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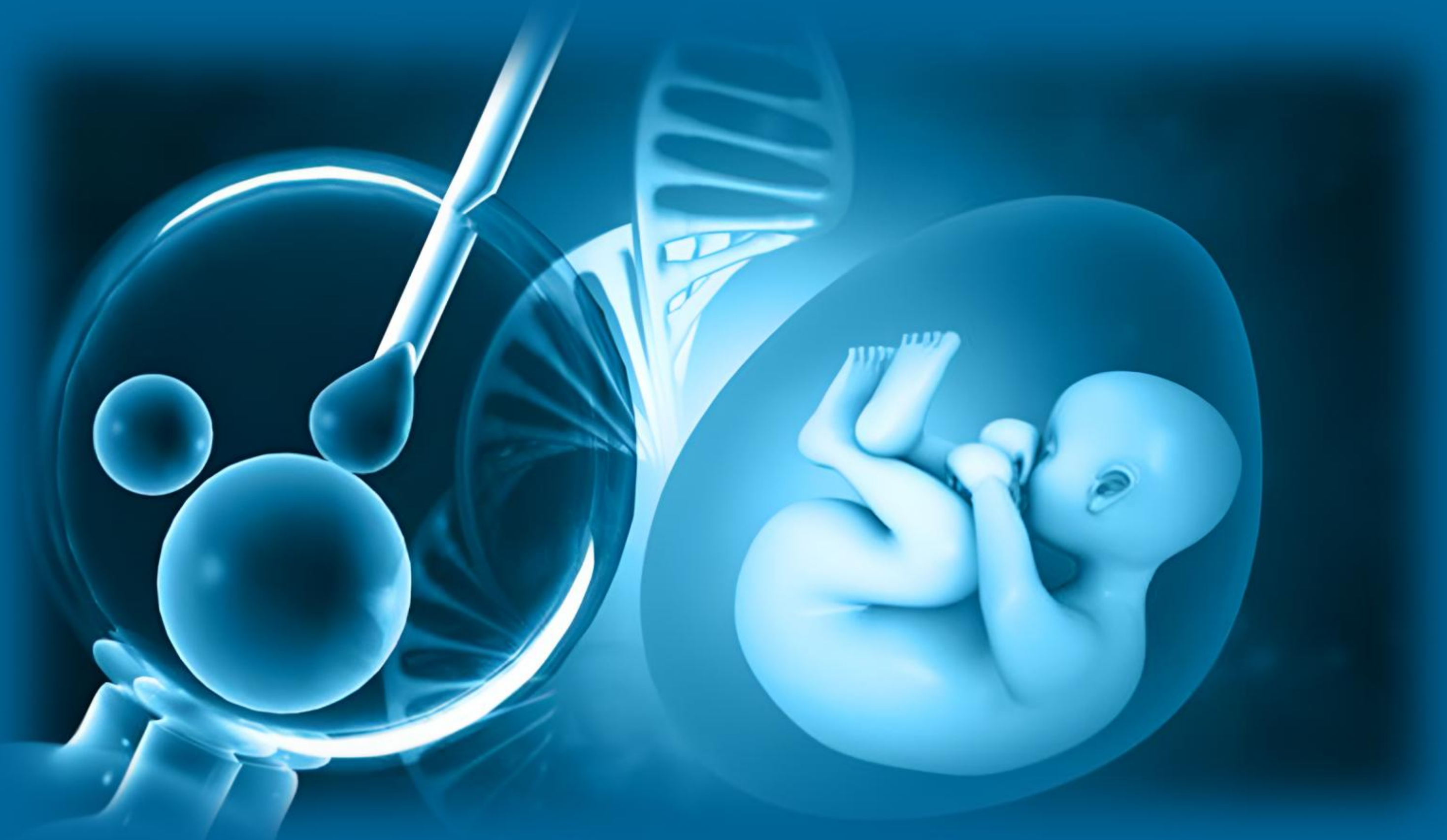

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The Effect of Settlement Areas on the Distribution of Wild Mammals: Case of Isparta

Bahaddin Uysal[1], Halil Süel[2*]

Abstract: This study examines the effects of settlement areas related to the distribution of wild mammals. The research was conducted in the central and surrounding settlements of Isparta province, focusing on the reasons why wild animals approach settlement areas and the consequences of these interactions. Using direct and indirect observation techniques, the distribution of wild animals and their interactions with settlement areas were mapped. The Inverse Distance Weighting (IDW) method was used to determine the distribution of the Red Fox (*Vulpes vulpes*), Golden Jackal (*Canis aureus*), European Badger (*Meles meles*), Stone Marten (*Martes foina*), Wild Boar (*Sus scrofa*), and European Hare (*Lepus europaeus*). The species were evaluated using geostatistical methods along with commonly used environmental variables such as Radiation Index, Heat Index, Solar Illumination, Hillshade Index, Slope, Landform Index, Solar Radiation Index, Ruggedness, Altitude, and Distance to Settlements. As a result of the study, it was concluded that there is a need to identify and integrate alternative variables that can better reflect human–wildlife interactions.

Keywords: Geostatistics, Wildlife, Isparta, Habitat, Interaction

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1. INTRODUCTION

Although the challenges of human–wildlife conflict date back to ancient times, it is rapidly growing as an interdisciplinary field of study focused on human–wildlife interactions. In recent years, there has been a noticeable increase in the number of scientific publications addressing this issue. These studies reveal that human–wildlife interactions have increased exponentially (Nyhus, 2016).

Throughout human history, interactions between humans and animals have sometimes been mutually beneficial, while at other times have developed to the detriment of wildlife. Across the globe, forests, agricultural lands, wetlands, seas, lakes, polar regions, and deserts are inhabited by wildlife species with diverse types and populations. Wildlife utilize suitable habitats based on their ecological requirements (Özkazanç & Yiğit, 2023; Özdemir, 2024). A multidisciplinary approach is essential for wildlife management studies aimed at understanding human–wildlife interactions.

With the advent of sedentary human settlements, the habitats of wildlife species located near human communities have gradually diminished, giving rise to increased human–wildlife interactions (Ekinci, 2023; Zenbilci et al., 2024). As a result of such conflicts, environmental, economic, social, public welfare, health, and safety damages have become inevitable (Ünal, 2012; Ünal 2019). Over time, technological advancements and evolving human needs and behaviors have further disrupted the balance between humans and wildlife, mostly to the detriment of the latter (Özkazanç, 2002; Özkazanç, 2012).

As the human population increases, the expansion of settlements and human activities such as agriculture, animal husbandry, and fishing continue to degrade wildlife habitats (Alkan and Ersin, 2018; Süel et al., 2021). The growing integration of human and wildlife habitats increases the likelihood of conflict and brings about additional environmental problems (Lavsund et al., 2003; Şafak, 2008). Wherever wildlife comes into contact with humans, they are subjected to varying degrees and forms of impact. The more densely populated and expansive human settlements become, the greater this impact. Once wildlife enters human-dominated areas, the conditions they face differ significantly from their natural habitats. Humans have reshaped nature to suit their own needs.

Under these conditions, wildlife will either avoid such urbanized areas altogether or, if compelled to remain, must adapt to these altered environments. If humans intend and make efforts to support them, wildlife may have an easier time adapting and potentially become part of the urban ecosystem (Leyla and Oğurlu, 2021). However, regardless of the situation, it is essential to take necessary precautions for the safety and health of both humans and wildlife, as various interactions are inevitable. In order to examine the effects of habitat changes on wildlife populations, one should consider not only the temporal decline of key habitat factors such as food, cover, and water in natural environments, but also the expansion of human settlements that alter the areas where wildlife sustain their natural lives. Changes in land use classifications, habitat loss, degradation and fragmentation, as well as pollution of soil, air, and water have an impact on the reduction of suitable habitats that can retain their natural characteristics. (Beşkardeş, 2016; Mert et., 2024).

Within the scope of this study, mammal species inhabiting the province of Isparta and its surroundings were identified through direct and indirect observation techniques. The spatial distribution of these species was mapped, their likelihood of approaching settlement areas was analyzed, and the species that interact most frequently with human settlements were determined.

2. MATERIALS AND METHODS

2.1. Study Area

The study area covers approximately 17,262 hectares and includes the central district of Isparta Province as well as the surrounding settlements of Sav Town, Yakaören, Deregümü, Kayı Village, Akkent, Küçükhacılar, and Büyükhacılar villages. The area comprises residential zones, highways, agricultural lands, scrublands, and forested areas.

A grid system was created for the study area based on background ; maps. Each cell in the grid corresponds to one pixel from the base maps, with each pixel representing a 100 × 100 m² area. Within this grid system, 2,000 cells were randomly selected for sampling. Each sample unit corresponds to a single pixel.

In these sample areas, field data were collected using direct and indirect observation techniques. Baddeley's (1985) "Presence-Absence" method was employed to evaluate wildlife presence within each sample unit.

2.2. Environmental Layers

This stage includes the data of terrain-related variables and the environmental base maps generated for the study. These base maps consist of slope, aspect, solar angles, hillshade index, solar radiation index, topographic position index, altitude, landform index, ruggedness, and radiation and solar illumination indices.

All environmental variables were generated using the ArcMap software. In this context, a Digital Elevation Model (DEM) of the study area was first created based on contour lines. Using this DEM, raster maps of aspect, slope, and elevation classes were derived.

Subsequently, using the "Topography Tools" extension (developed by Jennes, 2006) available in the same software, the Hillshade Index, Heat Index, and Landform Index maps were created based on the elevation data. In addition, with the help of the Solar Radiation extension, and using the radiation and illumination class maps, both the Solar Illumination Index (SII) and Solar Radiation Index (SRI) were generated (Riley et al., 1999; Mert et al., 2013).

Based on the correlation between Aspect, Bera Aspect, and the Radiation Index, the Radiation Index—which showed the strongest relationship—was selected (R Core Team, 2021; The jamovi Project, 2022). This index was then used in subsequent distribution analyses.

Table 1. Correlation Matrix

		Aspect	Bera Aspect	Radiation Index
Aspect	Pearson's r	—		
	p-value	—		
Bear Aspect	Pearson's r	-0.619	—	
	p-value	< .001	—	
Radiation Index	Pearson's r	0.475	-0.970	—
	p-value	< .001	< .001	

The relationship between the Solar Illumination Index and other variables was evaluated. Due to the very high correlation between the AM8 and PM16 variables, the remaining variables were excluded from subsequent analysis stages (Table 1).

2.3. IDW (Inverse Distance Weighting) Interpolation

IDW (Inverse Distance Weighting) interpolation is a method used to estimate the value of new data points based on known geographic data points. This method calculates the value of an unknown point using the values of nearby known points, assigning weights that are inversely proportional to their distances. In other words, the closer a known point is to the unknown point, the higher the weight it receives. Shepard (1968) noted that using weights inversely proportional to the square of the distance yields more accurate estimations when applying the IDW method. In a study by Watson et al. (1985), it was emphasized that IDW interpolation is widely used for surface modeling in environmental datasets, as it is faster and easier to apply compared to other interpolation techniques. IDW interpolation was performed using Python libraries such as SciPy and PyKrige. Additionally, Hot Spot Analysis was carried out to assess the relationship between wildlife species and their proximity to human settlements (Anselin, 1995; Rey & Anselin, 2010).

3. RESULTS-

3.1. Exploratory Data Analysis

A heatmap is a type of graphical representation that enables two-dimensional visualization of data and is commonly used for analyzing biological patterns observed in natural ecosystems (Wilkinson et al., 2009; Wu et al., 2016). In this study, the relationships between the Solar Illumination Index and Solar Exposure Index were examined, and AM8 and PM16 were selected as representative variables (Figure 1).

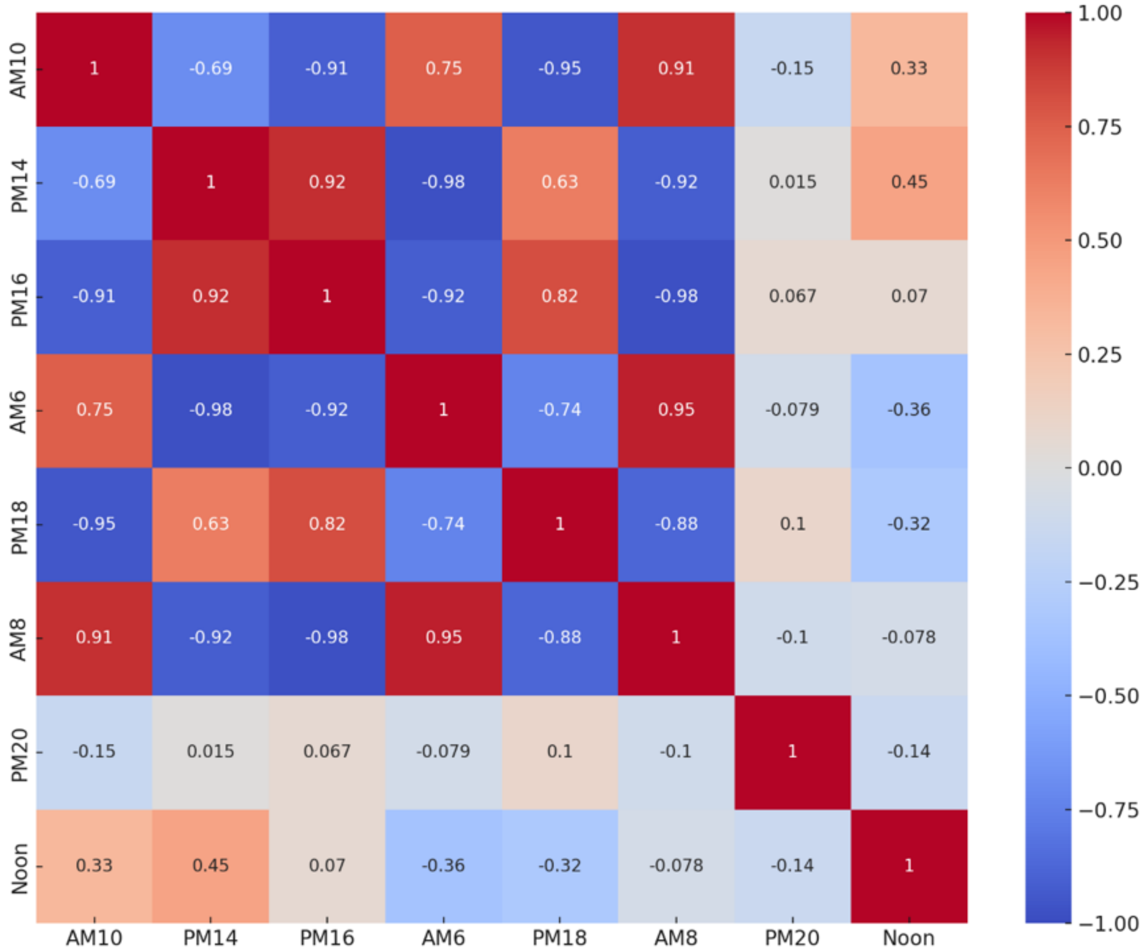

Figure 1. Results of the Correlation Analysis for the Solar Illumination Index

Correlation results among the variables were also obtained using a heatmap, and these variables were used in the subsequent analyses (Figure 2)

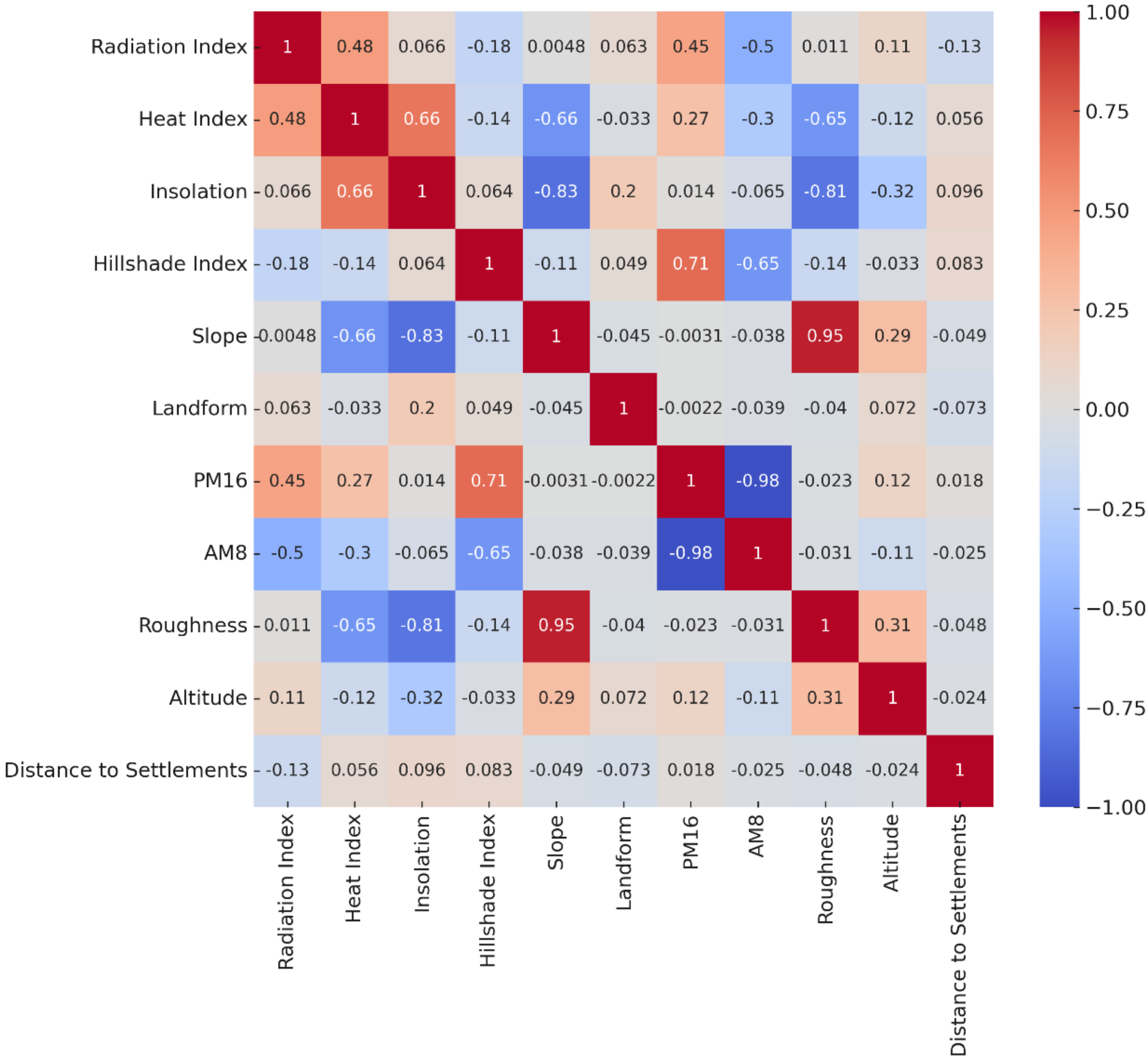

Figure 2. Correlation Results of Selected Environmental Variables

4.2. Relationships Between Animal Species and Environmental Variables

When the correlations between environmental variables and animal species were examined, no significant relationships were found. This suggests that the distribution of these species in urban areas occurs independently from common environmental factors (Figure 3).

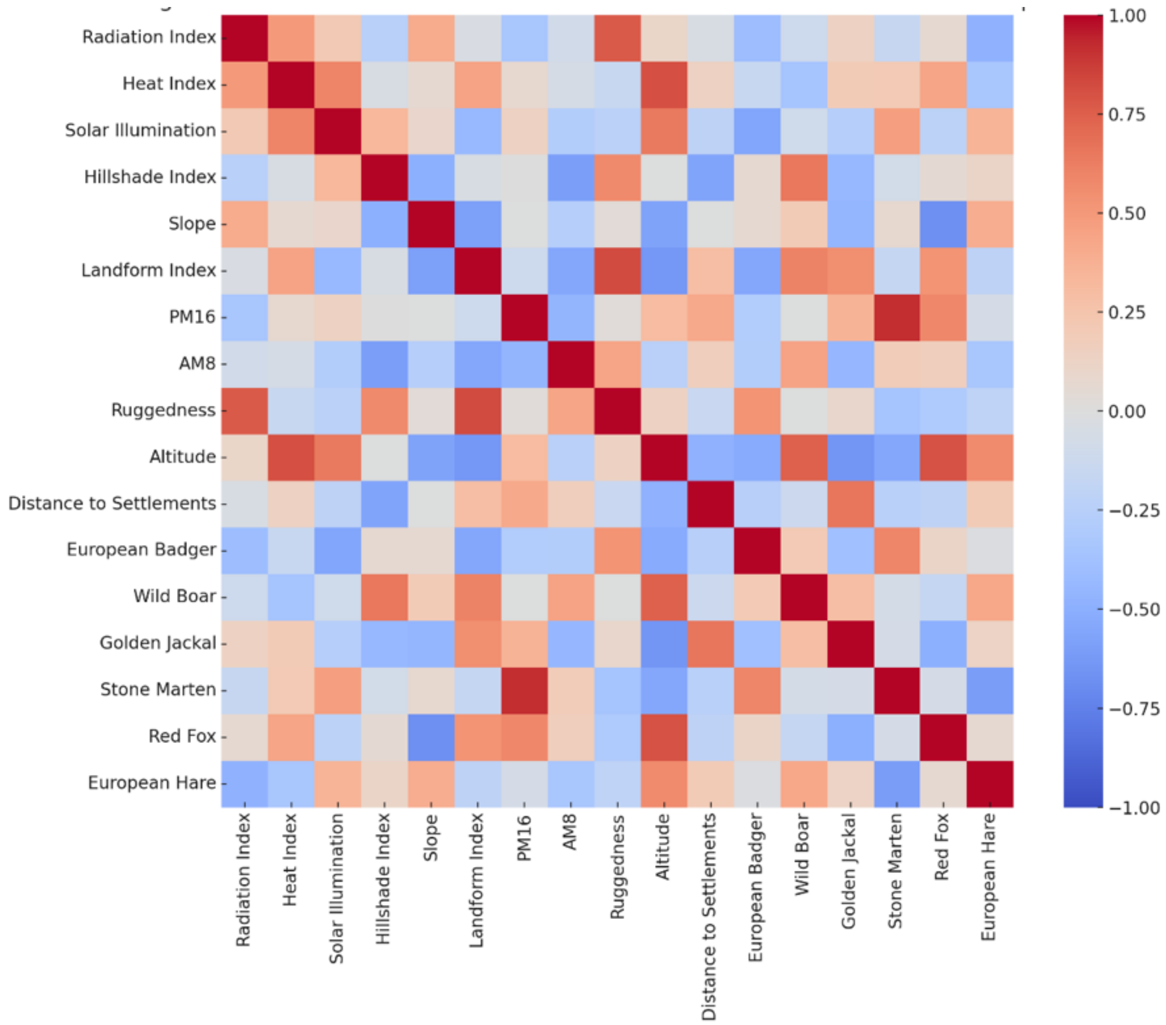

Figure 3. Correlation Results Between Environmental Variables and Animal Species

3.3. Species Distribution Maps

3.3.1. Distribution of the Red Fox

The density of red foxes is observed to be concentrated in certain areas, while it is more sparse in others (Figure 4). Hot spots for red foxes are generally located near settlement areas. The species is frequently observed in areas close to human settlements (Figure 5).

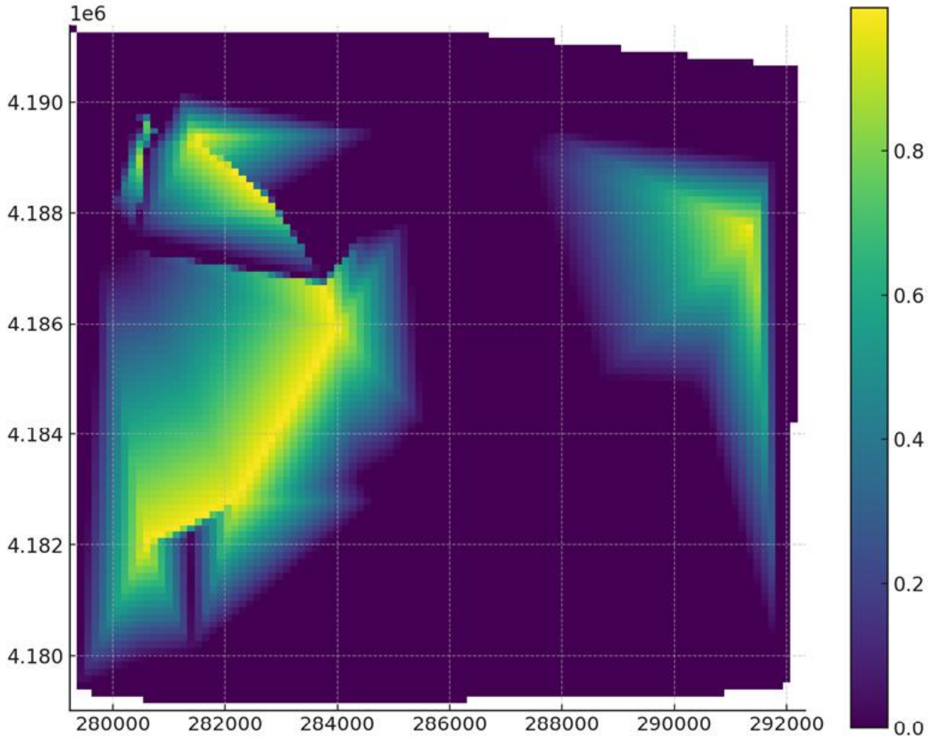

Figure 4. IDW Interpolation of Red Fox

The density of red foxes is observed to be higher in certain areas and lower in others. Red foxes are generally found near settlement areas and are frequently observed in these locations (Figures 4 and Figure 5).

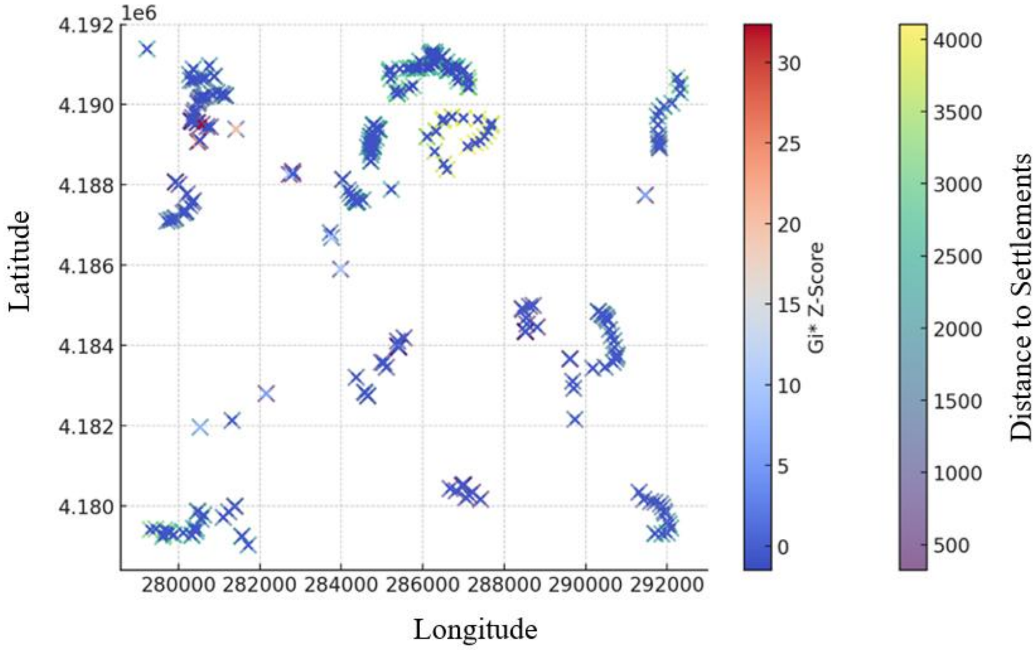

Figure 5. Hot Spot Analysis of Red Fox and Distance to Settlements

3.3.2. Distribution of the Golden Jackal

The golden jackal is observed to be partially concentrated in certain areas and generally occurs at a moderate proximity to settlement areas (Figures 6 and Figure 7).

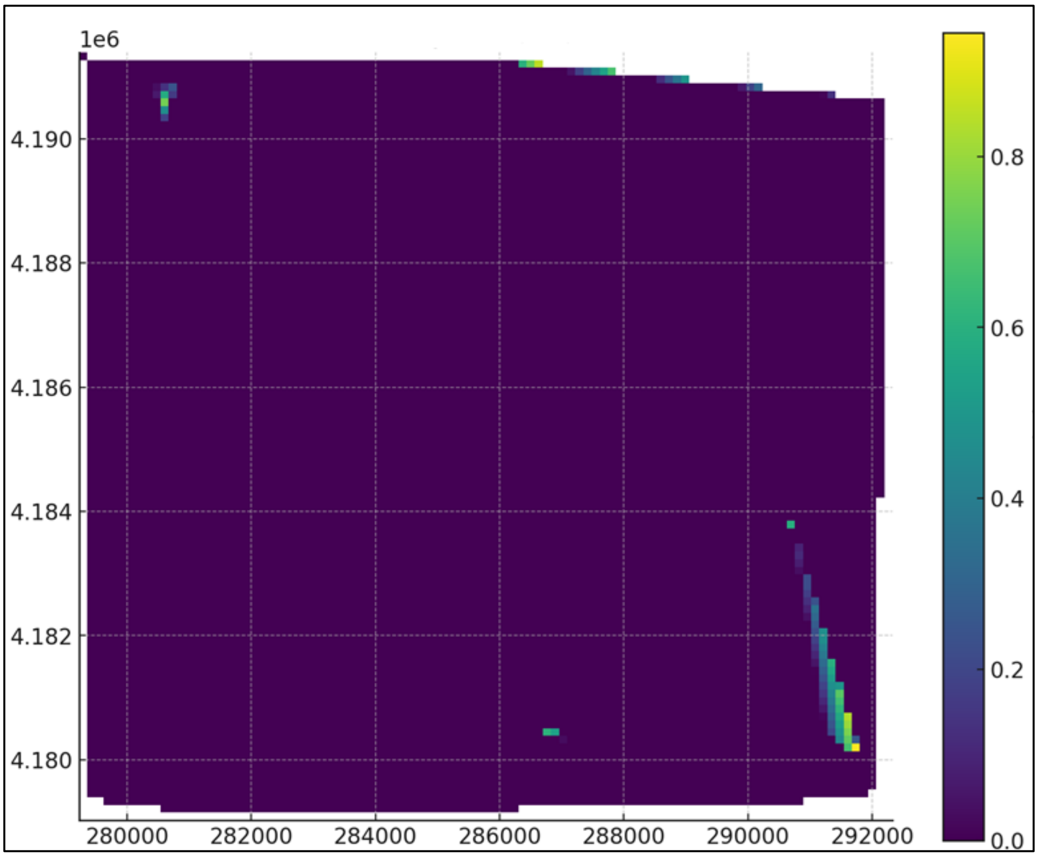

Figure 6. IDW Interpolation of Golden Jackal

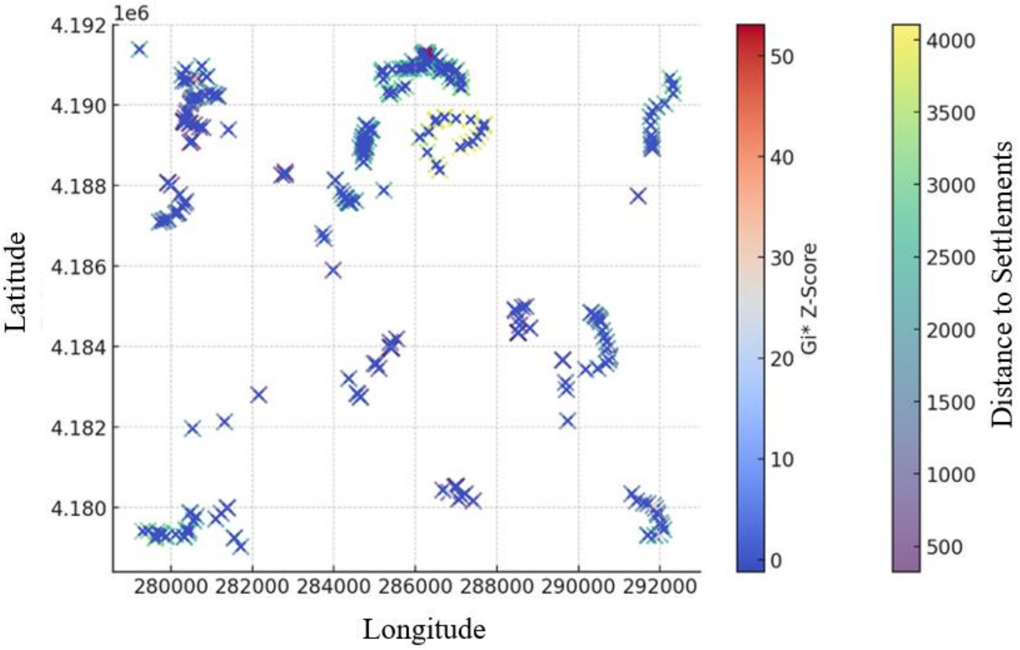

Figure 7. Hot Spot Analysis of Golden Jackal and Distance to Settlements

3.3.3. Distribution of the European Badger

The distribution of the European badger is concentrated in specific areas and is generally located farther from settlement zones. Therefore, it can be inferred that its interaction with urban areas is relatively limited (Figures 8 and Figure 9).

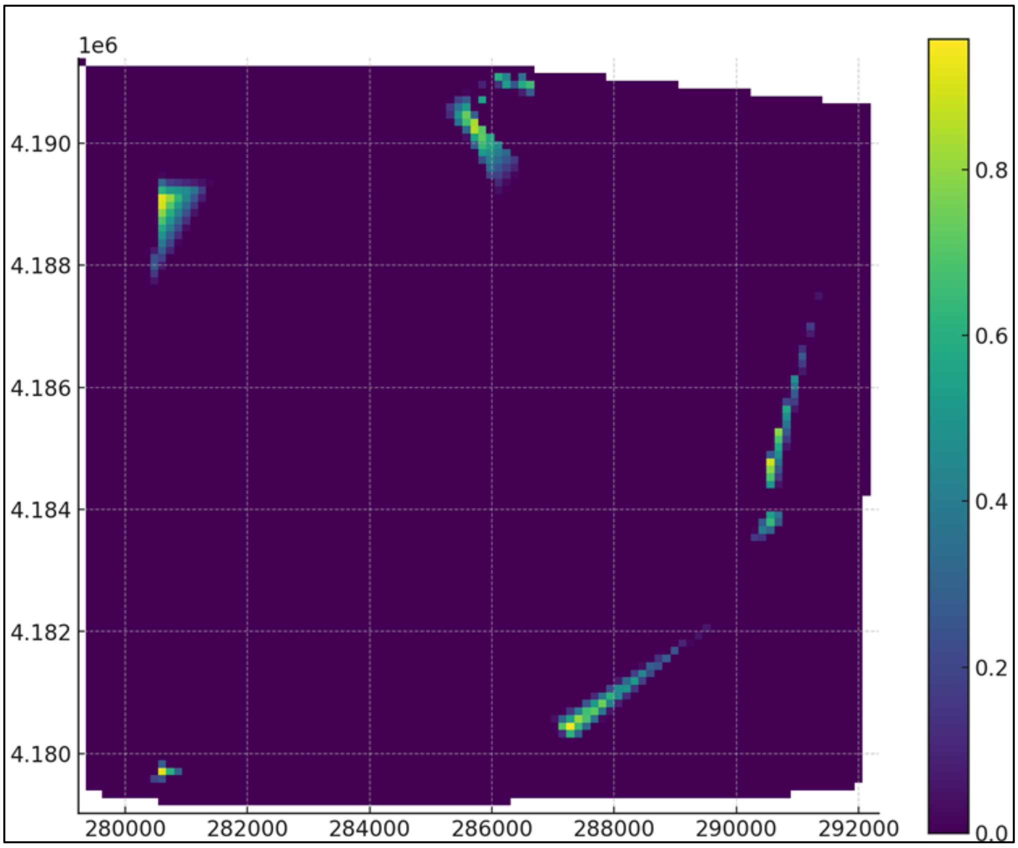

Figure 8. IDW Interpolation of European Badger

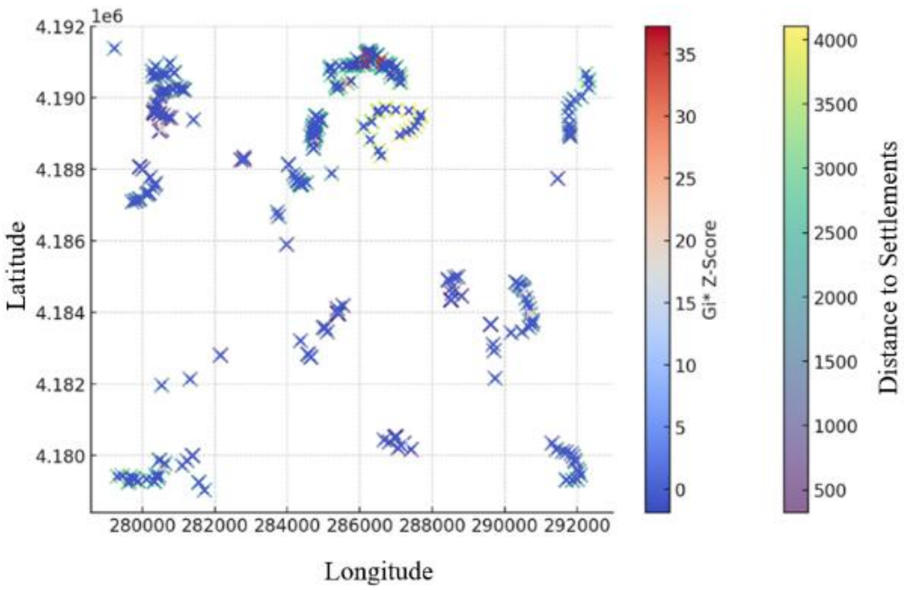

Figure 9. Hot Spot Analysis of European Badger and Distance to Settlements

3.3.4. Distribution of the Stone Marten

The stone marten appears to be concentrated in a very limited area and shows lower density in settlement regions. It is particularly observed to avoid areas with reinforced concrete structures (Figures 10 and 11).

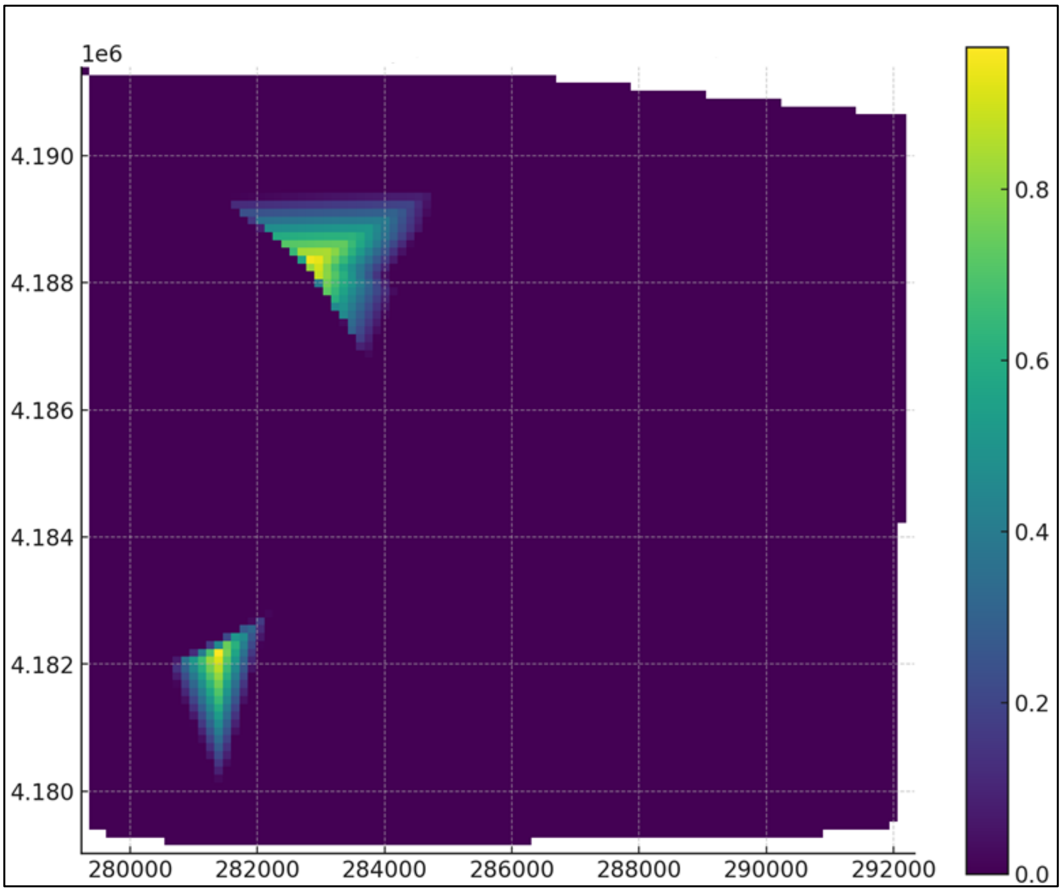

Figure 10. IDW Interpolation of Stone Marten

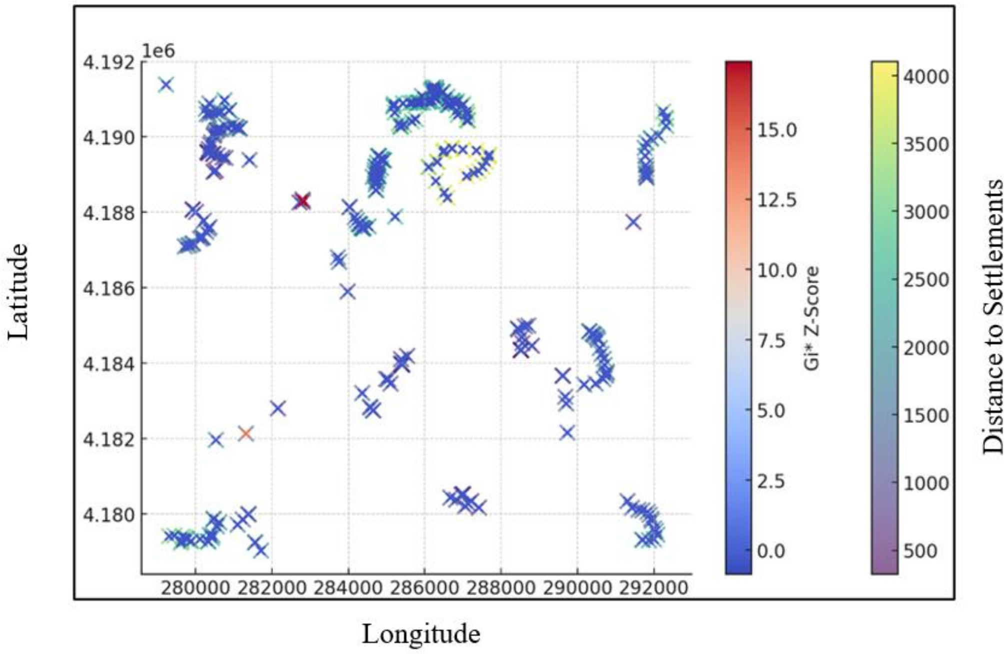

Figure 11. Hot Spot Analysis of Stone Marten and Distance to Settlements

3.3.5. Distribution of the Wild Boar

The density of wild boars is observed in many parts of urban areas, particularly in regions relatively close to human settlements. This indicates a higher level of interaction between wild boars and humans (Figures 12 and 13).

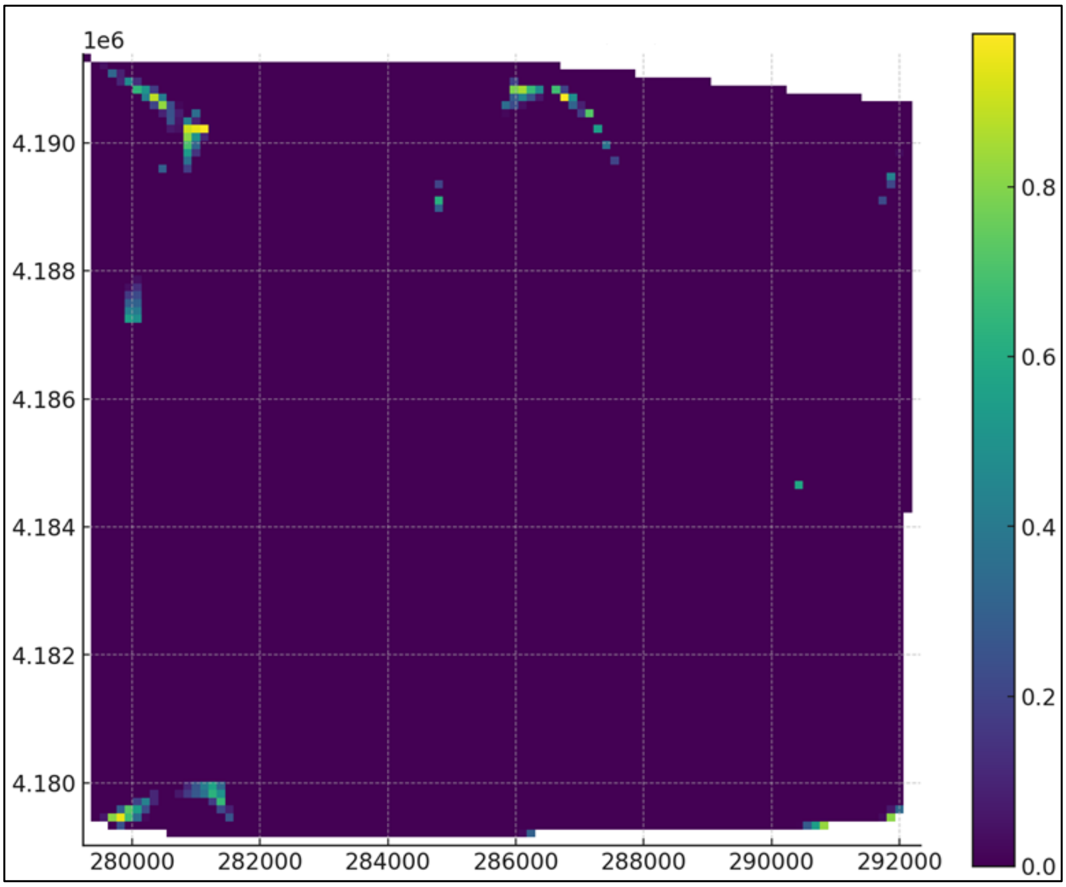

Figure 12. IDW Interpolation of Wild Boar

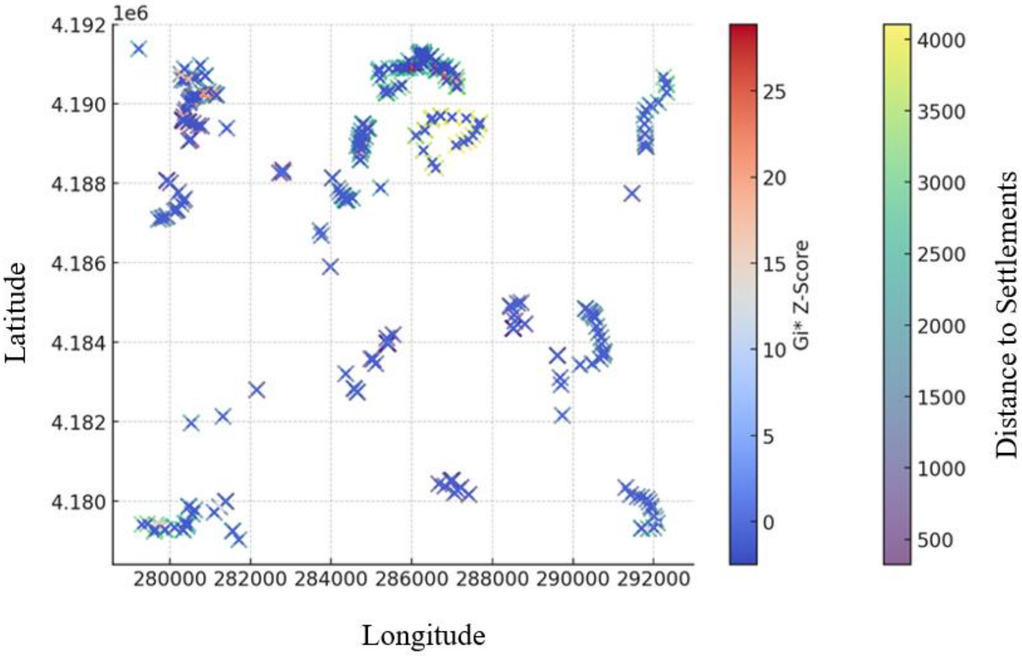

Figure 13. Hot Spot Analysis of Wild Boar and Distance to Settlements

3.3.6. Distribution of the European Hare

The density of the European hare is concentrated in specific regions, while lower densities are observed in other areas. It is also noted that the species does not tend to approach settlement areas closely (Figures 14 and Figure 15).

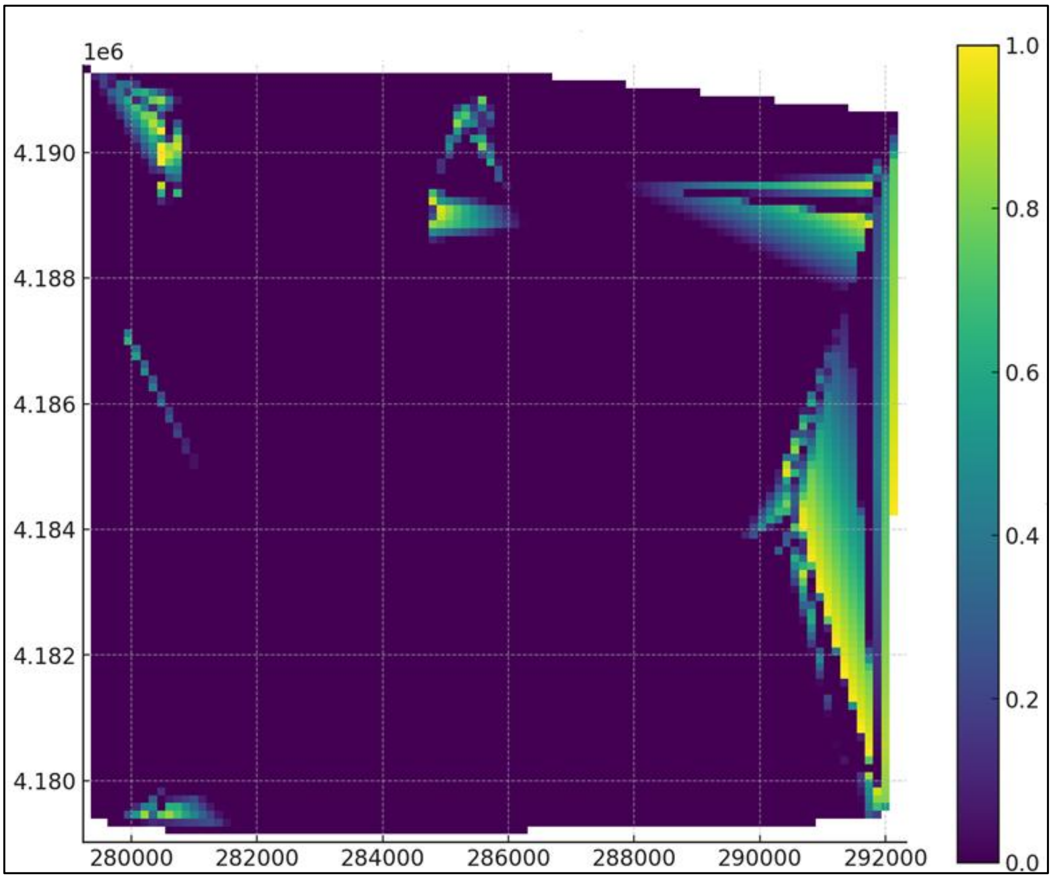

Figure 14. IDW Interpolation of European Hare

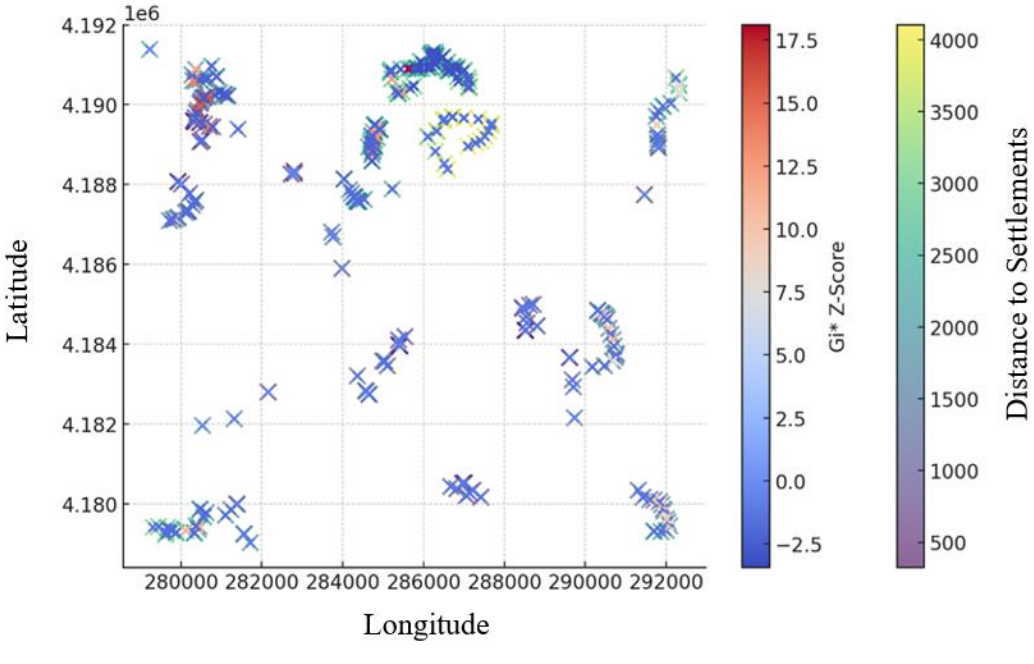

Figure 15. Hot Spot Analysis of European Hare and Distance to Settlements

4. DISCUSSION

The interaction between wild mammals and human settlements is increasingly a subject of ecological concern, particularly in the context of expanding urbanization and anthropogenic land-use change. This study offers insights into species-specific responses of wild mammals to settlement areas in Isparta, revealing varied levels of spatial interaction.

Species such as the Red Fox (*Vulpes vulpes*) and Wild Boar (*Sus scrofa*) were frequently observed near settlements, corroborating global studies that highlight the synanthropic behavior of these mammals. Red foxes are known for their high adaptability to urban environments, often benefiting from food subsidies in anthropogenic areas (Contesse et al., 2004; Bateman & Fleming, 2012). Similarly, wild boars increasingly exploit urban and peri-urban areas across Europe and Asia, driven by reduced predation risk and abundant food waste (Stillfried et al., 2017).

In contrast, species such as the European Badger (*Meles meles*) and Stone Marten (*Martes foina*) exhibited avoidance behavior, maintaining distance from densely populated or developed zones. This aligns with studies that associate badgers with more forested or semi-natural landscapes and indicate their sensitivity to urban encroachment (Davison et al., 2008). While stone martens are occasionally found in urban areas, their avoidance of densely built-up spaces may relate to their need for specific denning habitats and reduced competition (Herr et al., 2010).

Interestingly, the European Hare (*Lepus europaeus*) also showed low interaction with settlements. This species typically favors open fields and steppe environments, and its decline near urban areas is often attributed to habitat fragmentation and disturbance (Smith et al., 2005). In contrast, the Golden Jackal (*Canis aureus*) showed moderate interactions with settlements, indicating a transitional behavioral ecology likely influenced by population dynamics, prey availability, and competition (Šálek et al., 2014).

Another notable outcome is the lack of strong correlation between environmental variables and species distribution, indicating that traditional topographic and climatic layers may not fully capture anthropogenic pressures or resource-driven behaviors. Recent studies advocate for the inclusion of socio-environmental metrics such as human population density, waste availability, road density, and land-use intensity to improve species distribution models (Moll et al., 2019; Gaynor et al., 2018). This study's use of geostatistical approaches, especially IDW interpolation and hotspot analyses, provides a valuable framework but also highlights the need for a more comprehensive variable set for future modeling efforts.

This spatially explicit approach also underscores a critical conservation issue: the duality of urban areas as both threats and opportunities. While urban areas pose risks such as vehicle collisions, disease transmission, and persecution, they also serve as potential refugia for some adaptable species (McKinney, 2006). Consequently, adaptive management strategies, such as urban green infrastructure, wildlife corridors, and public education, must be tailored to species-specific behaviors and ecological thresholds (Soulsbury & White, 2015)..

5. CONCLUSION

This study demonstrates that wild mammal species respond differently to human settlements, depending on their ecological flexibility, behavioral plasticity, and resource use. The findings underscore the complexity of human–wildlife interactions in rapidly changing landscapes and suggest that a one-size-fits-all approach to wildlife management is inadequate.

To improve the reliability of future analyses, integrating anthropogenic variables—such as waste site proximity, traffic intensity, and human activity metrics—into geospatial models is recommended. Additionally, long-term monitoring and community-based conservation programs can help mitigate potential conflicts and foster coexistence between humans and wildlife in peri-urban and rural interfaces.

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The Effect of the Aspect and Machining Parameters on CNC Machining of Solid Wood Material

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Abstract: The selection of wood materials in accordance with the place of use and their processing under the most appropriate conditions will ensure the utilisation of natural resources with high efficiency. In the utilisation of wood material, it is known that the characteristics of the place where it grows and the place where it grows affect the properties of the log and timber obtained. In this study, the surface roughness (*Ra*) values of larch (*Pinus nigra* Arnold) and eastern beech (*Fagus orientalis* Lipsky) wood species growing in northern and southern aspects were determined under various machining parameters. The specimens were grooved using a Scilled 2040 CNC 3-axis milling machine at 3 different feeds of 1000 mm/min, 1500 mm/min and 2000 mm/min, 12000 rpm, 15000 rpm and 18000 rpm, using a 12 mm diameter HSS (High-speed steel) cutter. The surface roughness parameter *Ra* was determined on the surfaces obtained, and the data obtained was evaluated. When evaluated in general, the lowest *Ra* value for both wood species was obtained at 18000 rpm at 1000 mm/min for larch and 1000 mm/min or 1500 mm/min for beech at a feed of 1000 mm/min or 1500 mm/min for the specimens obtained from the southern aspect. A linear decrease in Ra value occurred for both wood species with increased revolutions. The lowest *Ra* values were obtained at 18000 rpm. Generally, the samples obtained from the southern aspect direction gave smoother surfaces for both wood species.

Keywords: CNC, wood machining, aspect, surface roughness.

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1. INTRODUCTION

Wood material has been used in many areas to meet human needs. This situation reveals the necessity of more efficient use of natural resources, such as wood materials.

Especially for solid wood materials, it is seen that it is essential to obtain quality and smooth surfaces to carry out the machining in a short time; it is essential to obtain quality and smooth surfaces to carry out the processing quickly and to know the process characteristics.

Metals, plastics, wood and composite materials are essential engineering materials. These materials are machined using CNC machines such as CNC (computer numerical control) lathes, vertical machining centres, CNC milling machines and routers. In furniture factories, CNC routers are used to shape the surfaces of solid wood materials and extensively medium-density fibreboard (MDF). Some of these MDF boards are covered with PVC film to be used for cabinet doors, and others are painted. Today, scientific research is carried out in machining wood and wood-based materials with CNC machines, which is becoming widespread day by day.

There are many studies on CNC machining of solid and wood-based materials. Considering the studies conducted in recent years, surface roughness values in the machining of MDF decreased with an increase in cutting tool diameter and feed. In contrast, the values rose with an increase in spindle speed. The system was optimised using artificial neural networks (Demir et al., 2021). Dust particles generated in the CNC machining of MDF were examined, and it was revealed that the amount of harmful particles can be reduced by optimising (Kminiak et al., 2021). The machining of heat-treated solid wood materials was investigated, and it was determined that the type of cutter milling cutter, feed and spindle speed were the most effective parameters on roughness (Pelit et al., 2021). Similar studies have been carried out on machining solid wood materials. Considering various machining parameters (speed, feed, cutter type, number of cutter teeth, depth of cut, cutter diameter, etc.), beech, oak, spruce and MDF (Kminiak et al., 2021), heat-treated pine, beech, linden (Pelit et al., 2021), maple (Gurau et al., 2022), walnut and ash (Çakıroğlu et al., 2022), MDFlam (Aktaş and Sofuoğlu, 2022a, 2022b), MDF (Dumanoglu and Bal, 2022), Bal et al., 2022; Açık, 2023), plywood, particleboard and MDF (Demir et al., 2022a; 2022b; Koleda et al., 2023), massive wooden edge-glued panels (Aktas and Sofuoglu, 2022), machining of densified wood materials (Sofuoglu et al., 2023; Tosun and Sofuoglu, 2023a; 2023b) were investigated.

Factors such as the regions where the trees from which the solid wood material is obtained grow, the climate and soil, etc., affect the properties of the wood material. This study aims to investigate the effect of growing conditions on the CNC machining of the wood material and the wood material's CNC machining and determine the optimum machining parameters considering the growing conditions and some basic CNC machining parameters. The aim is to increase productivity by obtaining the best surface quality of the wood material.

2. MATERIAL AND METHOD

In the selection of the tree species used within the scope of the study, larch (*Pinus nigra* Arnold) and eastern beech (*Fagus orientalis* Lipsky), which grow naturally at different elevations in the Simav district of Kütahya province, were selected. The selection of these wood species was influenced by the fact that they are widely grown and frequently used in the woodworking and furniture industry.

The logs (diameter, approximately 350 mm) (Figure 1) were turned into timber at a private enterprise in Kicir/Simav to obtain test specimens and kept in open-air conditions for natural drying (Figure 2). After drying the timber to a specific moisture content in natural drying, the conditioning of the samples was carried out at temperatures of (20 ± 2) °C and (65 ± 5) %, with a relative humidity of 12% moisture content (Figure 3).

Figure 1. Logs used in the preparation of test specimens

Figure 2. Natural drying of the lumber

The density of tree species was specified as larch south aspect 470 kg/m^3, larch north aspect 595 kg/m^3, eastern beech south aspect 684 kg/m^3, eastern beech north aspect 631 kg/m^3 (ISO 13061, 2014; ISO 13061-2, 2014).

Figure 3. Keeping the specimens in the air conditioning cabinet

The specimens, which were brought to 12% humidity in an air conditioning cabinet, were machined on a Scilled 2040 CNC 3-axis milling machine (maximum spindle speed = 18000 rpm) (Simav Faculty of Technology, Woodworking Industrial Engineering¸ Simav, Kutahya, Turkiye). New and sharp cutters were used. The experiments were carried out with a router cutter (Netmak, HSS 0450-08, 12 mm × 30 mm × 73 mm) that was 12 mm in diameter) (Figure 4).

Figure 4. Cutter type

Two parameters (feed and spindle speed) were used, and three levels were used in the experiment (Table 1).

Table 1. Assignment of levels to factors (wood species, feed, spindle speed and aspect)

Parameters	Level 1	Level 2	Level 3
Wood species	Beech	Larch	
Feed (mm/min)	1000	1500	2000
Spindle speed (rpm)	12000	15000	18000
Aspect	Northern	Southern	

The parameters used during CNC machining are given in Figure 5.

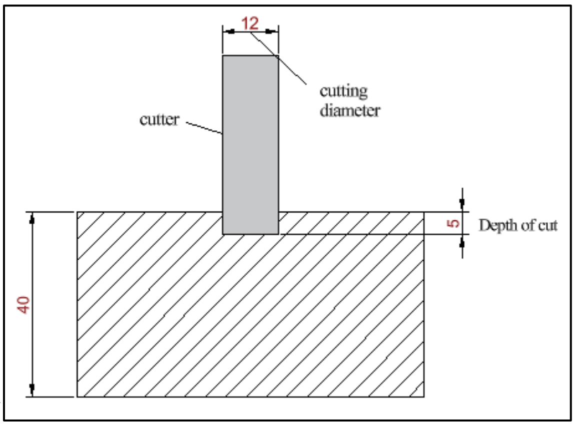

Figure 5. Parameters of the CNC process

A total of 108 pieces (54 northern + 54 southern) of dimensions of 12 mm x 60 mm were grooved on wood materials by a CNC router (Figure 6).

Surface roughness measurements were taken parallel to the grain on three separate lines on each specimen. The most preferred surface roughness parameter in the literature, average roughness (*Ra*) measurements were performed according to the protocols of ISO 24118-1 (2023), TS 2495 EN ISO 3274 (2005) and EN ISO 21920-3 (2022) principles.

Figure 6. CNC machining of specimens

Using a contact stylus trace method, the Surface Roughness Tester Time TR200 (Time Group Inc., China) was used to determine the *Ra* values (Figure 7). In this study, the Gaussian filter type was used. The sampling length was 0.8 mm, and the evaluation length was 4 mm. *Ra* values were measured with an accuracy of ± 0.01 μm. The speed of the stylus was 10 mm/min, the diameter of the stylus was 5 μm, and the angle of the stylus tip was 90°.

Figure 7. Roughness measurement of specimens

3. RESULTS AND DISCUSSION

Ra data obtained from trials with various parameters using specimens of beech and larch tree species are given in Table 2.

Table 2. *Ra* values obtained as a result of CNC machining under different machining conditions

Process No	Spindle speed (rpm)	Feed (mm/min)	Aspect	Beech (*Ra*, µm)	Larch (*Ra*, µm)
1	12000	1000	Northern	3.75	3.66
2	12000	1000	Southern	3.35	3.35
3	12000	1500	Northern	4.54	4.93
4	12000	1500	Southern	3.73	4.11
5	12000	2000	Northern	4.76	4.27
6	12000	2000	Southern	4.80	4.17
7	15000	1000	Northern	3.71	3.27
8	15000	1000	Southern	3.67	3.41
9	15000	1500	Northern	3.60	3.22
10	15000	1500	Southern	2.68	4.11
11	15000	2000	Northern	5.86	3.82
12	15000	2000	Southern	4.51	3.99
13	18000	1000	Northern	4.01	3.53
14	18000	1000	Southern	3.57	2.38
15	18000	1500	Northern	3.18	2.76
16	18000	1500	Southern	4.12	3.14
17	18000	2000	Northern	4.54	3.12
18	18000	2000	Southern	3.35	3.14

Figure 8 shows a probability plot for larch tree species, and Figure 9 shows a probability plot for beech tree species.

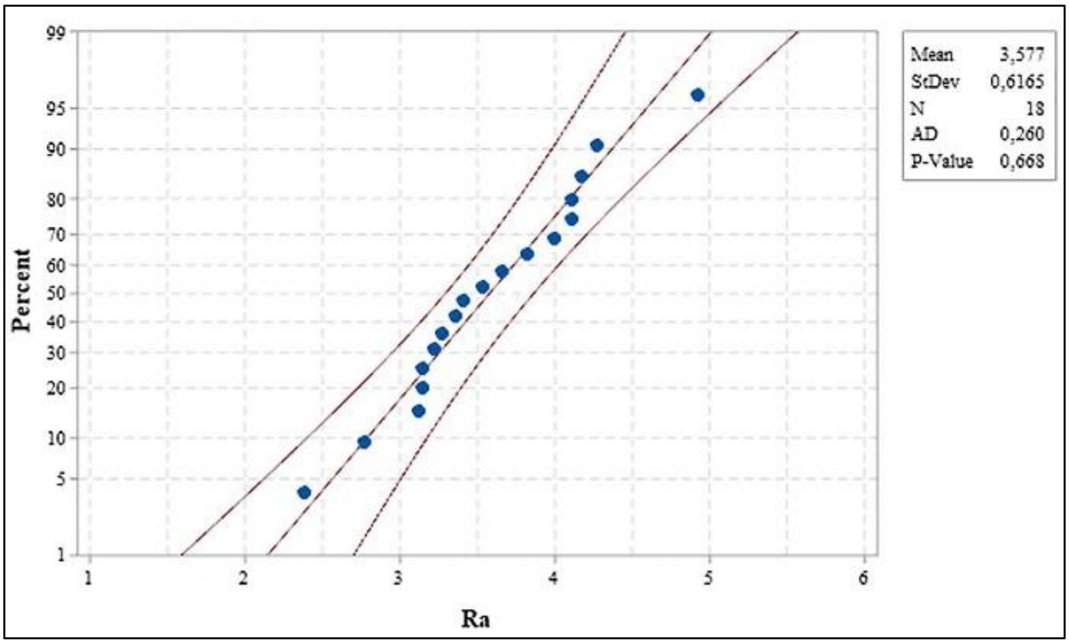

Figure 8. Probability plot for larch (*Ra*)

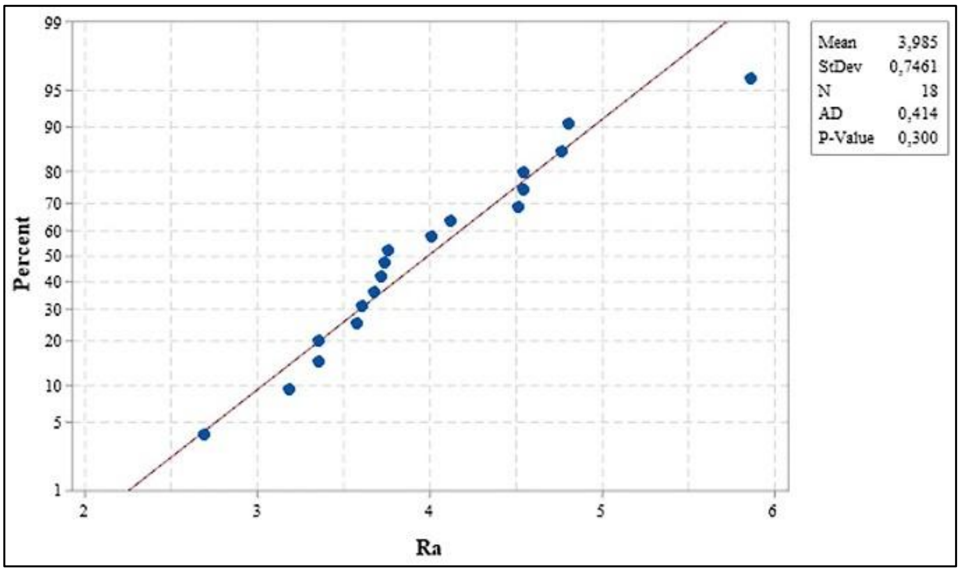

Figure 9. Probability plot for beech (*Ra*)

In the data obtained from the graphs, *P*=0.668>0.05 for larch and *P*=0.300>0.05 for beech, the Ra values are typically distributed at a 95% confidence level.

Table 3. ANOVA for larch wood machining

Source	DF	Adj SS	Adj MS	F-Value	*P*-Value
Spindle speed (rpm)	2	3.46710	1.73355	9.95	0.003
Feed (mm/min)	2	0.86970	0.43485	2.50	0.124
Aspect	1	0.03380	0.03380	0.19	0.667
Error	12	2.09100	0.17425		

According to the analysis of variance (ANOVA) in *Ra* in CNC machining of larch wood species obtained from north and south aspects, the effect of the number of revolutions (*P*=0.003<0.05) was found significant at a 95% confidence level. In contrast, the effect of feed (*P*=0.124>0.05) and aspect (*P*=0.667>0.05) was not found to be significant (Table 3).

As shown in Figure 10, as the speed increases from 12000 rpm to 18000 rpm, there is a linear decrease in *Ra* value. Ra value increases as the feed increases from 1000 mm/min to 2000 mm/min (the highest feed in CNC). The increase between 1000 and 1500 mm/min is higher than between 1500 mm/min and 2000 mm/min.

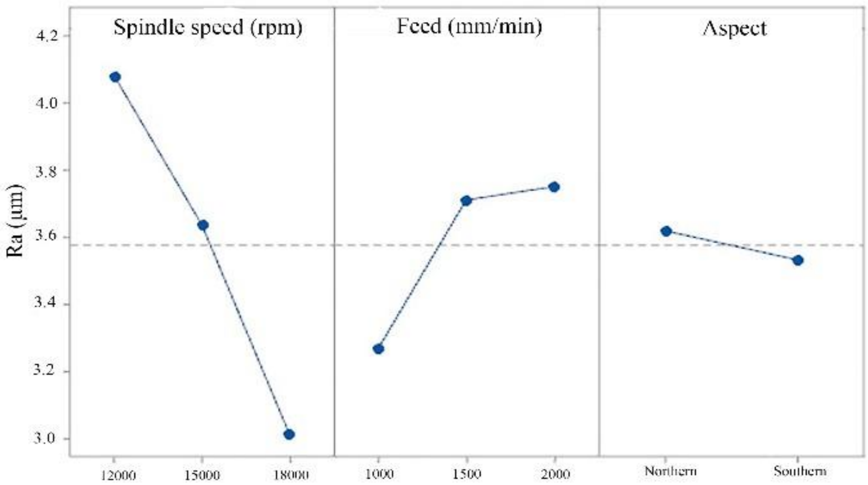

Figure 10. Effect of spindle speed, feed and aspect on larch (*Ra*) in measurements

When the literature is examined, it is seen that there are similar trends. It is known that when the feed is increased at the same speed, the number of cutter marks per unit distance decreases, and poorer surfaces are obtained. It is seen that similar results are obtained not only in CNC machining but also in the machining of solid wood materials such as planing, horizontal and vertical milling (Sofuoglu and Kurtoglu, 2014; Sofuoglu and Kurtoglu, 2015; Kaba and Bal, 2024). In terms of aspect, the Ra value was obtained lower on the surface obtained in the processing of wood species taken in the southern direction. The lowest *Ra* value for larch wood species was obtained at 18000 rpm at a feed of 1000 mm/min in the samples obtained from the southern direction.

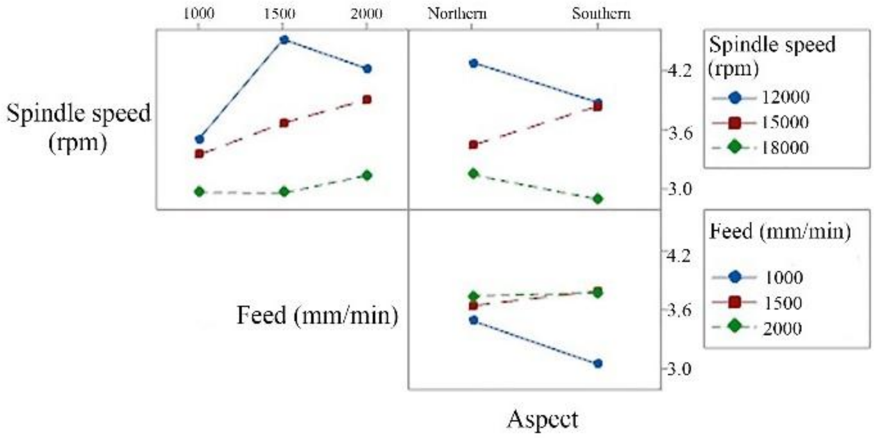

Figure 11. Interaction plot for larch

When the interactions in the machining of larch wood species in Figure 11 are examined, when the interaction graph for larch wood species is examined in the interaction of the spindle speed and feed, *Ra* values close to each other were obtained at 1000 mm/min at 12000 rpm and 15000 rpm. The highest *Ra* value occurred at 12000 rpm at a 1500 mm/min feed. Approximately close values were obtained at each feed at 18000 rpm. A linear Ra value increases as the feed increases at a spindle speed of 15000 rpm. When the interaction between view and spindle speed was analysed, very close values were obtained at 12000 and 15000 rpm in the specimens taken from the southern aspect. In the interaction of feed and aspect, close values were obtained at all three feeds in the northern aspect. In other words, the effect of the feed is very low in the north aspect.

Table 4. ANOVA for beech machining

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Spindle speed (rpm)	2	0.3924	0.1962	0.55	0.591
Feed (mm/min)	2	3.8257	1.9128	5.36	0.022
Aspect	1	0.9660	0.9660	2.71	0.126
Error	12	4.2799	0.3567		
Total	17	9.4641			

According to the results of the ANOVA in terms of *Ra* in CNC machining of beech wood species obtained from north and south aspects, the effect of feed (P=0.022<0.05) was found significant at a 95% confidence level. In contrast, the effect of the number of revolutions (P=0.591>0.05) and aspect (P=0.126>0.05) was not significant (Table 4).

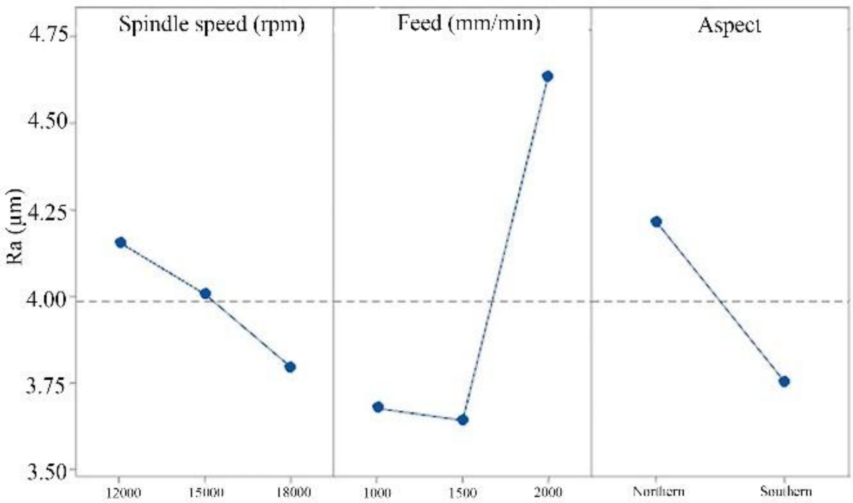

Figure 12. Effect of spindle speed, feed and aspect on beech (*Ra*) in measurements

As can be seen in Figure 8, there is a linear decrease in *Ra* value as the spindle speed increases from 12000 rpm to 18000 rpm. According to the obtained results, the surface roughness decreases with increasing spindle speed and increases with the feed (Davim et al., 2009; Sutcu and Karagoz, 2012; Sutcu, 2013; Sofuoglu, 2015; Koc et al. 2017; Hazir et al., 2017; Hazir and Koc, 2019; Bal et al., 2022; Tosun and Sofuoglu, 2023a; 2023b).

The reason for this is that smoother surfaces are obtained with the increase in the number of cutter marks per unit distance. Although this does not occur linearly in some studies, the lowest roughness values appear at the highest spindle speeds. It is thought that this is because the motors to which the cutters are connected to the shaft cause more vibration at certain speeds, and the machine's stability deteriorates during cutting. In addition, during idling at a spindle speed of 20000 rpm, the vibration was significant because of the resonance of the spindle head of the CNC (Ohuchi, 2001). While the Ra value between 1000 and 1500 mm/min shows a slight decrease, a significant increase occurs between 1500 mm/min and 2000 mm/min. Regarding aspect, the Ra value was lower in the faces obtained in machining tree species taken in the south direction. In both wood species, it is seen that smoother surfaces are obtained in the wood species taken from the southern aspect after machining. Smoother surfaces can be obtained in homogeneous wood materials with high density. However, in heterogeneous materials such as wood materials, if the density increase is due to slow growth in the parts where there are density changes, such as spring and autumn wood, these transitions may cause an increase in the roughness of the surface since the number of annual rings per unit distance will be high. It can be assumed that a similar situation is the case here. Generally, the lowest *Ra* value for beech wood species was obtained at 18000 rpm at a feed of 1500 mm/min (a similar value was obtained at 1000 mm/min) in the samples obtained from the southern aspect.

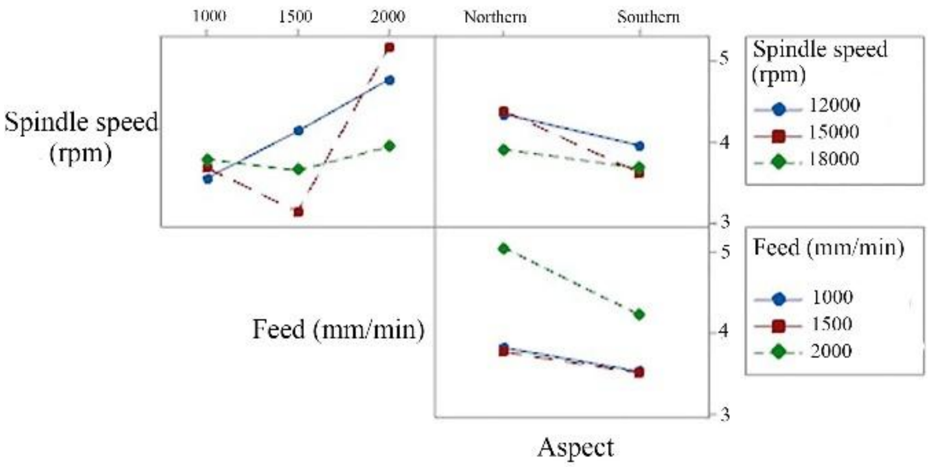

Figure 13. Interaction plot for beech

When the interaction graph for beech wood species is examined, a linear Ra value increases as the feed increases at 12000 rpm in the interaction of speed and feed. The highest Ra value occurred at 15000 rpm at 2000 mm/min feed. At 1000 mm/min feed, similar *Ra* values were obtained at all three speeds. In the interaction of aspect and speed, lower *Ra* values were obtained in the beech specimens obtained from the South direction at all three speeds. In the interaction of aspect and feed, the graphs were similar at 1000 and 15000 mm/min feed and although there was little difference, lower *Ra* values were obtained in the beech specimens grown in the south direction. In this interaction, the highest *Ra* value occurred at a 2000 mm/min feed in beech specimens obtained from the northern aspect.

4. CONCLUSIONS

In this study, larch (*Pinus nigra* Arnold) and eastern beech (*Fagus orientalis* Lipsky) wood species were selected as experimental materials. The wood species ' surface roughness (Ra) values were determined under various CNC machining conditions. The results obtained can be summarised as follows:

- While the effect of the number of revolutions was found to be significant for Larch in CNC machining, the effect of feed and angle was not found to be significant.
- While feed was significant for beech wood species, the effect of the number of revolutions and aspects was not significant.
- For both wood species, a linear decrease in *Ra* value occurred with increased spindle speed.
- Smoother surfaces were obtained by machining the wood samples from the southern aspect.

Ethics Committee Approval
N/A

Peer-review
Externally peer-reviewed.

Author Contributions
Conceptualization: İ.İ., S.D.S.; Investigation: S.D.S.; Material and Methodology: İ.İ., S.D.S.; Supervision: S.D.S.; Visualization: İ.İ., S.D.S.; Writing-Original Draft: İ.İ., S.D.S.; Writing-review & Editing: İ.İ., S.D.S.

Conflict of Interest
The authors have no conflicts of interest to declare.

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The Role of Digital Applications in the Real Estate Industry

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Abstract: This study examines the effective use of digital applications in the real estate sector. In the contemporary era, the advent of technological advancements has profoundly impacted real estate transactions, facilitating more expeditious, transparent and efficient purchase-sale and management processes through digital platforms. Digital tools facilitate access to critical data, including geographical location, zoning status, geometric structure, area size, title deed information and slope of real estate, obviating the necessity for field examination. This offers a significant advantage to both buyers and investors, enabling them to make more informed decisions. Furthermore, real estate consultants and industry professionals are enabled to offer more comprehensive services to their customers by utilising these technologies. The advent of digital platforms has facilitated access to preliminary real estate information, obviating the need for physical visits to municipal or cadastre directorates. This enhancement in convenience, particularly with regard to reduced time and cost, is a significant benefit. The integration of online maps, geographic information systems, and digital databases has been instrumental in enhancing the decision-making processes by furnishing users with detailed information regarding the current status of real estate. Consequently, investors and buyers are able to access the necessary data promptly, eliminating the need for extensive research into specific real estate. The instantaneous evaluation of real estate status within purchase-sale processes enhances the efficiency and reliability of these transactions. The present study examined the findings of a pilot field study conducted with the help of digital applications and investigated the effects of these applications on the sector. The results obtained demonstrate that digital tools have the capacity to save time, increase accuracy and strengthen reliability by accelerating decision-making processes in the real estate sector. In this context, the role of digitalisation in the sector is becoming increasingly important.

Keywords: Cadastre, parcel, real estate, zoning

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1. INTRODUCTION

In today’s era of rapid digital transformation, individuals are increasingly turning to digital platforms to meet their needs and find solutions to their questions. The real estate sector has been subject to this transformation, with users demonstrating a marked preference for websites and mobile applications as conduits for accessing the information they seek. Consequently, the ability of digital platforms to deliver services that align with user expectations is of paramount importance in fostering satisfaction and ensuring sustained engagement (Yalçın & Çatlı, 2024). Digital real estate is transforming the sector through the implementation of information and communication technologies, data collection systems and digital decision-making systems. This transformation facilitates urban planning and real estate development processes thanks to advanced technologies and decision support systems (Naeem, Rana, & Nasir, 2023). The development of digital platforms can improve the efficiency of the real estate market through automation and data organization (Sternik, Gareev, & Akhmetgaliev, 2021). These digital platforms facilitate the processes of buying, selling and renting property by offering tools such as high-resolution photos, videos and virtual tours (Da Costa, 2024). Geolocation offers significant benefits for the real estate industry. Consumers are able to view the geographical location of a property on a map, facilitating the examination of the surrounding residential and commercial areas without the necessity of a physical visit. This feature has been shown to facilitate more accurate buying and selling decisions (Martínez, Contreras, & Valdez Cervantes, 2015).

Geographic Information Systems (GIS)-based digital applications facilitate the process of inspecting and evaluating properties without the need for physical visits. The utilisation of a user-friendly GIS program facilitates the acquisition of informed decision-making by prospective buyers, as it enables the presentation of properties alongside relevant topographical, infrastructural, and environmental data (Ahmed, Alez, & Babu, 2015). In the contemporary era, an increasing number of municipalities are providing their citizens with access to location data for areas within their respective borders. This data has become readily available through digital platforms such as e-zoning and city guides. Access to data such as the zoning status, block, parcel or address information of real estate within the provincial borders is now possible. Furthermore, municipalities facilitate access to satellite and orthophoto imagery through dedicated city guide applications. These platforms offer location information, including 1/1000 scale zoning plans, zoning and cadastral parcels, neighbourhood boundaries, street and avenue names, door numbers, assembly areas, important places and parks, in an easily accessible format. In addition, the parcel query application developed by the General Directorate of Land Registry and Cadastre enables the user to query the province, district, neighbourhood, block and parcel information and location of the real estate. Furthermore, the platform offers insights into the geometric configuration of the properties. Access to 1/1000 scale zoning plans can be provided through the E-Plan automation systems of the Ministry of Environment, Urbanization and Climate Change.

To accurately locate a land parcel, a base map is needed. Google Earth provides satellite images of the earth's surface for free. Using these images, it becomes easier to locate a land parcel on the ground (Jasmee, Rani, & Jaafar, 2017). Mobile devices utilising the Android operating system are equipped with location-based features that facilitate the presentation of information on maps. Google Maps is an exemple of such location-based applications included in the Android operating system. Global Navigation Satellite Systems (GNSS) technology embedded within these devices utilizes satellite signals to determine the precise geographical coordinates of any given location on Earth (Putra, Sediyono, & Setiawan, 2017).

Whilst the Google Earth application provides access to location information via a three-dimensional image of the real estate, it also facilitates access to additional details, including street maps, photographs, and slope profiles.

Recent years have seen a marked increase in the number of purchase and sale transactions in the real estate sector, resulting in a significant increase in data and analysis requirements for relevant parties. The parcel query applications offered by the General Directorate of Land Registry and Cadastre offer a powerful solution to minimise uncertainties in this area. The "Analysis" feature of the application provides users with detailed data by year, allowing them to examine the density of purchases and sales, main property sales, mortgaged sales and independent section sales on a local basis. These analyses facilitate the identification of regions where sales transactions are concentrated in land registry offices, the disparities between regions, and the mobility trends. Furthermore, density analyses, bolstered by heat maps, facilitate the identification of parcels where sales transactions occur, while concurrently enabling the more precise monitoring of regional change and development trends. In the contemporary real estate sector, the accessibility of precise and expeditious information has become paramount for investors and professionals. The advent of novel generation parcel query applications that facilitate straightforward access to attribute information of all real estates throughout Turkey has the potential to reduce uncertainties in the sector and accelerate decision-making processes. The application enables users to verify the location of a real estate asset by entering specific details, including the province, district, neighbourhood and block information of the property. Furthermore, the application provides navigation support, facilitating the identification of the most efficient route to the property. In addition, users can access detailed information regarding the surrounding area, including slope and geographical features. The application enables users to visualise the locations of real estates, facilitating a comprehensive understanding of the property market.

Verification of title deed transactions via digital platforms has been demonstrated to be an effective measure in preventing fraud to a certain extent in recent years. However, forgery of title deed documents and identity information still remains a significant problem in the real estate sector (Mashatan, Lemieux, Lee, Szufel, & Roberts, 2021). It is imperative to utilise digital platforms such as the Land Registry and Cadastre Directorate's parcel query application, Google Earth, Google Maps and municipalities' e-zoning applications to ensure the safety of purchase and sale transactions conducted within the land registry office.

The acquisition of information from Google Earth constitutes a pivotal component within the domain of real estate applications. It provides users with accurate and easily understandable information, thereby facilitating more efficient and expeditious decision-making processes. The superior accuracy and clarity of the information provided by Google Earth undoubtedly provides a significant advantage to users. The acquisition of geographical coordinates, such as latitude and longitude, is a crucial aspect of real estate applications, facilitating the efficient collection of pertinent data. Furthermore, Google Earth facilitates the measurement of distances and areas, thereby enabling users to access this data without the necessity of an on-site visit. Google Earth boasts a plethora of functionalities. These include the creation of points, the display of the elevation profile of a property or real estate, and the recording of images. It is anticipated that practitioners who have not yet embraced these technological advancements will benefit from these innovations to provide more effective services. These advances will enable them to provide more efficient and high-quality services. (Ifediora & Efobi, 2022). Google Earth has become a staple of the scientific community, with its applications ranging from the correction of satellite image accuracy to the domains of cartography, geographic information systems (GIS), environmental and urban planning, land registry, transportation, forestry and agriculture (Atak, 2019). The search results for finding the region that suits the customer's demands and checking the location of the real estate for sale are presented on web pages with Google Maps and Google Earth integrations. Google Maps offers two-dimensional functionality, while Google Earth provides three-dimensional functionality (J.-T. Hwang, 2008). The acquisition of detailed property information is of paramount importance for both prospective buyers and real estate agents. Consequently, the aggregation of all pertinent information prior to property viewings facilitates informed decision-making. This approach is mutually beneficial for both realtors and sellers, as it enables realtors to enhance the attractiveness of properties by furnishing sellers with a more comprehensive array of information, while also streamlining the identification of potential issues, thereby conserving both time and financial resources. Furthermore, multimedia-supported presentation methods, such as the use of Google Earth to showcase the property's surroundings, virtual reality models of the property, and panoramic interior views, facilitate a more comprehensive evaluation of the property by prospective buyers (J. Hwang, 2007). Geographic Information Systems (GIS) have made significant contributions to the improvement of real estate transactions and the development of professional practices. GIS facilitates the acquisition of detailed information by enabling users to pose questions regarding the geographical characteristics of real estate, such as location, size, and type. The significance of this application is considerable, and its merits are too numerous to list in full (Ifediora & Efobi, 2022).

Google Maps facilitates the incorporation of maps into web-based platforms. Utilising the tools provided by Google, applications can be developed using 3D maps, maps can be designed for mobile devices, and geographic data can be visualised. Google Street View facilitates virtual tours at street level. This application displays roads, turns, names, and street numbers in public areas and places of interest, allowing users to navigate from one place to another through images (Martínez et al., 2015). Google Maps integration is a notable feature that enables users to visualise properties on a map according to their geographical location. Interactive maps furnish users with detailed information about the locations of properties, thereby aiding them in making more informed decisions and engendering greater confidence in real estate transactions (Ghandi, 2023).

The E-Plan automation system, developed by the General Directorate of Geographic Information Systems of the Ministry of Environment, Urbanization and Climate Change, provides citizens with straightforward access to all zoning plans. The system offers a comprehensive digital repository for zoning plan modifications and finalised plans, facilitating efficient management of urban development. Users can access this system via web and mobile applications, with notifications of changes being sent to parcel owners through the E-Government portal. Parcel owners are accorded the right to object to such changes, a process that can be undertaken electronically via the E-Government portal. E-Plan, a sophisticated geographic information system application, plays a pivotal role in the digitalisation of urbanisation processes. Concurrently, it is poised to serve as a foundational element for the development of smart cities. The software will play a central role in the management of future smart cities and will provide effective solutions in many areas from urban planning to citizen services.

The General Directorate of Land Registry and Cadastre has successfully digitised and transferred archive data from the Ottoman period to the present day to the digital environment. The organisation has also implemented digital projects, including the Web-land registry application and parcel query. However, it is imperative to establish the necessary legal frameworks to ensure the seamless integration of the land registry of The General Directorate of Land Registry and Cadastre, which is currently undergoing digitalisation, into the electronic domain. The transfer of land registry records and associated documentation to digital formats is expected to enhance efficiency and reduce the time required for transactions. The advent of digital land registry applications will, in the future, enable instantaneous execution of property-related transactions, including purchase, sale and transfer (Dinlemez & Ok, 2021). The General Directorate of Land Registry and Cadastre has embarked on a digital transformation process with the objective of enhancing service quality and ensuring user satisfaction. The implementation of appropriate technologies has been demonstrated to engender positive economic contributions, including the reduction of stationery and time costs. The digitalisation process at The General Directorate of Land Registry and Cadastre has made significant progress and these developments continue rapidly (Mezkit, 2020).

The objective of this study is to ascertain how digital platforms enhance the security of real estate transactions and prevent fraudulent activities, such as the presentation of erroneous locations, while also evaluating digital solutions that enable buyers to access sufficient information about details like zoning status, geometric shape, slope, and view without having to visit the property in person. In this context, the utilisation of digital tools such as the General Directorate of Land Registry and Cadastre's Parcel Inquiry Application, Google Earth, map services (Google Maps, Bing Maps, Yandex Maps) and e-zoning systems was analysed to examine buyers' access to reliable information about the real location of the real estate, zoning status and land structure.

This study addresses the lacuna in the extant literature concerning the manner in which digital platforms enhance security, transparency and efficiency in the real estate sector. The study examines the role of digital tools in preventing fraud, verifying locations, and facilitating access to zoning information. It also demonstrates how these tools can accelerate decision-making processes.

This study investigates the role of digital platforms in the real estate sector, examining the speed, transparency and reliability they provide in the purchase-sale and management processes. The analysis and pilot field study findings demonstrate that digital tools provide rapid access to critical information about real estate, facilitate decision-making processes and increase efficiency in the sector.

2. MATERIAL AND METHOD

The parcel 6 in the block 8308, located in the Akkent Neighborhood in the Central District of Isparta Province, was selected as the study area. The rationale behind this selection is twofold: firstly, its location on a hill, and secondly, its topography, which is characterised by a sloping land structure. While the slope of the land is determined approximately through digital platforms, the slope and elevation differences will also be clearly observed during the field study. In this study, a range of digital applications were utilised, including the municipalities' city guide and e-zoning applications, the parcel query application of the General Directorate of Land Registry and Cadastre, Google Maps, Google Earth, and the E-plan automation application of the Ministry of Environment, Urbanization and Climate Change. Moreover, a pilot study area was determined and the current map of the land was created in this area. As illustrated in Figure 1, the block 8308, located in parcel 6 of the Akkent Neighborhood within the Central Akkent Neighborhood of Isparta province, was queried using the e-City Guide application of Isparta Municipality. This action resulted in the retrieval of the 1/1000 scaled zoning plan for the specified parcel. As illustrated in Figure 1, the land is situated within the designated residential area, and the maximum permissible building height is stipulated as 21 meters.

The following criteria were employed in the analysis conducted in this study: Location and slope of the land, as well as the determination of slope and elevation differences through digital platforms. The digital applications utilised encompass e-zoning and city guide applications of municipalities, parcel query application of the General Directorate of Land Registry and Cadastre, Google Maps and Google Earth. In addition, the zoning status and construction rights of the land were also evaluated.

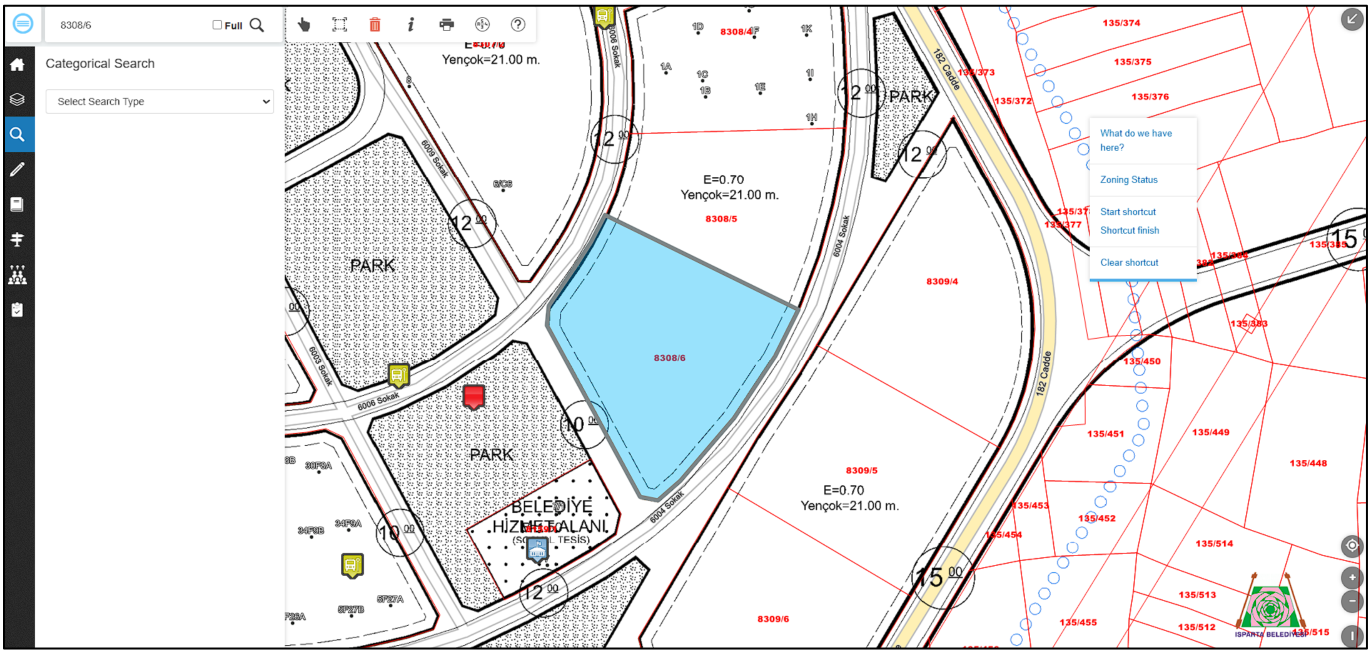

Figure 1. Parcel query in e-city guide.

In the e-city guide application, information regarding the desired area can be readily accessed by selecting layers such as "cadastre", "plan", "neighbourhood", "structure", "road" and "satellite" from the categories button. The layers in the e-city guide application are shown in Figure 2.

Figure 2. Display of layers in the e-city guide.

In the E-City Guide application, the zoning status information of the desired parcel can be accessed via the "Zoning Status" tab. Furthermore, following the viewing of the zoning status, plan notes in PDF format can be accessed, thus enabling more detailed information about the plan to be obtained. An illustrative example of zoning status, as depicted in Figure 3, is provided for reference. Upon examination of the plan, the following data can be deduced: the area value is 0.70, the maximum building height is 21 meters, there are park areas in the west and northwest of the parcel, and the Municipality Service Area is in the southwest. Consequently, all pertinent information regarding the zoning status of the parcel can be accessed via this digital platform.

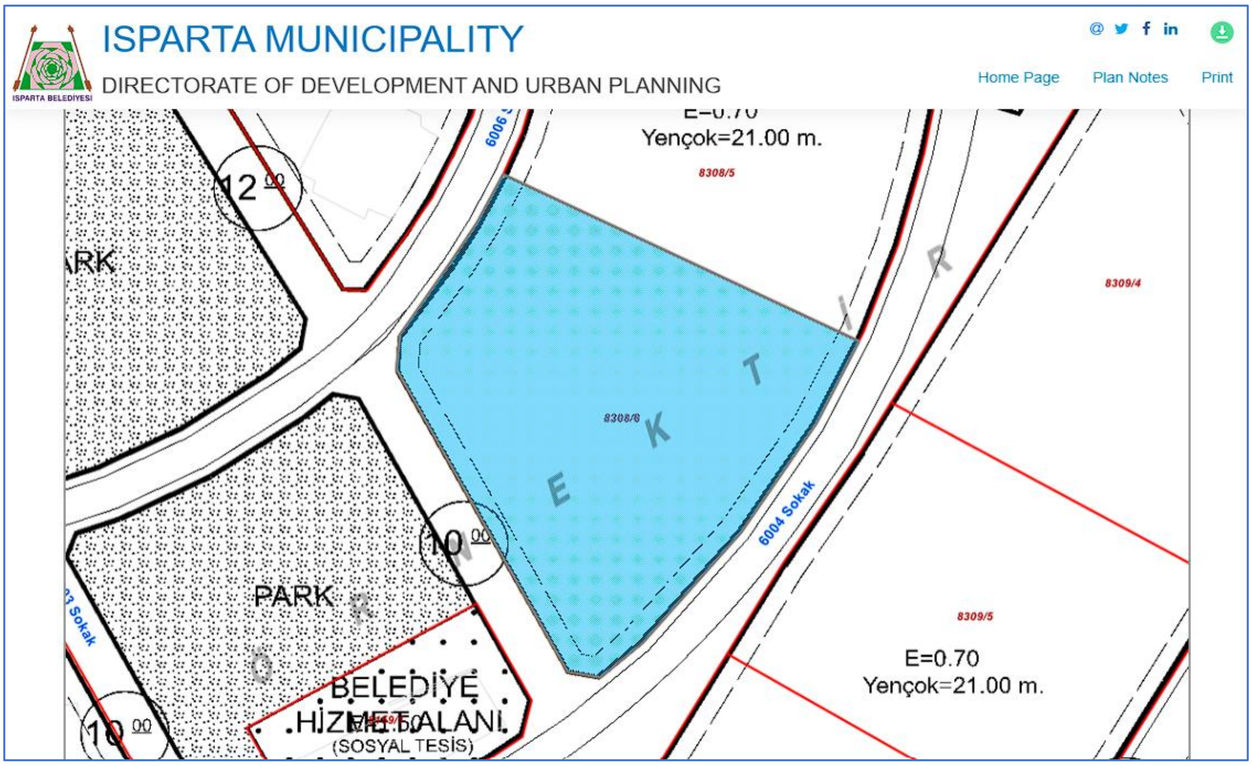

Figure 3. Zoning status display in e-city guide

As demonstrated in Figure 4, following the entry of the province, district, neighbourhood/village, block and parcel information of the real estate with the parcel query application of the General Directorate of Land Registry and Cadastre, the attribute information of the parcel and the geometric shape on the satellite image can be displayed. Moreover, in the event that the parcel contains condominiums, additional information, including the list of independent sections, the block name, and the number of independent sections, can be accessed. Furthermore, additional data, including geographical coordinates of the corner points of the parcel, side lengths, details pertaining to the parcel, and route information, can be accessed.

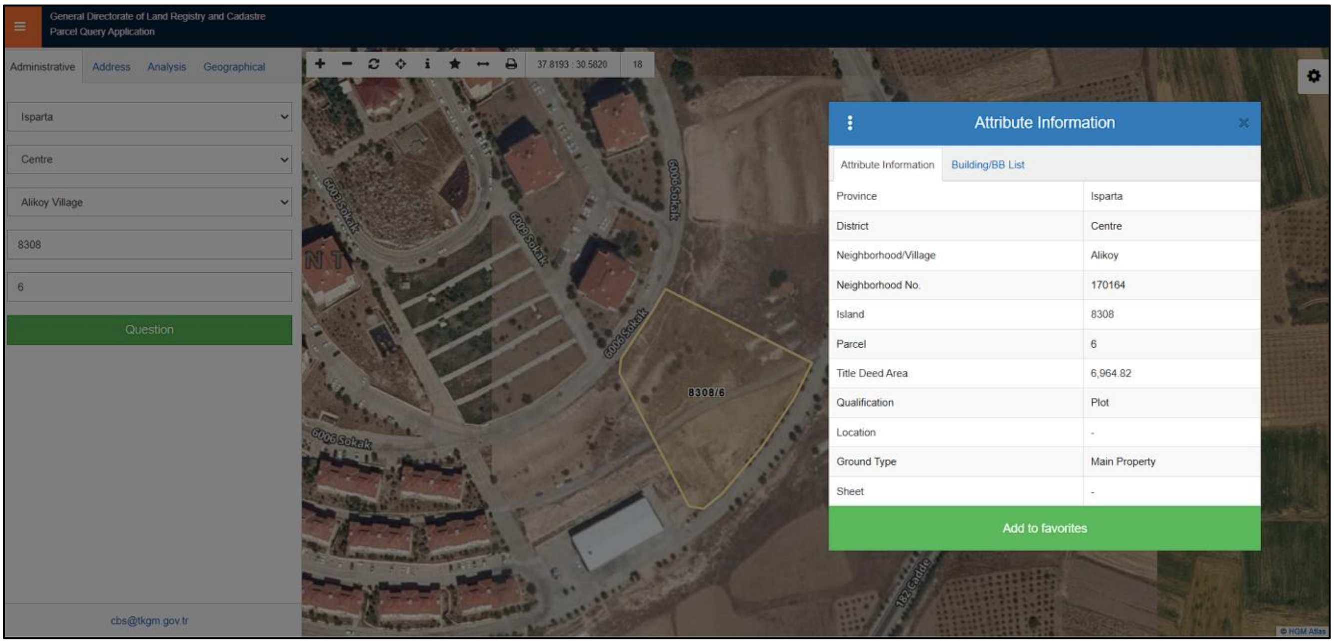

Figure 4. View from the Parcel Query Application

In order to ascertain the route to a specified parcel from one's current location, one may consult the route information provided by the parcel query application of the General Directorate of Land Registry and Cadastre. This route information can then be utilised in conjunction with map applications such as Google Maps, Bing Maps or Yandex Maps. Consequently, the closest distance to the parcel or the distance of the parcel to the city centre can be readily ascertained. As illustrated in Figure 5, the distance of the parcel to the city centre is 9.1 km.

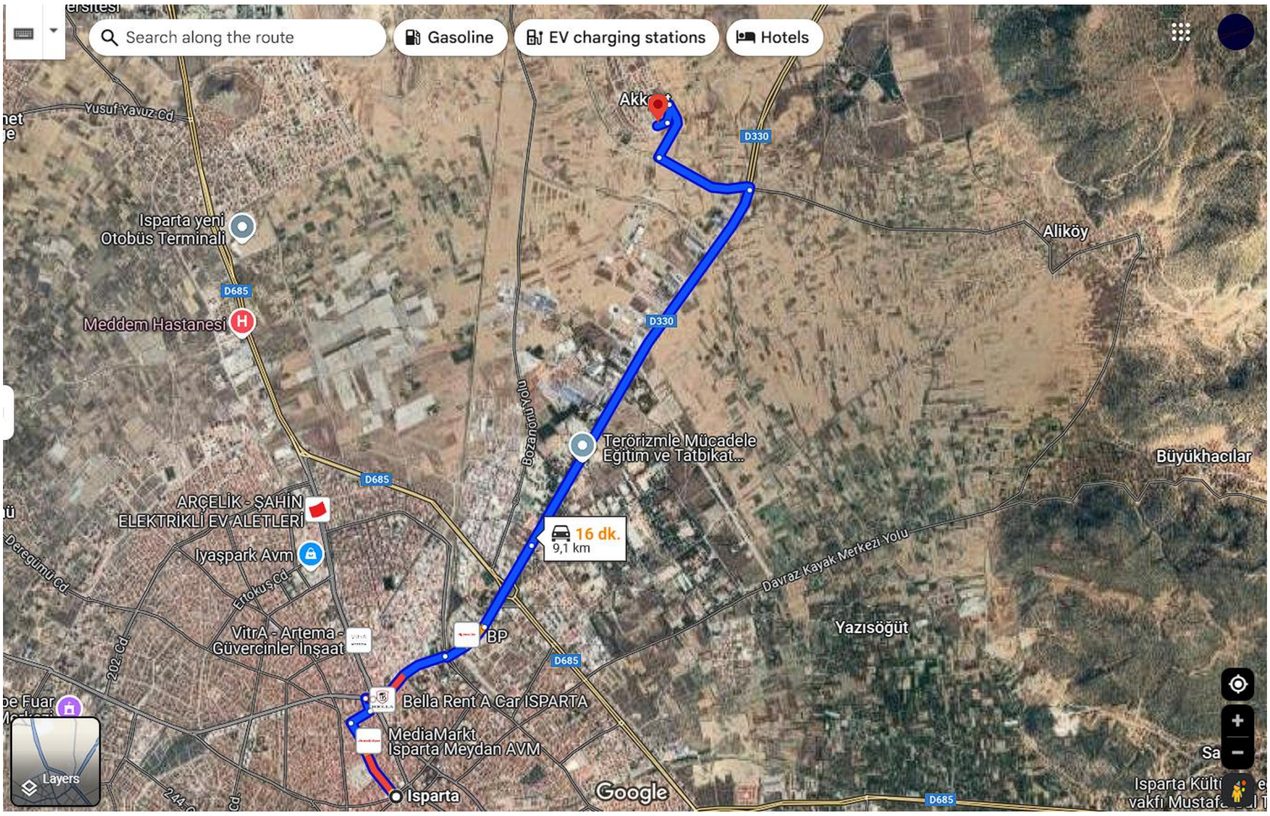

Figure 5. Navigation display (distance to center).

Following the determination of the distance of the property to the city centre, street photographs of the area in which the property is located can be accessed using applications such as Google Maps or Google Earth. These photographs provide detailed visual information about the roads, structures and the environment surrounding the property. Examination of the photograph of parcel number 6 of block 8308 in Figure 6 reveals that the parcel is located on a sloped terrain.

Figure 6. Display of street photography of the parcel

The parcel can be downloaded in KML format by selecting the download tab in the parcel query application of the General Directorate of Land Registry and Cadastre. Upon opening the downloaded file with Google Earth (see Figure 7), the geometric shape of the parcel and the attribute window can be observed on the 3D terrain. It is evident from this representation that the parcel is situated in a sloped terrain

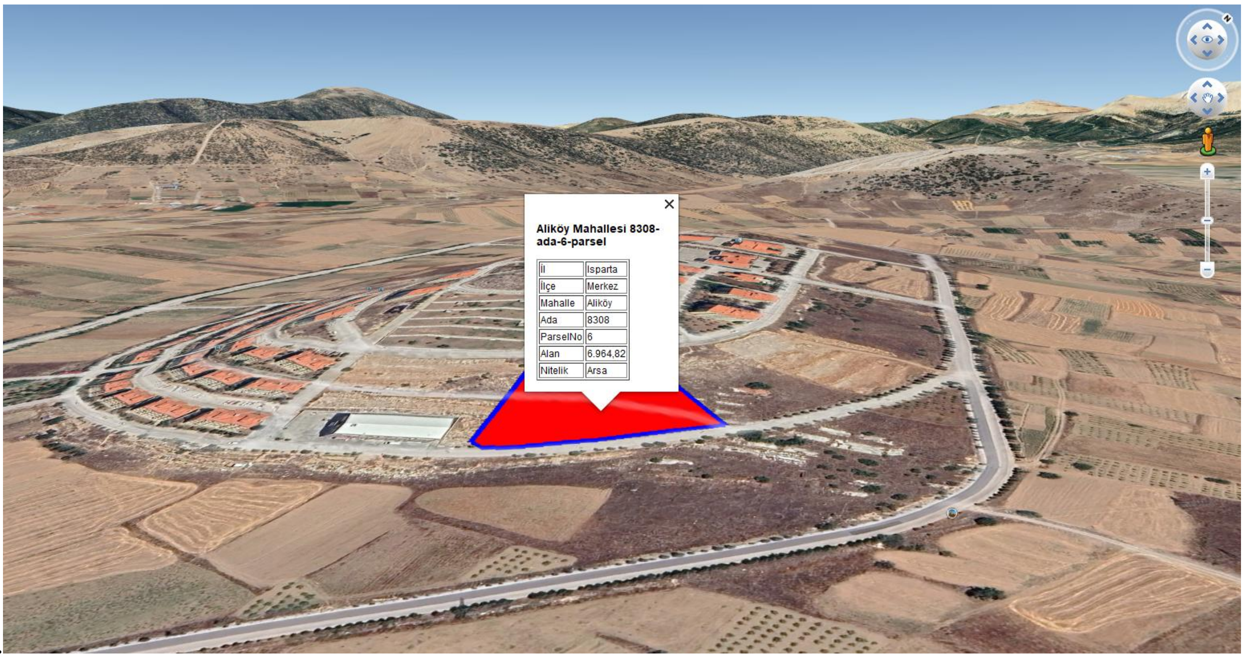

Figure 7. 3D display with Google Earth.

In the Google Earth application, an elevation profile can be created on the lines drawn transversely and longitudinally over the parcel. This process facilitates the acquisition of information pertaining to the elevation disparity and slope between the upper and lower points of the parcel. Figure 8 presents the elevation profile of the AB section of the parcel numbered 6 in block 8308, while Figure 9 illustrates the elevation profile of the CD section.

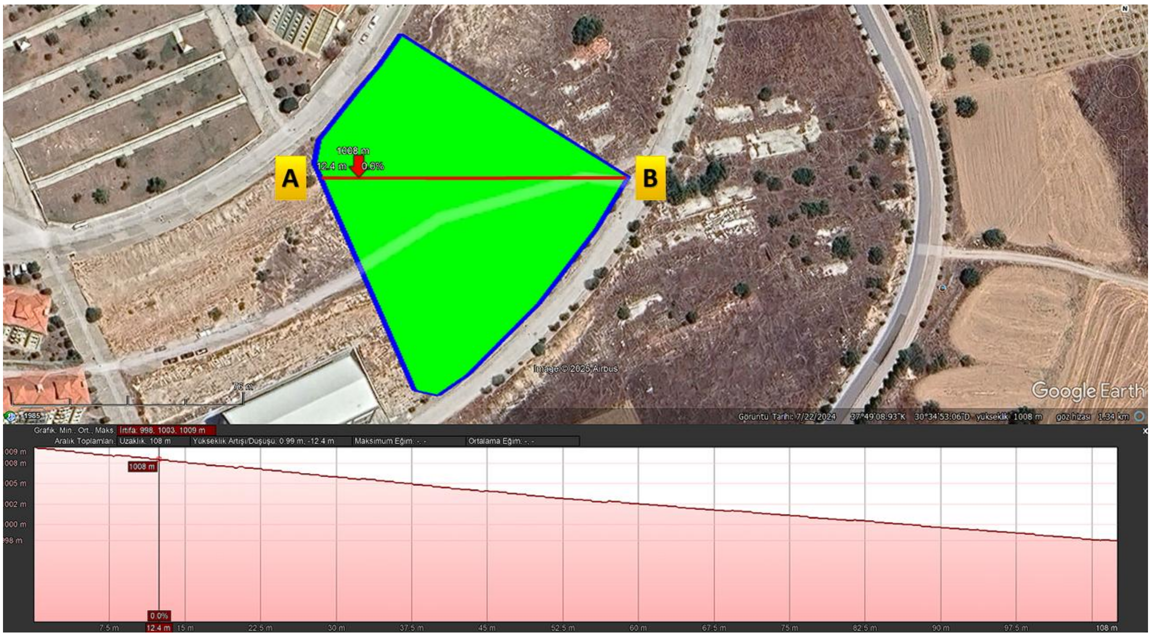

Figure 8. Elevation profile of the AB section of the parcel.

The AB section profile of the parcel reveals that the elevation of point A is 1009 metres, while point B has an elevation of 998 metres. This indicates an elevation difference of 11 meters between points A and B. The horizontal distance between these points is 101 metres. Utilising this measurement, the slope between points A and B is calculated to be approximately 11%. The CD section profile of the parcel indicates that the elevation of point C is 1012 metres and the elevation of point D is 993 metres. This indicates an elevation difference of 19 metres between points C and D, with a horizontal distance between them of 120 metres. Utilising these measurements, the slope between points C and D is calculated to be approximately 16%.

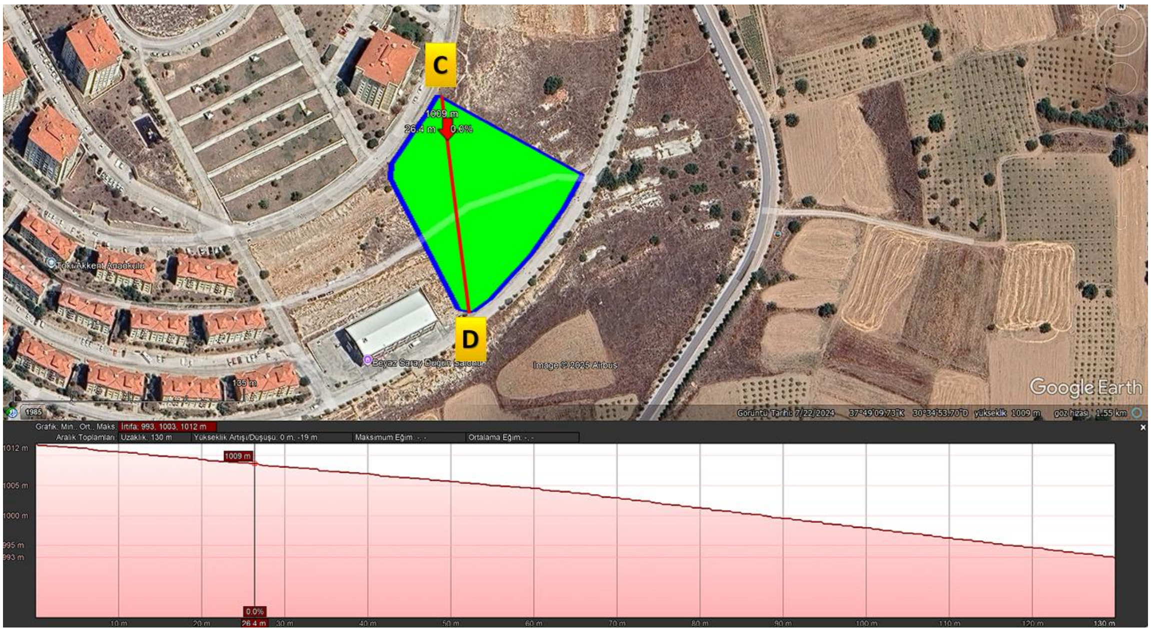

Figure 9. Elevation profile of the parcel's CD section.

The E-Plan Automation System of the Ministry of Environment, Urbanization and Climate Change (Figure 10) facilitates the retrieval of the geometric shape of the parcel by entering specific information regarding the province, district, neighbourhood or village, in addition to the block and parcel information of the location where information about the Implementation Zoning Plan is required. Thereafter, the Implementation Zoning Plan of the parcel can be brought and displayed on the satellite image. The system provides access to the 1/1000 scale Implementation Zoning Plans for all areas within Turkey that have approved zoning plans.

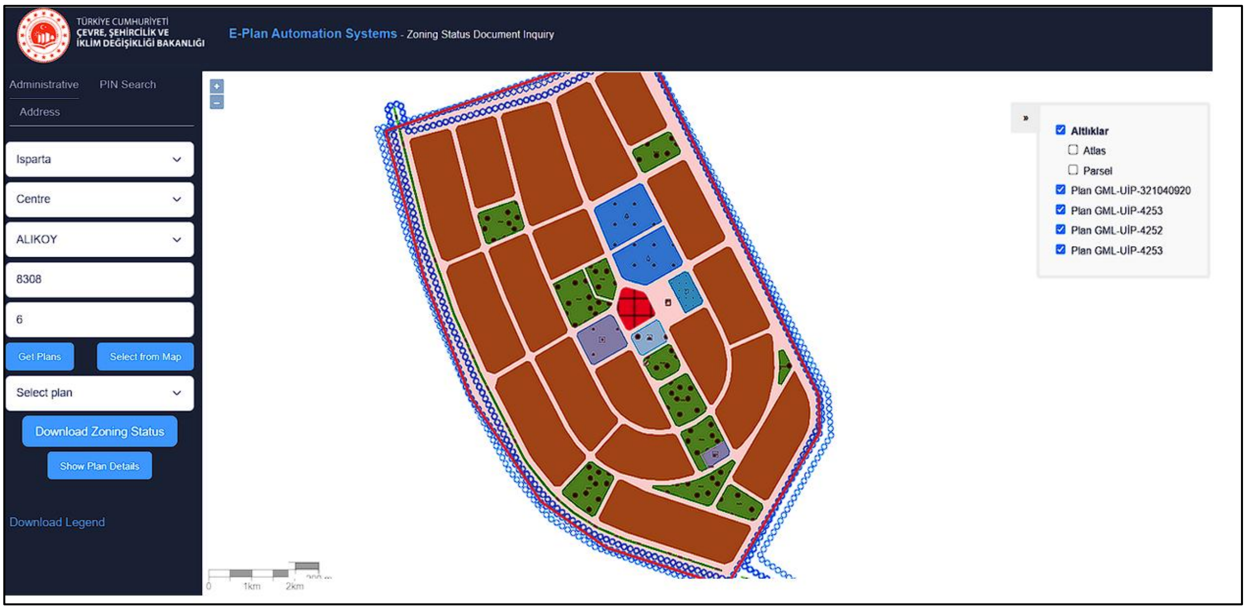

Figure 10. Zoning plan with e-plan automation system

The zoning status information of the parcel can be accessed in PDF format by selecting the "Download Zoning Status" button on the E-Plan Automation System of the Ministry of Environment, Urbanization and Climate Change. In municipalities lacking a City Guide or e-zoning application, the zoning status information of the parcels can be readily accessed via this digital platform. As illustrated in Figure 11, the zoning status document of the parcel in question was obtained from the E-Plan Automation System of the Ministry of Environment, Urbanization and Climate Change.

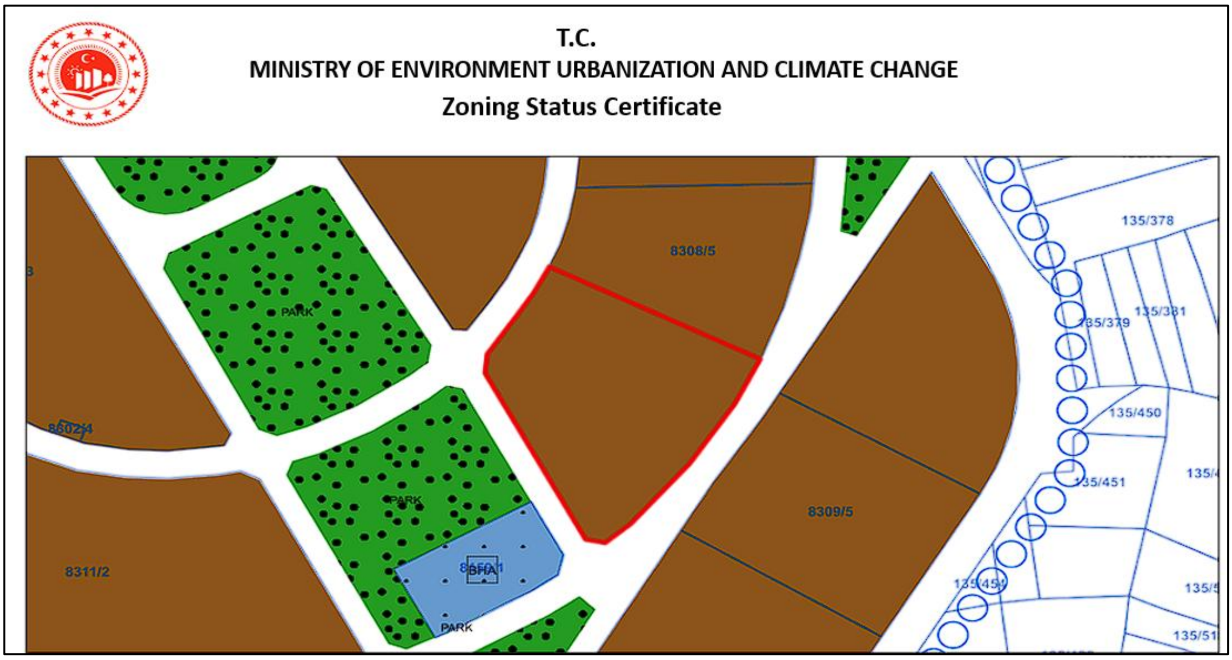

Figure 11. Zoning status with e-plan automation system.

The parcel query application of the General Directorate of Land Registry and Cadastre facilitates the display of purchase and sale transactions made in any region during the year on the parcel. As illustrated in Figure 12, the cluster map reveals the distribution of purchase and sale transactions within the Akkent Neighborhood, situated in the Central District of Isparta Province, during the year 2023. This application enables the acquisition of data pertaining to the frequency of purchase and sale transactions within the land registry of a specific region. This information can provide valuable insights for potential investors, assisting them in making informed decisions regarding their investment strategies.

Figure 12. Purchase and sale density in parcel query application for 2023 - cluster map

The Parcel Inquiry Application of the General Directorate of Land Registry and Cadastre facilitates the retrieval of attribute information regarding condominium buildings situated within a specific parcel. As illustrated in Figure 13, the "Building List" tab of the application enables the user to access the floor information (ground floor, first floor, second floor, roof, basement, etc.) and building number information of all independent sections in the selected building.

Attribute Information

Attribute Information | Building/BB List

#	Building Quality	Block	Independent Section Quantity
+	Condominium	F-10	16
+	Condominium	F-11	16
+	Condominium	F-12	16
+	Condominium	F-23	16
+	Condominium	F-24	16
+	Condominium	F-25	16
+	Condominium	F-26	16
+	Condominium	F-27	16
+	Condominium	F-6	16
+	Condominium	F-7	16
+	Condominium	F-8	16
+	Condominium	F-9	16

Add to favorites

Figure 13. Parcel query building information.

3. RESULTS AND DISCUSSION

In the course of this study, a field study was conducted on the parcel within the designated study area. A GNSS was utilised to measure 200 points within the study area, thereby acquiring their three-dimensional coordinates. The obtained coordinates were transferred to a computer, and a triangular model was created. Iso-elevation curves were then passed. Consequently, the topographical characteristics of the land were thoroughly measured, and the resulting data were utilised to prepare the current map of the land, as illustrated in Figure 12. The height of the lowest point was determined as 1027 metres and the height of the highest point as 1051 metres in the measurements made on the parcel number 6 of block 8308. This data indicates an elevation difference of 22 meters between the highest and lowest points of the parcel. The horizontal distance between the easternmost and westernmost points of the parcel (horizontal distance between points A and B) was measured at 101 metres. The easternmost point has an elevation of 1033 meters, while the westernmost point is 1047 meters high, resulting in a 14-meter elevation difference. Consequently, the elevation difference between the easternmost and westernmost points of the parcel is 14 meters. The calculations made on the current map determined the slope between the eastern and western ends of the parcel to be 13.86%, as illustrated in Figure 14. The horizontal distance between the northernmost and southernmost points of the parcel (horizontal distance between points C and D) was measured at 120 metres. The northernmost point has an elevation of 1051 meters, while the southernmost point has an elevation of 1027 meters. Consequently, the elevation difference between the northernmost and southernmost points of the parcel is 24 meters. The calculations made on the current map determined the slope between the northern and southern ends of the parcel to be 20%, as shown in Figure 15.

The objective of the fieldwork in this study is twofold. Primarily, it is to prepare the current map by measuring the topographic features of the land, and secondly, to support the accuracy of information on digital platforms.

The study conducted by Yalçın and Çatlı (2024) emphasises the impact of marketing efforts made through digital platforms in the real estate sector on customer satisfaction and loyalty. Martínez, Contreras and Valdez Cervantes (2015) emphasise that geolocation information offers a significant opportunity for the real estate sector, whereby customers can make more informed purchasing decisions by viewing the location of properties and surrounding areas on a map. Da Costa (2024) emphasises that digital real estate applications make buying, selling and renting transactions more accessible, efficient and transparent, facilitate users' research and offer the opportunity to make transactions remotely. It is also stated that artificial intelligence and digital database systems increase transaction accuracy and the market becomes more dynamic.

This study was observed that the data provided by digital platforms for land analysis exhibited substantial congruence with field measurements. Furthermore, it was demonstrated that users can access comprehensive real estate information in a timely and effective manner through digital platforms without the necessity of being physically present on the land.

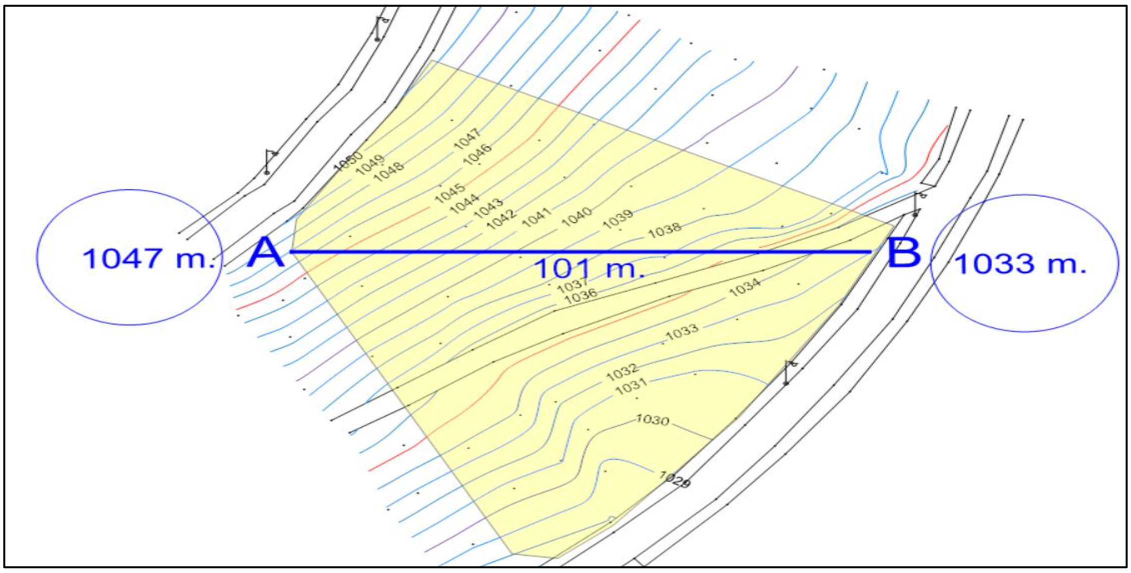

Figure 14. Elevation profile of the parcel's AB section on the current map.

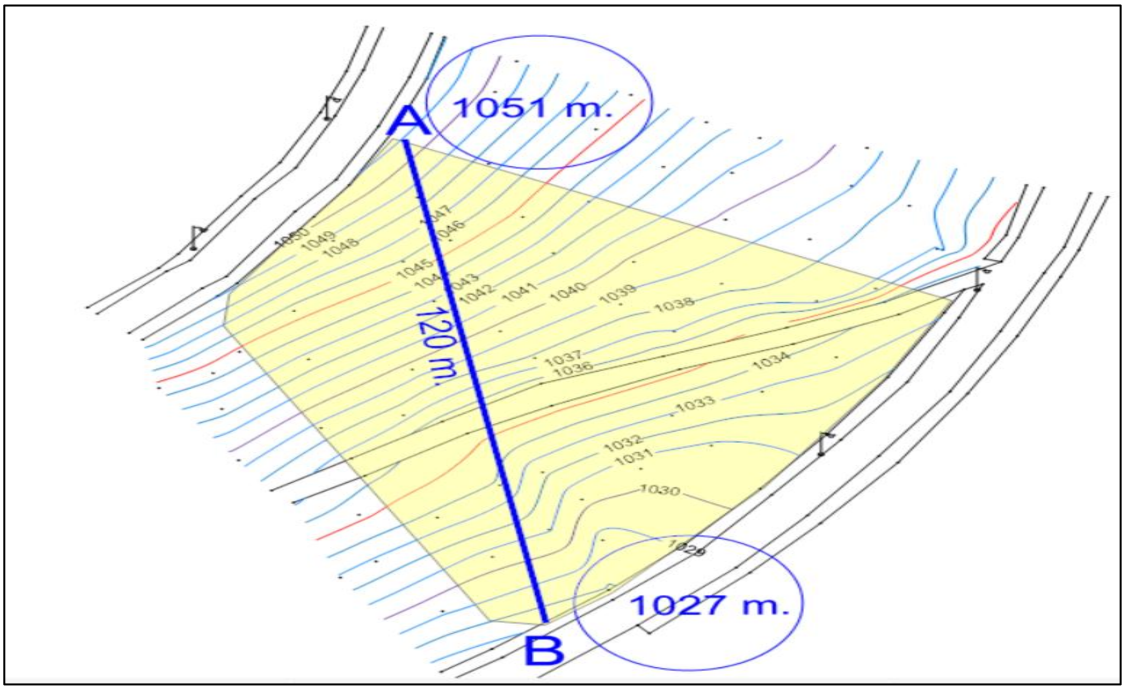

Figure 15. Elevation profile of the CD section of the parcel on the current map.

4. CONCLUSION

The utilisation of digital platforms is of paramount importance in order to prevent fraudulent activities involving erroneous location information in real estate purchase and sale transactions. In instances where real estate is registered in the land registry, but is situated in a different location and is being offered for sale, buyers may be misled and consequently become victims of fraud. The utilisation of digital applications facilitates the verification of the actual location of real estates, thereby ensuring a more secure environment for transactions and preventing potential buyers from being misled.

Digital platforms have transformed the real estate sector by enabling prospective buyers to access detailed information about potential properties without physical visits. The parcel query application of the General Directorate of Land Registry and Cadastre enables the visualisation of the geometric shape and façade lengths of the property on satellite imagery, upon entry of the province, district, neighbourhood/village and block-parcel information. Furthermore, navigation support can be provided via map applications such as Google Maps, Bing Maps or Yandex Maps using the route information in the parcel query application. Consequently, users can access information regarding the nearest transportation options to the property, as well as the distance to the city centre.

The Parcel Inquiry Application of the General Directorate of Land Registry and Cadastre facilitates the retrieval of attribute information pertaining to condominium buildings situated on a specific parcel. In the event that the immovable property to be purchased is a flat, details such as the number of independent sections, the number of floors and the building number can be accessed through the "Building List" tab in the application. This approach serves to avert potential issues, such as erroneous independent section sales, which may be recorded in the land registry. The zoning status of the parcel of interest can be ascertained through the municipalities' City Guide or e-Zoning applications. In the absence of such an application, the necessary information can be accessed through the e-Plan Automation of the Ministry of Environment and Urbanization. This approach enables the acquisition of pertinent details, including the function of the property in the 1/1000 scaled zoning plan, the status of its floor zoning permit, its precedent value, and whether it is designated as abandoned to the road, without the necessity of physical inspection of the property.

It is possible to access a range of information, including whether the parcel is situated on a slope or in flat land, the percentage of slope, and the elevation difference between the corner points. In the context of this study, the parcel downloaded in KML format from the parcel query application of the General Directorate of Land Registry and Cadastre was opened in the Google Earth application. The elevation differences between the separation corner points were visualized via Google Earth, and transverse and longitudinal lines were drawn with the elevation profile dimensions. Following a thorough analysis, the following calculations were made: the profile slope in the AB line was calculated to be 11%, and the profile slope in the CD line was calculated to be 16%. The GNSS measurements made in the field enabled the creation of a triangle model and the passing of iso-elevation curves. The field measurement results indicated that the slope on the AB line was 13.86%, while the slope on the CD line was 20%

A series of comparisons were made using Google Earth, and it was determined that the slope difference in the AB line was 2.86%, and the slope difference in the CD line was 4%. This finding indicates that digital platforms such as Google Earth can be utilised to obtain approximate information about the slope of the land.

The integration of comprehensive details pertaining to the geometry, zoning status, slope analysis, street photographs, satellite and orthophoto images, facade lengths and surface area of a given real estate asset onto a singular digital platform will indubitably engender a substantial degree of convenience for users. Consequently, users will be able to access comprehensive information about real estate in a timely and effective manner through digital platforms.

Digital platforms have been shown to provide usable data for land analysis, and it has been observed that these data are largely consistent with field measurements. This finding indicates that digital mapping tools can serve as a reliable and effective auxiliary instrument in planning processes.

Ethics Committee Approval
N/A

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Conflict of Interest
The authors have no conflicts of interest to declare.

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Yazar rehberi

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Başlık ve özet (İngilizce): Özet 500 kelimeyi geçmeyecek şekilde yazılmalıdır. Araştırmanın gerekçesini, amaçlarını, uygulanan yöntemi, sonuç ve önerileri içermelidir. Özet sonuna 3-6 kelimeden oluşan anahtar kelimeler eklenmelidir.

Ana metin: Makale ana metni tek satır aralıklı olarak yazılmalı, çizelge ve şekillerle birlikte toplam 15 sayfayı geçmemelidir. Konu başlıkları 1., 1.1., 1.1.1., şeklinde numaralandırılmalıdır.

Dipnotlar: Metin içerisinde dipnotlardan olabildiğince kaçınılmalıdır. Çizelge ve şekillerde ise gerekli olması halinde ilgili objenin altında yer almalıdır.

Semboller ve kısaltmalar: Birim sembolleri Uluslararası Birimler Sistemine (The International System of Units; SI) göre olmalıdır.

Kaynaklar: Metin içinde geçen kaynaklar yazarların soyadları ve yayın yılı ile birlikte verilmelidir (Örnek: Özkan vd., 2008; Özdemir, 2015). Metin sonundaki kaynaklar önce alfabetik sonra kronolojik sıraya göre sıralanmalıdır. Bir yazarın aynı yılda birden fazla yayınına atıf yapılmışsa, bu kaynaklar yayın yılından sonra gelecek a, b, c… harfleriyle ayrılmalıdır (Örnek: Kandemir, 1999a; 2000b; 2001).

Çizelgeler ve şekiller: Bütün çizelge ve şekiller metin içerisinde atıf sıralarına göre ardışık olarak numaralandırılmalı ve ilgili yere eklenmelidir. Çizelgelerin üzerinde ve şekillerin altında başlıkları yer almalıdır. Çizelge ve şekiller hem elektronik ortamda hem de kağıt baskıda net olarak görünür ve anlaşılabilir olmalıdır. Şekiller en az 300 dpi çözünürlüğünde hazırlanmalıdır. Şekillerde kullanılan karakterler Times New Roman yazı tipinde olmalıdır.

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