

THE IMPACT OF URBAN POPULATION CHANGE ON FORESTS, IN-FOREST RECREATION AREAS AND URBAN FORESTS IN TURKEY

KÖSE, M.

*Bursa Technical University, Faculty of Forestry, Department of Forestry Engineering, Bursa,
Turkey*

(e-mail: murat.kose@btu.edu.tr)

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Abstract. This study aimed to investigate the effects of rapid population growth and urbanization on forests, in-forest recreation areas and urban forests in Turkey. Therefore, through the consideration of the urban population changes in Turkey between 1973-2019, “Forestry Statistics” related to the changes in the forest existence, in-forest recreational areas and urban forests were evaluated. Within the scope of “Forestry Statistics”, both forestry data and population data were considered separate variables, and 36 variables were created in this context. According to this, while the total forest area in Turkey was 20,199,296 ha in 1973, it increased by 2,541,001 ha (12.6%) and reached 22,740,297 ha by 2019. According to the up-to-date data, there have been increases in growing stock and annual current increment, as well as forest areas in Turkey. It is a fact that there is a transformation in favor of forests in rural areas of the country. However, it is not possible to talk about a similar situation in urban areas. Although there is a positive correlation between the urban population and forest presence across the country, it is not at the same rate. The urban population increases several times faster than the extent of forest areas and growing stock.

Keywords: *urbanization, rural changes, forestry statistics, growing stock, annual current increment, Turkey*

Introduction

Along with the Industrial Revolution, the increase in population, production and consumption, development of technology, and increasing economic activities brought along rapid urbanization worldwide. Rapid urbanization, which started much earlier in developed countries, has caused intense migration from rural areas to urban areas all over the world since the 1900s; consequently; the urban population has continuously increased, while the rural population has been constantly decreasing.

The rapid increase of the population in urban areas and migration caused unplanned and distorted urbanization, especially in underdeveloped countries, which brought many multi-dimensional problems. Urbanization is, therefore, a phenomenon that has demographic, economic, political, social, technological and environmental dimensions, and also changes and affects human attitudes and behaviors. Today, while rapid urbanization has caused changes in the amount and structure of forest areas in the world and in Turkey, it has also caused a change in the habits of urban people in terms of benefitting from forest areas and spending time in these areas. In the last decade, global attention has begun to focus more on ecological and environmental issues (United Nations Environment Program (UNEP, 2020; Pata et al., 2020; Nathaniel et al., 2020; Zambrano-Monserrate et al., 2020; Guo et al., 2020; Zhou et al., 2022). Because with the change in living standards in the last decade, people have become more interested in outdoor activities (Lin and Liu, 2021).

This situation causes people to need natural environments where they can spend their leisure time socially, culturally and physiologically for various purposes. In order to meet these needs, in-forest recreation areas and urban forests, which are relatively natural and unspoilt today, are of great importance. In this sense, recreation is an intangible ecosystem service that is affected by the preferences and needs of individuals, and the development of recreation should be based on certain criteria and indicators that will be realized with the participation of the public (Scholte et al., 2018; Nigussie et al., 2021). In addition to its personal benefits, recreation has various and multidimensional advantages such as leadership development, participation in the community, ethnic and cultural interaction, strong family formation, preventive health services, productive workforce, reduction in crime and violence, tourism, environmental health, wildlife protection, and rehabilitation (Broadhurst, 2001; Özgüç, 2017).

Human beings have depended upon forests to survive since prehistoric times (Misbahuzzaman and Smith-Hall, 2015). The demand for forest resources is closely related to economic development and population growth (Wang et al., 2015). According to Department for International Development (DFID) (2002) and Yeşildal (2020), today about 840 million people living on an income of less than 1 USD \$ a day live in rural areas with high dependence on natural resources such as forests. While the world's forests covered an area encompassing 4.128 billion ha in 1990, it decreased by 129 million ha to 3.999 billion ha in 2015. The proportion of forests covering 31.8% of the land surface has decreased to 30.8% and the forest area per capita has decreased from 0.8 to 0.6 ha in the world between 1990 and 2015 (Food and Agriculture Organization of the United Nations (FAO), 2015). Although the change in forest areas decreased from 30.6% to 26.8% in underdeveloped countries, it increased from 30.9% to 31.3% in OECD (Organization for Economic Development and Cooperation) countries and from 35% to 38% in European Union countries (World Bank (WB), 2017). Therefore, developed countries increase their forest areas and growing stock by preserving their existing forests and establishing new forests with afforestation, while forest areas in underdeveloped and poor countries decrease.

When the reasons for the changes in forest areas are considered for all countries, population changes at the national level stand out (Ryan et al., 2017). In addition, many human-induced negative impacts, such as opening forest areas for agricultural land, differences in socioeconomic structure at global, national and local levels (Lambin and Meyfroidt, 2010; Shi et al., 2017), illegal use of forest areas (Kuemmerle et al., 2009), legal regulations based on short-term populist policies that do not take into account the sustainable management of forests (Min-Venditti et al., 2017), and removing forest cover for illegal settlements, play an important role in this change.

Since 99.9% of the forest areas in Turkey are under state ownership, Turkish forestry is based on public administration and property. These areas are managed the General Directorate of Forestry (GDF) and the General Directorate of Nature Conservation and National Parks (GDNCNP), which are affiliated to the Ministry of Agriculture and Forestry.

While there is a decrease in forest areas in the world in general, Turkey is among the countries that increased the extent of its forests such as China. According to the current data, there have been increases in growing stocks and current annual increment, as well as forest areas in Turkey. On the other hand, with the rapid urbanization process, the number and amount of in-forest recreation areas and urban forests have also increased, as the demand of the people living in metropolitan areas for recreation has increased. This study

was conducted in order to investigate the effects of rapid population growth and urbanization on Turkish forestry, forest areas, growing stock, annual current increments, in-forest recreation areas and urban forests. For this purpose, in this study, in which the relevant data between 1973-2019 were evaluated, the changes in forest areas, growing stock, current annual increment, in-forest recreation areas, and urban forests were analyzed and their transformations were examined through the consideration of the total population, urban population and rural population changes in Turkey.

Material and method

An important part of the data used in the study was taken from “Forestry Statistics” which has been regularly published every year since 2007 by the General Directorate of Forestry (GDF) (GDF, 2021a). In Turkey, since 1963, data collection and inventory techniques have been used throughout the country on forest areas, and the first comprehensive information based on spatial measurement was published by GDF in 1973. However, during the 26 years from 1973 to 1999, the forest inventory was not published. Then, in 2004, 2012 and 2015, 2018 and most recently in 2019, the statistics including data about the forest areas distribution, growing stock, current annual increment, urban forests, recreation areas, silviculture and afforestation services, etc. were shared with the public. Therefore, since the first data on forestry based on measurement and research started to be shared GDF in 1973, the year 1973 was taken as the starting year in this study. Turkey’s forest existence and its location on the world are given in *Figure 1*.

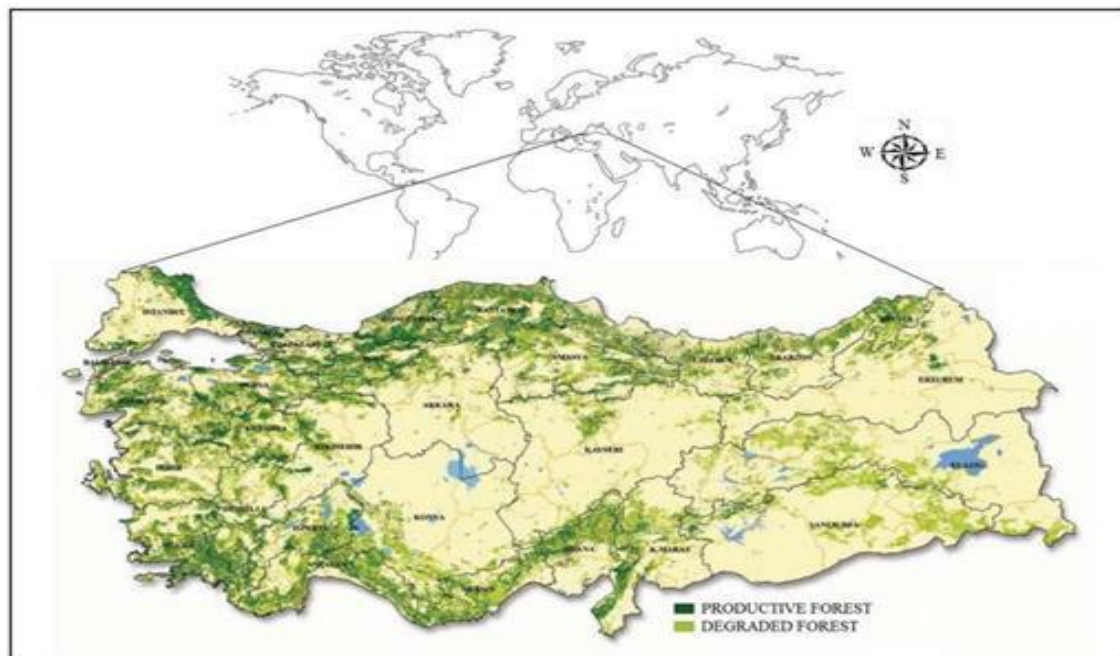


Figure 1. Turkey’s forest existence and its location on the world (GDF, 2021b)

Therefore, in this study, through the consideration of the total population, urban population and rural population changes in Turkey between 1973-2019, “Forestry Statistics” related to the changes in the forest areas, growing stock, current annual

increment, in-forest recreation areas and urban forests were evaluated. Within the scope of “Forestry Statistics”, each data related to forestry were accepted as a separate variable, and years, the general population of the country, the population living in urban areas and the population living in rural areas were also defined as variables (GDF, 2021a; Turkish Statistical Institute (TUIK), 2020). As a result, a total of 36 variables were created within the scope of this study (*Table 1*).

Table 1. Variables used in the research

No	Variable name	Code	Type	No	Variable name	Code	Type
1	Elapsed time	ET	Year	19	Annual current increment	ACI	m ³ /year
2	Rural population	RP	Person	20	Average increment	AI	m ³ /ha
3	Urban population	UP	Person	21	Growing stock per person	GSPP	m ³ /person
4	Total population	TP	Person	22	Number of in-forest recreation areas of type A	NFRA	Number
5	The share of the urban population in the total population	UP/TP	%	23	Area of in-forest recreation areas of type A	AFRA	ha
6	The share of the rural population in the total population	RP/TP	%	24	Number of in-forest recreation areas of type B	NFRB	Number
7	Productive forest area	PFA	ha	25	Area of in-forest recreation areas of type B	AFRB	ha
8	The ratio of productive forest area to total forest area	PF/TF	%	26	Number of in-forest recreation areas of type C	NFRC	Number
9	Hollowed closed forest area	HCF	ha	27	Area of in-forest recreation areas of type C	AFRC	ha
10	The ratio of hollowed closed forest area to total forest area	HCF/TF	%	28	Total number of in-forest recreational areas	TNFR	Number
11	Total forest area	TFA	ha	29	Total area of in-forest recreation areas	TAFR	ha
12	Forest area per person	FAPP	ha	30	In-forest recreation area per person	FRPP	m ² /person
13	Productive forest growing stock	PFGS	m ³	31	Number of urban forests	NUF	Number
14	The ratio of productive forest growing stock to total growing stock	PFGS/TGS	%	32	Urban forest area	UFA	ha
15	Hollowed closed forest growing stock	HCGS	m ³	33	Urban forest area per person	UFPP	m ² /person
16	The ratio of hollowed closed forest growing stock to total growing stock	HCGS/TGS	%	34	Total number	TN	Number
17	Total growing stock	TGS	m ³	35	Total area	TA	ha
18	Average growing stock	AGS	m ³ /ha	36	Total area per person	TAPP	m ² /person

The criteria used in the definitions of rural and urban population differ among researchers. Some researchers take the population into account and some consider the functions of the settlement, whereas some take the population density into account. Since the available statistics can only be obtained from the Turkish Statistical Institute in this study, the criteria and data of the Turkish Statistical Institute are taken as basis. On the other hand, the Turkish Statistical Institute evaluates the population living in provincial and district centers as urban population, and the population of other settlements as rural population.

The frequency distributions and rates of change of the variables were calculated, evaluated and interpreted. In addition, the significance, strength and direction of the relationships between these variables were tested with correlation analysis. Correlation analysis is a statistical method which reveals the direction, degree and importance of the relationship between variables. In order to evaluate the research data and perform statistical analysis, Microsoft Excel and Statistical Package for Social Science 23.0 programs were used.

Results and discussion

Urban population and change of forest areas

The increase in the urban population emerges as a phenomenon experienced in the development process in Turkey as well as in the world. The rural-urban migration movement, which started with the Industrial Revolution in Western Europe, started after 1950 in Turkey (Tümertekin, 1973; Doğanay, 1997; Keleş, 2012). The share of the urban population in the total population increased continuously in the 1950-1980 period, but the rural population continued to increase in quantity during this period (Yılmaz, 2015).

According to *Table 2*, the urban population has a high-level positive significant relationship ($r = 0.97$) with the total population, and a high-level negative significant relationship with the rural population ($r = -0.92$). Similarly, the elapsed time (year) has a high level negative significant relationship with the rural population ($r = -0.83$), and a high-level positive significant relationship with the urban population ($r = 0.98$) and the total population ($r = 0.99$). As a matter of fact, while the share of the rural population in the total population was 15,702,851 (75.0%) in 1950, it was 25,091,950 (56.1%) in 1980 (TUIK, 2020). However, the share of the rural population in the total population started to decrease in amount for the first time after 1980 (Yılmaz, 2015). The issue to be considered here is that while the general population in Turkey continues to increase continuously, the rural population started to decrease in quantity for the first time in 1980. In this context, according to *Table 3*, when a general assessment of the population change in Turkey between 1973-2019 is made, it is seen that the total population was 38,450,702 in 1973 and 83,154,997 in 2019, with an increase of approximately 116.3%. While the share of the urban population in the total population (UP/TP) was 15,597,881 (40.6%) in 1973, this figure has increased continuously and reached 77,151,280 (92.8%) in 2019. The share of the rural population (RP/TP) in the total population has steadily decreased to 22,852,821 (59.4%) in 1973 and to 6,003,717 (7.2%) in 2019. In Turkey, where the population census is carried out every five years, the share of the rural population in the total population was 56.1% in 1980 and 46.9% in 1985 (TUIK, 2020). The urban population and the rural population were equalized once between 1980 and 1985, and in the following years, the gap between them gradually widened in favor of the urban population (*Fig. 2*).

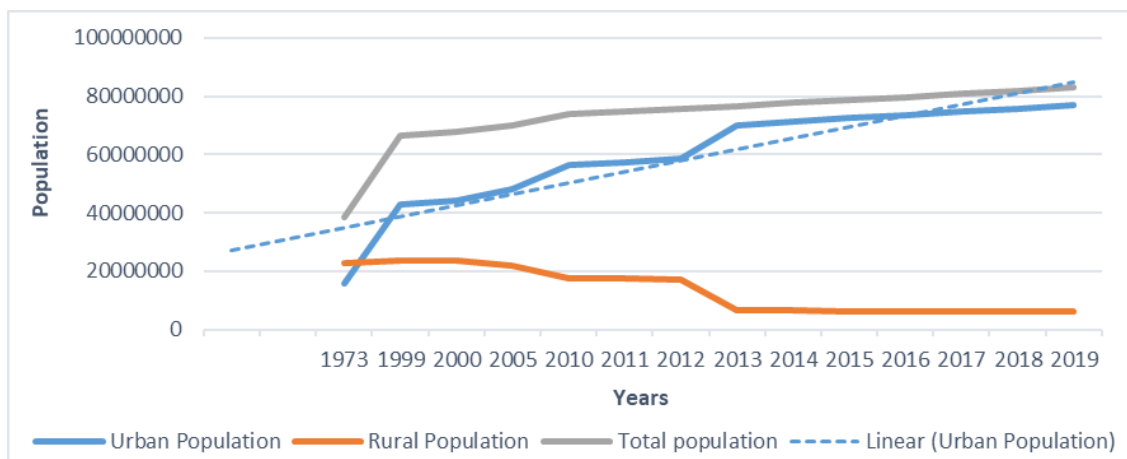


Figure 2. Population change in Turkey by years

Table 2. Correlation analysis matrix

T. population	U. population	R. population	Elapsed time	
			1.00	Elapsed time
		1.00	-0.83	R. population
	1.00	-0.92	0.98	U. population
1.00	0.97	-0.80	0.99	T. population
0.93	0.98	-0.94	0.95	Pr. For. area
-0.94	-0.99	0.94	-0.95	H. c. forest area
0.92	0.97	-0.94	0.94	T. forest area
-0.95	-0.88	0.64	-0.94	Forest area p. per.
0.96	0.99	-0.92	0.97	Pr. for. growing stock
-0.83	-0.91	0.93	-0.86	H. c. for. growing stock
0.96	0.99	-0.92	0.97	T. growing stock
0.97	0.99	-0.90	0.98	Av. growing stock
0.94	0.99	-0.93	0.96	An. current increment
0.95	0.98	-0.91	0.96	Av. increment
-0.56	-0.38	0.03	-0.51	Growing stock p. per.
0.77	0.80	-0.74	0.77	Num. of type A
0.74	0.74	-0.64	0.74	Area of type A
0.76	0.75	-0.65	0.75	Num. of type B
0.75	0.64	-0.37	0.73	Area of type B
0.81	0.80	-0.73	0.84	Num. of type C
0.11	-0.00	0.14	0.59	Area of type C
0.88	0.91	-0.84	0.91	T. num. of rec. areas
0.25	0.16	0.02	0.27	T. area of rec. areas
0.20	0.09	0.09	0.22	Rec. area p. per.
0.87	0.87	-0.83	0.90	Num. of u. forests
0.46	0.43	-0.39	0.53	U. forest area
-0.15	-0.24	0.28	-0.09	U. for. area p. per.
0.88	0.91	-0.85	0.91	Total number
0.33	0.24	-0.06	0.35	Total area
0.26	0.16	0.02	0.28	T. area p. per.

As can be understood from the data obtained above, for various reasons, especially after the 1980s, the urban population in Turkey started to increase rapidly and the rural population started to decrease. It is a fact accepted by many researchers that rural-to-urban migration is the most important reason for the population increase in urban areas in Turkey (Gümüş, 2004; İlter and Ok, 2004; Şen and Toksoy, 2006; Türker et al., 2017); Günşen and Atmış, 2019; Köse, 2020). With the continuous increase of the population since 1927 in Turkey, the agricultural lands passed through inheritance have been divided into smaller units. In addition, many factors, such as the increase in mechanization in agriculture; the higher employment, education and health opportunities in big cities compared to rural areas; and the transformation of big cities into attraction centers in the eyes of the public in recent years, can be counted as the main reasons for migration from rural to urban centers.

Table 3. Distribution of the population and forest areas by years (GDF, 2021a; TUIK, 2020)

Year	Urban population*	UP/TP (%)	Rural population*	RP/TP (%)	Total population*	Productive forest area** (ha)	PF/TF (%)	Hollowed closed forest area** (ha)	HCF/TF (%)	Total forest area** (ha)	Forest area per person (ha/person)
1973	15,597,881	40.6	22,852,821	59.4	38,450,702	8,856,457	43.8	11,342,839	56.2	20,199,296	0.53
1999	42,938,282	64.4	23,732,556	35.6	66,670,838	10,027,568	48.3	10,735,680	51.7	20,763,248	0.31
2000	44,006,274	64.9	23,797,653	35.1	67,803,927	10,126,510	48.6	10,707,654	51.4	20,834,165	0.31
2005	48,107,406	68.9	21,683,899	31.1	69,791,305	10,621,221	50.1	10,567,526	49.9	21,188,747	0.30
2009	54,807,219	75.5	17,754,093	24.5	72,561,312	10,972,509	51.3	10,417,274	48.7	21,389,783	0.29
2010	56,222,356	76.3	17,500,632	23.7	73,722,988	11,202,837	52.0	10,334,254	48.0	21,537,091	0.29
2011	57,385,706	76.8	17,338,563	23.2	74,724,269	11,380,753	52.7	10,226,860	47.3	21,607,613	0.29
2012	58,448,431	77.3	17,178,953	22.7	75,627,384	11,558,668	53.3	10,119,466	46.7	21,678,134	0.29
2013	70,034,413	91.3	6,633,451	8.7	76,667,864	11,940,495	54.5	9,959,240	45.5	21,899,734	0.29
2014	71,286,182	91.8	6,409,722	8.2	77,695,904	12,322,321	55.7	9,799,013	44.3	22,121,335	0.28
2015	72,523,134	92.1	6,217,919	7.9	78,741,053	12,704,148	56.9	9,638,787	43.1	22,342,935	0.28
2016	73,671,748	92.3	6,143,123	7.7	79,814,871	12,797,148	57.0	9,638,787	43.0	22,435,935	0.28
2017	74,761,132	92.5	6,049,393	7.5	80,810,525	12,890,148	57.2	9,638,787	42.8	22,528,935	0.28
2018	75,666,497	92.3	6,337,385	7.7	82,003,882	12,983,148	57.4	9,638,787	42.6	22,621,935	0.28
2019	77,151,280	92.8	6,003,717	7.2	83,154,997	13,083,510	57.5	9,656,787	42.5	22,740,297	0.27

*Prepared by using the data of the Turkish Statistical Institute (TUIK, 2020)

**Values between 1999-2005, 2005-2009, 2009-2012, 2012-2015, 2015-2018 were calculated by interpolation from data for 1973, 1999, 2005, 2009, 2010, 2012, 2015, 2018, 2019 (GDF, 2021a)

There is a high-level significant positive correlation between the elapsed time (year) and the amount of total forest area ($r = 0.94$) and productive forest area ($r = 0.95$), whereas there is a high-level significant negative relationship between the elapsed time (year) and the amount of hollowed closed (degraded) forest area ($r = -0.95$) (Table 2). In this sense, when the situation is evaluated according to Table 3, in the period between 1973, when the first inventory was published, until 2019, when the last inventory was published, the total and productive forest areas of Turkey increased continuously and the hollowed closed forest area decreased. Accordingly, in 1973, Turkey's total forest area was determined to be 20,199,296 ha. Of this, 8,856,457 ha (43.8%) (PF/TF) is productive, whereas 11,342,839 ha (56.2) (HCF/TF) is hollowed closed forest. The concept expressed as productive forest here is the forest areas where the canopy, which is the degree of the trees covering the soil surface, is more than 10%, where wood raw material is produced. The forest areas where the canopy is 10% or less and where wood raw material is not produced are considered as hollowed closed forest. The concept of "hollowed closed forest" has been used by GDF since 2015. Previously, the concept of "degraded forest" was used instead of this concept.

Likewise, according to Table 3, although the rate of hollowed closed forest area in Turkey decreased to 42.5% (9,656,787 ha) in a 46-year period between 1973 and 2019, the proportion of productive forest areas increased to 57.5% (13,083,510 ha). On the other hand, the total forest area increased by 2,541,001 ha (12.6%) in the same period and reached 22,740,297 ha in 2019. The surface area of Turkey is 78,356,200 ha (URL-1), and the ratio of forest areas to country surface area increased from 25.8% in 1973 to 29.0% in 2019. When we look at the ratio of total surface measurements of the forest areas of some countries in the world, this rate is 73.7% in Finland, 68.7% in Sweden,

49.8% in the Russian Federation, 42.7% in Bosnia-Herzegovina, 40.6% in Georgia, 37.2% in Spain, 35.9% in Bulgaria, 32.7% in Germany, 32.5% in Italy, 31.5% in France and 22.7% in Hungary (URL-2). When the situation of Turkey is compared to countries such as Bosnia-Herzegovina, Bulgaria, Italy, France and Georgia with similar ecological conditions, it is seen that Turkey is in the last ranks.

However, in Turkey, especially the afforestation works that started from the 1960s and continued increasingly until today, the rehabilitation works of degraded areas and their reflection on the records have caused the rate of productive forest areas to increase continuously. In addition, the migration from rural areas to urbans, which started in the 1950s and accelerated after the 1980s (Yılmaz, 2015), caused a significant decrease in the population of forest villages and a change in the socio-economic and demographic structure. This situation has resulted in the elimination or significant reduction of many negative human-induced factors such as grazing pressure, illegal utilization of forests, opening forest areas for agriculture and settlement. This is another situation which causes an increase in both total and productive forest areas.

In fact, the difficulties experienced still continue due to the incompatibility between the definition of forest in the 1st article of the Forest Law No. 6831 in Turkey and the definition of forest by the United Nations Food and Agriculture Organization (FAO). By FAO, *areas larger than 0.5 hectares with trees that have more than five meters of height and more than 10 percent top closure or that can reach these threshold values in their natural area are accepted as forest* (FAO, 2010a). In addition, in order for an area to be considered as a forest, the forest use of this area must be the dominant use. The areas where the canopy is less than 10% are called other wooded areas (Global Observations of Forest Cover and Land-use Dynamics (GOFC-GOLD), 2009).

In Turkey, *“tree and shrub communities grown with labor are considered as forests together with their locations”* (URL-3). Here, as seen in the last version of the Forest Law No. 6831 in force, it is stated that not only the vegetation but also the land itself is considered forest. However, all wooded places are not classified as forest, there are some exceptions in the definition of forest such as “reed areas, all kinds of thorny areas, parks, places covered with all kinds of trees, and shrubs on the owned land whose surface area does not exceed three hectares” (GDF, 1956).

In this context, there is no limit value for the size of the area and the canopy regarding the acceptance of a place as a forest in Turkey. However, in owned lands, the area should be a minimum of 3 ha. According to the 2010 data, Turkey’s forest existence is 21,537,091 ha, of which 11,202,837 ha are productive forest (GDF, 2021a). FAO, on the other hand, specified Turkey’s forest area as 11,334,000 ha in the same year (FAO, 2010b). Almost half of the figure calculated by GDF is recognized as Turkey’s forest area by FAO. This difference is due to the use of forest definitions accepted by Turkey and FAO. As a matter of fact, international institutions such as FAO give only productive forest areas as Turkey’s forest area (Foresters’ Association of Turkey (FAT), 2019).

However, forest definitions accepted in many countries are different from the forest definition made by FAO. For example, the canopy criterion is taken as 30% in some countries such as Brazil, Peru, Mexico, Malaysia, Thailand; as 25% in Malaysia, Paraguay and Morocco; as 15% in India and Ghana (Sasaki and Puntz, 2009); and as 20% in China (Shi et al., 2011). The differences in forest definitions of different countries are not only due to the canopy criteria; the minimum area (0.5 ha) and minimum tree height (5 m) criteria given by FAO also vary from country to country.

According to the United Nations Framework Convention on Climate Change (UNFCCC), the forest is an area of minimum 0.05-1.0 ha, consisting of trees that can reach a height of at least 2-5 m, with 10-30% hill cover (UNFCCC, 2002). Therefore, in many countries, including Turkey, some areas that FAO does not accept as forest are considered as forests, and some areas that FAO accepts as forest are not considered as forest. According to GOFC-GOLD (2009), the Designated National Authority (DNA) in each country is responsible for the forest definition.

There is a high-level significant negative relationship ($r = -0.88$) between the amount of forest area per capita across the country and the urban population, whereas there is a high-level significant negative relationship ($r = -0.95$) between the amount of forest area per capita across the country and the total population (*Table 2*). Accordingly, as the total population and urban population in the country increase, the total and productive forest areas per capita decrease. As seen in *Table 3*, while the total forest area in Turkey increased by 12.6% between 1973-2019, the total population increased by 116% in the same period. Due to this rapid increase in the total population, forest area per capita continued to decrease continuously. Forest area per capita was calculated as 0.53 ha/person in 1973 and 0.27 ha/person in 2019. As can be seen, in the 46-year period between 1973 and 2019, the total amount of forest area per person including degraded forest areas decreased by almost half. Productive forest area per person is less, and it was found as 0.23 ha/person and 0.16 ha/person in 1973 and 2019, respectively.

However, in order to evaluate the adequacy of the productive forest area per capita in Turkey, it is necessary to compare it with the forest area per capita in other countries. When evaluated in this sense, it is estimated that the total forest area of the world was just over 4 billion ha in 2010, which corresponds to an average of 0.6 ha of forest per person (FAO, 2010b). According to FAO (2015), in Russia, one of the richest countries in the world in terms of forest, the amount of forest area per capita is 5.75 ha, whereas it is 9.74 ha in Canada and 2.23 ha in Brazil. On the other hand, forest areas per capita in some countries in the Mediterranean climate zone, including Turkey, with similar ecological conditions to Turkey, are as follows: 1.33 ha/person in Montenegro, 0.63 ha/person in Georgia, 0.55 ha/person in Bosnia-Herzegovina, 0.53 ha/person in Bulgaria, 0.45 ha/person in Croatia, 0.39 ha/person in Spain, 0.38 ha/person in Serbia, 0.35 ha/person in Greece, 0.30 ha/person in Portugal, 0.28 ha/person in Albania, 0.26 ha/person in France and 0.16 ha/person in Italy (Forest Europe, 2018; Foresters' Association of Turkey (FAT), 2019). Looking at these figures, Turkey ranks last, along with Italy. If Turkey makes the degraded forest areas productive, it will be able to improve its rank among other countries.

Growing stock and increment changes in forests

In the 46-year period between 1973-2019, *Table 4* shows the changes of the growing stock, which express the total wood amount of forests in Turkey, and the increment values, which express the increases in growing stock.

There is a high-level significant positive relationship ($r = 0.97$) between the elapsed time (year) and total growing stock, and there is similarly a high-level significant positive relationship ($r = 0.97$) between the elapsed time (year) and productive forest growing stock; however, there is a high-level significant negative relationship ($r = -0.86$) between the elapsed time (year) and the hollowed closed forest growing stock (degraded) (*Table 2*). In this direction, when the data in *Table 4* are evaluated, between the years of 1973-2019, the growing stock in all forests in Turkey increased, regardless

of the distinction between productive and degraded. While all forests had a growing stock of 935,512,150 m³ in 1973, this value increased by 79.5% (743,844,060 m³) in 2019 and reached the level of 1,679,356,210 m³. According to this, it is understood that the growing stock of Turkey's forests has increased by an average of 16,170,523 m³ each year over the course of 46 years.

Table 4. Distribution of the population, growing stock and annual increment values by years (General Directorate of Forestry, 2020; Turkish Statistical Institute (TUIK), 2020)

Year	Productive Forest Growing Stock* (m ³)	PFGS/TGS (%)	Hollowed Closed Forest Growing Stock* (m ³)	HCGS/TGS (%)	Total Growing Stock* (m ³)	Average Growing Stock (m ³ /ha)	Current Annual Increment* (m ³ /year)	Average Increment (m ³ /ha)	Growing Stock Per Person (m ³ /person)
1973	847,033,015	90.5	88,479,135	9.5	935,512,150	46.3	28,063,205	1.4	24.3
1999	1,113,612,229	92.7	87,179,408	7.3	1,200,791,637	57.8	34,269,650	1.7	18.0
2000	1,127,849,222	92.8	87,497,938	7.2	1,215,347,160	58.3	34,605,090	1.7	17.9
2005	1,199,034,187	93.1	89,090,585	6.9	1,288,124,772	60.8	36,282,291	1.7	18.5
2009	1,290,450,115	93.9	83,790,811	6.1	1,374,240,926	64.2	38,454,916	1.8	18.9
2010	1,347,453,572	94.3	81,051,145	5.7	1,428,504,717	66.3	40,061,594	1.9	19.4
2011	1,373,751,906	94.8	76,069,420	5.2	1,449,821,326	67.1	40,543,474	1.9	19.4
2012	1,400,050,239	95.2	71,087,695	4.8	1,471,137,934	67.9	41,025,353	1.9	19.5
2013	1,446,641,335	95.3	71,375,352	4.7	1,518,016,687	69.3	42,651,596	1.9	19.8
2014	1,493,232,432	95.4	71,663,008	4.6	1,564,895,440	70.7	44,277,840	2.0	20.1
2015	1,539,823,528	95.5	71,950,665	4.5	1,611,774,193	72.1	45,904,083	2.1	20.5
2016	1,555,964,749	95.6	71,258,046	4.4	1,627,222,795	72.5	46,269,389	2.1	20.4
2017	1,572,105,971	95.7	70,565,427	4.3	1,642,671,398	72.9	46,634,694	2.1	20.3
2018	1,588,247,192	95.8	69,872,808	4.2	1,658,120,000	73.3	47,000,000	2.1	20.2
2019	1,609,841,860	95.9	69,514,350	4.1	1,679,356,210	73.8	47,200,000	2.1	20.2

*Values between 1999-2005, 2005-2009, 2009-2012, 2012-2015, 2015-2018 were calculated by interpolation from data for 1973, 1999, 2005, 2009, 2010, 2012, 2015, 2018, 2019 (GDF, 2021a)

At the same time, there is a high-level significant positive relationship ($r = 0.98$) between elapsed time and average growing stock (Table 2). As a matter of fact, while the average growing stock per hectare was 46.3 m³/ha in 1973, this value increased by 59.5% to 73.8 m³/ha in 2019. It seems that the increase in total growing stock generally occurs in productive forests. In terms of growing stock per unit area, Turkey is seen to be in the last ranks when compared to countries with similar ecological conditions. For example, the growing stock per unit area is 216 m³/ha in Croatia, 164 m³/ha in Bosnia-Herzegovina, 183 m³/ha in Bulgaria, 173 m³/ha in France, 161 m³/ha in Georgia, 154 m³/ha in Serbia, 149 m³/ha in Italy, 147 m³/ha in Montenegro, 99 m³/ha in Albania, 66 m³/ha in Spain and 48 m³/ha in Greece (FAO, 2015). Growing stock per unit area in Turkey is lower than in countries with similar ecological conditions, which can be related to the fact that the proportion of degraded forest areas in the total forest area is high and that forest areas generally have poor habitat characteristics.

When evaluating the condition of the forests, it is necessary to consider the annual current increment amounts in addition to the growing stock. According to the statistical analysis (Table 2), there is a positive significant relationship between the annual current increment amount and the urban population ($r = 0.99$) and the elapsed time ($r = 0.96$).

Accordingly, when the data in *Table 4* are evaluated, the annual current increment amount of all forests in Turkey was 28,063,205 m³ in 1973, and this figure increased by 68.2% in 2019 and reached 47,200,000 m³. The annual current increment amount per unit area (ha) of the country's forests is parallel to this situation. In other words, while the annual current increment amount per unit area in all forests was 1.4 m³/ha in 1973, this figure increased to 2.1 m³/ha in 2015.

According to the 2015 data (FAO, 2015), when we look at the situation in countries with the richest forest existence in the world in terms of the annual current increment per unit area, it is seen that it is 1.3 m³/ha in the Russian Federation, 3.6 m³/ha in China and 2.9 m³/ha in the United States. In countries with similar ecological conditions to Turkey, the annual current increment amounts are 4.9 m³/ha in France, 4.2 m³/ha in Croatia, 3.8 m³/ha in Bulgaria, 3.5 m³/ha in Italy, 2.4 m³/ha in Montenegro, 1.9 m³/ha in Spain and 0.3 m³/ha in Albania (Forest Europe, 2018; Foresters' Association of Turkey (FAT), 2019). Considering the annual current increment per unit area in terms of fertile forests, it can be said that Turkey has an average value among the countries with similar ecological conditions.

While forest areas increased in 46 years between 1973 and 2019 in Turkey, there were also increases in growing stock and annual current increments. It can be said that these increases are caused by the afforestation, maintenance and rehabilitation works carried out by the forestry organization for many years. On the other hand, especially since the 1980s, with the increase of migration from rural to urban areas, human-induced pressures (illegal cutting, illegal opening and settlement in forest areas, animal grazing, etc.) have disappeared or decreased significantly. This situation enabled the forest areas to increase and degraded forest areas to become productive. For example, in a study conducted by Turkish Environmental Foundation (TEF) (2001), it was stated that the village population in the Black Sea Region decreased by up to 70% and that the empty agricultural areas turned into forest ecosystems.

In addition to these, with an administrative decision put into effect in 2006, the works carried out within the scope of transforming forests that are operated as coppice forest throughout the country as a high forest are an important factor in the increase in growing stock and annual current increments. As a matter of fact, according to GDF (2021a), the forest area operated as coppice forest in Turkey in 1973 constituted 45.6% (9,264,689 ha) of the whole forest area. This value decreased to 22.6% in 2010 and to 5.0% in 2019. Thus, the forests in the areas transformed from coppice forests to high forests were not cut down every 20 years, and annual increment has thus been ensured for many years.

There is a medium-level significant negative relationship ($r = -0.51$) between growing stock per capita and the elapsed time (*Table 2*). In this sense, although the growing stock and the current annual increment in Turkey have been constantly increasing, the growing stock per capita has continuously decreased due to the faster increase in the total population in the country. As a matter of fact, while the growing stock per capita was 24.3 m³/person in 1973, this figure was calculated as 20.2 m³/person in 2019. According to FAO (2010 b), the total growing stock in the world's forests is 527 billion m³ or 131 m³/ha. However, the growing stock per hectare in the world's forests is generally increasing, except for North America and the Russian Federation. On the other hand, when we look at the situation in countries with similar ecological characteristics with Turkey, the growing stock per capita is as follows: 195.4 m³/person in Montenegro, 102.4 m³/person in Bosnia-Herzegovina,

101.5 m³/person in Georgia, 97.6 m³/person in Croatia, 96.2 m³/person in Bulgaria, 58.4 m³/person in Serbia, 43.3 m³/person in France, 26.0 m³/person in Spain, 23.1 m³/person in Italy, 18.8 m³/person in Albania, and 16.8 m³/person in Greece (Forest Europe, 2018; Foresters' Association of Turkey (FAT), 2019). Therefore, in terms of growing stock per capita, Turkey falls behind many countries with similar conditions except for Albania and Greece.

In-forest recreation areas and urban forests

The concept of urban forest was first expressed in Canada in 1965 by Jorgenson (Johnston, 1996; Konijnendijk, 2003; Randrup et al., 2005). However, according to Raundrup et al. (2005), the beginning of the urban forest concept in Europe was in the 1980s, with studies in England and the Netherlands. In Turkey, the concept of urban forest has been brought to the agenda after the 1980s (Serin and Gul, 2006; Köse, 2020).

When the development of urban forestry is examined, landscape development and mental and physical health come to the fore as the starting point, while issues such as air and sound pollution as well as microclimate changes have started to take priority due to environmental problems caused by urbanization (Carter, 1995; Nowak et al., 2006; Vos et al., 2013). The concepts of “urban forest” and “urban forestry” are defined differently in many countries. For example, according to Konijnendijk (2003), urban forest and urban forestry definitions are as follows: In Finland, “it is a forest area in or around the urban area, whose main purpose and function is recreation.” In the Netherlands, the term “urban green” is used instead of the concept of urban forest, and it covers all of the urban green areas. In the United States (USA), “it is the whole of vegetation and green areas that benefit the enrichment of the quality of life of the society.” In countries with low levels of urbanization (Finland, Sweden, etc.), traditional forestry works generally come to the fore, whereas in countries with more urbanization such as England and the Netherlands, works on urban forest/forestry are increasing (Ottisch, 1999). As it can be understood from here, the concepts of “urban forest” and “urban forestry” vary according to the state of the countries in terms of forest and their expectations from urban forests.

GDF, which has the ownership of forests on behalf of the Treasury in Turkey, has all kinds of rights such as management, planning, operation, etc. on forests. The expectations of the urban people from forests were met from the green areas in the urban centers, such as parks, gardens, etc., which were previously under the administration of municipalities. However, GDF has started to establish in-forest recreation areas (A, B and C type) and urban forests (D type) in forest areas in order to meet the recreational needs of the urban people for more than 40 years.

The main purpose of in-forest recreation areas and urban forests is to produce recreational services. According to the National Parks Regulation (URL-4, 1986), in-forest recreation areas are defined as “forest area with recreational and aesthetic resource values”. On the other hand, according to the Regulation on Recreation Areas issued by GDF in 2013 (URL-5, 2013), the definition of recreation areas is as follows: “They are forest areas that meet the various rest, entertainment and sports needs of the society, provide daily or overnight accommodation needs of the people, and have recreational and aesthetic resource values.” In addition, this regulation defined three different in-forest recreation areas as A, B and C type and urban forests as type D. A type A in-forest recreation area is a recreation area with overnight accommodation,

whereas a type B in-forest recreation area is a recreation area where overnight accommodation is not available. A type C in forest recreation area, on the other hand, refers to the places that are used daily and that allow the local people to sell their local products.

Establishment of urban forests and in-forest recreation area in Turkey is subject to the permission of the Ministry of Agriculture and Forestry. According to the legislation in force in Turkey (URL-5, 2013), the term urban forest, which is considered in the D-type recreation area category, is a concept that is still discussed in developing countries. Since it is not yet fully a system settled and fit for purpose in Turkey, the differences between urban forest, in-forest recreation area (type A, B, C) and green areas in and around urban areas other than other forest regimes have not been clearly revealed. However, considering the Regulation on Recreation Areas, Application Communiqué on Recreation Areas and the situations in practice, the differences between urban forests and in-forest recreation areas can be explained as follows.

Accordingly, the basic criteria that distinguish urban forests from in-forest recreation areas and the functions that should be found in urban forests are as follows: (1) Offering the social functions of forests such as health, sports, aesthetics and culture to the service of the public, apart from the traditional picnic concept; (2) introducing the technical forestry activities and local flora and fauna; (3) giving the young generations the love and awareness of the forest; (4) enabling activities for tourism purposes; (5) reflecting the historical and cultural characteristics of the region. In addition, according to the application instruction of the law published by GDF (URL-6, 2014), except in compulsory cases, a minimum of 2 ha and a maximum of 50 ha of area should be allocated for A and B type in-forest recreation areas, whereas a minimum of 1 ha and a maximum of 20 ha of area should be allocated for C type in-forest recreation areas and a minimum of 5 ha and a maximum of 300 ha of area should be allocated for urban forests. In addition, in this application instruction, the number (54 different structures and facilities for A-type, 46 different structures and facilities for B-type, 30 different structures and facilities for C-type and 42 different structures and facilities for D-type urban forests were proposed) and characteristics of buildings and facilities which could be built in each type of in-forest recreation areas and urban forests were specified. However, in practice, it is seen that the rule regarding area sizes is not followed. For example, according to GDF (2021a), the smallest urban forest is 1.5 ha (Aydın/Karacasu Urban Forest), and the largest urban forest is 847.5 ha (Kanuni Sultan Süleyman Urban Forest). In terms of in-forest recreation area, the smallest is 0.02 ha (Karabük/Yenice İncedere C-type), while the largest is 768.0 ha (Adana/Karaisalı Topalak Dörtler C-type).

According to *Table 5*, a total of 40 (A-type: 17, B-type: 23) in-forest recreation areas were established in 1973, and their total area is 1,127 ha. The number of in-forest recreation areas established in 2019 reached 1,387 (A-type: 164, B-type: 342 and C-type: 881) on 17,009 ha of land. The duty of operating in-forest recreation areas and urban forests is largely transferred by GDF to municipalities and village legal entities in return for rent. The General Directorate of Forestry has concentrated on the establishment of in-forest recreational areas in forest villages outside the city centers in order to contribute to rural development, especially since 2003. Accordingly, between 2005 and 2011, there has been a significant increase in the number and size of in-forest recreation areas, whereas there has been a sudden decrease in this sense since 2012 (*Table 5*). This situation was caused by the closure of some of the in-forest recreation

areas, as the forest villagers could not earn enough income from the in-forest recreation areas and had difficulty in paying the annual rental fees they had to pay to the General Directorate of Forestry.

Table 5. Distribution of the number and area changes of urban forests and in-forest recreation areas in Turkey by years (GDF, 2021a)

Year	Type A		Type B		Type C		Total (A + B + C)		Urban forest (Type D)		Urban forest per person (m ² /person)	Total		Total area per person (m ² /person)
	Number	Area (Ha)	Number	Area (Ha)	Number	Area (Ha)	Number	Area (Ha)	Number	Area (Ha)		Number	Area (Ha)	
1973	17	614	23	513			40	1,127				40	1,127	0.72
1980	25	981	51	1,103			76	2,084				76	2,084	1.06
1985	31	1,122	65	1,553	1	32	97	2,707				97	2,707	1.01
1990	4	1,851	94	2,464	10	102	108	4,417				108	4,417	1.33
1995	56	2,242	120	3,578	19	123	195	5,943				195	5,943	1.54
2000	59	2,311	132	4,119	45	499	236	6,929				236	6,929	1.57
2005	102	3,976	178	5,625	213	33,402	493	43,003	33	4,840	1.01	526	47,843	9.95
2010	106	4,257	191	6,043	1,039	144,664	1,336	154,964	85	9,662	1.72	1,421	164,626	29.28
2011	46	1,539	108	3,384	1,295	149,388	1,449	154,311	110	11,230	1.96	1,559	165,541	28.85
2012	46	1,539	105	3,295	1,286	10,528	1,437	15,362	122	12,720	2.18	1,559	28,082	4.80
2013	53	1,678	105	2,774	1,239	9,924	1,397	14,376	126	11,867	1.69	1,523	26,243	3.75
2014	77	2,739	114	3,038	1,123	9,060	1,314	14,837	127	9,946	1.40	1,441	24,783	3.48
2015	122	4,190	173	3,515	1,016	8,165	1,311	15,870	133	10,315	1.42	1,444	26,185	3.61
2016	124	4,254	205	3,979	975	8,033	1,304	16,266	145	10,550	1.43	1,449	26,816	3.64
2017	130	4,066	234	4,302	953	7,890	1,317	16,258	142	10,444	1.40	1,459	26,702	3.57
2018	149	4,498	290	4,694	936	7,497	1,375	16,689	137	10,361	1.37	1,512	27,050	3.57
2019	164	4,914	342	5,088	881	7,007	1,387	17,009	134	10,199	1.32	1,521	27,208	3.53

There is a medium-level significant positive relationship ($r = 0.53$) between the amount of urban forest area and the elapsed time, and a medium-level significant positive relationship ($r = 0.43$) between the amount of urban forest area and urbanization (Table 2). Urban centers, which offer better social and economic conditions for people in Turkey, as in the whole world, are transformed into a built ecosystem where all of their time is spent, and there is therefore an increase in the demand and need for green space in urbans (Köse, 2020). As a result of these expectations, 134 urban forests were established in a total area of 10,199 ha between 2003 and 2019, in line with the “urban forest project” that was put into practice in Turkey in 2003. As seen in Table 5, the number of urban forests in Turkey has increased (145) until 2016, and has decreased after this date. It is considered that this situation is caused by the closure of a part of the urban forests that were opened to operation, since sufficient resources were not allocated for the operation of the urban forests.

According to Table 5, the total urban forest area in 2019 covers approximately 0.04% of Turkey’s total forest area, 0.08% of the productive forest area, and 0.01% of the total

land area. In 2019, the total number of both in-forest recreation areas and urban forests was 1,521, and the area covered by them was 27,208 ha. In 2019, the total area of urban forests and in-forest recreation areas covers approximately 0.1% of Turkey's total forest area, 0.2% of the productive forest area, and 0.03% of the total land area. In this sense, the amount of green area (urban forest + in-forest recreation area) per person in Turkey is 3.53 m². The World Health Organization (WHO) states that the green area per person in cities should be at least 9 m², and 10 to 15 m² is ideal (Götze et al., 2008; Pogue, 2010). According to the data of 2013, the green area per person in developed countries is around 20 m² on average, while it varies between 1-9 m² in the urban centers of Turkey (URL-7, 2013). For example, the amount of green space per person in some European cities is 23.6 m² in Berlin, 29.2 m² in Brussels, 26.1 m² in Milan, 32.9 m² in Liverpool, 18.0 m² in Barcelona, and 124.7 m² in Vienna (Anonymous, 2000).

According to the provisions of the "Regulation on Principles for Plan Making" (URL-8, 2001), which is still in force in Turkey, the amount of green space per person in urban areas has been determined as at least 10 m². In this sense, many scientific studies were conducted in order to determine the amount of green areas per person in urban centers, and it was aimed to consider the deficiencies observed on the urban green space presence. For example, it was determined that there was 3.1 m² green area per person in Antalya (Ortaçesme et al., 2000), 1.9 m² in Istanbul (Aksoy, 2001), 3.0 m² in Isparta (Gül and Küçük, 2001), 5.4 m² in Kayseri (Öztürk, 2004), 1.4 m² in Kahramanmaraş (Doygun and İlter, 2007), and 4.0 m² in Burdur (Yenice, 2012). Therefore, it is clear that the current urban green space amount per capita in Turkey is well behind both the green space standards specified within the scope of the Zoning Legislation for Turkish cities and the available green space amount in many European cities.

Conclusions and recommendations

Since people, who would like to get rid of the tiring and depressing life of metropolises, whose population continues to increase rapidly, turn to forests and urban centers expand to forest borders, an increasing number of urban people in Turkey and the world have become interested in forests and natural areas.

Since 1927, the total population and urban population have continuously increased in Turkey (TUIK, 2020). In addition, while the share of the rural population in the total population decreased with the migration process, the share of the urban population increased significantly. The decrease in the rural population has reduced the negative effects of the rural population on forests. In other words, because the number of people living in the countryside has been decreasing, the demand for firewood and round timber raw materials from forests has been decreasing, grazing pressure on forests and pastures has been easing as the number of animals has been decreasing, and new areas have not been opened from forests for illegal settlements and agriculture. In addition, forest areas, which were previously opened as agricultural land, have been turning into forests again as they have been abandoned due to migration. Therefore, it is a fact that there is a transformation in favor of forests in the rural areas of Turkey.

However, it is not possible to talk about a similar situation in urban areas. According to the statistical analysis, although there is a positive relationship between urban population and forest area, and growing stock and annual increment, it is not at the same rate. The urban population increases several times more than the forest area, growing

stock and annual increment. This increase creates significant pressures on forests. As cities grow, they approach the forest boundary. This situation brings about illegal settlements in forested areas due to the populist policies of the political powers. These illegal settlements have been paved the way with the changes made in the Constitution and laws in different times from past to present. On the other hand, allocations given from forest areas for education, health, mining, industrialization, transportation, recreation and tourism, etc. create significant threats on forests. While giving these allocations, the concept of public benefit is taken into account in practice. However, since the criteria and conditions of the concept of public benefit are not revealed in a concrete way, they are often interpreted differently by different people. Therefore, the criteria and conditions of the concept of public benefit should be clearly and comprehensively presented in a way which would not harm forests.

In addition, despite the increase in total forest area and growing stock in Turkey, the amount of forest area and growing stock per total population and urban population is gradually decreasing. This situation should be taken into account in the development of forward-looking forestry policies. At the same time, any regulations in the Constitution and laws, which would be against forests (implementations of taking out of forest boundaries with regulations 2B, etc.), should be avoided.

There is no significant difference between forests, which are separated as urban forests with a separate definition and sign, and other in-forest recreation areas in the forest in terms of purpose, application and public utilization demands, and it is indeed quite possible to state that all types of in-forest recreation areas in the forest serve urban forestry (Sağlam and Elvan, 2017). In fact, considering the examples in the world in urban forestry practices as mentioned in this study, it can be said that a large part of the green open areas outside the forest regime created in the urban also serve urban forestry, which is contrary to the understanding in Turkey.

Urban forests in Turkey are on average 8.4 years old ($=134/16$). 134 urban forests have been established in 16 years, mostly for populist and political purposes, which do not comply with the understanding of urban forestry in developed countries. Such an application, which is incompatible with urban forest planning and management principles, brought many problems and caused some of them to be closed later. This has led to a waste of labor and capital. In urban forests and other in-forest recreation areas, buildings and facilities that are not suitable for the natural structure of forests are being built by using the recreation demands of the people as an excuse. In fact, it is against the Constitution and the Laws to make structuring in forest areas restricted by the Forest Law (Law No. 6831), and even to issue regulations such as guidelines and communiqués to legitimize what has been done. The construction of these structures and facilities causes the forests and natural structure (ecological balance, wildlife, etc.) to deteriorate and not to return to their former state for many years. At the same time, this situation is contrary to the understanding of urban forestry of developed countries in the world. Municipalities are the biggest operators of urban forests and recreation areas in Turkey. Nevertheless, municipalities and special administrations do not take sufficient initiative in the establishment, planning and management of urban forests. In this sense, municipalities and special administrations should act together with the forestry organization.

Therefore; especially in urban settlements, in order to prevent the activities of the urban people against the forests such as deforestation, settlement, illegal logging, those working in practice should be more careful, political authorities should abandon

populist policies, and researchers and academicians should make more scientific publications to attract the attention of the public on this issue. It is important that this subject is scientifically supported by forestry research institutions in order to reveal the criteria of the concept of “public benefit” in detail regarding the areas subject to permission and easement in forests. Due to the fact that there is no significant difference between urban forests and other recreation areas in terms of application and utilization demands of the people of the city. The definition of all forest recreation areas, city parks and wooded green areas in and around the urban should be re-evaluated within the scope of urban forest according to the current legislation. In this context, the definition of “urban forest” in the current legislation should be rearranged.

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