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The Impact of Covid-19 on Real Estate Demand Based on Green Spaces: Case Study of Türkiye (Ankara)

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Abstract

The COVID-19 pandemic in 2020 revealed its impact on various sectors inside our country. The aim of this study is to evaluate the impact of changing socio-economic lifestyle habits during the COVID-19 pandemic on the demand for real estate in Çankaya and Keçioren districts of Ankara., specifically regarding open and green areas. The study's approach involves doing statistical analysis on a dataset consisting of around 28,400 entries from the REIDIN Data&Analytics. This analysis is performed using the E-Views Economic Analysis software. Linear regression analysis and the Kalman Filter Method are used. Then, spatial analyses were performed using GIS by using kernel density analysis. It has been observed that Çankaya's unit pricing per square meter has been found to be higher than those of Keçiören. Based on the residential real estate type, the rate of preference for houses with gardens and distinctive green areas was 4.17% in 2018, 4.22% in 2019, and 4.45% in 2020 in Çankaya district, and 0.13% in 2018, 0.15% in 2019, and 0.14% in 2020 in Keçiören district. Comparisons indicate that the rates in Keçiören are very low. It was concluded that demand for green-space real estate in the Keçiören district increased after the pandemic compared to the pre-pandemic period. On the other hand, in the Çankaya district, there has been a decrease in monthly demand for real estate with green areas since March 2020. During the same period, demand for real estate with green areas in Çankaya remained stable.

Keywords:
COVID-19 pandemic, Real estate demand, Open-green space, Spatial and econometric analysis

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INTRODUCTION

In 2020, the COVID-19 pandemic, which is believed to have originated in Wuhan, China, at the end of 2019 and spread globally, has reached growing public health problem. While there is a decline in demand for accommodations, food and beverages, transportation, education, entertainment, and touristic tours, there has been an increase in demand and significant changes in consumer behavior in other sectors, including health, cargo, and electronic commerce (Izzah, Dilaila and Yao 2021; Baker, Farrokhnia, Meyer, Pagel, and Yannelis 2020; Dones and Young 2020; d'Acci, 2019). The pandemic has caused changes in the real estate industry as well as all other industries. Global restrictions imposed to mitigate the effects of the pandemic have reshaped work, education, shopping, and health habits in residential areas under the slogan "stay at home." In addition to providing shelter, residences now serve the basic functions of working, learning, healthy living, and shopping. Those residing in high-rise buildings such as apartments, residences, and housing blocks have sought to live in detached houses with gardens, balconies, terraces, or houses close to green areas, which they consider to be more free and healthier, and to continue their outdoor activities. This has altered the demand for real estate among users during the pandemic (Mattarocci and Roberti 2020; Severino 2020; Çörek Öztaş 2020; Beuscher and Rudel, 2009).

During the time of the pandemic, there was more demand for detached houses and houses close to green spaces. This caused the prices of these types of housing to go up. Particularly appealing are houses with gardens, balconies, or terraces, a playground within walking distance, active and passive green spaces, recreation areas, sports areas, and walking tracks. Because of this, people in the real estate industry have sped up the production of "residence areas suitable for pandemic life," which have functions that are integrated with natural and subsequently introduced landscape elements, green living spaces, and outdoor spaces (Çörek Öztaş 2020).

The COVID-19 Pandemic, one of the global breaking points, has also had multidimensional effects, particularly on the city economy. There has been a negative impact on the disposable income of those who have been forced to stop working as a result of the pandemic-induced recession or who face an increased risk of layoffs or pay cuts. Additionally, it has been observed that factors other than income are responsible for observable shifts in real estate demand patterns, as is the case in all economic sectors (Ling, Wang and Zhou 2021; Balcı and Türk 2020; Signorelli, Capolongo, D'Alessandro and Fara 2020; Aisha and Susanto, 2018; Beuscher and Rudel, 2009). When evaluating the studies conducted by real estate sector stakeholders, it has been emphasized that a residence can be considered a healthy home if it has a garden, terrace, balcony, natural ventilation, proximity to green areas, and earthquake-resistant construction (Latinopoulos, 2022; Worden, Hazer, Pyke and Trowbridge

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2020; Severino 2020; Çörek Öztaş 2020; Sohn, Kim, Kim and Li, 2020; Kilnarova and Wittmann, 2017).

This study's objective is to assess the effect of shifting socioeconomic lifestyles on real estate demand during the COVID-19 pandemic in the context of open and green spaces. Different social, cultural, and economic structures in the Çankaya and Keçiören districts of Ankara have different real estate requirements. In this context, the benefits of open and green spaces to society, because of their effect on the demand for real estate, have been explained, including those in terms of public health and welfare and cultural development.

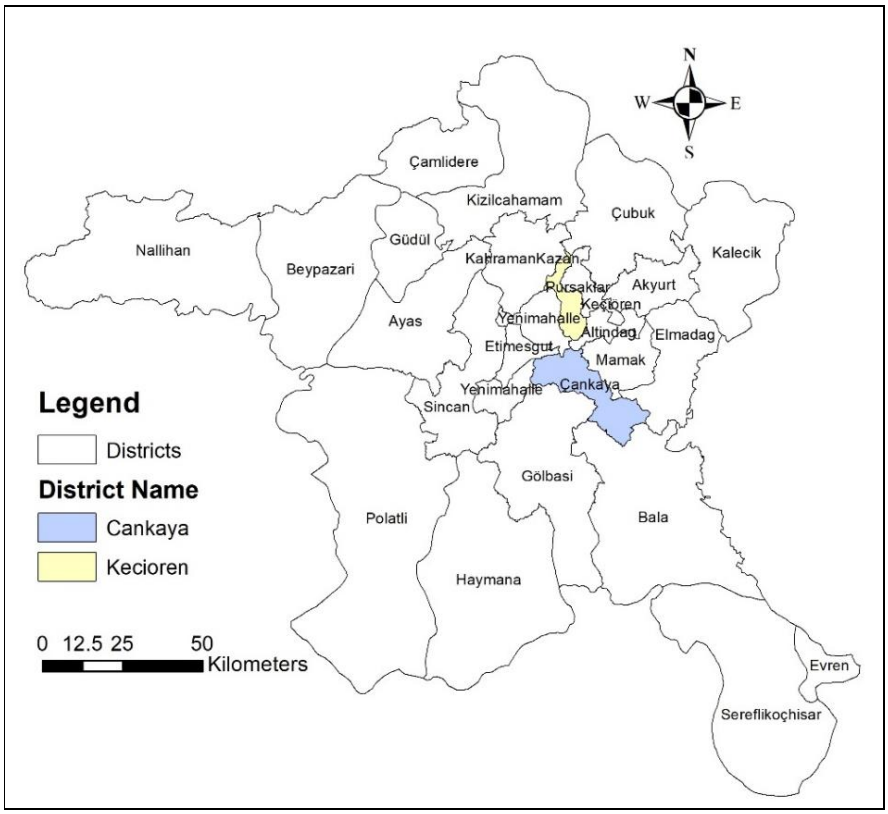

Figure 1. Districts of Ankara

In urban areas, the growth of population and construction occur simultaneously. It indicates that the more people in a community, the more construction there is. Among the twenty-five districts of Ankara, where the population density is high, it is planned to compare two districts with different socio-economic levels as the study area. In this context, the districts of Çankaya and Keçiören were chosen, and the study area was restricted to these two districts (Figure 1).

MATERIAL AND METHOD

This study assesses how the demand for real estate in the context of open and green spaces during the COVID-19 pandemic period is affected by shifting socioeconomic life habits. In this context, the epidemic began in our country in March 2020, thus 2018 and 2019 considered the pre-pandemic period and 2020 and 2021 considered the post-pandemic

period in the period covering the years 2018-2021. Over these time periods, the topic will be the focus of statistical, econometric, and spatial analyses, and the outcomes will be used to reveal changes in real estate demand and their relationships to green spaces. The method determined in this context consists of four main steps in general terms (Figure 2):

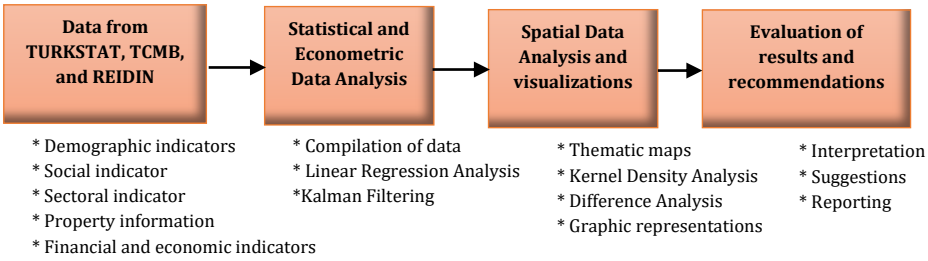

Figure 2. Methodology of the study

The first step in the study is to collect and interpret data from Turkish Statistical Institute (TURKSTAT), The Central Bank of the Republic of Türkiye (TCMB), and REIDIN Data & Analytical Real Estate Data Services. The data collected in the second step were compiled, and statistical and econometric analyses were performed with the help of E-Views Econometric Analysis software. Two different models named Model 1 and Model 2, were used in the context of econometric analysis of real estate demand. Model 1 employed linear regression analysis, whereas Model 2 utilized the Kalman filter method. In the third step, spatial analyses were performed on the compiled data using Kernel Density Analysis with the ArcGIS v.10.8.1 software, thematic maps were produced within the framework of the obtained findings, and the results were visually presented. Finally, the analyzed data and outputs were interpreted, and a set of suggestions were given.

ANALYSES AND FINDINGS

Within the scope of the analysis, monthly real estate sales reports from July 2014 through December 2020 were utilized. The REIDIN Data & Analytics database was queried for the relevant data. The date of March 2020 was identified as the start of the pandemic in Türkiye and was selected as the dummy variable; after this date, the analysis defined the pandemic period. To examine the demand for green space in the Keçiören and Çankaya districts of Ankara, the following real estate subtypes were combined with the green space variables. Variables called 'vineyard', 'garden', 'farm', and 'farmhouse', as well as 'cadastral land', 'miscellaneous land', 'detached house', 'prefabricated house', 'field', 'villa', and 'mansion', were chosen as the determinants of green area according to real estate subtypes (Table 1). In the analyses, these variables were chosen to represent the demand for green space. To make comparisons between the districts of Çankaya and Keçiören, comparable variables were selected from common types and date ranges. To represent the amount of green space in the analysis, the monthly frequency of sales advertisements was considered. In addition, different levels of

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significance-based filtering were performed. E-Views Econometric Analysis software was utilized in the performed analyses.

Table 1. Determinants of green area according to real estate subtypes for the districts of Keçiören and Çankaya (REIDINRebis, 2021b)

Real estate subtypes	**Keçiören**	**Çankaya**
Vineyard	30	200
Garden	585	668
Farm	39	44
Farmhouse	74	118
Mansion	13	59
Miscellaneous land	211	NA
Detached house	133	1,507
Prefabricated house	31	353
Field	635	5,277
Villa	359	18,002
Total	**2,110**	**26,228**

The approach determined here is that, using the demand-creation model, if there is a need for green space, household demand for this type of property should increase. As a result, an increase in demand will result in an increase in supply. In other words, the number of real estate types represented as green areas in the advertisement should increase or decrease. In this regard, the study discusses the number of real estate properties with their own green area that are submitted to monthly advertisements as a dependent variable. As a result, the changes in the number of real estate advertisements (around 28,400 data) with their own green area presented before and after the COVID-19 pandemic were examined using the dummy variable, which takes the value "0" before the COVID-19 pandemic and "1" after the COVID-19 pandemic.

Two models were used in the econometric analysis of the demand for real estate with its own green area presented in the study. First, with fixed parameters, the change in demand for green area real estate before and after the pandemic was examined using linear regression analysis, which was designed as Model 1. Furthermore, because the coefficients were obtained with the Model 1 estimation, the Kalman Filter Method designed as Model 2, was used as the next step. At this point, the goal was to observe the monthly changes in the effects during the pandemic period using a model with time-varying parameters, and Model 2 was used in this direction. Model 2 yielded results on the direction and impact of demand during the pandemic period. The following sections contain information and findings about these models.

Model 1: Linear Regression Analysis

In this model, linear regression analysis was utilized. The Linear Regression Analysis is a statistical technique used to determine the impact of other independent variables on the dependent variable's ability to demonstrate a certain change. The purpose of Linear Regression Analysis is to determine how well the independent variables, also known as features, predict the values of the dependent variable, also known as the target.

According to the equation used in the study,

$$Y_i = \alpha + \beta k_i + \varepsilon_i \quad \text{(Eq.1)}$$

Y_i represents the number of monthly postings, while k_i is a dummy variable with a value of 0 before March 2020 and 1 after, α and β are the parameters of the model, ε is the error term. For the coefficient estimates in the model, Newey-West Varying Variance and Autocorrelation Consistent (HAC) standard errors were utilized. In cases of autocorrelation or varying variance, consistent estimators were thus obtained (Newey and West, 1986).

According to the findings from the analysis of the number of sales advertisements, the demand for real estate with green areas increased after the pandemic compared to the period before the pandemic in Keçiören district. In the Çankaya district, the demand for real estate with green areas decreased after the pandemic compared to the period before the pandemic.

Model 2: Kalman Filter

The Kalman Filter is an algorithm that generates predictions in a state space model with the least mean square error (Kalman, 1960; Kalman and Bucy, 1961; Kalman, 1963). It is an iterative technique for updating the one-step ahead estimate of the state mean and variance based on the information obtained. The Kalman Filter is a very useful tool because the state-space model provides a broad formulation for linear models that can easily handle time-varying parameters, measurement errors, and missing data. Furthermore, there are two major advantages to representing a dynamic system in state space: First, the state space form allows unobserved variables to be included in and predicted by the observable model. Second, the powerful recursive Kalman (Bucy) Filter can be used to analyze state space models. As a result, the related method estimates model parameters using maximum likelihood methods. One of the most essential steps in the analysis of the Kalman Filter is to set up the system composed of measurement and transition equations (Kalman, 1960). In the Kalman filter method, the measurement equation relates the observed measurements to the underlying state of the system. On the other hand, the transition equation is the system of equations that demonstrates how the varying parameters in the measurement equation

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change over time. The model was built as follows to obtain the varying parameter estimates:

Measurement equation	$Y_i = \alpha_i + \beta_i k_i + \varepsilon_i$	$\varepsilon_i \sim \text{iid } N(0, \sigma_\varepsilon^2)$	(Eq.2)
Transition equation	$\alpha_i = \alpha_{i-1} + \eta_i$	$\eta_i \sim \text{iid } N(0, \sigma_\eta^2)$	(Eq.3)
	$\beta_i = \beta_{i-1} + e_i$	$e_i \sim \text{iid } N(0, \sigma_\eta^2)$	(Eq.4)

Table 2. Time-varying parameter estimates for the districts of Keçiören and Çankaya (July 2019 to December 2020).

Date	Keçiören	Çankaya
July 2019	-12.1113	-56.8636
August 2019	-6.3057	-30.3160
September 2019	-5.4483	-36.7920
October 2019	-3.3678	-34.4690
November 2019	-2.7760	-34.9476
December 2019	-2.9179	-35.0599
January 2019	-1.7651	-35.0630
February 2020	-0.4244	-35.0579
March 2020	-0.3098	-35.0562
April 2020	0.2349	-35.0572
May 2020	-0.3917	-35.0581
June 2020	-1.0007	-35.0582
July 2020	-0.7065	-35.0583
August 2020	-0.7425	-35.0582
September 2020	-0.7858	-35.0581
October 2020	-0.7443	-35.0582
November 2020	-0.7520	-35.0584
December 2020	-0.8068	-35.0583

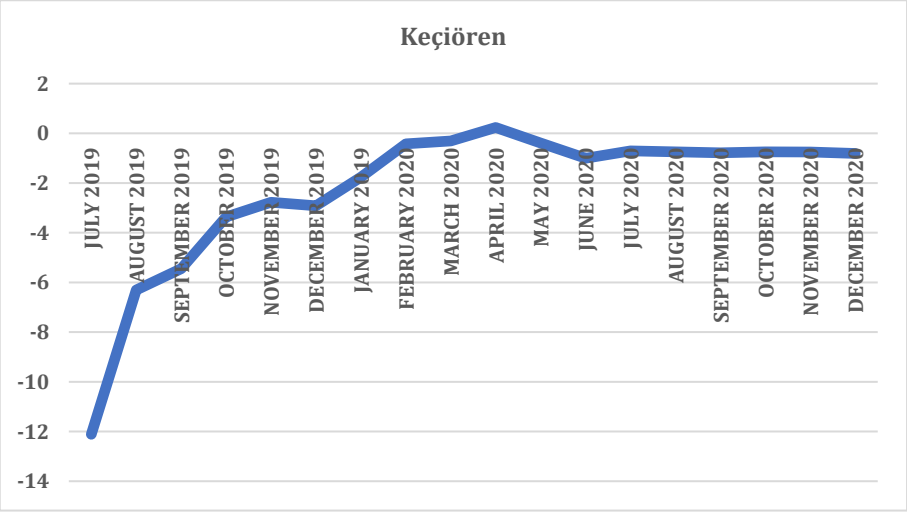

Figure 3. Time-varying parameter estimates for the districts of Keçiören (July 2019 to December 2020).

While there was an increase in demand for real estate with green areas in Keçiören in April 2020, just after March 2020, which was regarded as

the beginning of the pandemic for the district of Keçiören, the demand decreased in the subsequent months. In the period beginning in July 2019 and ending in April 2020, there is a downward trend in the demand for real estate in green areas. In addition, based on the obtained estimates of time-varying parameters, there has been a decrease in the monthly demand for real estate with green areas during the relevant pandemic period beginning in April 2020. As a result of the pandemic, the decline in demand was at its greatest in June. However, there was a decline in demand up until July 2020, and it is observed that it remained stagnant (Figure 3).

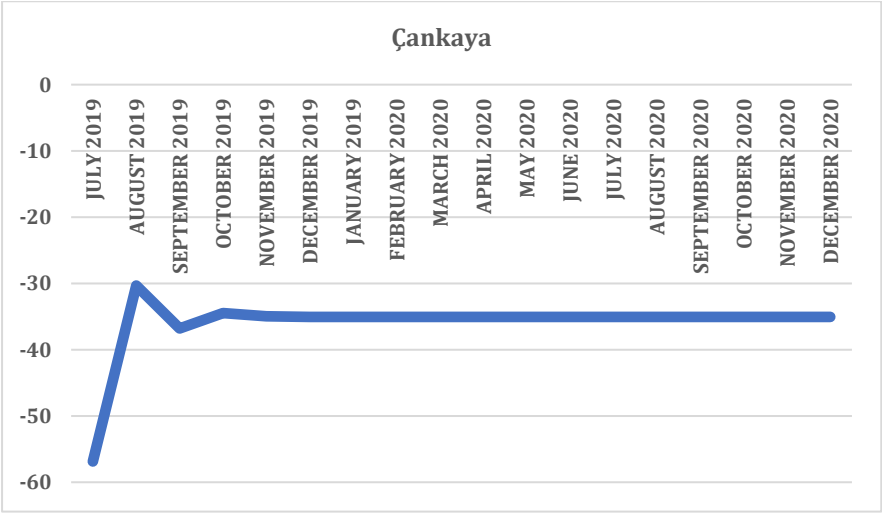

Figure 4. Time-varying parameter estimates for the districts of Çankaya (July 2019 to December 2020).

According to the time-varying parameter estimates obtained for the Çankaya district, when examined from the start of the pandemic, there has been a decrease in the monthly demand for real estate with green areas in Çankaya since March 2020, with the general decline in the relevant period following a stable course. Furthermore, a general examination of the period between July 2019 and December 2020 reveals that the decrease in demand decreased between July 2019 and August 2019, then increased between August 2019 and September 2019, and then decreased again from this date until October 2019. The subsequent period, which includes the pandemic period, shows a stagnant course in the decline in demand (Figure 4).

SPATIAL DATA ANALYSES

The current population of Ankara province and Çankaya and Keçiören districts for 2021 were obtained from the population data collected by TURKSTAT every year through the address-based population registration system. The total population of Ankara consists of 5,747,325 people. While the total population of Çankaya district is 949,265; the total population of Keçiören district is 942,884 (TURKSTAT, 2021). The total population of Çankaya and Keçiören districts corresponds to approximately 33% of Ankara's total population. This means that one out of every three people residing in Ankara lives in Çankaya or Keçiören

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districts (Figure 5). (Detailed maps containing populations on a neighborhood basis are included in appendix a and b)

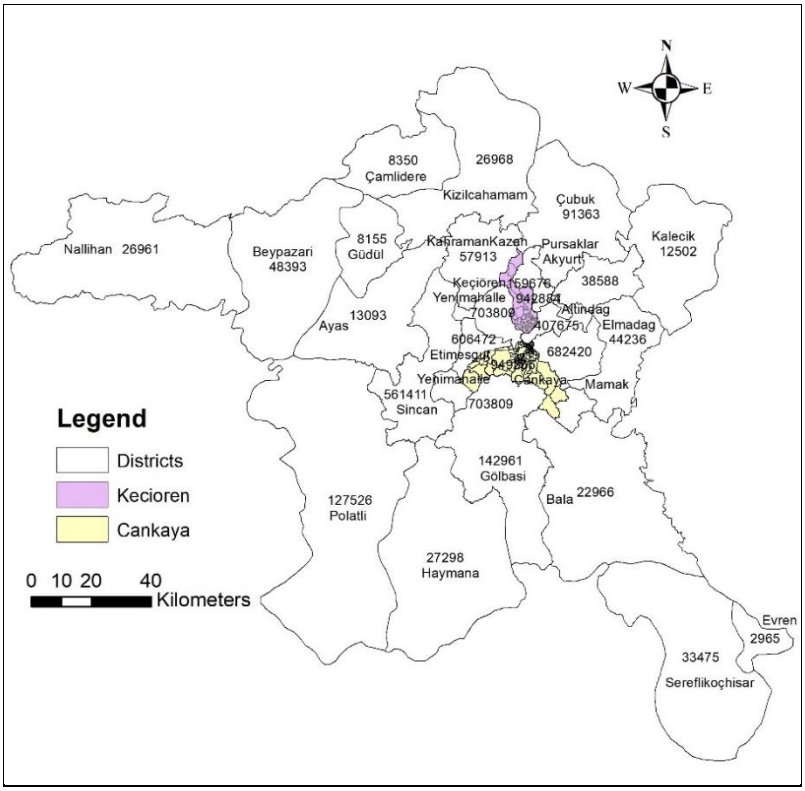

Figure 5. Neighborhood population map

Accordingly, when the two districts are compared, the population is concentrated in the Alacaatlı, Birlik and Üniversite of the Çankaya district, while in Keçiören, it is concentrated in the Atapark, Kuşcağız, Yayla, Ayvalı, Bağlarbaşı, Esertepe, Şehit Kubilay, Pınarbaşı, Etlik, Kanuni, İncirli neighborhoods.

Table 3. Average income in Ankara, Çankaya and Keçiören over time (TL) (2014-2020) (REIDINRebis, 2021a)

Years	Ankara (TL)	Çankaya (TL)	Keçiören (TL)
2014	1,889	3,297	1,638
2015	2,019	3,594	1,745
2016	2,181	3,928	1,885
2017	2,558	3,487	2,134
2018	2,787	3,745	2,380
2019*	3,282	4,552	2,793
2020*	3,795	5,555	3,244

* 12-month average exchange rate for 2019 is 1 USD=5.6814 TL and 1 EURO=6.3595 TL; for 2020 is 1 USD=7.0160 TL and 1 EURO=8.0284 TL. (TCMB, 2021)

The increase in monthly income per capita and the increase in real estate acquisition can be said to have a direct proportional increase with each other. As a result, it is worthwhile to examine the annual increase in monthly income per capita in Ankara and two selected districts. When the change in monthly income per capita in Ankara is examined by year, it is

seen that there is a directly proportional increase based on the years studied (no data is available for 2021). The annual increase rate of this increase is observed to range between 8% and 15%. When the change in monthly income per capita for Çankaya and Keçiören districts is compared over time, the average income in Çankaya is approximately 40% higher than the average income in Keçiören (Table 3).

The Socio-Economic Rating (SER) displays the relative socio-economic rankings as well as regional rankings at the district and neighborhood levels. The goal is to rank the regions based on their welfare, livability, and cultural levels using the variables used. In this context, the variables used are sales and rent values for the welfare level; population, housing density, number of stores, rail public transportation systems, number of health institutions, life satisfaction data, number of beds per 1000 people in hospitals, population per family doctor, population per 112 Station, population per ambulance, total crime rates, household numbers, airborne particulate matter concentrations (PM_{10}), and culture.

REIDIN SER regions are clustered based on their similarity to one another into nine distinct predetermined classes. There are nine classes determined: A+, A, A-, B+, B, B-, C+, C, C-, and this classification demonstrates the socioeconomic superiority of districts and neighborhoods to one another. The final SER score ranking is for 2020. SER scores were compared in the Çankaya and Keçiören neighborhoods in this context, which explains the selection of the two test areas in the study (Table 4).

Table 4. SER values by districts of Ankara (REIDINRebis, 2021a)

District	SER Value	District	SER Value	District	SER Value
Çankaya	**A+**	Altındağ	C	Kahramankazan	C-
Yenimahalle	B	Mamak	C	Polatlı	C-
Gölbaşı	B-	Beypazarı	C-	Çubuk	C-
Etimesgut	B-	Kızılcahamam	C-	Elmadağ	C-
Keçiören	**C+**	Pursaklar	C-	Akyurt	C-
		Sincan	C-		

According to Table 4, Çankaya averaged an A+ on the SER, whereas Keçiören averaged a C+. Çankaya has higher average sales prices and rental values on a residential basis than Keçiören in 2020, at a level that will affect the welfare level; the livability level is higher in terms of demographic structure, transportation and health services, and air quality; and in terms of education level and cultural structures, the cultural level is higher.

When the House Price Index (HPI) (2017=100) data, calculated to monitor the quality-adjusted price changes of houses in Türkiye, is analyzed, a continuous increase in the HPI is observed both in Türkiye and in Ankara between the years 2018 and 2021, as shown in Figure 5. It was concluded that the rate of increase in HPI, particularly in 2020 and 2021, was higher for both Türkiye and Ankara during the studied period than in previous years.

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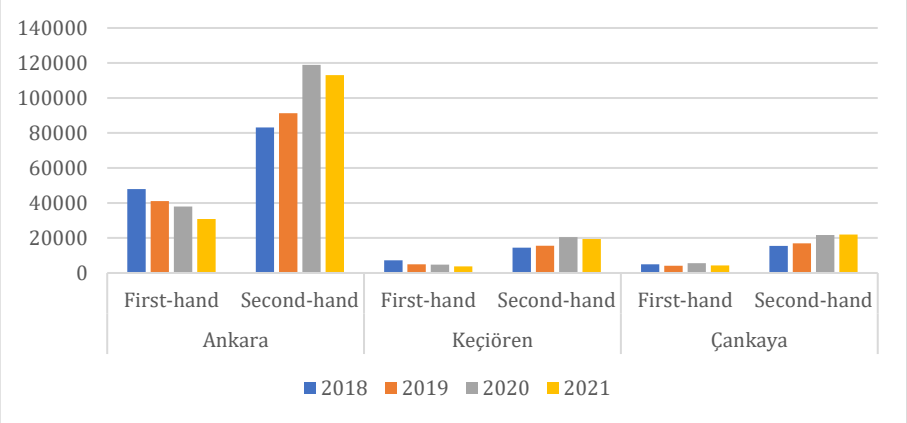

Figure 6. Total house sales in Ankara, Çankaya and Keçiören over time (2018-2021) (REIDINRebis, 2021b)

Based on the housing sales data for the districts of Keçiören and Çankaya, as shown in Figure 6, a total of 20.526 (4.932 first-hand, 15.594 second-hand) houses were sold in 2019, 25.283 (4.761 first-hand, 20.522 second-hand) houses were sold in 2020 and 2021, and 23.170 (3.755 first-hand, 19.415 second-hand) houses were sold in 2021. Çankaya had the sale of 21.120 residences in 2019 (4.158 first-hand, 1.962 second-hand), 27.278 residences in 2020 (5.569 first-hand, 21.709 second-hand), and 26.229 residences in 2021 (4.304 first-hand, 21.925 second-hand). As is the case throughout Ankara, it is observed that second-hand housing sales are primarily carried out in the Keçiören and Çankaya districts, which account for about one third of all housing sales.

Table 5. Price per square meter and year-on-year fluctuations for Keçiören and Çankaya from 2018 to 2019. (REIDINRebis, 2021b)

Years	Keçiören (TL)	Çankaya (TL)	Rate for Keçiören	Rate for Çankaya
2018	1515	2518	4%	2%
2019*	1583	2565	16%	16%
2020*	1839	2969	37%	29%
2021	2514	3829		

* 12-month average exchange rate for 2019 is 1 USD=5.6814 TL and 1 EURO=6.3595 TL; for 2020 is 1 USD=7.0160 TL and 1 EURO=8.0284 TL. (TCMB, 2021)

The difference between 2018 and 2021 has grown in direct proportion for both districts according to the m^2 housing sales prices in the Keçiören and Çankaya districts. The Çankaya district has higher m^2 price values than the Keçiören district. Keçiören has a higher variation in the rate of increase in m^2 prices than Çankaya district for 2018–2019, despite Çankaya district having higher housing m^2 prices for the 2019–2020 and 2020–2021. For the years 2018-2019, the change is 4% in Keçiören and 2% in Çankaya; 16% in Keçiören and Çankaya for the years 2019-2020; and 37% in Keçiören and 29% in Çankaya for the years 2020-2021 (Table 5).

Upon analyzing the sales statistics of the districts of Çankaya and Keçiören based on real estate categories, it is evident that focusing types constitute the majority of transactions. Compared to the district of

Çankaya, house sales in Keçiören are 3–9% higher. When sales in the Çankaya and Keçiören districts are examined by residential real estate type, the rate of preference for housing types with gardens and green areas (e.g., farmhouse, mansion, detached house, villa) is determined to be 4.17% in 2018, 4.22% in 2019, and 4.45% in 2020 for the Çankaya district. When each type of house is evaluated separately, total sales tend to decrease over time. On the other hand, in the Çankaya district, there is a slight increase in the preference level for housing types with their own green areas. When compared to Çankaya district, the rates in Keçiören district are very low. It was calculated that it would be 0.13% in 2018, 0.15% in 2019, and 0.14% in 2020. When each type of home is evaluated separately, it is possible to conclude that sales of apartments are rising while sales of other types are falling. In the Keçiören district, the preference level for housing types with distinctive green areas increased slightly in 2019 and then decreased again in 2020.

Determination of the densities of green areas

The density and distribution of green spaces (such as parks, playgrounds, forests, picnic areas, recreational areas, etc.) were analyzed. Most parks and other green spaces can be found in the southern part of the district Keçiören, which contains a total of 421. Northern and western Çankaya are where you'll find most of the district's green spaces. There are 546 parks and other green spaces in this area (REIDINMap, 2021).

The Kernel Density Analysis function of ArcGIS v.10.8.1's Spatial Analysis Tool was used to express the density of points related to green areas. This function calculates the density per unit area based on the number of points and lines provided and a default search radius. In this study, the density was calculated using the software's default parameters (Silverman's Rule of Thumb). The thematic map showing the change in home sales in the Çankaya and Keçiören districts over time was overlaid with maps displaying green area densities to reveal the relationship between home sale prices and green space. On the map, the regions with green tones indicate areas with a high concentration of green areas in the district. The spaces with dense green areas are represented by the dark green areas produced by the kernel density analysis, while the spaces with less dense green areas are shown by a gradual opening of the green color tone.

According to Figure 7, the part where the green areas in Keçiören are concentrated to Ayvalı (27), Kuşcağız (22), Etlik (20), Bağlarbaşı (19), Atapark (19), Esertepe (18), Yayla (16), Kavacık Subayevleri (13), İncirli (13), Osmangazi (12), Sancaktepe (12), Şehit Kubilay (12), Basınevleri (11), Kanuni (11), Kalaba (10), Ovacık (10), Şefkat. (10), and Yeşiltepe (10) neighborhoods.

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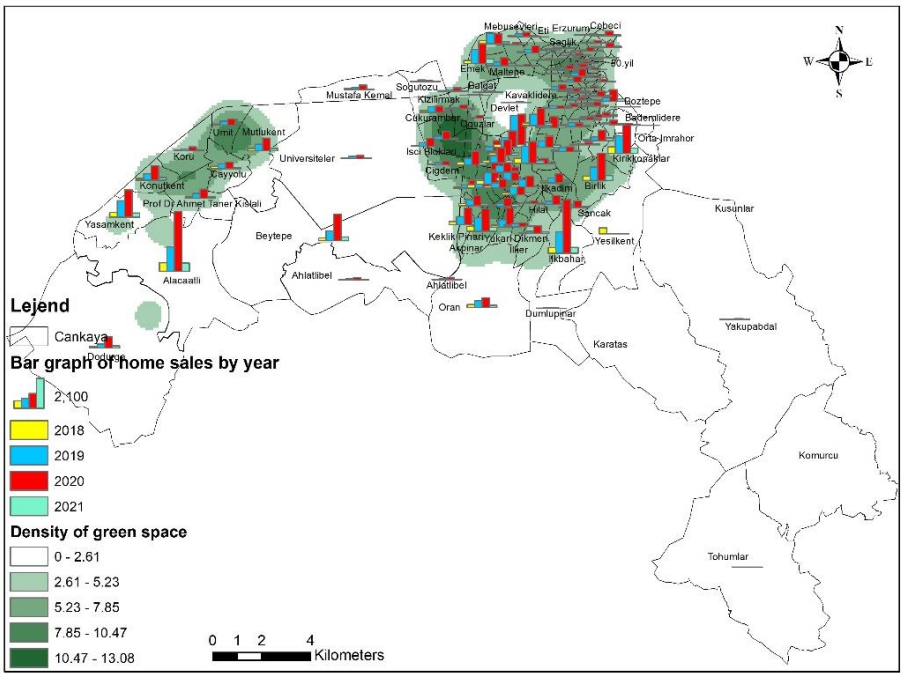

Figure 7. The relationship between the number of housing sales in Çankaya district over the years and green areas

According to Figure 8, the part where the green areas in Çankaya are concentrated (together with the number of green areas) is located at Mutlukent (28), Prof. Dr. Ahmet Taner Kışlalı Mh. (24), Birlik (23) Ümit (22) Koru (19), Konutkent (16), Yaşamkent (16), İşçi Blokları (14), Alacaatlı (12), Yıldızevler (12), Oran (12), Çukurambar (12), Çayyolu (11), Kırkkonaklar (11), Huzur (10), Çiğdem (10), Yukarı Dikmen (10), and Dodurga (10) neighborhoods.

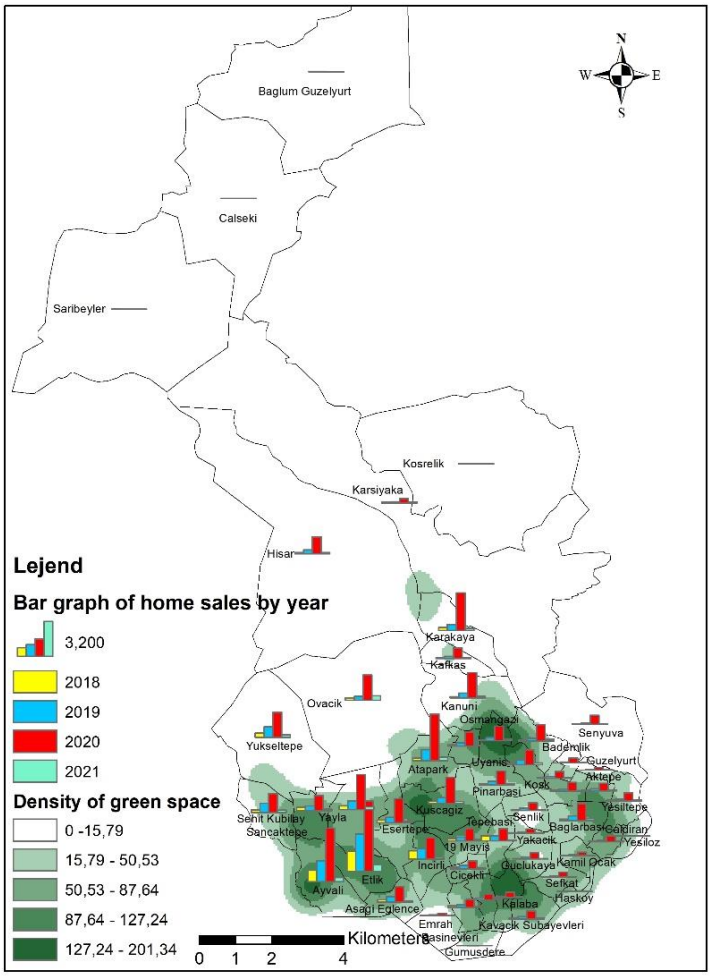

Figure 8. The relationship between the number of housing sales in Keçiören district over the years and green areas

The bar graphs of the housing sales for the neighborhoods of Çankaya and Keçiören for four different dates (2018, 2019, 2020, and 2021) are overlaid in Figures 7 and Figure 8 to show the relationship between the annual house sales in the neighborhoods and the green spaces. When the distribution of housing sales preferences was examined, it became clear that homes close to green spaces are in high demand.

Producing Thematic Maps

To map the real estate sales data of the Çankaya and Keçiören districts, the housing data were first grouped in the database. The data were then classified into 8 classes using the Natural Breaks-Jenks Method in the ArcGIS v.10.8.1 environment, and thematic maps for real estate sales data and difference maps showing the change between years were generated. The findings obtained through thematic maps and difference maps generated based on 2018, 2019, 2020, and 2021 were expressed spatially while mapping the real estate sales data of the Çankaya and Keçiören districts.

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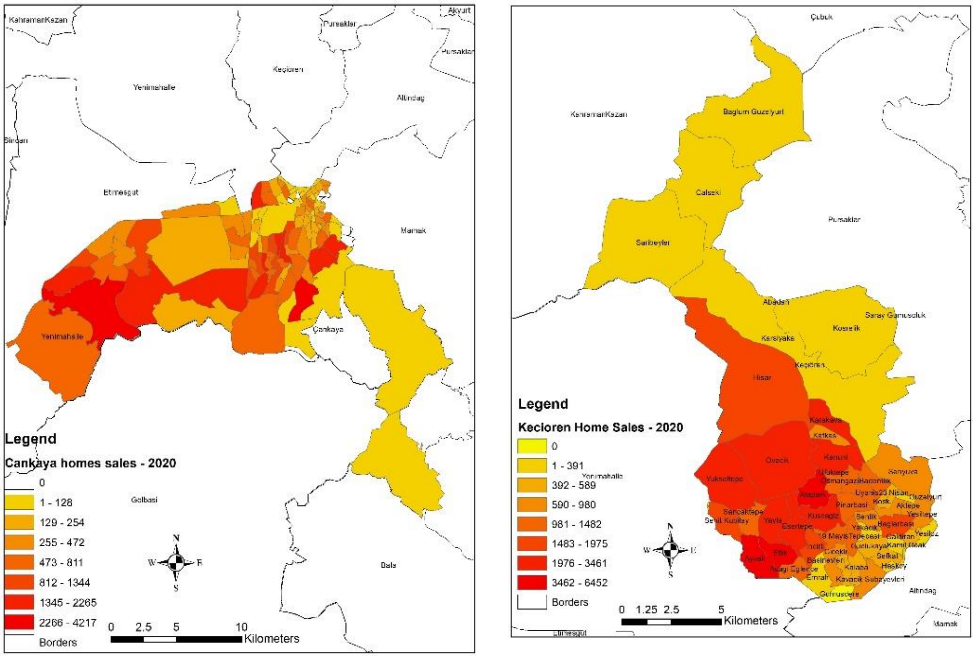
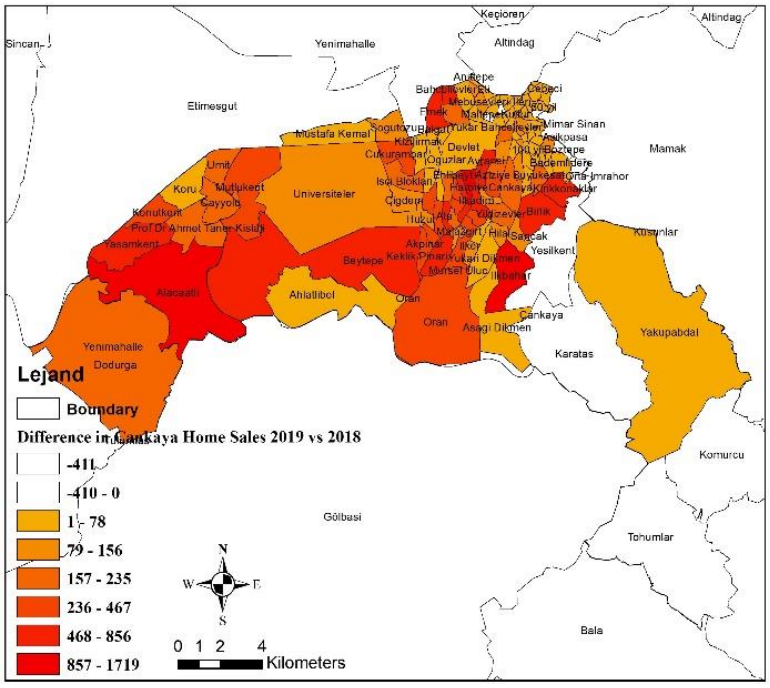


(a) (b)

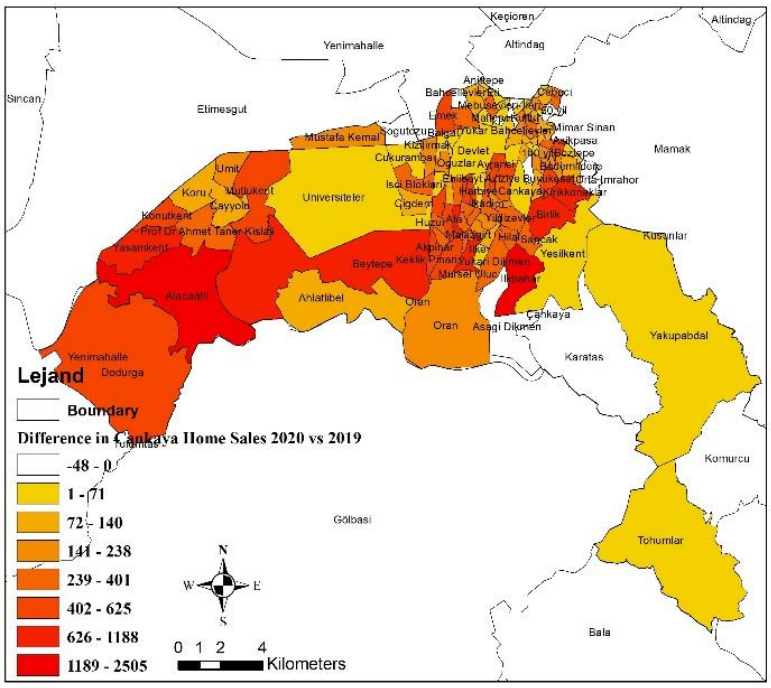
Figure 9. The The year 2020, when the highest sales were realized in Çankaya (a) and Keçiören (b) districts

According to Figure 9, when the number of housing sales in Çankaya and Keçiören districts is analyzed by years, the top 10 neighborhoods with the highest sales in 2020, for Çankaya, are Alacaatlı, Bahar, Harbiye, Kırkkonaklar, Yaşamkent, Birlik, Beytepe, Ata, Keklikpınarı, and Emek neighborhoods. For Keçiören district, it is seen that the top 10 neighborhoods with the highest sales in 2020 are Etlik, Ayvalı, Atapark, Karakaya, Yayla, Kuşcağız, Ovacık, Kanuni, Yükseltepe and Esertepe neighborhoods.

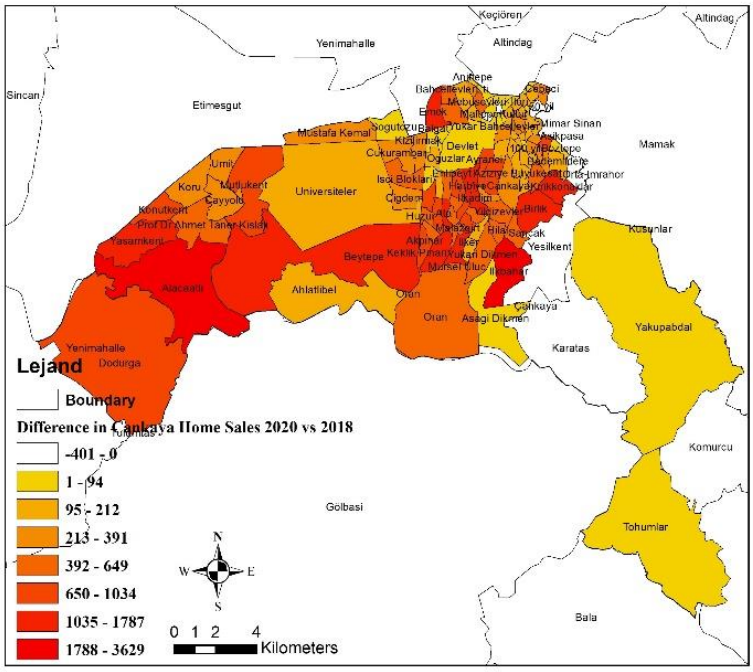


(a)

Figure 10. Differences in house sales in Çankaya district between the years 2018-2019 (a), 2019-2020 (b), and 2018-2020 (c)



(b)



(c)

The variation in housing sales in the Çankaya district in 2018, 2019, and 2020 is shown in Figure 10. On the map, the neighborhoods with the highest real estate sales are highlighted in red, whereas the neighborhoods with the lowest sales are highlighted in light yellow. The difference between 2018 and 2019 is the most significant, according to Harbiye (1719), Alacaatlı (1124), and İlkbahar (1116); the difference between 2019 and 2020 is the most significant, according to Alacaatlı (2505), İlkbahar (2269), and Beytepe (1188); the difference in home sales was the most pronounced between 2018 and 2020, particularly

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in Alacaatlı neighborhood, the most sales were provided in 2020, with 4,217 house sale. The greatest housing sales differences are between 2018 and 2020, according to an analysis of the three different maps of the Çankaya district.

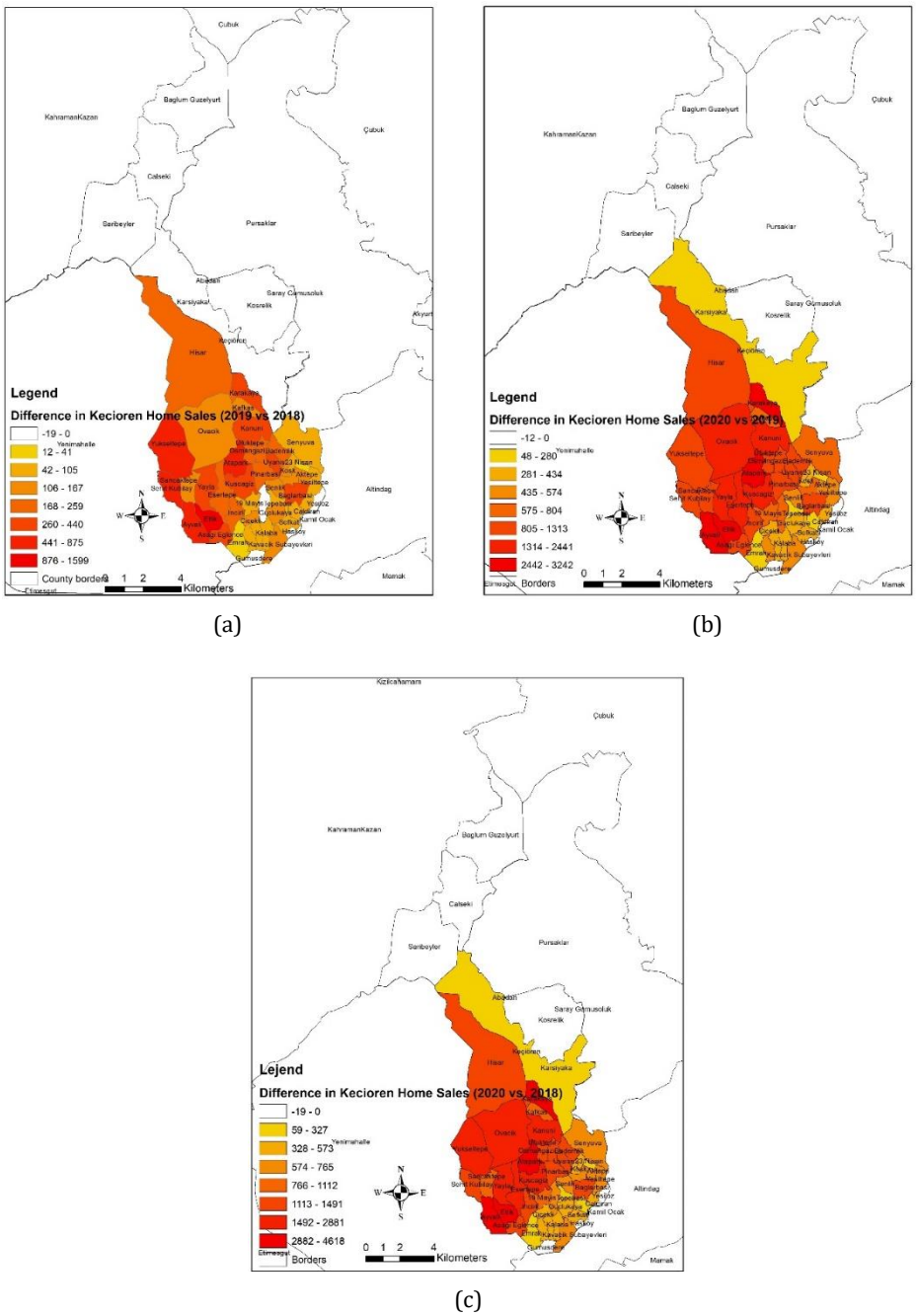

Figure 11. Housing sales differences of Keçiören district between the years 2018-2019 (a), 2019-2020 (b), and 2018-2020 (c)

Figure 11 shows that when the difference maps showing the change in house sales in Keçiören district between 2018, 2019, and 2020 are analyzed, it was observed that sales in the difference maps of 2018 and 2019 are more intense at Etlik (1599), Ayvalı (875), and Atapark (774). Atapark (3242), Etlik (3019), Ayvalı (2995) and Karakaya (2904) have the highest sales data between 2019 and 2020, while Etlik (4618), Atapark (4016), Ayvalı (3,870), and Karakaya (3188) have the highest

sales data between 2018 and 2020. When the three difference maps of Keçiören district was evaluated together, the highest sales were realized in Etlik with 6452 residences in 2020. Again, for this neighborhood, it was seen that the difference in house sales is the highest in the period between 2018-2020.

CONCLUSION AND RECOMMENDATIONS

With the emergence of the COVID-19 pandemic at the end of 2019, many sectors at the local, national, and global levels were impacted by the epidemic's negative social, economic, and physical consequences. The deterioration of health, confinement to homes, alienation from social environments, cessation of education, feeling of isolation, fear of death, and depression have caused physical and social deterioration. Production declines, business closures, layoffs, workforce loss, unexpected changes in trading activities, some sectors declining and others becoming more prominent, financial concerns, and other factors resulted in economic losses and inequalities. As a sector affected by all these negatives, the real estate sector, which is at the heart of people's shelter and protection, has attempted to develop a perspective and implement measures to overcome the situation with the least amount of damage. During the pandemic period, solutions to problems in the real estate sector were sought, and decisions were made to implement housing-type investments that would allow users to overcome the problem socially and physically. In this context, designing healthier, more livable, functional, nature-integrated, and sustainable housing areas has become the construction industry's primary goal, and this has directly affected the real estate industry, causing the process to transform positively for users. Users have begun to prefer detached houses with their own green areas, gardens, balconies, terraces, or houses near green areas to avoid the restlessness and depression caused by staying at home during the pandemic period.

On the other hand, the change in housing prices and demand, which cannot be solely attributed to the global epidemic, has also been significantly influenced by the economic change in certain periods or the country's real estate sector decisions. The TCMB reduced the policy rate from the second half of 2019 to the first half of 2020, before increasing it in the fourth quarter of 2020. The policy interest rate continued to rise in the first quarter of 2021, while it fell significantly in the fourth quarter of this year (TCMB, 2021). Taking this into account, although it has been observed that housing sales in Türkiye tend to increase after the first months of the pandemic process, with housing loan interest rate cuts and the facilitation of loan supply conditions, the rise in policy rates, the change in conditions, and the increase in construction costs, it has entered a new period of decline because of the effects of global economic fluctuations.

Although the increase-decrease in housing demand varies with financial sufficiency, individual preferences, needs, and demands that

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arise because of the period's conditions are also effective in the demand for housing type. Therefore, the pandemic period has brought some changes in housing demand. People living in high-rise buildings preferred structures with gardens, balconies, terraces, or demanded accommodation units with open and green areas or near open green areas for education, work, shopping-rest or requested accommodation units near an open green space for a healthy life. This shift in demand has resulted in an increase in housing prices. This demonstrated that green spaces were not only used for recreation but also contributed to bettering citizens' health, integrating citizens with nature, and increasing the value of the dwelling.

Due to the defined reasons explained above, the districts of Çankaya and Keçiören examined in this study have the highest population in Ankara. When income levels are examined, Çankaya's income level is higher than Ankara's overall, whereas Keçiören's income level is lower than the Ankara average. The average income in the Çankaya district is approximately 40% higher than the average income in the Keçiören district. Based on the socioeconomic rating levels, Çankaya is at A+ and Keçiören is at C+. The value of the house to be purchased increases in direct proportion to the income. Thus, houses with higher prices are sold in Çankaya district compared to Keçiören. The reason for this is because the unit prices per square meter in Çankaya (2,565 TL/m²-2019; 2,969 TL/m²-2020) are greater than those in Keçiören. (1,583 TL/m²-2019; and 1,839 TL/m²-2020). According to the residential real estate type, the rate of preference for houses with gardens and distinctive green areas (farmhouse, mansion, detached house, villa, waterside residence) was 4.17% in 2018, 4.22% in 2019, and 4.45% in 2020 in Çankaya district, and 0.13% in 2018, 0.15% in 2019, and 0.14% in 2020 in Keçiören district. When compared to the Çankaya district, the rates in Keçiören are very low[1].

After the pandemic, demand for green-space real estate in the Keçiören district increased in comparison to the pre-pandemic period. The demand for real estate with green areas in Çankaya district decreased after the pandemic compared to the period before the pandemic. Following March 2020, which was considered the start of the pandemic, for the Keçiören district, there was an increase in demand for real estate with green areas in April, followed by a decrease in demand in the following months compared to April. According to the time-varying parameter estimates obtained, the monthly demand for real estate with green areas in general has decreased beginning in April 2020. While the decrease in demand was at its peak in June 2020, there has been a decrease in demand since July, and it has continued to stagnate since then.

[1] m² prices in 2019 for Keçiören is 279 $ and 249 € while Çankaya is 452 $ and 403 €; in 2020 for Keçiören is 262 $ and 229 € while Çankaya is 423 $ and 370 € (TCMB, 2021).

When examining the pandemic period specifically for the Çankaya district, there has been a decrease in monthly demand for real estate with green areas since March 2020. During the same period, it was observed that the decrease in demand for real estate with green areas in Çankaya remained stable. Furthermore, general examinations showed that the decrease in demand decreased between July 2019 and August 2019, then increased between August 2019 and September 2019, and then decreased again from this date until October 2019. The subsequent period, which includes the pandemic period, shows a stagnant course in the decline in demand.

When the years between 2018 and 2020 were examined, it was observed that the following neighborhoods had the most house sales: Alacaatlı, Harbiye, Kırkkonaklar, İlkbahar, Yaşamkent for Çankaya, and Etlik, Ayvalı, Atapark, İncirli, Karakaya for Keçiören. The relationship between the number of house sales and green areas in both Çankaya and Keçiören districts between these years demonstrates that housing sales preferences are over areas on or near green areas.

Between 2020 and 2021, sales dropped dramatically, and no useful data could be found. In other words, as the pandemic process gradually lost its impact, housing sales have fallen between these years. As a result, this particular situation may be studied as a different topic.

The fact that there are more apartment-style homes and less green space in the Keçiören district than in the Çankaya district shows how much more people needed open green spaces during the pandemic. During this time, people in Keçiören have been looking for homes with their own green space. In the Çankaya district, there are more homes with their own green space, there is more green space in the district, and it is easier to get to green spaces than in Keçiören. This shows that home ownership hasn't changed much since the pandemic, and it is still going in the same direction. One possible reason for the drop in demand for homes in this area during and after the pandemic is that the prices per square meter of houses in Çankaya with their own green spaces went up faster than the interest in these kinds of houses.

If a general evaluation is done, the population of the district, the size of the household, differences in cultural structure, changes in tastes and preferences, and the desire for physical and mental relaxation of people who have to stay at home because of the pandemic can be seen as possible socio-cultural reasons for the different demand for housing with different sizes and features in each district. Also, different income levels of the districts, the government's housing policies, the interest rates on housing loans, and making it easier to get loans can all be seen as possible economic factors that will lead to a preference for more expensive housing. Also, the speculation that housing prices will go up even more in the future because it's hard to know the pandemic situation as a speculation that led to the increase in housing prices by making more people want to live in the districts (appendix c).

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Considering these evaluations, the following recommendations for green areas and their relationship to real estate can be made:

- When developing city plans, green spaces should be planned in a balanced and systematic manner throughout the city, rather than separately from residential areas.
- The amount of urban green space per capita should be reconsidered, taking into account the population of the neighborhoods as well as the possibility of using them as a resting and regeneration area, as well as a gathering area in emergencies such as natural disasters.
- Access to open and green space in the immediate vicinity of existing residential areas should be enhanced.
- In the residential areas that are planned to be built, it should be ensured that the natural and built environments are planned in an integrated manner.
- In addition to considering elements that improve ventilation, such as balconies and terraces, new residences should prioritize the planning of residential areas with gardens, open spaces, and green areas.
- Interior design elements for ventilation, maximum daylight use, and efficient energy use should be prioritized in the interior design of new houses to be built.
- Functional interior designs incorporating natural elements (roof garden, open-closeable terrace-balcony garden, winter garden, etc.) should be implemented in accordance with demand changes manifested at various times and for various reasons.

The importance of green spaces in terms of citizens' quality of life and a healthy city life in terms of physical and social aspects has been demonstrated by this study. The results demonstrate that green spaces close to residential areas not only raise the value of homes but also significantly improve people's quality of life. Therefore, when planning residential areas, city officials should consider the proximity of green areas visible from the house and within walking distance as an important criterion. Green areas near residences will benefit citizens' health, both physically and psychologically, and will serve as places where people can get away from indoor spaces, be alone with nature, and relieve stress. Furthermore, green areas near residential areas can be used as a gathering area in the event of disasters and emergencies, as well as an activity area for citizens to socialize.

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Resume

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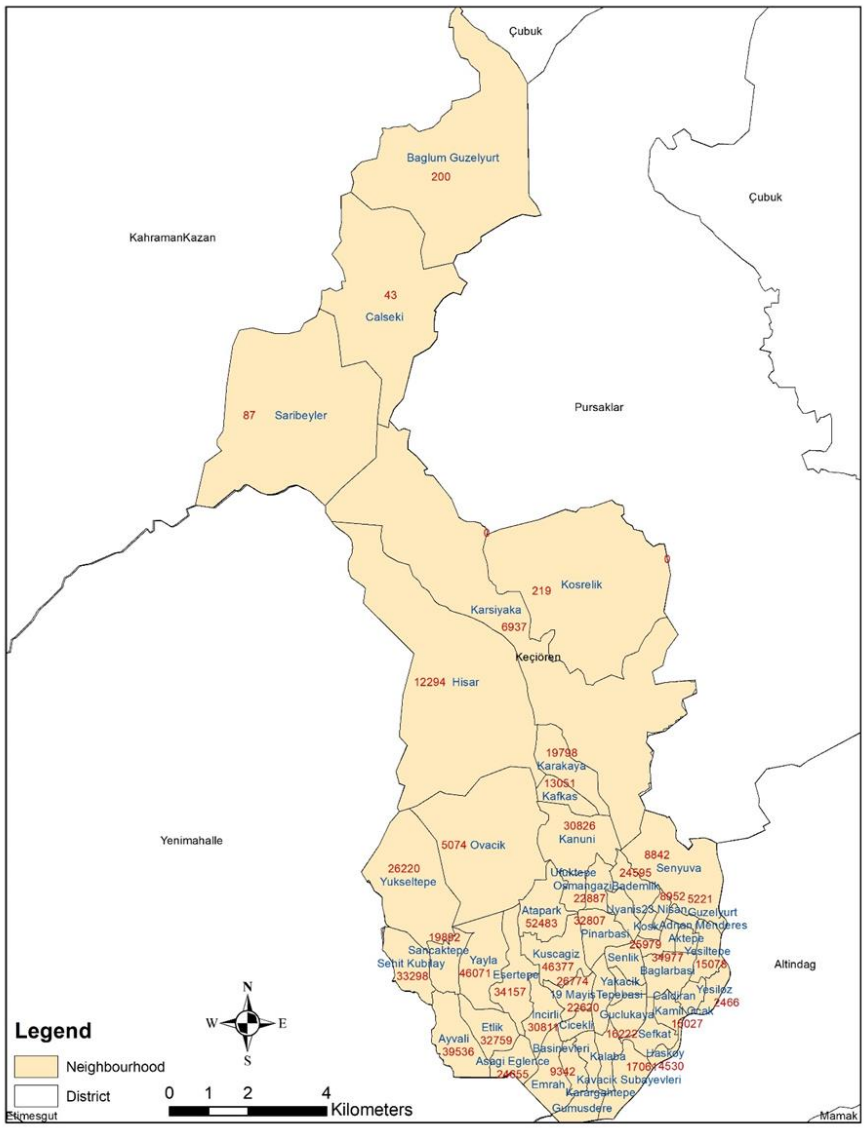
Appendix a. Keçiören's neighborhood population map



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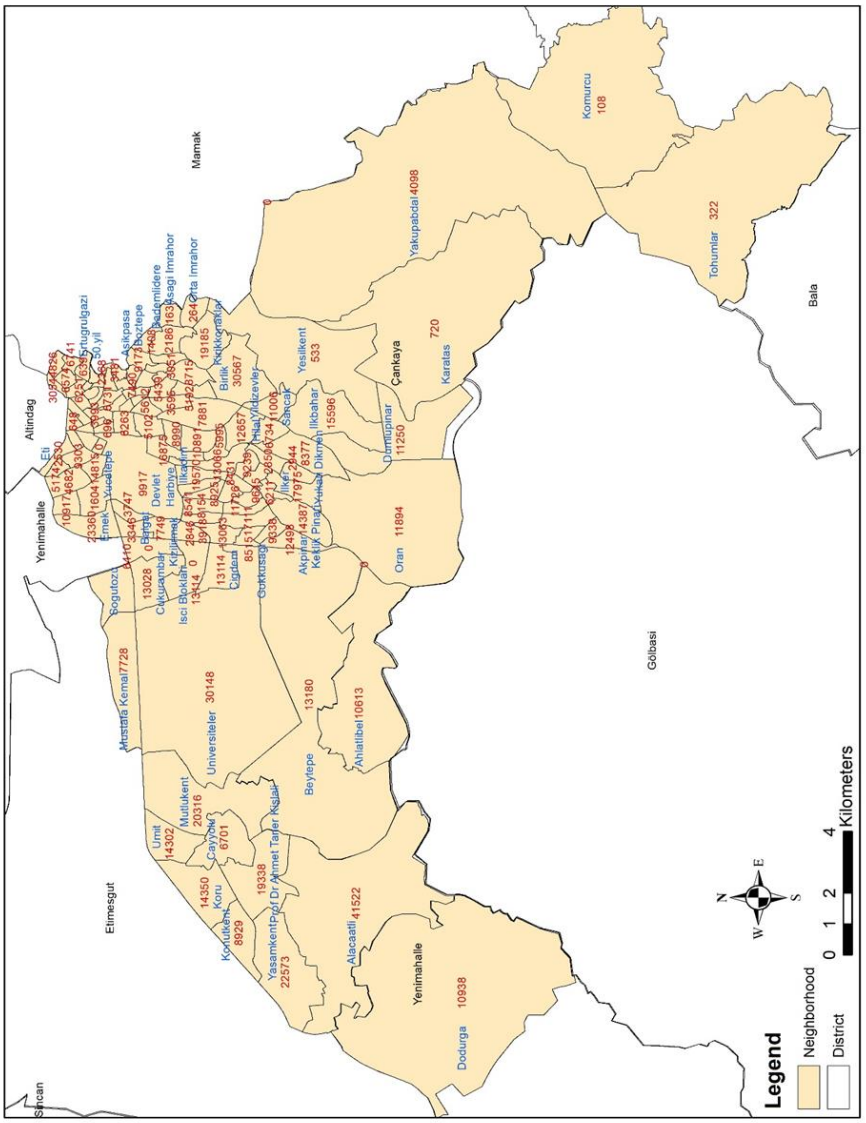
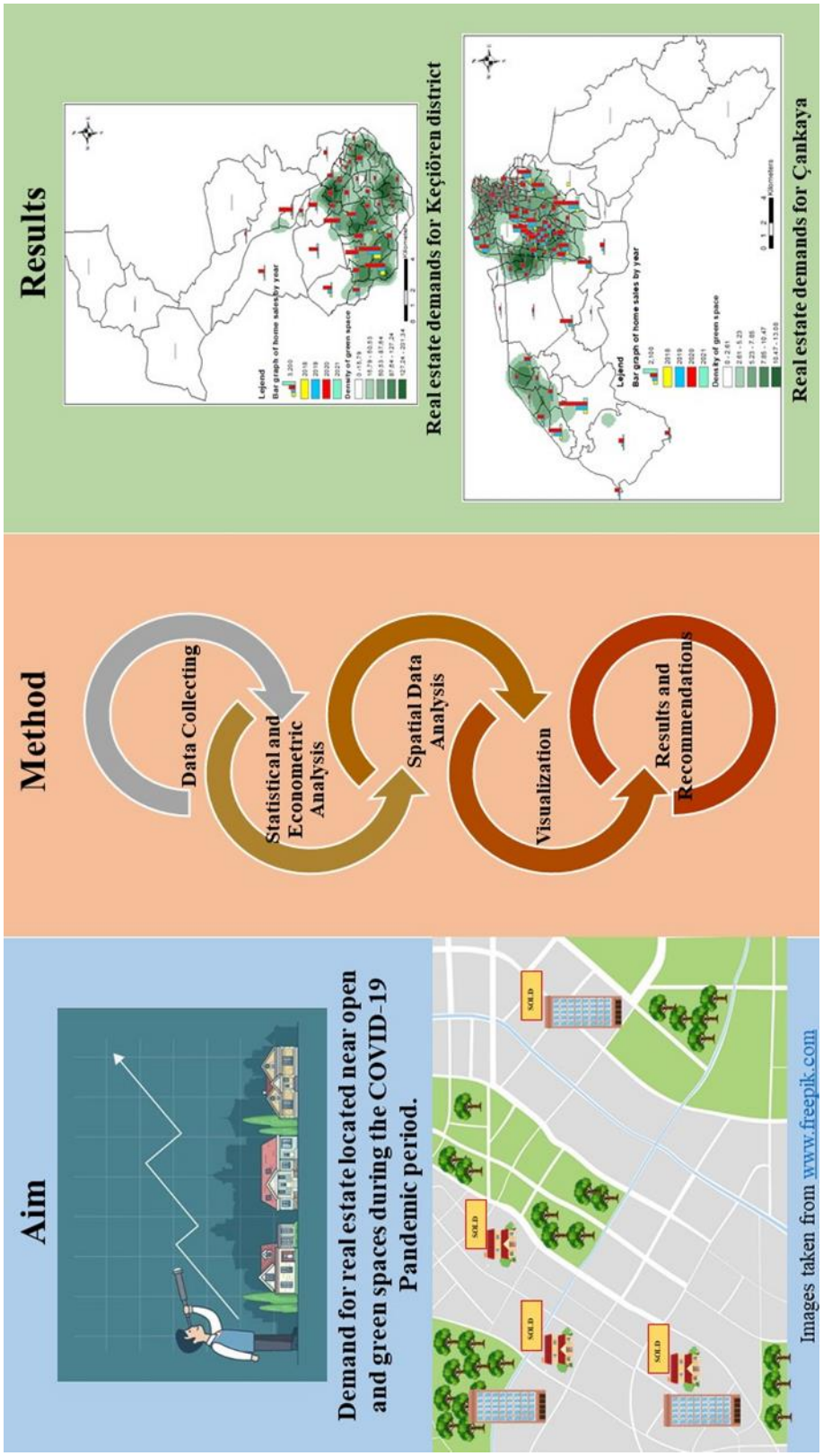
Appendix b. Çankaya's neighborhood population map



Appendix c. Graphical abstract



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