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Interactions Between Migration, Forest Crime, and Land Use Change in Tekirdağ, Türkiye

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Abstract

Aim of study: This study aims to investigate the interactions between land use classes, population change, and forest crimes in the Tekirdağ Forest Planning Unit for the period 2007-2023.

Area of study: Tekirdağ was chosen as the case study area because it is one of the provinces that receive the most immigration in Türkiye.

Material and method: Stand maps, population information, and forest crime numbers were obtained for use in the study. Land use classes for 2008 and 2016 were created using stand maps. Additionally, forest crime numbers for the 2002-2023 period and population data for the 2007-2023 period were provided. Changes in land use classes, population, and forest crimes were examined according to the relevant years, and the relationships between them were investigated. The relationships between population and forest crimes were determined by Pearson's correlation coefficient.

Main results: The most significant changes in land use classes were determined as an increase of 6138.8 ha in broadleaf forests and a decrease of 13673.0 ha in agricultural areas. During the 2007-2023 period, the population increased continuously at variable rates. The relationships between annual population and forest crimes were examined in the 2007-2023 period, and it was determined that the highest relationship was negative between population and grazing crime (r=-0.641).

Research highlights: In-migration in the study area and the decrease in the rural population have been effective in forest crimes committed in the region. In-migration has led to a decrease in grazing crime and an increase in individual occupation crimes in rural areas.

Keywords: Population Change, Migration, Forest Area, Land Cover, Pearson's Correlation Coefficient

Tekirdağ, Türkiye'de Göç, Orman Suçu ve Arazi Kullanım Değişimi Arasındaki Etkileşimler

Öz

Çalışmanın amacı: Bu çalışmanın amacı Tekirdağ Orman İşletme Şefliğinde 2007-2023 periyodu için arazi kullanım sınıfları, nüfus değişimi ve orman suçları arasındaki etkileşimlerin araştırılmasıdır.

Çalışma alanı: Tekirdağ, Türkiye'nin en çok göç alan illerinden biri olması nedeniyle çalışma alanı olarak seçilmiştir.

Materyal ve yöntem: Çalışmada meşcere haritaları, nüfus bilgileri ve orman suç sayıları kullanılmıştır. Meşcere haritaları kullanılarak 2008 ve 2016 yılı arazi kullanım sınıfları oluşturulmuştur. Ayrıca 2002-2023 periyodu için orman suç sayıları ve 2007-2023 periyodu için nüfus verileri temin edilmiştir. İlgili yıllara göre arazi kullanım sınıfları, nüfus ve orman suçlarındaki değişimler incelenmiş ve aralarındaki ilişkiler Pearson korelasyon katsayısı ile belirlenmiştir.

Temel sonuçlar: Arazi kullanım sınıflarındaki en belirgin değişimler yapraklı ormanlardaki 6138.8 ha'lık artış ve ziraat alanlarındaki 13673.0 ha'lık azalış olarak belirlenmiştir. 2007-2023 periyodunda nüfus değişken oranlarda sürekli artış göstermiştir. 2007-2023 sürecinde yıllık nüfus ve orman suçları arasındaki ilişkiler incelenmiş ve en yüksek ilişkinin nüfus ve otlatma suçu arasında negatif yönlü olduğu belirlenmiştir (r=-0.641).

Araştırma vurguları: Çalışma alanında meydana gelen iç göç ile kırsal nüfustaki azalma, bölgede işlenen orman suçlarında etkili olmuştur. İç göç özellikle otlatma suçunun azalmasına ve kırsal alanlarda münferit işgal suçlarının artmasına neden olmuştur.

Anahtar Kelimeler: Nüfus Değişimi, Göç, Orman Alanı, Arazi Örtüsü, Pearson Korelasyon Katsayısı

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Introduction

Migration is a significant force influencing ecosystems (VanWey et al., 2012; Robson & Klosster, 2019). Concepts on the relationship between migration and the environment also emphasize migration as an indicator for environmental change (Neumann & Hilderink 2015). There is a rapid urbanization problem throughout the world. Approximately 2.5 billion more people are expected to settle from rural areas to cities in the next 30 years (DESA, 2019). Angelsen et al. (2020), in addition to the effects of migration on land use, leading to the use of less labor-intensive agricultural practices due to the population emptying of agricultural lands due to migration and a decrease in labor supply also say that migrants can replace them through purchases from production with cash income support for those left behind. He stated that they could purchase consumer goods or invest in different sectors with little impact on land consumption. Taylor et al. (2006), Aguilar-Støen et al. (2011) and Schmook & Radel (2008) also emphasized that remittances and migration can serve as incentives and instruments for households to alter their land use practices.

It is accepted that with the idea of new rurality, livelihoods and occupations in rural areas have diversified. Accordingly, household incomes have shifted towards non-agricultural production types, and the importance of workers' remittances for rural economies has increased (Keles et al., 2007; Angelsen et al., 2020). In addition, life in rural areas is becoming more active, farmers are getting older, and with the rapid flow of ideas along with developing information technologies, demands and consumption are also affected (Cole et al., 2015). However, despite all these transformations and changes, most of the population in developing countries continues to live in rural areas (Rigg, 2006). Forests are seen as an important source of income for those living in rural areas (Bozali et al., 2015).

Forests serve as a source of food, energy, and revenue for millions, while forest-based enterprises additionally offer employment and income prospects for numerous others (Sreedharan & Matta, 2010; Sivrikaya et al., 2013; Özcan et al., 2022; Yılmaz et al., 2023). Forests presently encompass 30.8 percent of the Earth's terrestrial surface (FAO, 2020). The total forest area is 4.06 billion hectares (FAO & UNEP, 2020). Three hundred fifty million of the most impoverished individuals globally rely entirely on forests for their sustenance and survival, whereas 1.6 billion rural inhabitants depend on forests to varying extents (Abdullah et al., 2016; Chao, 2012; Hlaing et al., 2017; Moe & Liu, 2016). An opportunity is also created for the improvement of forests due to the decrease in human density in rural areas in response to the population density and chaos in cities caused by migration (TÜİK et al., 2005). It can be said that, especially in developing countries, there is an extensive bibliography in the literature on migration between rural areas and from rural areas to cities, especially on the changes caused by migration on forest cover and the relations between them (Barbier & Carr, 2005; Lambin et al., 2001; Rudel et al., 2002). With the increase in urban population, a significant part of the new residential areas needed due to unplanned and rapid urbanization are supplied from forests illegally (Ok, 2010). According to Juniwaty et al. (2019), migration also affects forests and the use of forests. For example, considering that women and older people are left behind in rural areas where men migrate more intensively, the way of benefiting from forests will also differ. Additionally, when there is migration for educational purposes, extra costs will arise for households, which will intensify agriculture and cause damage to forests. In the case of migration from rural to urban areas, the pressure on forests decreases, and therefore, a decrease in forest crimes is expected. Changes in forest crimes are also observed in Türkiye due to migration. There was a steady decrease in forest crimes committed between 1990 and 2010 due to migration from rural to urban areas. So much so that during this period, there was a 71.1% decrease in the number of forest crimes committed (-72.6% in cutting crime; -83.6% in transportation crime; -68.5% in forest clearing crime; -75.4% in grazing crime) has been experienced (Atmış & Günşen, 2016). Tekirdağ was chosen as the case study area in this research. The reason for this is that Tekirdağ is among the provinces that receive

the most immigration in Türkiye. The main aim of the study is to examine the relationship between land use change, migration, and forest crime from 2007 to 2023 in Tekirdağ, NW Türkiye.

Migration and Forest Cover Change in Türkiye

In the 1950s, distinct features began to emerge in Turkish agriculture. These can be stated as low productivity, low agricultural income, inequality in income distribution and land ownership, and fragmentation of agricultural lands (Keleş, 2006). As the number of tractors increased at the beginning of the 1950s, nearly one million farmers had to move away from agriculture and leave rural areas (Karpat, 2003). In addition, as infrastructure services (such as roads, electricity, water) and vehicles began to reach villages in these years, the increase in new roads and vehicles providing transportation accelerated migration from villages to cities (Türkdoğan, 2006). Factors such as inadequate agricultural land due to population growth in rural regions, inability to adopt modern agricultural techniques and technologies, insufficient employment prospects, and limited educational and healthcare services have compelled rural inhabitants to migrate to urban areas in search of improved opportunities. However, population mobility began in Türkiye in the 1950s (Günşen & Atmiş, 2015). Table 1 shows the change in urban and rural population from 1927, when the first census was held in Türkiye, to 2022.

Table 1. Changes in rural and urban population in Türkiye

Census Years	Total	Urban Population	Urban Population Rate (%)	Rural Population	Rural Population Rate (%)
1927	13648270	3305879	24	10342391	76
1935	16158018	3802642	24	12355376	76
1940	17820950	4346249	24	13474701	76
1950	20947188	5244337	25	15702851	75
1960	27754820	8859731	32	18895089	68
1970	35605176	13691101	38	21914075	62
1980	44736957	19645007	44	25091950	56
1990	56473035	33326351	59	23146684	41
2000	67803927	44006274	65	23797653	35
2012	75627384	58448431	77	17178953	23
2013	76667864	70034413	91	**6663451**[1]	9
2022	85279553	79613279	93	5771274	7

[1]In 2012, Law for Metropolitan Municipalities that the law no 6360 has been introduced. Under this law, 14 metropolitan municipalities have been established and in 30 city which has a status of metropolitan, towns and villages has been joint to district municipalities.

Since 1950, there has been a migration from rural areas to urban centers, resulting in a decline in the population ratio of villagers to city dwellers. The population of towns, conversely, experienced significant growth, particularly when individuals migrated from rural areas. In 1950, over 25% of the whole population resided in urban areas. Subsequent years witnessed a rapid increase in that figure, and by 1970, 38% of the whole population resided in urban areas. Historically, census data has indicated a consistent increase in urban populations, culminating in the current figures. From 1980 to 1990, the rural population of Turkey had its inaugural decline. Despite the increase in the rural population during the 1960s, their proportion of the total national population continues to decline (Table 1).

Turkey possesses a diverse array of flora and fauna due to its 78 million hectares of land. Forests also have a significant influence in this variety. Turkey possesses forests that encompass 23.2 million hectares, constituting 29.8 percent of its terrestrial area. Approximately one-quarter of Türkiye's land area consists of forests. Approximately 48.5% of forests are believed to have an ecological

purpose, encompassing watershed protection and erosion prevention. Additionally, 42 percent serve an economic role, encompassing the production of roundwood, firewood, and non-wood forest products, while the remaining 9 percent pertain to social and cultural aspects. The General Directorate of Forestry (GDF) oversees the majority of Turkey's forests, predominantly controlled by the government. Privately owned forest area is less than two-thousandths of the entire forest area (about 30 thousand hectares). Türkiye forests are operated by the forest management department, which is the smallest operating unit, with forest management plans prepared with a return period of 10-20 years (GDF, 2021). The map showing Türkiye's forest assets is given in Figure 1.

Figure 1. Forest distribution map of Türkiye (GDF, 2021)

The size and changes of forest areas in Türkiye are shown in Figure 2 according to the forest inventory assessment results and years (1973, 1999, 2004, 2012, 2015, 2020) carried out to date (GDF, 2021). According to GDF data, Türkiye's total forest area is 23.2 million ha as of 2022. This forest area amount is 29.8% of the country's total area.

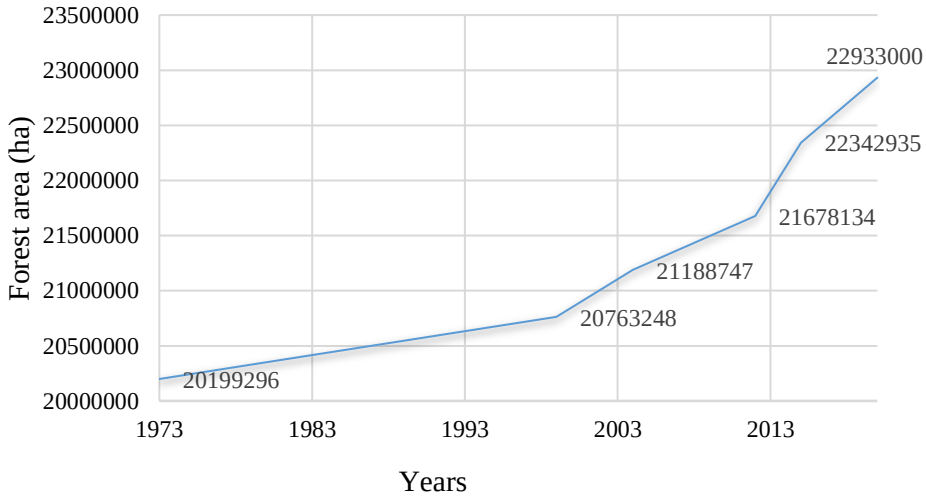

Figure 2. Forest areas according to forest inventory results

Türkiye's forests, accounting for 13% of the total forest coverage in the European Union (EU), have a critical role in terms of protecting biological diversity, reducing the negative consequences of climate change as well as being the primary livelihood opportunity for forest villagers whose number is around 7 million (World Bank, 2017).

Materials and Methods

Study Area

The study area is covered by Tekirdağ Forest Planning Unit and located between 27º 07' 43'' – 27º 43' 15'' eastern longitudes and 40º 45' 12'' – 41º 16' 28'' northern latitudes in Tekirdağ, NW Türkiye (Figure 3). The highest point of the study area is Uçaktaşı Hill at the southern border with 924 m, and the lowest point is 0 m at the coast of the Marmara Sea in the south and south-east. The study area is in Tekirdağ city center, and transportation to consumption centers is easily provided by land, sea, and railway. Tekirdağ Forest Planning Unit forests are 132 km away from Istanbul and 140 km away from Edirne, which are the closest consumption centers. The mean annual temperature of the study area is 13.8 ^{0}C, and the mean annual precipitation is 574.7 mm. The main tree species in the study area are *Pinus brutia*, *Pinus nigra*, *Pinus pinea*, *Cedrus*, *Juglans regia*, *Quercus petraea*, *Quercus cerris*, *Carpinus*, *Tilia*, and different types of broad-leaved trees (Anonymous, 2016).

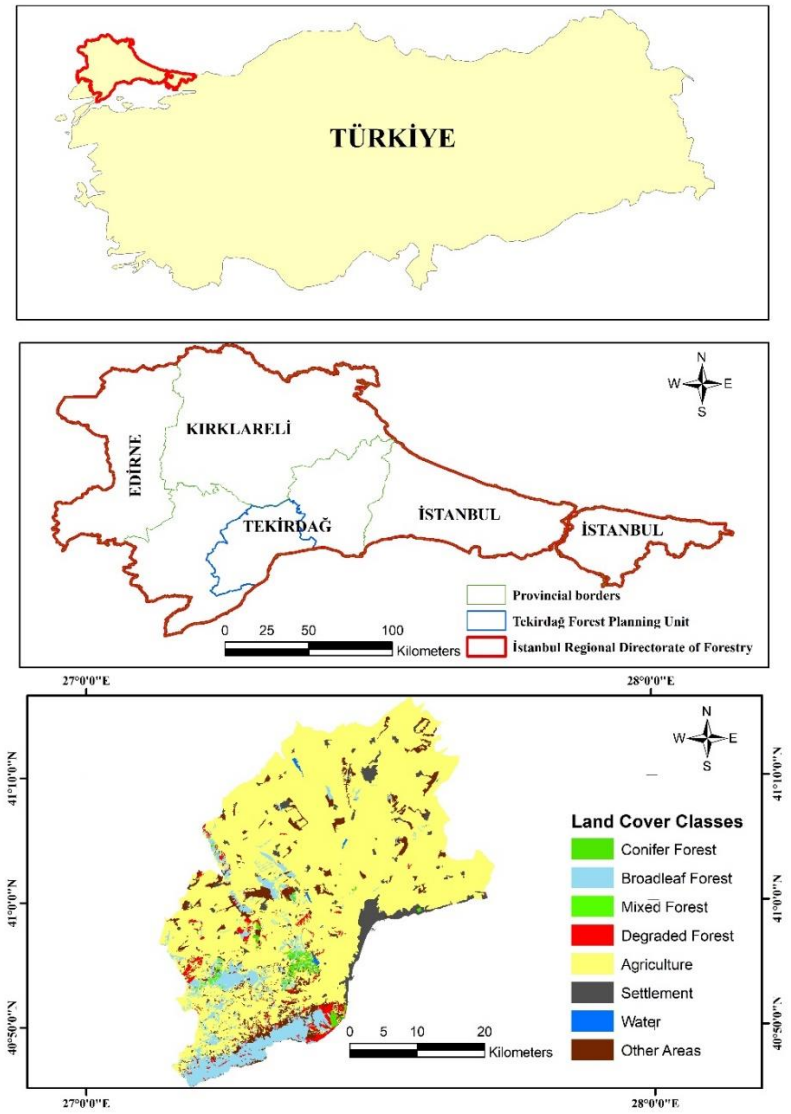

Figure 3. Location of the study area

Data and Method

In carrying out this study, stand maps were obtained from the forest management plans of 2008 and 2016 covering the study area for land use classes. Land use classes of the study area were divided into eight land use classes using stand maps as coniferous forest, broadleaf forest, mixed forest, degraded forest, settlement, agriculture, water, and other areas (forest soil, pasture, etc.). Population data for the 2007-2023 period was obtained from the Turkish Statistical Institute (TUIK), and information on the number of forest crimes such as cutting, transport, keeping, hunting, opening, occupation, and grazing for the years covering the 2002-2023 period was obtained from GDF. In this study, the interactions between land use classes, population, and forest crimes were evaluated based on the relevant years. In addition, the change in Tekirdağ provincial population and forest crimes in the period 2007-2023 was examined using Pearson's correlation coefficient.

Results

Land Use Status

Area distribution and change amounts for land use classes for 2008 and 2016 were presented in Table 2. Among the land use classes, the largest area belongs to agricultural areas. 87.98% of the total area in 2008 and 78.92% in 2016 consisted of agricultural lands. It has been determined that there has been a decrease of 13673.0 ha in agricultural lands in the intervening 8 years. Another class that attracted attention was the broadleaf forest class. While it had a share of 4.48% in the total area in 2008, it increased to 8.54% in 2016. During this period, the amount of broadleaf forest area increased by 6138.8 ha. A decrease of 477.7 ha was determined in coniferous forests and an increase of 120.3 ha in mixed forests. There was a decrease in degraded forest areas, and their ratio to the total area decreased from 5.20% to 1.90%. While the total forest area in 2008 was 16669.0 ha, it became 17465.3 ha in 2016. A total of 796.3 ha of forest area increased. There was an increase of 3.17% in settlement areas, and the area increased by 4781.5 ha. Water areas increased by 304.0 ha, from 29.4 ha to 333.4 ha.

Table 2. Areal distribution and amount of change of the land use classes

Land use Classes	2008		2016		Change (+/-)	
	Area (ha)	%	Area (ha)	%	+	-
Conifer Forest	1952.5	1.29	1474.8	0.98		477.7
Broadleaf Forest	6759.8	4.48	12898.6	8.54	6138.8	
Mixed Forest	106.9	0.07	227.2	0.15	120.3	
Degraded Forest	7849.8	5.20	2864.7	1.90		4985.1
Settlement	486.5	0.32	5268.0	3.49	4781.5	
Agriculture	132857.5	87.98	119184.5	78.92		13673.0
Water	29.4	0.02	333.4	0.22	304.0	
Other areas	970.8	0.64	8762.0	5.80	7791.2	
Total	151013.2	100.00	151013.2	100.00		

The spatial distributions of land use classes were mapped and presented in Figure 4. It was seen that the majority of the area consisted of agricultural lands in 2008, and settlements, broadleaf forests, water areas, and other areas within the agricultural lands were established in 2016. It has been determined that large-scale settlements have been established, especially in the southeast of the area. It was determined that the degraded stands in the center and west of the region in 2008 turned into productive broadleaf stands in 2016.

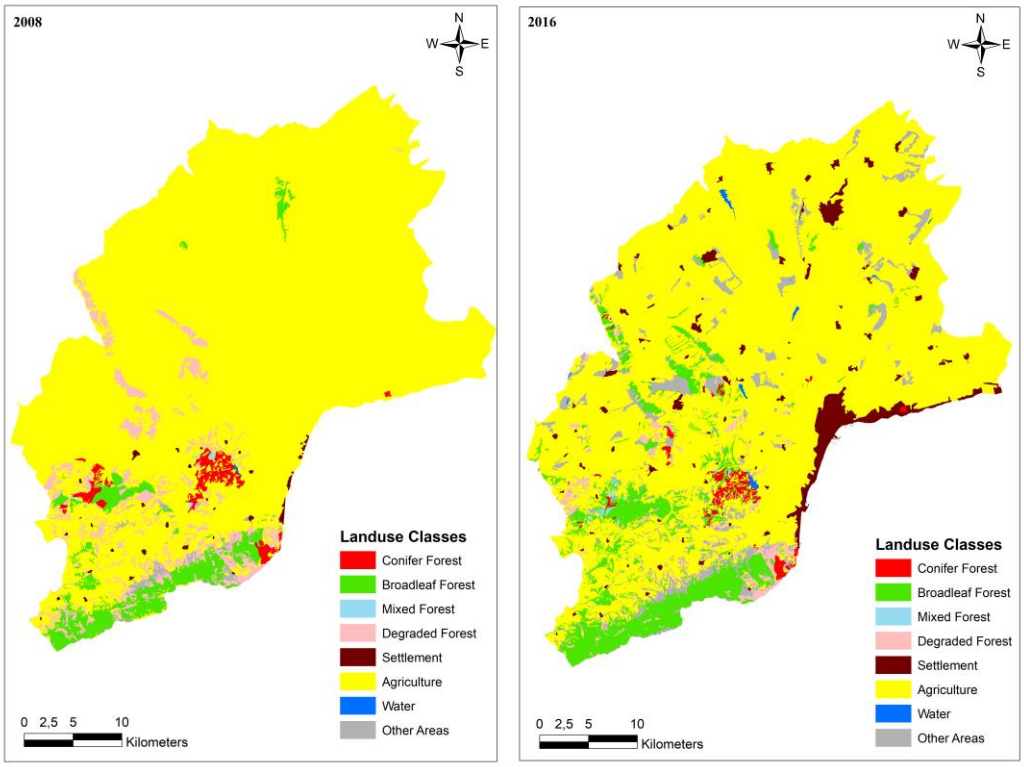

Figure 4. Spatial distribution of land use classes for the study area

Population Density and Forest Crimes

The migration information received and given by Tekirdağ province periodically between 2008 and 2023 is given in Table 3. Net migration between 2008 and 2023 is 270550. The total population of the province increased by 396287 during this period. During the related period, 68% of the increase in the total population resulted from in-migration. According to the table, it is seen that migration to Tekirdağ from other provinces tends to increase on an annual basis during the 2008-2023 period.

Table 3. Immigration information for Tekirdağ (TUIK, 2023b)

Year	In-migration	Out-migration	Net migration
2008	47534	22373	25161
2009	37665	29066	8599
2010	41307	29433	11874
2011	42265	28620	13645
2012	42155	28042	14113
2013	45313	31681	13632
2014	52994	31266	21728
2015	54482	33937	20545
2016	56536	32290	24246
2017	55391	34658	20733
2018	53895	41010	12885
2019	48911	38109	10802
2020	50764	28468	22296
2021	60190	37516	22674
2022	63354	37969	25385
2023	8272	6040	2232
Total	761018	490478	270550

The population of Tekirdağ started to grow rapidly in the years following the rapid industrialization movement after the 1980s. Since the 1990s, there has been rapid industrialization, especially in some districts of Tekirdağ (Çorlu, Çerkezköy, and Kapaklı). 52 of the organizations included in the "Türkiye's 500 Largest Industrial Enterprises" list operate in Tekirdağ. The presence of a total of 14 industrial zones in the province increases employment demand and encourages migration. In addition to hosting places suitable for summer tourism, being adjacent to Istanbul, Türkiye's largest city, and being close to the European border are other factors that encourage migration to Tekirdağ (Çorlu Chamber of Commerce and Industry, 2015). It can also be seen in Table 4 that the reasons listed cause migration to Tekirdağ. According to the table, the population of Tekirdağ shows a continuous increase during the 2007-2023 period (TUIK, 2023a).

According to Figure 5, the number of forest crimes in Tekirdağ, which was 68 in 2002, was determined to be 117 in 2023. There has been a 1.7-fold increase in forest crimes in the period 21 years. The most committed and recorded crimes in 2002 were cutting (32) and transfer (20). As of 2023, occupation (74) and cutting (22) were recorded as the most committed forest crimes. The most committed forest crimes and their customs during the 2002-2023 period are, respectively, occupation (633), cutting (478), opening (330), grazing (222), transport (165), and keeping (110).

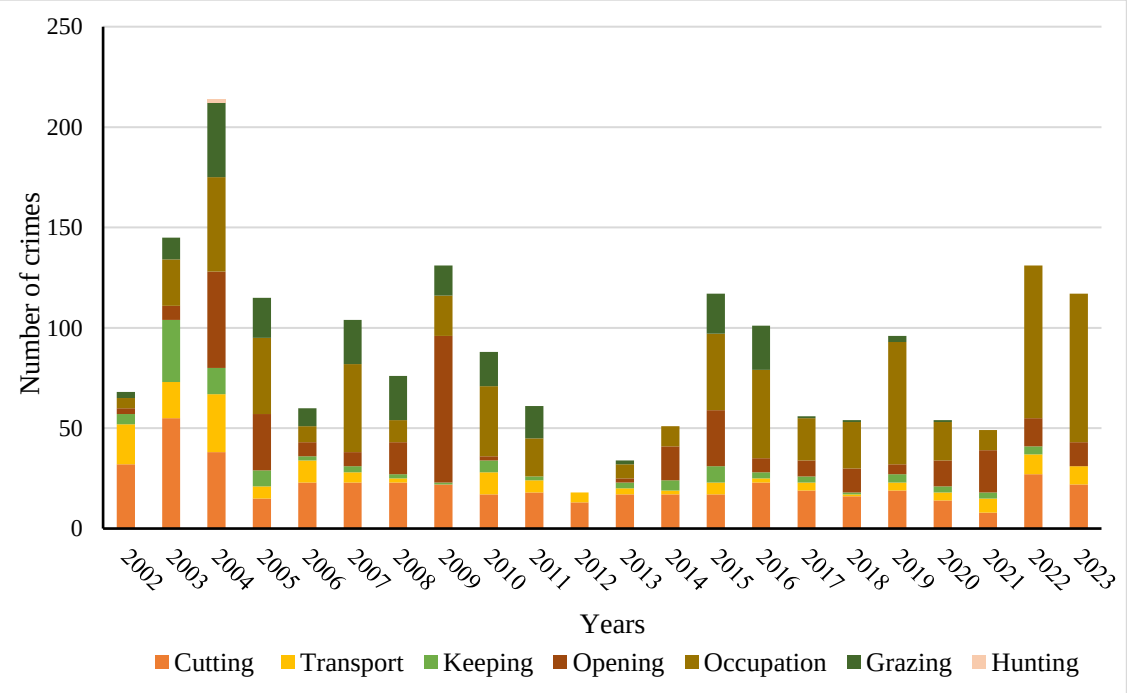

Figure 5. Forest crimes in Tekirdağ between 2002-2023

The changes in population and forest crimes over the years between 2007 and 2023 are presented in Table 4. In the relevant years, the population increased steadily every year. Additionally, the correlation relationships between population and forest crimes are given in Table 5, and regression lines between population and forest crimes are presented in Figure 6. The highest correlation relationship was found between population and grazing (r=-0.671). Another forest crime related to population has been determined as an occupation (r=0.468). While there was a negative relationship between population and grazing, a positive relationship was found between population and occupation.

Table 4. Population and forest crime in Tekirdağ covering the years 2007-2023

Year	Population	Cutting	Transport	Keeping	Opening	Occupation	Grazing
2007	728396	23	5	3	7	44	22
2008	770772	23	2	2	16	11	22
2009	783310	22	0	1	73	20	15
2010	798109	17	11	6	2	35	17
2011	829873	18	6	2	0	19	16
2012	852321	13	5	0	0	0	0
2013	874475	17	3	3	2	7	2
2014	906732	17	2	5	17	10	0
2015	937910	17	6	8	28	38	20
2016	972875	23	2	3	7	44	22
2017	1005463	19	4	3	8	21	1
2018	1029927	16	1	1	12	23	1
2019	1055412	19	4	4	5	61	3
2020	1081065	14	4	3	13	19	1
2021	1113400	8	7	3	21	10	0
2022	1142451	27	10	4	14	76	0
2023	1167059	22	9	0	12	74	0

Table 5. Pearson's correlation values between population and forest crimes

		Population	Cutting	Transport	Keeping	Opening	Occupation	Grazing
Population	Pearson correlation	1	-0.126	0.294	-0.041	-0.110	0.468	-0.671**
	Sig. (2-tailed)		0.629	0.251	0.875	0.674	0.058	0.003

** Correlation is significant at the 0.01 level (2-tailed)

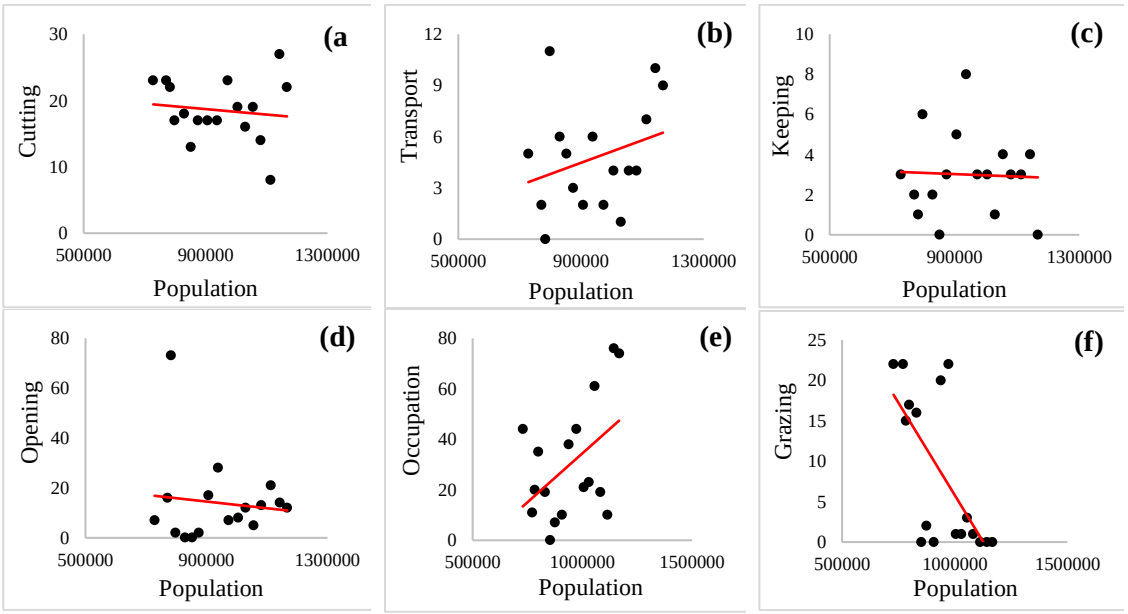

Figure 6. Regression lines between population and forest crimes

Discussion

Türkiye placed sixth globally in forest expansion, achieving a net gain of 114000 hectares year from 2010 to 2020 (FAO, 2020). The only reason for this increase is not the afforestation efforts. The regions in Türkiye experiencing an increase in forest area are those with emigration and a declining rural population. In towns where agricultural fields and pastures are abandoned, forests naturally regenerate; conversely, in provinces experiencing migration and unregulated urbanization, forests become fragmented and diminish in size (Atmiş, 2021; Atmiş & Akkemik, 2022). The increase in area also played a role in increasing total volume and

current increment figures. In addition, reasons such as the evacuation of forest villages because of migration and the decrease in illegal exploitation of forests have increased the accumulation of volume in forests. The widespread use of natural gas and coal in the last thirty years has also significantly reduced the fuelwood pressure on forests (Kömürlü et al., 2022).

In this study, it was determined that the most remarkable land class among the land use classes prepared for Tekirdağ was agricultural land. While 87.98% of the total area was agricultural land in 2008, this rate was determined as 78.92% in 2016. One of the main reasons for the 13673.0 ha decrease in agricultural areas is the conversion of these areas into settlement areas. When the spatial distribution of land use classes was examined, it was determined that the areas that were agricultural land in 2008 turned into settlements and other areas (private area areas, facilities, mine, pastures, graveyards, etc.) in 2016 (Figure 4). In addition, when the population data of Tekirdağ province is examined for the period 2007-2023, it is seen that the population tends to increase continuously over the years (Table 3). This situation shows that Tekirdağ is a province that receives intense immigration. It has been determined that the amount of in-migration that Tekirdağ province received on an annual basis during the 2008-2023 period was constantly higher than the amount of out-migration it gave out (Table 4). Tekirdağ province's industrialization since the 1980s and its wide employment opportunities are among the reasons for receiving both in and out-migration (Çorlu Chamber of Commerce and Industry, 2015). Migration from rural areas to urban areas has also caused the agricultural lands in the region to decrease and be converted into settlement areas.

In the study of Aydın & Aydın (2011), land use maps of 1997 and 2010 were evaluated in the GIS and revealed the change in land use. It was determined that agricultural and residential areas decreased significantly in this period, while forest areas, on the contrary, tended to increase. The population growth rate in Küre district of Kastamonu province, which is the study area, was calculated as -27.1% between 1990-2000 and -30.4% between 2000-2010. It has been stated that the reason for this situation is the migration from villages and towns to the provincial center and other cities. The main purpose of the study of Şenyiğit & Yılmaz (2019) is that from 1985 to 2017, there was an increase of approximately 512 ha in residential areas, which was the class with the largest increase in the 32 years in the study area, a 231 ha increase in green areas, a 54 ha decrease in water availability, a decrease in agricultural. It was determined that there was an increase of 13 ha in areas and a decrease of 712 ha in empty areas. Migration from villages to cities, the need for settlements due to population growth, and the expansion of public institutions were stated as the main reasons. According to Çalda & Makta (2010), when looking at the changes in land cover/use classes (unused land, agricultural area, residential area, green area) in the study area Kayseri province between 1987 and 2009, the class that has undergone the biggest change in 22 years is "unused land" became the "land" class. "Unused land," which covered more than half of the study area in 1987, decreased by 49% in 2009 and was largely replaced by agricultural land. In 1987, it was observed that agricultural areas were largely around stream beds. Later, with the emphasis on dry farming and the development of irrigation methods, there was a 48.3% increase in the field of agriculture in 22 years. The 27.8% population increase in Kayseri province from 1985 to 2009 was not homogeneous, and the density occurred only within the metropolitan borders. The expansion of the city did not affect agricultural areas or green areas; the expansion was in the form of utilizing unused land. Gülersoy (2014) examined the changes in land use and their reasons in the period 1984-2010 in Seferihisar district. It has been stated that between 1984 and 2010, there was a decrease of 18% (1178 ha) in field areas, 4% (624 ha) in forest areas, and 3% (460 ha) in pasture areas, while there was an increase of 92% (1756 ha) in residential areas. The construction of more residences and recreational facilities due to migration has been one of the main reasons for the decrease in forest and maquis areas. Its proximity to the capital city of Izmir and improved transportation facilities have accelerated the destruction of forest-scrub areas in the

research area. In another study by Günşen & Atmiş (2019), correlation analysis was used to reveal the changes in the forest area of the provinces and the change in the provincial population. It has been stated that there is a statistically significant negative relationship between these two variables at the 95% confidence level (-0.273*). According to this result, the forest area increased in the provinces, whereas the general population of the province decreased. According to Unal et al. (2019), according to the regression model developed in their study, the total population coefficient was positive. In other words, it has been revealed that as the total population increases, there is also an increase in forest areas. Ali et al. (2005) estimated in their study that forest cover would disappear by at least 50% in 30 years. The study also stated that mass deforestation due to rapid population growth is not supported by the data collected for this study.

In the study, there was an increase in the broadleaf forest class and a decrease in degraded forest areas (Table 2). These changes were related, and it has been determined that degraded, non-productive stands have transformed into productive broadleaf stands (Figure 4). When the total forest areas were examined, the forest area was 16669.0 ha in 2008, increased by 796.3 ha in 2016, and reached 17465.3 ha. The main reason for this increase is the decrease in social pressure on forests due to the decrease in rural population. While the other area class was formed only from forest areas in 2008, it was determined that in 2016, the areas belonging to this land class diversified into mines, non-cadastral wooded areas, facilities, private areas, pastures, and graveyards. Therefore, as a result of these areas increasing in 2016, there was an increase of 7791.2 ha in the other areas class.

For Tekirdağ province, the relationships between population and forest crimes, which changed over the years in the 2007-2023 period, were examined with Pearson's correlation coefficient (Table 5 and 6). A statistically significant relationship was found between population and grazing crime (r=-0.671, p>0.05). The fact that this relationship is negative indicates that grazing damage decreases with an increase in population. The most important reason for this finding is the decrease in the rural population rather than the increase in the total population. With the decrease in rural population, the pressure on forest areas has decreased, and therefore, the grazing damage has also decreased. Another relationship was found between population and occupation crime (r=0.468). This positive relationship shows that occupation crime increases with population. One of the reasons for this relationship is the increase in settlement areas due to rising urban population. The increase in population and the need for settlement areas triggered the occupation crime. It has been observed that forest crimes are mostly related to rural population movements. According to Bayramoğlu & Kadıoğulları (2018), it was determined that the amount of crime in Torul Forest Enterprise decreased significantly with the changes that occurred in parallel due to the decrease in population in rural areas. According to Alkan (2014) and Güloğlu et al. (2021), it was determined that there was a significant decrease in forest crimes as a result of migration from rural areas. Şen & Toksoy (2006) also stated in their study that in rural areas where population pressure decreased in Türkiye, the distribution of forests in the area increased, and their structural condition improved. Still, in urban areas where the population increased, the pressure on forest areas increased.

Conclusion

We aimed to investigate the correlation among land cover alteration, migration, and forest-related crimes. In our study, it was revealed that the change in population is a very important factor in terms of land use change, the situation of forest crimes, and the change in forest areas. Deforestation in Türkiye is evident in provinces characterized by elevated urban populations, swift urban growth, and significant immigration (Günşen & Atmiş, 2019). The decrease in the population living in forest villages has also reduced the dependence on forest resources, especially fuel wood. In addition to the decrease in forest clearing and forest destruction, forest areas in villages tend to increase as a result of unused lands becoming forested over time (Alkan, 2014). Despite the

migration from rural to urban areas, local people who have to continue their lives in rural areas and who are not in a very economically sufficient situation need wood for both wood and fuel. Therefore, in these areas, there is a tendency towards different forest crimes such as smuggling, cutting, and opening. Throughout Türkiye, deforestation and consequent changes in land use occur in residential areas where the population is mostly distributed in urban areas, receives excessive migration, and the population increases. It should also be noted that many of the settlements that have experienced losses in terms of forest areas in this way are places where removals from forest areas occurred in accordance with Article 2B of Forest Law No. 6831.

In regions with significant urbanization, it is crucial to mitigate urban pressures on forested areas. The designation of forested regions for non-forestry activities needs to be legally constrained, and additional initiatives should be undertaken to establish new forested areas. Türkiye should reorganize its forestry organization structure in this direction (Günşen & Atmiş, 2019).

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Conflict of Interest

The authors declare that they have no conflict of interest.

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