



The spatial evaluation of the real estates in the Konya- Hacıkaymak Neighborhood with the analytical hierarchy process method

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Abstract

Real estate valuation is the appraisal of the real estate with an objective and impartial point of view, by evaluating many criteria related to the real estate, such as the characteristics of the real estate, the environment and the conditions of use. While valuing the immovable, it is necessary to consider all the criteria of the immovable and to determine the superiority of the criteria to each other in order to make the valuation qualified. Generally, in real estate valuation studies for residences, the spatial criteria of the real estate are ignored and are not considered important, but in fact, spatial characteristics also play an important role in determining the value of the real estate. In order to be able to evaluate spatially, it is necessary to determine and research the criteria effectively. In this study, the importance of spatial criteria in real estate valuation has been emphasized. It is aimed to make a spatial valuation of all residences located in Hacıkaymak Neighborhood in Selçuklu district of Konya province. 8 main criteria have been determined in order to make the evaluation in terms of location. The Analytical Hierarchy Process (AHP), which is the most widely used of the Multi-Criteria Decision Making (MCDM) methods, was used to determine the order of importance and weighting among these criteria in the evaluation of the houses in the selected region. Relationships between these criteria were determined with the help of literature research and expert opinions. In order to carry out this study, analyzes made with the help of Geographic Information Systems (GIS) were used. Distance maps of each criterion were produced and then a spatial value map was produced using the weighting obtained by the Analytical Hierarchy Process. As a result; The value of the immovables located within the boundaries of Hacıkaymak District in Konya/Selçuklu has been determined according to their spatial characteristics.

1. Introduction

The immovable is the whole of the goods that cannot be changed, cannot be moved from where they are located, and are fixed in place. Real estate valuation, on the other hand, is the estimation of the defined value of a real estate or a real estate project on the valuation day, based on independent, impartial and objective criteria [1]. Real estate valuation is defined as the sum of the formalities necessary for the objective and independent determination of the value of real estate, taking into account factors such as quality, benefit, environmental conditions and use [2].

In order to make a real estate valuation, it is necessary to know the value concepts related to real estate well and to reveal the differences [1]. Real estate valuation is a developing and important discipline today. It is important in terms of protecting the rights of the public and individuals, which are used for public needs such as expropriation, data regulations, nationalization and land-land arrangements, and private sector needs such as real estate and capital markets, insurance and banking [3]. It is not possible to talk about a precise model or mathematical method in valuation of real estate because there are many different methods used in valuation and

the criteria affecting the value of the real estate play an effective role in choosing which of these methods to use. Sometimes, real estate valuation may be preferred by more than one method.

While valuation of real estates that are residential properties, properties related to the residence are generally taken into consideration and external factors, that is, locational factors, are not included in the valuation. In order to make a qualified valuation, it is important to consider all the criteria for the house and to weigh the criteria according to their superiority to each other. Positional factors are also undeniably important and necessary in making housing valuation.

One of the methods used in real estate valuation and the preferred method in this study is Multi-Criteria Decision Making (MCDM) techniques. MCDM methods are a process that evaluates multiple criteria together and assigns values to alternatives [4]. It enables the determination of the best alternative when it comes to the evaluation and analysis of multiple criteria in the same time period. This method is preferred because more than one criterion affects the value of the real estate in real estate valuation. MCDM methods also have some advantages over each other. In this respect, the method is determined by showing which method to use can yield more qualified results.

Yalpir [5] conducted a survey to determine the factors affecting the value in his study. He created data sets in two different regions according to the structuring and aimed to select the most suitable model by determining the alternatives with fuzzy logic. Yalpir and Ünel [6] found that the criteria affecting the land value are; how it is formed in academic studies, legislations and international standards has been examined. In the study of Özcan [7], real estate value maps of the region were created for Mahmutlar Neighborhood, located in the Alanya district of Antalya province, using Analytical Hierarchy Process and Geographic Information Systems technology. Tunca and Üstüntaş [8], the study area was determined as the borders of 7 neighborhoods located within the borders of Seyhan district of Adana. They determined 10 criteria affecting the value of the real estate and created a mathematical model by weighting it with the TOPSIS method. Ertaş [9] aimed to educate real estate valuation in Turkey in his study. In Özgüven and Erenoğlu [10] studies, it is aimed to create a real estate value map of Çanakkale Province, Merkez District, Esenler District. They determined the criteria affecting the real estate value and produced a real estate value map as a result of the model obtained with the help of the Analytical Hierarchy Process.

In this study, Hacıkaymak neighborhood located in Konya/Selçuklu was determined as the study area. It is aimed to make a spatial real estate valuation of all residences in the neighborhood within the spatial criteria. In this study; 8 main criteria were determined in terms of location and it was aimed to draw attention to the importance of spatial criteria in the valuation of real estate by emphasizing the changes in the value of the houses in a neighborhood based on only spatial criteria. In the study, spatial criteria were weighted using the Analytical Hierarchy Process method. Geographic Information Systems technology was used in the production of the distance and spatial real estate valuation map.

2. Material and Method

Analytical Hierarchy Process (AHP) is one of the multi-criteria decision-making methods in which a hierarchical structure is created among alternative criteria [11]. It also provides a methodology for calibrating the numerical scale for the measurement of quantitative and qualitative performances. The scale ranges between 1/9 for the least valuable, 9 for the more important, and 1 for the equal ones [11]. In its general form, AHP is a method used to perform both deductive and inductive thinking without using analogies by considering several factors simultaneously, allowing dependency and feedback, and making numerical trade-offs to arrive at a synthesis or conclusion [12].

The necessary steps for the analysis and solution of a decision problem with AHP are as follows [13]:

1. Defining the decision problem is the first step. After the decision problem is defined, important criteria are determined depending on the perspective from which this problem will be analyzed.
2. Scoring is made according to the pairwise comparison method for the determined criteria. The degrees of value for this are as in Table 1. In this pairwise comparison method, all criteria are compared with each other and their superiority to each other is expressed numerically by giving values from 1 to 9, taking into account the previous pairwise comparisons in terms of consistency [14].

Table 1. Value Scale [14]

Significance Scale	Defines	Description
1	Equally important	Both criteria are equally important.
3	Moderately important	One criterion is superior to the other.
5	Extremely important	One criterion is strongly superior to the other.
7	Very strongly important	One criterion is strongly superior to the other.
9	Absolute degree of importance	One criterion is absolutely superior to the other.
2,4,6,8	Intermediate values	Values used when compromise between two consecutive criteria is required.

3. Pairwise comparison matrices are created. The comparison matrix is an n x n square matrix (Equation (1)) [15].

$$A = X_{ij} = (n \times n) \quad (1)$$

1	X_{12}	$X_{13} \dots$	X_{1n}
X_{21}	1	$X_{23} \dots$	X_{2n}
X_{31}	X_{32}	1 ...	X_{3n}
...
X_{n1}	X_{n2}	$X_{n3} \dots$	1

The synthesis process is started to determine its weight among all criteria. Each column total is found (Equation (2)).

$$B_{ij} = X_{ij} / \sum_{ni=1} X_{ij} \quad (2)$$

As a result of this operation, the B column vector is created (Equation (3)).

$$B_{ij} = (n \times 1) \quad (3)$$

b_{11}
b_{21}
b_{31}
...
B_{n1}

Each value in the A matrix is divided by its column sum and in this way the normed matrix A is obtained (Equation (4)).

$$N = (n \times n) \quad (4)$$

$1/b_{11}$	X/b_{11}	$X/b_{11} \dots$	X/b_{11}
X/b_{21}	$1/b_{21}$	$X/b_{21} \dots$	X/b_{21}
X/b_{31}	X/b_{31}	$1/b_{31} \dots$	X/b_{31}
..
X/b_{n1}	X/b_{n1}	$X/b_{n1} \dots$	$1/b_{n1}$

By summing the same column values in the N matrix, the criterion weights matrix (1xn) is obtained.

4. Consistency Measurement and Sensitivity Analysis; Before the criterion weights are used in the analysis, it is tested for usability. Performing this test is important for the accuracy of the study.

The values in the A matrix are multiplied by the criterion weights matrix and the values in the same row are summed. In this way, the (1xn) T matrix is obtained. We divide the values in the T matrix by the corresponding values in the criterion weights matrix. When we add the values in the obtained T/C matrix and take the average, this value is the lambda value. With this lambda value, the consistency index is calculated (Equation (5)).

$$CI = \lambda_{max} - n / n - 1 \quad (5)$$

Table 2. Randomness Indicator Values [12]

n	RI	n	RI
1	0	6	1.24
2	0	7	1.32
3	0.58	8	1.41
4	0.90	9	1.45
5	1.12	10	1.49

The Randomness Indicator Value is determined by the help of Table 2 according to the number of criteria. The CR value required to determine consistency and precision is calculated as CI/RI . The CR value is expected to be less than 0.10 for consistent and sensitive analysis. If it is less than 0.10, grading between criteria can be made using the criterion weights matrix [16].

3. Results

The study area handled in this project is Hacıkaymak District in Selçuklu district of Konya province (Figure 1). In this study, it is aimed to evaluate the houses in Hacıkaymak District by considering the spatial criteria. The zoning map of the region and its current version on google maps have been provided. Buildings, roads and other layers in the neighborhood were transferred to ArcGIS 10.5 using Netcad 8 GIS. The centers affecting the real estate value were checked simultaneously with Google Earth, and each of them was recorded in different layers. These layers were also transferred to ArcGIS 10.5 with .kml extension and all data was obtained in this way.

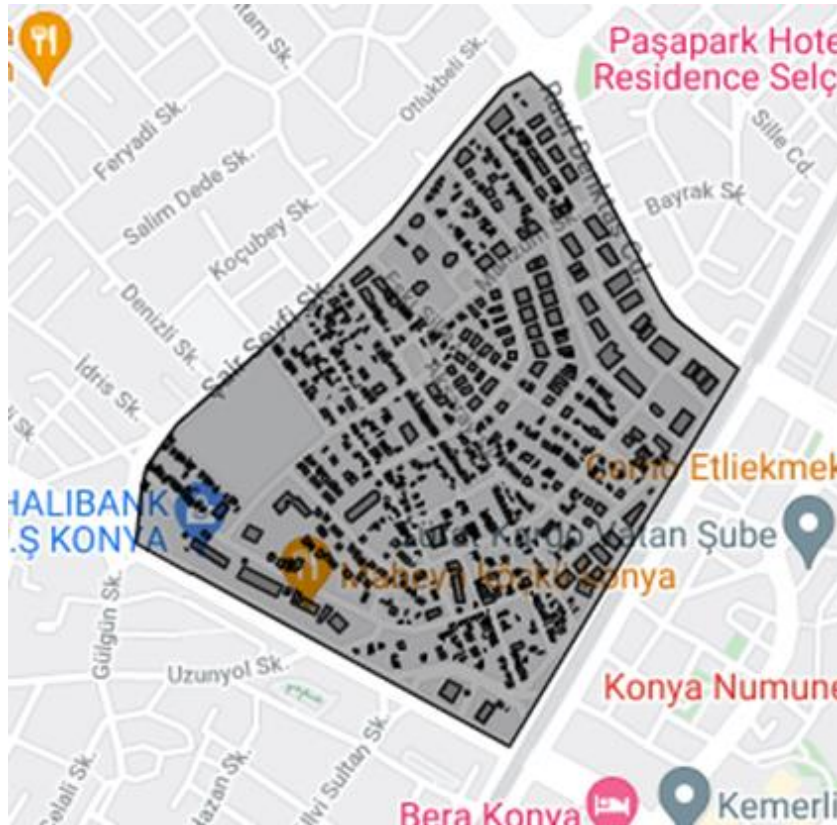


Figure 1. Field Area [17]

Analytical Hierarchy Process method, which is a modern valuation method mentioned above, was used in the evaluation of the criteria affecting the value of the real estate. First of all, in order to implement this process, spatial criteria affecting the housing valuation were determined (Table 3).

Table 3. Spatial Criteria

Criteria	Description
Distance to Health Centers	Proximity to Health Centers is very important in terms of emergency health situations
Distance to Transportation	Ease of transportation has been determined as a criterion because it facilitates the flow of life
Distance to Markets	Being close to the markets provides convenience in terms of meeting the needs
Distance to Street	Commercial centers, markets, hospitals and stops make real estate on the street more valuable
Distance to Park-Green Area	Proximity to parks and green areas is important for sports and social activities
Distance to Schools	Proximity to education centers is important for families with children
Distance to Pharmacies	Distance to pharmacies is important in case of urgent need
Distance to Mosques	Proximity to worship centers is important in terms of ease of worship

After the criteria are determined, pairwise comparisons are made with the help of the questionnaire and literature review, the superiority between the criteria is determined and the comparison matrix is formed (Table 3). The criterion weights and the effect percentage are determined (Table 4).

Table 3. Comparison Matrix

1	2	2	5	5	6	6	9
1/2	1	2	3	4	5	6	7
1/2	1/2	1	3	5	5	6	7
1/5	1/3	1/3	1	2	3	5	5
1/5	1/4	1/5	1/2	1	2	5	5
1/6	1/5	1/5	1/3	1/2	1	3	5
1/6	1/6	1/6	1/5	1/5	1/3	1	2
1/9	1/7	1/7	1/5	1/5	1/5	1/2	1

Table 4. Criterion Weights and Percentage Impact

Distance to Health Centers	0.306	30.6
Distance to Transportation Centers	0.219	21.9
Distance to Market	0.192	19.2
Distance to Street	0.099	9.9
Distance to Green Fields	0.077	7.7
Distance to Education Centers	0.056	5.6
Distance to Pharmacy	0.03	3
Distance to Worship Centers	0.021	2.1

Before the determined criterion weights are used in the analysis, it is tested whether they are usable. For this, Lambda, CI, RI values are calculated. The number obtained with CI/RI is expected to be less than 0.10 for the analysis to continue.

Lambda = 8.837258
 CI = 0.119608
 RI = 1.41
 CI/RI=0.084829

Since $0.08 < 0.10$, it has been determined that it is appropriate to use these values for analysis.

After this stage, it is passed to the stage of analysis using GIS technology. Criteria are set and distance analysis maps are created with ArcGIS 10.5. As a result, a spatial real estate value map is produced by using the weights determined for these distance maps and criteria.

In terms of location, 8 criteria have been determined. Distance to the street (Figure 2), distance to places of worship (Figure 3), distance to pharmacies (Figure 4), distance to markets (Figure 5), distance to schools (Figure 6), distance to green areas (Figure 7), distance to health centers (Figure 8), distance maps to transportation centers (Figure 9) were produced using the ArcGIS 10.5 program. Since the proximity to the determined criteria makes the house valuable in terms of location, each criterion has been evaluated with distance maps. Then, these maps were combined based on the determined Analytical Hierarchy Process weighting, in line with the weighting of the criteria. As a result; real estate value map was produced based on spatial criteria (Figure 10).

4. Conclusion and Discussion

Real estate valuation is an increasingly important issue today. In real estate valuation, the location of the spatial criteria is undeniably important. One of the most important investment tools is housing. Housing has always been important from the first-time people started to settled life until today. Evaluation and analysis of houses, which are a great need for human life and an important investment tool, and all kinds of studies on this, are important for the development of the real estate valuation area.

Many factors play a role in determining the value of houses. Undoubtedly, the location factor, which people always attach importance to, constitutes an important part of the criteria affecting the house. The reason why spatial criteria are important is that they are factors that make life easier and are necessary for well-being. Therefore, the analysis of the location and all the criteria related to the location is directly related to the value of the real estate.

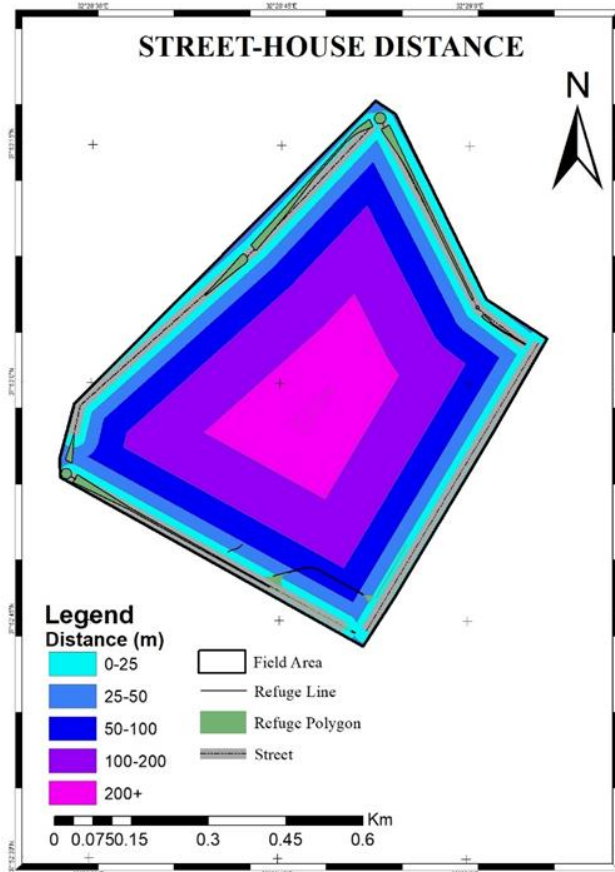


Figure 2. Distance Buffer Analysis Map to Street

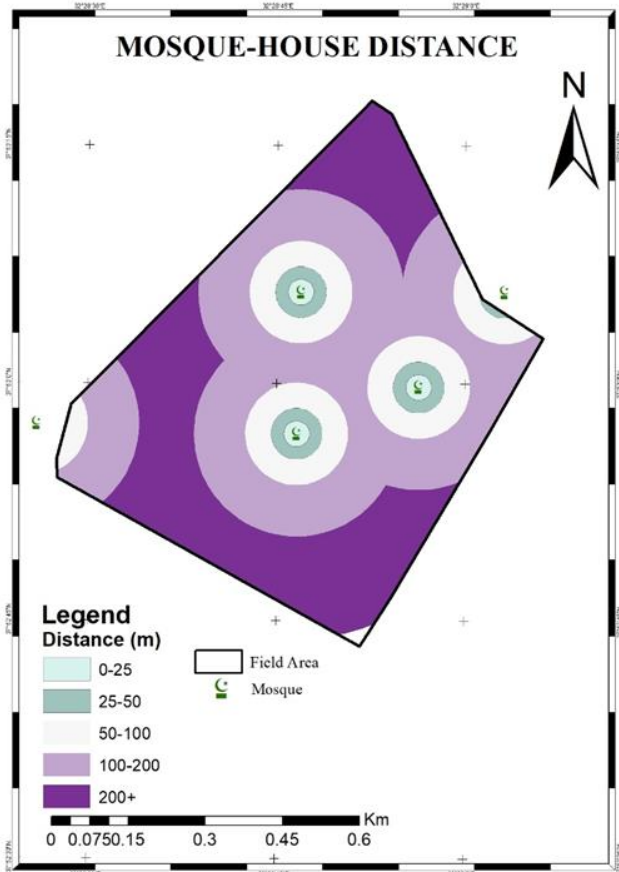


Figure 3. Distance Buffer Analysis Map to Mosques

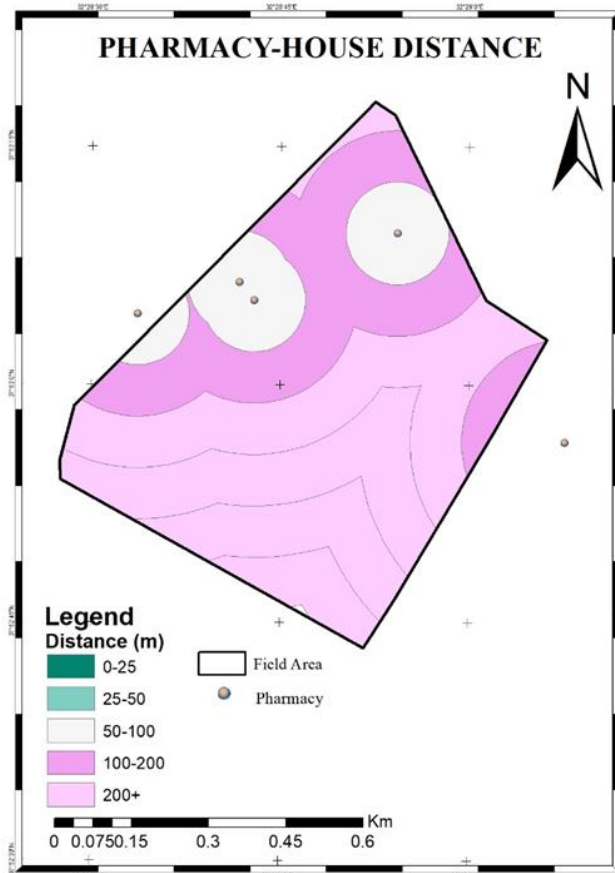


Figure 4. Distance Buffer Analysis Map to Pharmacies

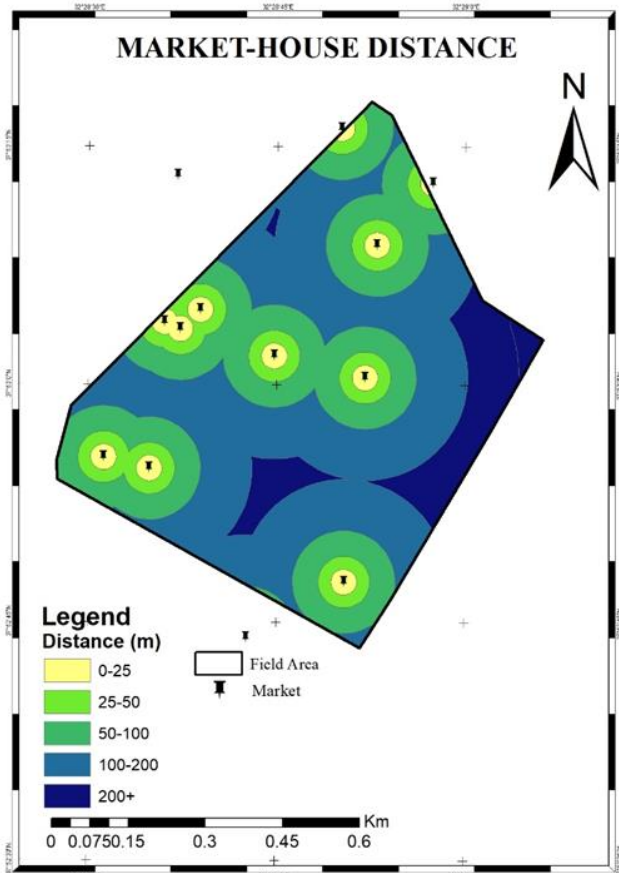


Figure 5. Distance Buffer Analysis Map to Markets

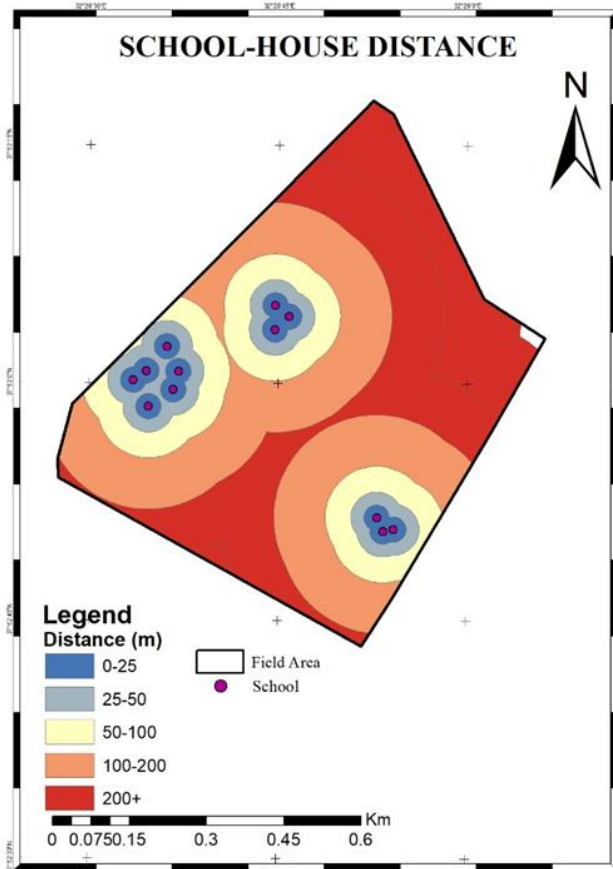


Figure 6. Distance Buffer Analysis Map to Schools

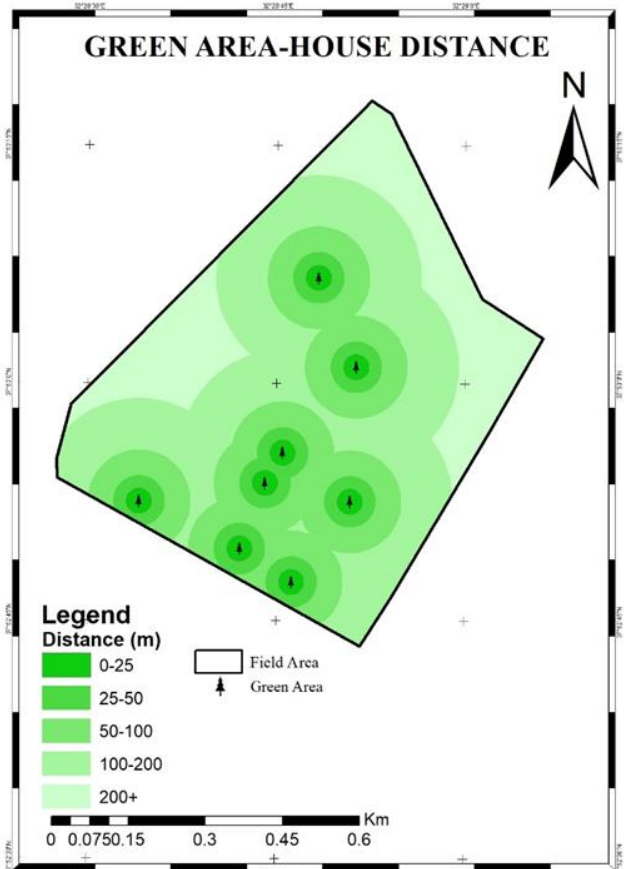


Figure 7. Distance Buffer Analysis Map to Green Areas

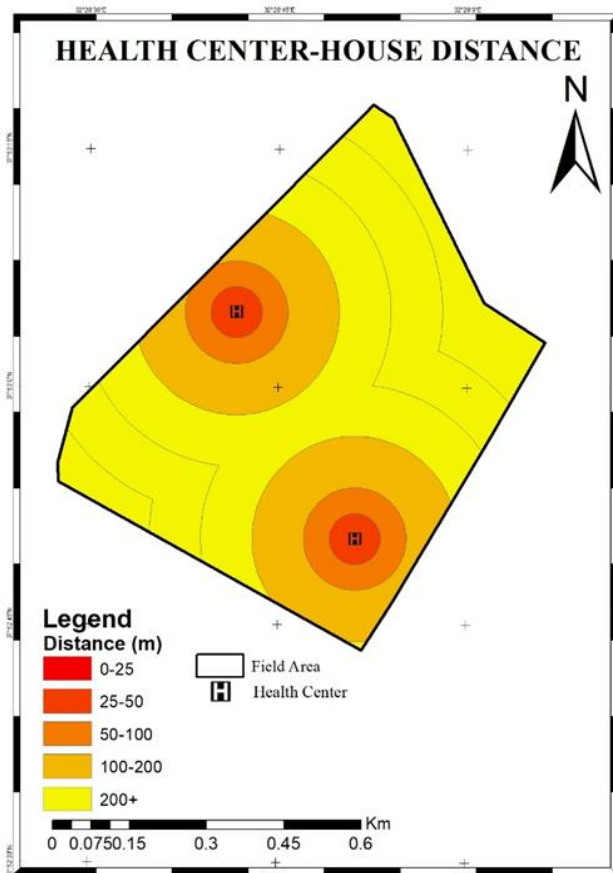


Figure 8. Distance Buffer Analysis Map to Health Centers

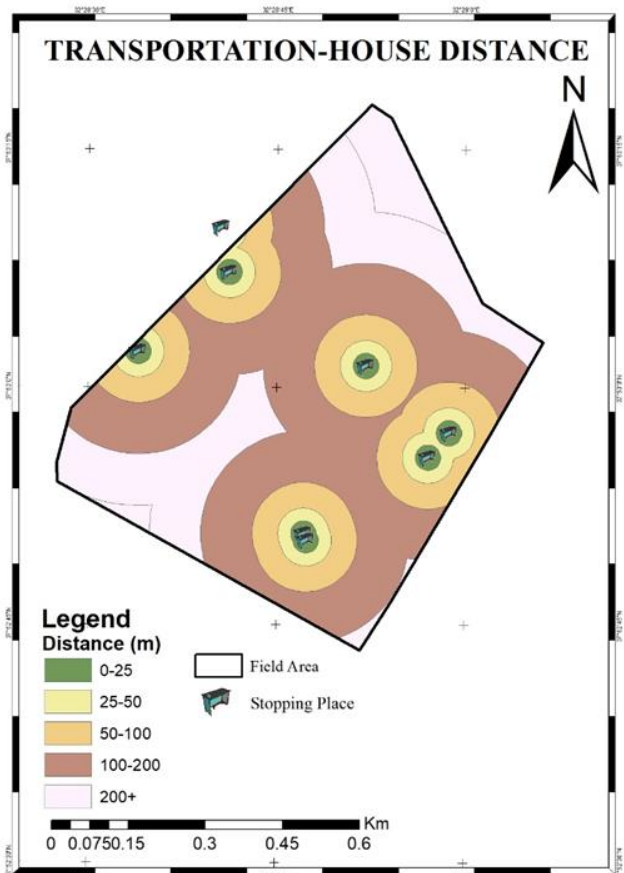


Figure 9. Distance Buffer Analysis Map to Transportation

In this study, it is aimed to make a spatial valuation of the residences in the Hacıkaymak District in Konya. The base used in the study was obtained from the zoning maps of the Selçuklu district of 2019 and Google Maps. The criteria affecting the value of the immovable and the residences were taken from the zoning map and Google Maps, and some operations were carried out in the ArcGIS 10.5 program in order to perform the necessary analyzes in the GIS environment.

For the evaluation of the immovables, 8 main spatial criteria have been determined. These criteria are; distance to the street, distance to health centers, distance to education centers, distance to transportation centers, distance to pharmacies, distance to prayer centers, distance to markets, distance to green areas. Distance maps of these criteria were created. The superiority of the criteria to each other was determined by survey study and scientific research. Within this ratio, the Immovables were weighted by the AHP method according to the degree of importance in the light of the criteria subject to the distance analysis. According to the weighting obtained, a spatial value map of the Hacıkaymak District was produced (Figure 10).

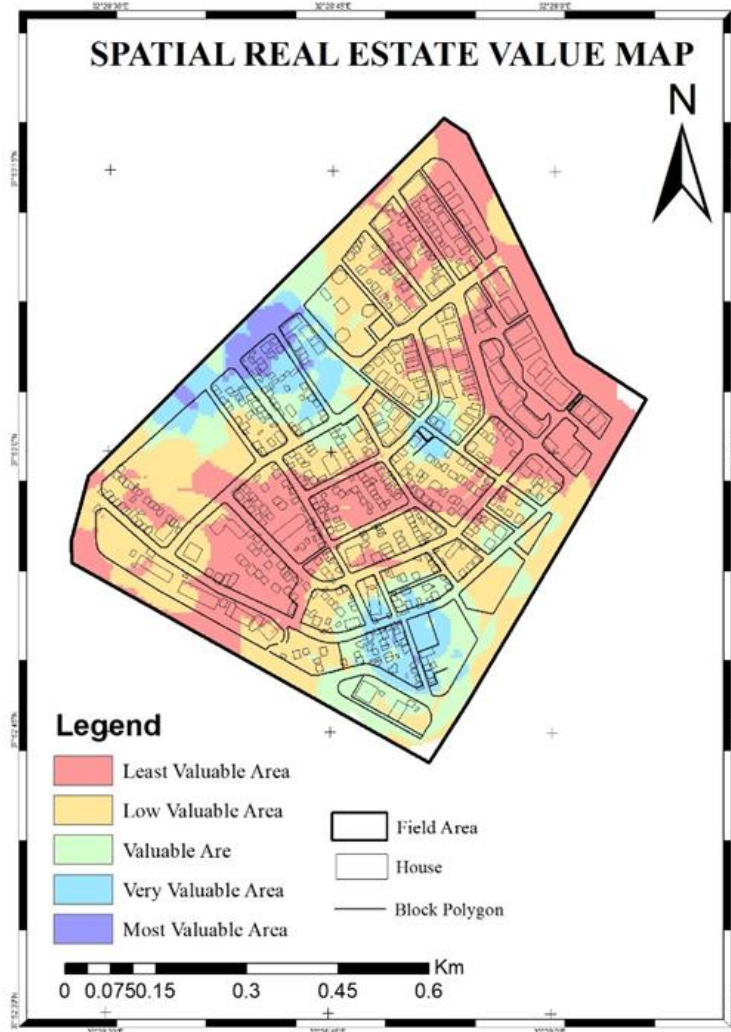


Figure 10. Immovable Value Map by Spatial Criteria

With this study, it is aimed to emphasize the importance of spatial criteria in real estate valuation by showing the effect on the houses located in the same neighborhood. In the real estate value map produced, it has been determined that the houses closer to the street are also closer to other facilities. It has been determined that the houses in the inner parts of the neighborhood are less valuable in terms of location compared to the houses in the outer part.

In the light of this study, it is desired to draw attention to the importance of positional criteria on the basis of valuation. While valuation of the house is made, the criteria of the house are generally taken as a basis. But positional criteria are not considered that important. In fact, spatial criteria are among the factors that affect the value of the house. In order to make the valuation of the house more qualified, it will be important to consider the spatial criteria and to affect the valuation. Based on only the spatial criteria, the change in the spatial value of the houses in a neighborhood is clearly seen in the spatial valuation map produced for the real estates. Therefore, it has been determined that the positional factors that may affect the valuation should be included in the valuation process and this is a requirement for a qualified valuation.

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Author contributions

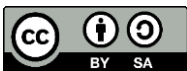
Bengü Özsubaşı: Writing-Original draft preparation, Methodology, Application, **Mehmet Ertaş:** Reviewed and Editing, Investigation.

Conflicts of interest

The authors declare no conflicts of interest.

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