical Conversion	0.0422
13	Quality of external structure	Numerical Conversion	0.0789
14	Type of heating	None (0) ...Central Heating (1)	0.0649
15	Fuel type	None (0) ... Natural gas (1)	0.0416
16	Dues Status	Numerical Conversion	0.0302
17	Rent income	Numerical Conversion	0.0649
18	Distance to city center	Numerical Conversion	0.0422
19	Distance to shopping center	Numerical Conversion	0.0284
20	Area Topographic structure	Mountainous (0) ... Flat (1)	0.0191

Table 1. Weights of the criteria used in the evaluation of the houses

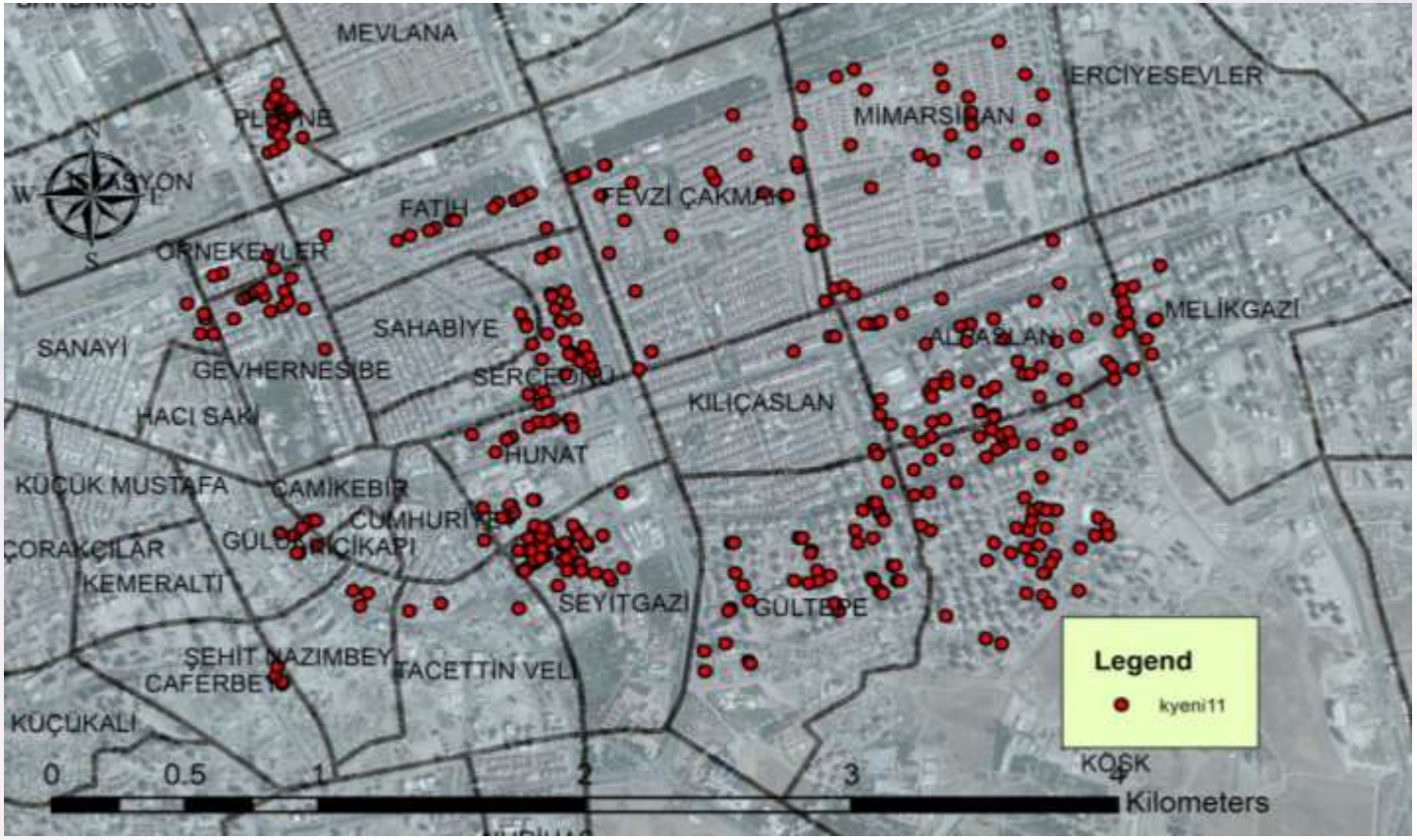

Figure 1. Housing locations on satellite map

In order to apply location-based multi-criteria decision analysis in ArcGIS software, a weight is applied to each of the specified criteria of the WLC score, and then the sum of the criterias results is combined into a single layer to obtain a suitability map. In this case, 585 housing information with respect to the 20 criterias has been entered in to attribute table. Point based raster maps were created for each criteria by using WLC method on the software and suitability values were obtained by entering weights (Si). In the method, values close to 1 means it is indicated values appropriate for the decision maker and values close to 0 means it is indicated inappropriate values.

FID_	ID	DEGER	yasP	cepheP	kalanP	odasayP	bansayP	manzaraP	siteiciP	otoparkP	guvsisP	ygenP	kgetP	kkat1P	smuzP	avmuzP	ilkuzP	bdkalP	isturP	yakturP	aidatP	topyapiP
252	SER02	185000	0.4694	0.25	0.4361	0.5	0.3333	0.75	0.50	0.33	0.33	0.0000	0.35	0.80	0.9387	0.9541	0.7338	0.3333	0.66	1.00	0.25	1
253	SER03	250000	0.4286	0.25	0.4925	0.5	0.3333	0.75	0.50	0.33	0.33	0.0000	0.375	1.00	0.9225	0.9573	0.8386	0.4444	0.66	1.00	0.25	1
254	SER04	200000	0.7347	0.50	0.4737	0.5	0.3333	0.75	1.00	0.66	1.00	0.0000	0.4	1.00	0.1098	0.3590	0.8818	0.5556	1.00	1.00	0.2	1
255	SER05	212000	0.4898	0.75	0.4925	0.5	0.6667	0.75	0.50	0.66	0.33	0.0000	0.35	1.00	0.9260	0.9733	0.8260	0.4444	0.66	0.50	0.25	1
256	SER06	210000	0.6939	1.00	0.4549	0.5	0.3333	0.75	1.00	0.66	1.00	0.0000	0.4	1.00	0.1329	0.4124	0.8973	0.5556	0.66	1.00	0.2	1
257	SER07	380000	0.6531	1.00	0.6992	0.75	0.6667	1.00	1.00	0.66	0.66	0.0000	0.45	0.20	0.9075	0.9252	0.9224	0.4444	1.00	1.00	0.5	1
271	SER21	225000	0.6939	0.50	0.4549	0.5	0.3333	0.75	0.50	0.66	0.33	0.0000	0.4	1.00	0.9075	0.9573	0.8489	0.4444	0.66	1.00	0.2	1
273	SER02	185000	0.4694	0.25	0.4361	0.5	0.3333	0.75	0.50	0.33	0.33	0.0000	0.35	0.80	0.9387	0.9541	0.7338	0.3333	0.66	1.00	0.25	1
274	SER03	250000	0.4286	0.25	0.4925	0.5	0.3333	0.75	0.50	0.33	0.33	0.0000	0.375	1.00	0.9225	0.9573	0.8386	0.4444	0.66	1.00	0.25	1
275	SER04	200000	0.7347	0.50	0.4737	0.5	0.3333	0.75	1.00	0.66	1.00	0.0000	0.4	1.00	0.1098	0.3590	0.8818	0.5556	1.00	1.00	0.2	1
276	SER05	212000	0.4898	0.75	0.4925	0.5	0.6667	0.75	0.50	0.66	0.33	0.0000	0.35	1.00	0.9260	0.9733	0.8260	0.4444	0.66	0.50	0.25	1
277	SER06	210000	0.6939	1.00	0.4549	0.5	0.3333	0.75	1.00	0.66	1.00	0.0000	0.4	1.00	0.1329	0.4124	0.8973	0.5556	0.66	1.00	0.2	1
278	SER07	380000	0.6531	1.00	0.6992	0.75	0.6667	1.00	1.00	0.66	0.66	0.0000	0.45	0.20	0.9075	0.9252	0.9224	0.4444	1.00	1.00	0.5	1
279	SER08	260000	0.7551	0.00	0.6241	0.75	0.6667	0.50	0.50	0.66	0.66	0.0000	0.375	0.60	0.9191	0.9359	0.9186	0.5556	0.66	1.00	0.25	1
280	SER09	205000	0.4490	1.00	0.4925	0.5	0.3333	0.75	0.50	0.66	0.33	0.0000	0.35	1.00	0.9422	0.9573	0.7547	0.3333	0.66	1.00	0.25	1
281	SER10	185000	0.6327	0.75	0.3609	0.5	0.3333	0.75	1.00	0.66	0.33	0.0000	0.35	0.60	0.8890	0.9615	0.8805	0.5556	0.66	1.00	0.2	1
282	SER11	290000	0.6327	0.25	0.6992	0.75	0.3333	1.00	0.50	0.66	0.33	0.0217	0.4	0.80	0.8266	0.9145	0.7757	0.4444	0.66	1.00	0.25	1
283	SER12	220000	0.6531	0.25	0.4925	0.5	0.6667	1.00	0.50	0.66	0.33	0.0000	0.38	1.00	0.8382	0.9359	0.7966	0.5556	0.66	1.00	0.25	1

Table 2. Score values used in the evaluation of Housing

ID	Housing Name	Neighborhoods	Si
2729	Forum Rezidans	Hunat	0.8441
2918	Forum Rezidans	Hunat	0.8440
3319	Bekaş konutları	Gültepe	0.8199
787	Sararpark	Köşk	0.4927
908	Sararpark	Köşk	0.4861
...	...	…	...
149	Boztoprak Apt.	Mimar Sinan	0.4248
216	Boztoprak Apt.	Mimar Sinan	0.4248
542	Arı Apt.	Ş.Nazımbey	0.3881
148	İpek Apt.	Mimar Sinan	0.3548
215	İpek Apt.	Mimar Sinan	0.3548

Table 2. Suitability values used in the evaluation of Housing

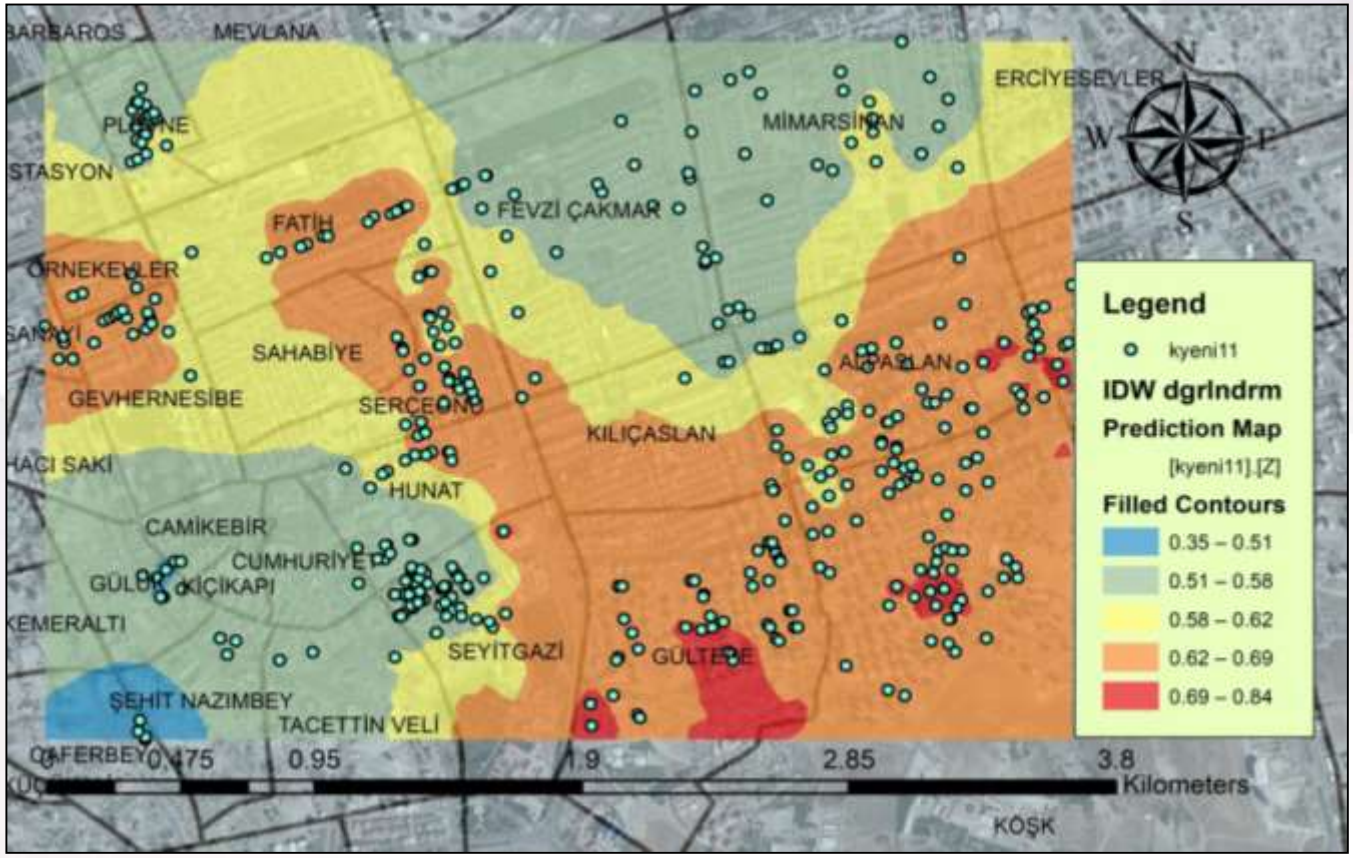

Figure 2. Housing evaluation map obtained by using IDW method

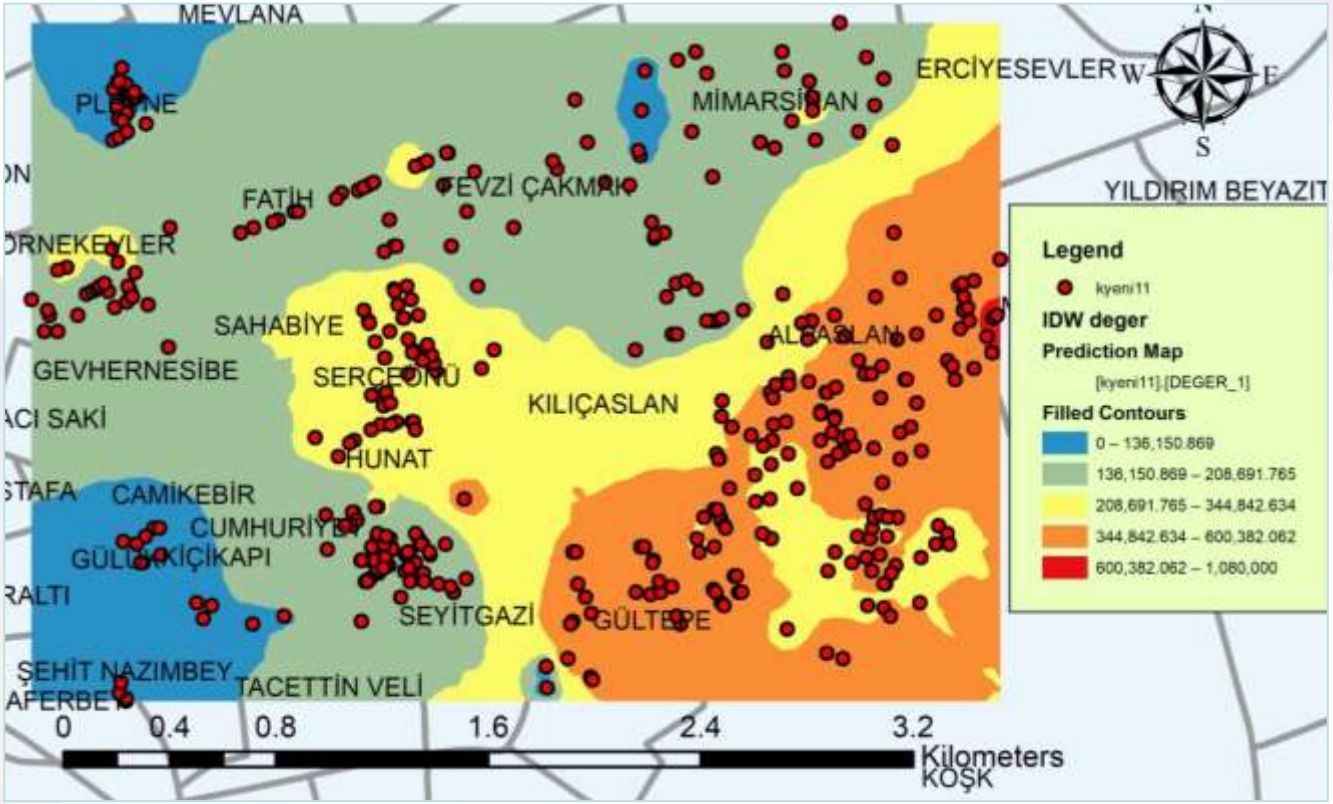

Figure 3. Housing value map obtained by using IDW method

Results and Suggestions

- In the method, weights value were determined by AHP decision method. Among the 20 criteria determined, the most important criteria in weighting was the the house front, the landscape and the quality of external structure. The GIS-based WLC method was used to evaluate the houses successfully with respect to the 20 criterias.
- Areal-based raster maps were generated by the IDW interpolation method using the Suitability values obtained from the WLC method. According to the result of Evaluation on the map, Köşk, Gültepe, Kılıçarslan and Alpaslan are the well suitable neighborhoods. These neighborhoods are the preferred neighborhoods in terms of housing value and investment in Kayseri. The Suitability score map obtained with respect to the 20 criteria is similar to the housing value map.
- Determined weights using different decision making methods such as Analytical Hierarchical Processes, Analytical Network Processes and TOPSIS can be used in WLC method. The weights determined by these methods are used in the WLC method and the results can be evaluated on the map and compared with the results obtained in the article.

Thanks for your patience