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Rural population mobility, deforestation, and urbanization: case of Turkey

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Abstract The benefits of the forests are well known and are by their existence alone an amenity. Nonetheless, urbanization as one of the most remarkable features of social development has immense effects on forest resources and land use. In this study, it is hypothesized that there are temporal interactions among the rural population dynamics, urbanization, and forest resources. Data set is based on rural population, total population, and forest areas for the period of 1990–2017. Regression analysis (the ordinary least square, OLS) and dummy variable in regression were used by taking the years into consideration. The coefficient of total population in the regression model developed in our study was positive, which means with the increasing total population, there is an increase in forest areas as well, contrary to common opinion in the literature. With this study, a positive/linear temporal relation between the forest area and urbanization via the regression statistics was determined. There is a significant inverse relation between rural population decline and forest area increase too. Our results provide also a compelling evidence that rural population mobility, afforestation, and forestry policy have strong effects and play an important role over the forest management and forest policy in Turkey.

Keywords Rural population dynamics · Urbanization · Forest policy · Afforestation · Dummy variables

Introduction

In a society, political and economic elements of development consisting of social structure, knowledge, powers, livelihood quality (both socially and environmentally understandable in general), and ecological resilience have aroused as especially prominent aspects of human/environment interactions (Nightingale 2003). Human activities and environmental issues are the two most common research subjects as well (Gibson 2018). In the sense of the biological concept, that argument stems from the carrying capacity of natural resources such as water, air, soil (Ramakrishnan 1998), and forests. Forests are an inherent component of the landscape and existence of mankind (Ciesielski and Stereńczak 2018); provide multiple benefits to multiple users (Kishor and Belle 2004); improve the environmental quality, economic opportunity, and esthetic values (Sanesi et al. 2007; Marziliano et al. 2013; Coletta et al. 2016); behave like biodiversity vaults (Christopoulou et al. 2007); and are an important carbon storage affecting climate change by acting like a regulator in ecosystem services (MAE 2003; Delphin et al. 2016). The benefits generated from forests are widely

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known and are by their existence alone an amenity. That is why, the forest protection must be considered with regard to social, economic, and political nature and habits (Piussi and Farrell 2000). They are increasingly at risk due to climate change, pests, diseases, exploitation, and urbanization (Coletta et al. 2016).

Urbanization has gained attention as one of the most noteworthy features of social development (Li et al. 2012; He et al. 2016; Allington et al. 2017) via the rural to urban migration; thus, population has been excepted as a dominant trend globally (UNFPA 2007) in the twentieth century. Hence, cities have become the most important habitats for the people (Su et al. 2011). By 2050, the population in the world is predicted to reach 9 billion which was once 6 billion in 2000 and 3 billion in 1960 (UNFPA 2007). The pressure emerging from population is a great distress for the developing world, albeit the immensely restricted per capita demand for resources in the developing countries (Ramakrishnan 1998). Increase in population will cause land use and cover changes (LULCC) in a significant way and hinder the provisioning ecosystem services (Vitousek et al. 1997; MAE 2003; EC 2009; Hoyer and Chang 2014). Rural population dynamics may cause two opposite scenarios of LULCC and are not tied to just one factor (Blaikie and Brookfield 1987). It is also the main subject of environmental and ecological change (GLP 2005; Mooney et al. 2013), deforestation, or forest transition (Angelsen and Kaimowitz 1999; Grau and Aide 2008; Taylor et al. 2016). Expanding urbanization throughout non-urban lands for new urban areas is a significant anthropogenic factor that affects ecosystems (Bengston et al. 2005; Zhang et al. 2012; Yue et al. 2013; He et al. 2016; Delphin et al. 2016), directly through the transformation of vegetation into urban infrastructure (Pennington et al. 2010). LULCC has transformed environmental and natural ecosystems via rapid urbanization (Huang et al. 2009; Lin and Ben 2009; Göl et al. 2011; Liu et al. 2014) and is under the growing pressure of the anthropogenic stressors (Sicard et al. 2016). As an ecosystem, forests are highly vulnerable/sensitive to anthropologic activities (Lele et al. 2008) as well. Deforestation rates are far from being uniform across the world (Allen and Barnes 1985). Although deforestation has declined, it is still a serious problem in scope and quantity (Köthke et al. 2013; Calle et al. 2016) and is a real trend almost in all developing countries (Allen and Barnes 1985). Understanding drivers of deforestation has an important role to develop policies and measures allowing modifications in current trend in forestry towards a more climate/biodiversity/ecosystem friendly outcomes (Kissinger et al. 2002; Hosonuma et al. 2012; Van Khuc et al. 2018) and to get long-term social-ecological sustainability (Allen and Padgett Vásquez 2017). Furthermore, assessment of the effects of LULCC in the sense of ecology and environment could also provide a starting point for decisions on land use, environmental governance, and urban planning when deforestation is taken into account.

It is hard to draw obvious causal linkages among the migration, urbanization, LULCC, and deforestation due to its influential interactions with other causes (Gray and Bilsborrow 2014; Walters 2016; Erkan Buğday and Özden 2017). Urbanization deserves special emphasis as it converts forestlands to many kinds of other developments (De Chant et al. 2010), because the migratory patterns could have important social effects depending on changing conditions (Ramakrishnan 1998). A few studies condense on implications such as degradation of multi-environmental forest functions (i.e., conservation of biodiversity, regulatory functions on microclimate, removal of atmospheric pollutants, preservation of water resources, soil protection from erosion, and flooding); reduce in recreation opportunities; and devious damaging effects on present economic activities (Christopoulou et al. 2007). Thus, this paper explores and explains the relationship among rural population dynamics, migration, urbanization, and deforestation by asking the following questions: (i) Did urbanization affect forest policies in Turkey? (ii) How did the forest resources change, and which factors influenced that? To answer these questions, we analyzed the population trends and changes in forest resources from 1990 to 2017. It is also explored the potential relationships between these variables. We conducted an empirical study to evaluate the effect of urbanization (from rural areas to urban areas) with currently available data. There are many studies on migration related to its socioeconomic and cultural dimensions (Walters 2016), but there are few studies, which specifically examine the influence of urbanization on forest resources in Turkey. We hypothesized that there are temporal interactions among rural population dynamics such as migration, urbanization, and forest resources.

Material and methods

Data description

Data used in the study are the official data gathered from various relevant institutions, of which are General Directorate of Forestry (GDF), Ministry of Development, and Turkish Statistical Institute of Turkey. In the 1990s, the population increased by about six times. Referring to changes both in the rural and urban population in 1927, mechanization in agriculture has caused a decrease in rural population and was approximately 76%, in the 1950s. A detailed map for the population density in Turkey is given in Fig. 1.

As of 2017, the rate of rural population fell to 7.5% and urban population increased to 92.5%. In addition to that, 7.1 million people representing about 8.7% of the total population live in 21.723 forest villages in or nearby forests (OGM 2014, 2015, 2017) (Table 1).

Data set used in this study is based on the amount of rural population, total population, and forest areas for the period of 1990–2017. The period was taken between 1990 and 2017 because data for the pre-1990 period were not available for some of the variables.

There has been an increase of 2.143.639-ha forest area since the first forest inventory in 1963 (OGM 2015). Figure 2 shows the forest cover distribution in Turkey. A total of 2.338.073 ha was afforested throughout the history of the Republic in Turkey. According to official statistics for the period of 1990–2016, which we took as a base for our research, a total of 957.662 ha was afforested, which represents 40% of all afforestation. As of 2017, according to the management plans, the total forest area amounted to 22.342.935 ha, of which 12.704.148 ha productive and 9.638.787 ha nonproductive (OGM 2015, 2017).

To understand and to see both the density of forest cover and population at the same time, Fig. 3 is given.

Data analysis

Minimum, maximum, mean, and standard deviation for the forest area, rural population, and total population are given in Table 2 and their yearly changes are shown in Table 3. While data on the forest area could be obtained at regional level (Fig. 4), rural population could be obtained at country level. Thus, we did not evaluate our data set at regional level. A flowchart explaining the designed study is shown in Fig. 4.

We conducted an analysis of our data by years. Regression analysis (the ordinary least square, OLS) was separately performed to describe

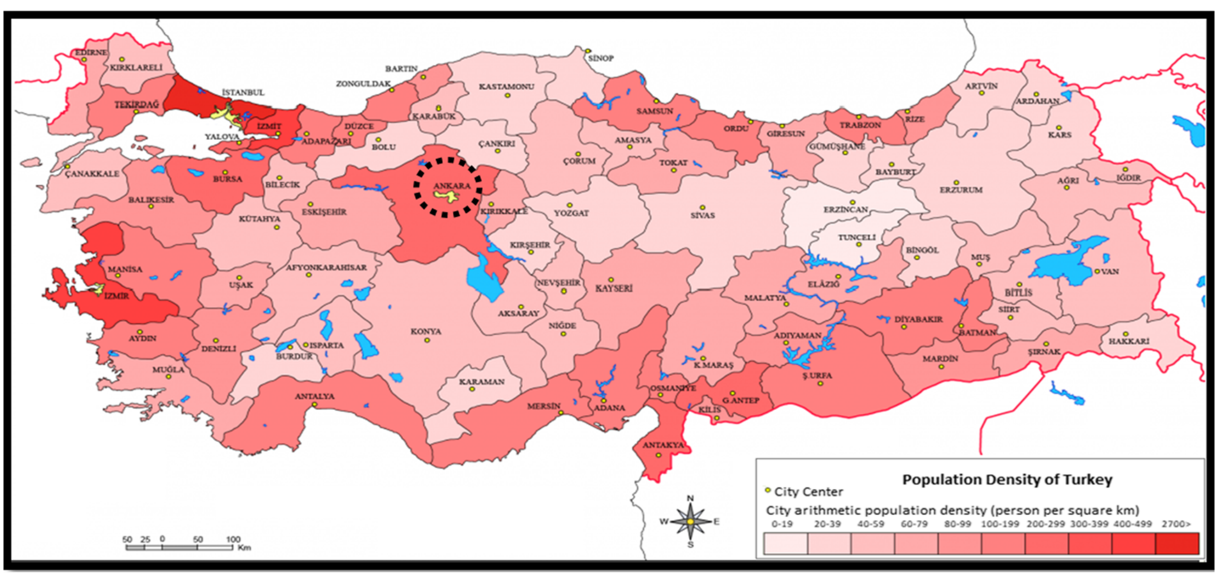

Fig. 1 The population density in Turkey (Saygılı 2016) (The place that is shown in a circular is the capital of Turkey)

Table 1 Population changes in Turkey (1927–2017)

Inventory years	Urban population	Urban population rate (%)	Rural population	Rural population rate (%)	Total
1927	3.305.879	24.0	10.342.391	76.0	13.648.270
1935	3.802.642	24.0	12.355.376	76.0	16.158.018
1940	4.346.249	24.0	13.474.701	76.0	17.820.950
1950	5.244.337	25.0	15.702.851	75.0	20.947.188
1960	8.859.731	32.0	18.895.089	68.0	27.754.820
1970	13.691.101	38.0	21.914.075	62.0	35.605.176
1980	19.645.007	44.0	25.091.950	56.0	44.736.957
1990	33.326.351	59.0	23.146.684	41.0	56.473.035
2000	44.006.274	65.0	23.797.653	35.0	67.803.927
2012	58.448.431	77.0	17.178.953	23.0	75.627.384
2013	70.034.413	91.0	6.663.451[a]	9.0	76.667.864
2015	72.523.134	92.1	6.217.919	7.9	78.741.053
2017	74.749.736	92.5	6.060.789	7.5	80.810.525

Resource: ADNKS 2013; TKİB 2011; TÜİK 2011, 2012, 2016; Ünal and Birben, 2016)

[a] Law for Metropolitan Municipalities got into force in 2012 and 14 new metropolitan municipalities were designated by. In 30 metropolitan city, all the towns and villages were designated as district municipalities.

relationships between the amount of forest area-total population and the amount of forest area-rural population for each year.

$$\text{Forest area } (FA) = f(\beta_{FA}, \text{total population}) + \varepsilon_{FA} \quad (1)$$

$$\text{Forest area } (FA) = f(\beta_{FA}, \text{rural population}) + \varepsilon_{FA} \quad (2)$$

where β_{FA} is the parameter vector to be estimated and ε_{FA} is the error term associated with models.

Rural population mobility was a critical factor, affecting the change in forest areas. Therefore, we also focused on temporal change of rural population mobility. So, regression analysis with dummy variable was used for evaluating the effects of temporal variation in rural population on change in forest areas. In our study, all analyses were

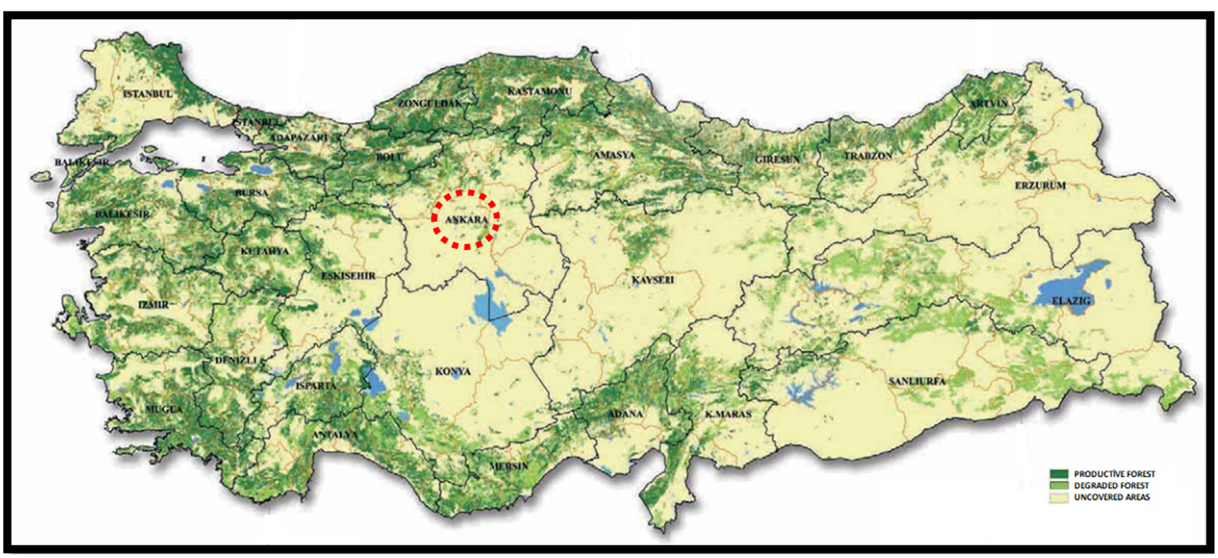

Fig. 2 Forest cover in Turkey (OGM 2017) (The place that is shown in a circular is the capital of Turkey)

Fig. 3 Forest density in provinces of Turkey (OGM 2017) (The place that is shown in a circular is the capital of Turkey)

made by using SPSS® software package 22 IBM Inc., USA. The equation belongs to dummy variable approach is as follows:

$$Y = \beta_1 + \beta_2 X_2 + \beta_3 S_1 + \beta_4 S_2 + \beta_5 S_3 + \varepsilon \quad \left(\begin{array}{l} S = 1 \text{ if period is } 1990\text{–}2000; 0 \text{ otherwise}, \\ S = 1 \text{ if period is } 2001\text{–}2010; 0 \text{ otherwise}, \\ S = 1 \text{ if period is } 2011\text{–}2017; 0 \text{ otherwise} \end{array} \right. \tag{3}$$

where Y is the actual forest area, X is the rural population, β_1 and β_2 are the fitting parameters, S is the dummy variable, and ε is the error term.

Evaluation method

We evaluated OLS and dummy variable approach for rural population in terms of goodness-of-fit statistics, including the adjusted coefficient of determination (R^2_{adjusted}) and the percentage of root mean squared error (RMSE (%)).

$$R^2_{\text{adjusted}} = 1 - \frac{(n-1)}{(n-p)}\left(1 - R^2\right) \tag{4}$$

$$\text{RMSE } (\%) = 100\sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(y_i - \hat{y}_i\right)^2} \tag{5}$$

where n is the number of observed data, p is the number of fitting parameters, y_i is the observation value for ith forest area, and $\hat{y}_i$ is the prediction value for ith forest area. In addition, we evaluated model performance visually by error patterns. We also evaluated these relationships in detail in terms of rural mobility, afforesta-

Table 2 Descriptive statistics of data set used in this study

Variable	Min.	Max.	Mean	Std. dev.
Forest area (× 1.000 ha)	20.199	22.343	20.987	0.714
Rural population (× 1.000)	6.060	23.797	19.057	6.153
Total population (× 1.000)	53.594	80.810	62.216	8.261

Table 3 Forest area, rural population, and total population in terms of year level

Period	Forest area (× 1.000 ha)	Rural population (× 1.000)	Total population (× 1.000)
1990–2000	20.763	23.797 (37.6%)	63.174
2001–2010	21.537	21.180 (28.7%)	73.722
2011–2017	22.343	6.060 (7.5%)	80.810

*The values in parentheses indicate the percent of rural population in total population

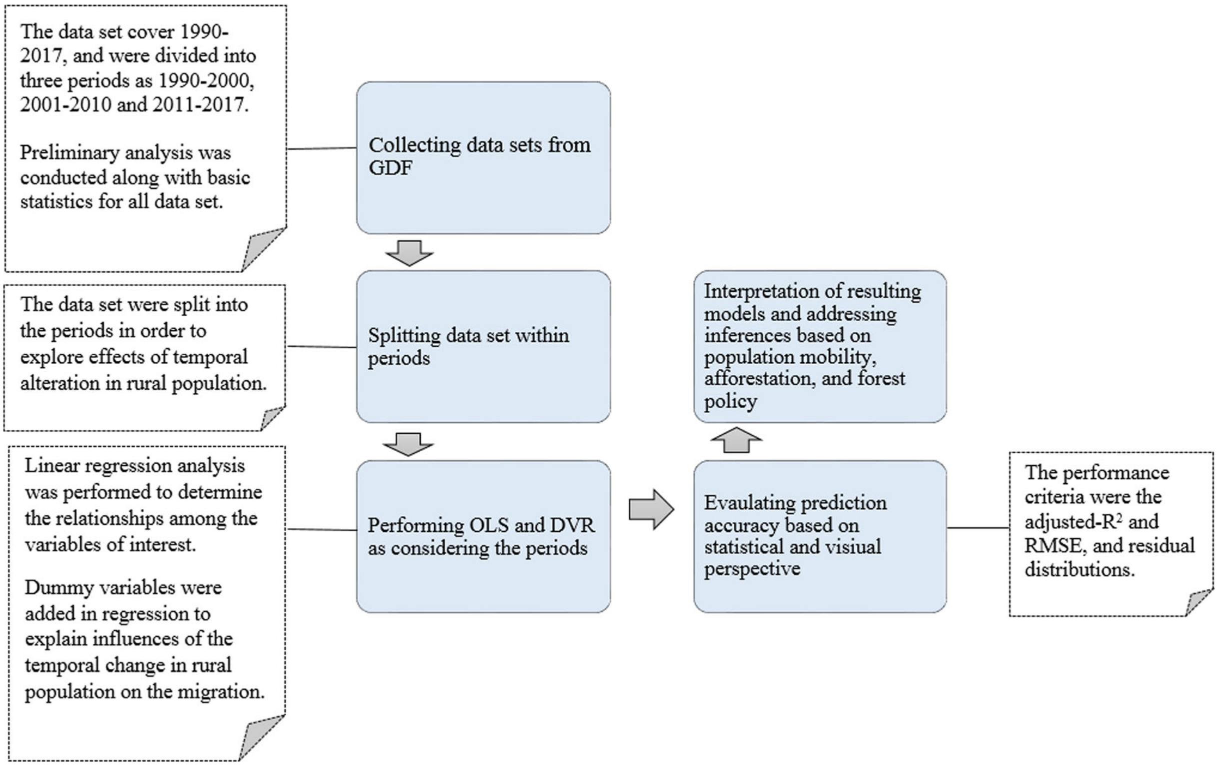

Fig. 4 Flowchart explaining the designed data processing procedure

tion, and forest policies because rural mobility is often not sufficient alone to explain the forest area changes. Therefore, information on afforestation and forest policies are needed to comprehensively evaluate the relationships among these factors.

Results and discussion

Determination of the relationships by OLS technique

The first analysis was performed using total population as an explanatory variable. The regression model developed for the 1990–2000 period explained 38% of the forest area variability. This value was 87% for the 2001–2010 period and 78% for the 2011–2017 period (Table 4).

When rural population was used as an explanatory variable, 23%, 80%, and 29% of the forest area variability for 1990–2000 (R1 model), 2001–2010 (R2 model), and 2011–2017 (R3 model) period were explained, respectively (Table 5). Except for models R1 and R3, others were significant at 95% significance level, which was attributed to the inadequacy of data. R1 model was not significant but it might be tolerated owing to the fact that it had *P* value of 0.07. However, the coefficient of rural population parameter in R1 model was positive. With the decreasing rural population, it is expected to

Table 4 Regression statistics for the relationships between forest area and total population by years

Period	Function	Model	R^2_{adj}	*P* value
1990–2000	$FA = 17.420 + 0.049TP$	(T1)	0.38	0.025
2001–2010	$FA = 14.057 + 0.101TP$	(T2)	0.87	0.000
2011–2017	$FA = 9.961 + 0.154TP$	(T3)	0.78	0.005

FA forest area, *TP* total population

Table 5 Regression statistics for current and lagged relationships between forest area (FA) and rural population (RP) in terms of the periods

Period	Function	Model	R^2_{adj}	*P* value
1990–2000	$FA = 15.154 + 0.230RP$	(R1)	0.23	0.070
2001–2010	$FA = 36.728 - 0.719RP$	(R2)	0.80	0.000
2011–2017	$FA = 22.319 - 0.038RP$	(R3)	0.29	0.124

Table 6 Statistics for dummy variables in regression for relationships between forest area and rural population

Method	Model	R^2_{adj}	RMSE (%)	Sig. (at 5% level)
OLS method without dummy variable	(M1)	0.62	1.22	0.000
OLS method with dummy variable	(M2)	0.94	0.89	0.000

increase in forest areas. While the R3 model was not significant at 95% level, its results were similar to actual values. Therefore, we decided to use the R2 and R3 to explain the relationship between the rural population and forest area.

The coefficient of total population in the regression model developed in our study was positive, that means with the increasing total population, there is an increase in forest areas as well. This result was inconsistent with the results of d'Annunzio et al. (2015). They found that forest cover changes in West Asia were stable for the 1990–2010 period. Our results showed a reasonable increase in forest areas for the same period in Turkey. However, Keenan et al. (2015) reported 10.6% of the increase in forest area from 1990 to 2015 for West Asia. Similarly, the percentage change in forest areas of Turkey for the period of 1990–2017 was 10.6.

Delineating the population movements taking place in Turkey in the last 50 years, internal migration can be examined mainly in three separate periods (1950–1960, 1960–1980, 1980–2000). The results revealed that the rural population mobility has strong effects on the change of forest area; the increase of the village populations; the limited supply of agricultural land, and the uneven distribution of land ownership. The increase in labor originated from industrialization has been influential on migration trend over villagers who are seeking for better health and education services in urban areas. In the 1980–2000 period, all obstacles to the mobility and migration within the country were overcome with investments in transportation infrastructure and communication and information technology. Therefore, the temporal analysis of rural population mobility (migration from rural to urban) is necessary for an adequate understanding of the forest area changes.

Analysis of temporarily rural mobility by DVR

When we did not take temporal variation in rural population into account, the adjusted coefficient of determination (R^2_{adj}) was 0.62, but when we did, R^2_{adj} increased from 0.62 to 0.94 as in Table 6. The inclusion of dummy variable method (M2) to the model contributed substantially the model performance. In addition, RMSE was lower for M2 method than OLS (M1) method in predicting forest area.

The results showed that the correlation coefficient between actual and predicted forest area was 0.96 for M2 method and 0.78 for M1 method (Fig. 5). The distribution of error terms for both methods indicated that there is an overestimation across the range of our data in predicting forest area (Fig. 6). However, that of M2 method showed a decreasing trend with increasing predicted values indicating that M2 method was more reliable than M1 method in predicting forest area. The results revealed that the rural population mobility has strong effects on the change of forest area.

The number of people employed in rural areas has decreased substantially after the year 2002 (Yakışık and Zülfikar 2013). This situation caused migration from rural to urban and thus the social pressure on the forests has reduced. While the regression model improved (R1 model) for the 1990–2000 period explained 23% of forest area variability, the R2 model had a high explanatory after the 2001–2010 period and the coefficient of rural population was negative (Table 5). This result indicated the decreasing social pressure on the forests.

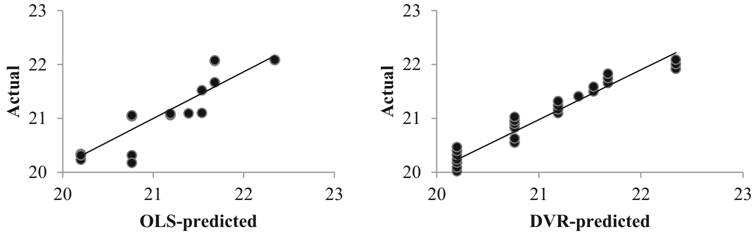

Fig. 5 Scatter plots for actual versus predicted values of forest area by OLS (left) and dummy variables in regression (DVR) (right)

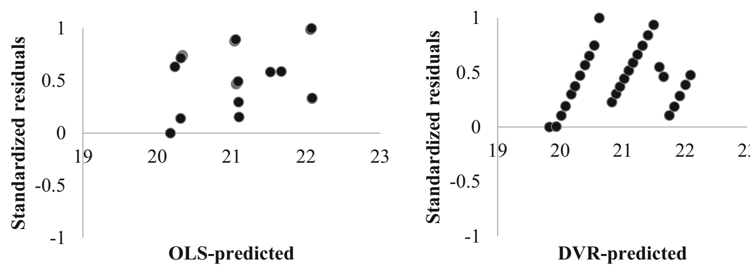

Fig. 6 Distribution of standardized residuals for OLS method (left) and dummy variables in regression (DVR) (right)

Evaluation of the factors relation to change in forest areas

Performance of the R1 and R3 was inadequate for the 1990–2000 and 2011–2017 period (Table 5) since the afforestation and forest policies have an important influence on forest area change for the mentioned period and their effects could not be included in the regression model. Rapidly growing population, urbanization, economic activities, and varying consumption habits

Table 7 Political and legal basis

Key political basis	Policy implementation tools
Development plans	Tenth Development Plan (2014–2018)
	Ninth Development Plan (2007–2013)
	Eighth Five-Year Development Plan (2001–2005)
	Seventh Five-Year Development Plan (1996–2000)
	Sixth Five-Year Development Plan (1990–1994)
Action plans	National Strategy and Action Plan to Combat Desertification (2015–2023)
	Turkey's Climate Change Action Plan (2011–2023)
	National Biological Diversity Strategy and Action Plan (2007)
	National Environmental Strategy and Action Plan (1999)
Projects and programs	National Forestry Program (2004–2023)
	Regional Development Projects (2015–2019)
	Turkey's Public Environment and Forestry Research Program (2006)
Strategy documents	Turkey Climate Change Strategy (2010–2023)
	National Rural Development Strategy (2014–2020)
	National Environmental Strategy and Action Plan 1997
	National Watershed Management Strategy (2014–2023)
	General Directorate of Forestry Strategic Plan (2010–2014)
	General Directorate of Forestry Strategic Plan (2013–2017)
	General Directorate of Forestry Strategic Plan (2017–2021)
Council reports	Forestry Council (1993)
	Environment and Forestry Council (2005)
	Forest and Water Final Report (2013)
	Forest and Water Final Report (2017)
Master plans	Forest Mentoring Research Master Plan (1995)
	Turkey Agricultural Research Project Master Plan Forestry Research (1999)
	National Forestry Research Master Plan 2007–2012
	Forestry Research and Development Master Plan 2016–2017
Government programs	19 different Government Programs (1989–2017)

Table 8 National and international legislation

Year	International conventions
1971	Convention on Wetlands of International Importance, especially as Waterfowl Habitat, also known as the RAMSAR Convention
1972	Convention Concerning the Protection of the World's Cultural and Natural Heritage, also known as the World Heritage Convention
1973	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), also known as the Washington Convention
1979	Convention on the Conservation of European Wildlife and Natural Habitats, also known as the Bern Convention
1992	United Nations Convention on Biological Diversity (CBD)
1992	United Nations Framework Convention on Climate Change
1994	United Nations Convention to Combat Desertification
2000	European Landscape Convention, also known as the Florence Convention
2004	International Treaty on Plant Genetic Resources for Food and Agriculture
Year	National Laws/Statutory Decrees
1956	Forest Law
1957	Law on Agricultural Protection and Agricultural Quarantine
1983	Environment Law
1983	National Parks Law
1983	Law on the Protection of Cultural and Natural Properties
1995	National Afforestation and Erosion Control Mobilization Law
2003	Land Hunting Law
2011	Statutory Decree on the Organization and Functions of the Ministry of Forestry and Water Affairs
2011	Statutory Decree on the Organization and Functions of the Ministry of Environment and Urbanization

increased the pressure on the environment and natural resources (KB 2013). Turkey carries out policies and practices to improve life quality and to protect the environment along with economic and social development in order to safeguard future generations to benefit from scarce natural resources. About half of the forests in Turkey is degraded. Reforestation and rehabilitation of such areas have a special significance in Turkey's forest policy since 1937 (OGM 2012).

While the decrease in forest areas in Turkey is an expected situation due to forest degradation and losses caused by population growth, migration, and rapid urbanization, in the last 30 years, there is a remarkable increase (about 1 million ha) in forest areas. In the emergence of this result, the strong political desire to increase the spatial size of forest areas through the protection, development, and afforestation, the effective and continuously updated legal legislation (national and international), and the perception of society to nature and forests have played an important role. Tables 7 and 8 show the political and legal basis, which have influenced the expansion of forest areas over the years.

When the past and present situations are evaluated together in general and while the current yearly increase in the growing stock and increment is remarkable, it is also remarkable that the ratio of tree felling is decreasing, and leading a political shift from mere timber production to multipurpose use (Ecological and Sociocultural) in recent periods (Keleş et al. 2017) (Table 9).

Regeneration of the forests in areas where human impact decreased is also noteworthy. In recent years, clear cuts have been reduced in coppice forests and speeding up the conversion of these areas into high forest has been accelerated. Private afforestation efforts in Turkey have started in 1986. It is expected that the promotion of private afforestation by the afforestation legislation, the development of the people's environmental consciousness, and the changes in the understanding of Statism shall take this ratio beyond. International agreements on forestry have also been

Table 9 Distribution of forests' main functions (2012 and 2015)

Main functions	Productive (ha)		Degraded (ha)		Total (ha)		%	
	2012	2015	2012	2015	2012	2015	2012	2015
Economic	7.941.86	7.411.79	5.679.69	3.831.30	13.621.55	11.243.09	63	50
Ecological	2.911.61	4.192.53	4.000.81	5.095.31	6.912.42	9.287.84	32	42
Socio-cultural	705.18	1.099.82	438.96	712.16	1.144.15	1.811.99	5	8
Total	11.558.66	12.704.14	10.119.46	9.638.78	21.678.13	22.342.93	100	100

Source: OGM 2015, 2017

implemented. In this context, the Forestry Sector Review Study was prepared in cooperation with the World Bank, and Turkey's National Forestry Program was prepared with the support of the FAO. The identification and implementation of the National Criteria and Indicators for Sustainable Forest Management are important outcomes of international process/support (DTP 2007).

Conclusion

Turkey has adopted sustainable development as a main forest policy in the early 1930s. In particular, sustainable development was at the forefront of the basic principles. However, rapidly growing population, urbanization, economic activities, and diversified consumption habits have increased the pressure on the environment and natural resources. The most basic nature of the relationship between the population and the environment is in the form of mutual interaction. This interaction is realized through intermediate variables of social and economic nature. For example, size, distribution, and increase rate of the population are influential on variables such as land, income distribution, and consumption level which affect the use of natural resources (water, air, soil, forests, minerals) as volume and productivity (rate of transformation). From this point of view, the population will continue to impact the environment through destruction of forests and shrubs, the abandonment of rangelands, and fallow requirements in agriculture (DPT 1997).

The decline in the rural population due to the immigration has altered the pressure on forest resources. In addition, the decrease in land clearing for agriculture, forest degradation, and natural forest regeneration of the abandoned lands has increased the forest areas. Nevertheless, in Turkey, the neglects to migrants and their problems have been maintained (Alkan 2014). This study shows a temporal relation between the forest area and urbanization via the regression statistics. That is also very clear in the official inventories, which shows the changes in main functions of the forests as in Table 7.

There are rapid changes among the main functions of the forests—a 10% increase at ecological functions and a 3% increase at socio-cultural functions from 2012 to 2015. In 2015, economic functions rate was well below the 13% for the 2012 rate steaming from changing demands caused by the urbanization and socioeconomic factors that are also affecting the forest policy and management. The rural population mobility, especially decrease in rural population, is highly influential on forest policy and management that, even when we only consider the conversion of coppice forests (6.344.908 ha in 1999 and 2.723.217 ha in 2015) to high forests via the functional forest planning, we can see that effect. For further research, interchanges in population between the regions are more important than the chances in county/cities.

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