Politics and Tree Cover Loss: Evidence from High-Resolution Satellite Data

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Abstract

Environmental issues have gained saliency in Turkish politics over the last decade, especially after the Gezi Park demonstrations. However, no systemic empirical evidence exists to inform us about the relationship between politics and tree cover in Turkey. Although Turkey witnessed significant tree loss over the last decades, we do not know how much of this damage is attributed to politics. Using high-resolution satellite data, this paper provides the first empirical relationship between local politics and tree loss. The results show that districts with Justice and Development Party (AKP) mayors have higher tree loss by around a combined area of 62 football pitches on average. These results imply that local governments can have a substantial impact on the environment despite their limited effect in the design of environmental policies.

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1 Introduction

The environment has been a contentious topic for Turkish politics over the last decade. Environmental issues have gained saliency, especially after the Gezi Park demonstrations, which had started to defend the last green space in Taksim, Istanbul. Despite this increased attention, no systemic empirical evidence exists to inform us about the relationship between politics and tree cover. In the absence of empirical evidence, while environmental resistance movements blame the government for destroying green spaces for infrastructural projects and minings operations, Erdoğan denied the allegations. On the contrary, he claimed that his government planted "4.5 billion trees" under his leadership.[1] As a result, we are unable to adjudicate between these different claims, despite the availability of high-resolution satellite data on green spaces. Although we know that green spaces are destroyed over the last decades in Turkey[2], we do not know whether AKP governments are more harmful to the environment compared to others. It could be that the deforestation trend would be the same, primarily because of economic activities and population growth, if a different political party ruled the country.

By using high-resolution satellite data, this paper provides the first empirical evidence on politics and tree loss by analyzing the relationship between Justice and Development Party (*Adalet ve Kalkınma Partisi*, *AKP*) municipalities and green spaces. The results show that districts governed by the AKP mayors are more likely to witness tree loss: on average, districts with AKP municipalities have higher tree loss by around 0.05 percent.[3] Although this magnitude might look small, this share is with respect to the whole net land[4] including both settled areas and its surroundings as well as unsettled areas far from where people actually live. Therefore, the share is much more significant relative to settled areas. Moreover, it does not take into account the central government, whose effect should make AKP and non-AKP municipalities more similar to the extent that environmentally damaging projects spread across the country. Hence, these results are probably smaller than the actual relationship between politics and tree cover loss.

Although the results that AKP municipalities are more detrimental than others to green spaces may not be surprising for environmental resistance movements, it is not theoretically clear why AKP municipalities should be more damaging. Firstly, local governments in Turkey are not the most important actors for the environment. Therefore, one could argue that we should not see differences within the country, but we should see overall damage across the whole country, driven by the actions of the central government. In line with this logic, many studies rightly argued that local governments are not the primary actors in Turkey's environmental policy due to the centralized nature of decision-making. However, despite being ineffective in the formulation of environmental policies, local governments are

[1] `https://bit.ly/2BjkJLW`

[2] See, for instance, `https://www.globalforestwatch.org/dashboards/country/TUR`

[3] For an average-sized district, this is roughly equal to 44 hectares, or a combined area of 62 football pitches.

[4] It is net since I exclude permanent water bodies such as rivers, lakes, reservoirs from the calculations.

important actors for environmental governance.[5] Equipped with more than 150 laws and by-laws that give authority on the environmental governance,[6] municipalities are responsible for around 85 percent of the total public environmental spending.[7] Moreover, although the forests are owned by the central state, municipalities are responsible for taking care of the green spaces within the urban areas. The availability of high resolution data[8] means that we can measure changes not only in forest areas, where most of the official data exist, but also in the green spaces in the urban areas.

Secondly, many argue that Turkey's political parties are not different when it comes to developmentalism because they are all willing to sacrifice the environment in exchange for economic development. Since the foundation of the republic, the idea of development through rapid economic growth is not challenged by any political movement.[9] Despite differences in other dimensions (economic ideology and progressive/conservative values), political parties in Turkey have always supported developmental projects irrespective of their ideology.[10] Hence, AKP municipalities should not necessarily be different from others due to this historical continuity of pro-developmental logic. Moreover, the environmentalist discourse in Turkey is mostly dominated by planting trees, and environmentalism is restricted to protecting trees.[11] Therefore, within this narrow environmentalism, AKP governments could be "pro-environment" as well.

The literature has also shown another historical continuity that should make AKP municipalities similar to others concerning the preservation of green spaces. Political patronage has always been a historical problem for Turkey,[12] and therefore, all political parties are equally likely to cater to private interests at the expense of the environment. Although such private interests could harm the environment in general, the historical continuity of political patronage suggests that we should not observe differences between AKP and non-AKP municipalities in terms of their damages to green spaces.

[5] Gökhan Orhan, "Yerel Yönetimler ve Kuresel İklim Değişikliği," in *Kuramdan Uygulamaya Yerel Yönetimler ve Kentsel Politikalar*, First Edition, ed. Yakup Bulut et al. (Pegem Akademi, 2013).

[6] Cemal Öztaş and Eyüp Zengin, "Yerel Yönetimler ve Çevre," *Journal of Social Policy Conferences*, 2011, 181–200, ISSN: 1304-0103.

[7] Düriye Toprak, "Türkiye'nin çevre politikasında yerel yönetimlerin rolü: yerel yönetim bütçesinin incelenmesi," *Maliye Araştırmaları Dergisi* 3, no. 2 (2017): 187.

[8] The tree loss data is provided at 30-meter resolution.

[9] Murat Arsel, "Reflexive developmentalism? Toward an environmental critique of modernization," in *Environmentalism in Turkey*, ed. Fikret Adaman and Murat Arsel (Routledge, 2016), 29–48.

[10] Hande Paker et al., "Environmental organisations in Turkey: Engaging the state and capital," *Environmental Politics* 22, no. 5 (2013): 760–778; Ethemcan Turhan et al., "Beyond special circumstances: climate change policy in Turkey 1992–2015," *Wiley Interdisciplinary Reviews: Climate Change* 7, no. 3 (2016): 448–460.

[11] Begüm Özkaynak et al., "The Gezi Park resistance from an environmental justice and social metabolism perspective," *Capitalism Nature Socialism* 26, no. 1 (2015): 99–114.

[12] Metin Heper and E Fuat Keyman, "Double-faced state: political patronage and the consolidation of democracy in Turkey," *Middle Eastern Studies* 34, no. 4 (1998): 259–277.

That being said, however, Turkey slowly turned into a competitive authoritarian regime[13] over the last decade, which is characterized by competitive (though unfair) elections with an unconstrained executive. Raising political rents in the absence of strong checks and balances is easier,[14] suggesting that AKP municipalities could get more leeway for political patronage as Erdoğan became more authoritarian. Indeed, the evidence shows that private interests are more easily satisfied over the last decade.[15] Therefore, with democratic backsliding, AKP municipalities may find more space than others to cater to private interests, which could have adverse implications for the environment.

This paper makes several contributions. It provides the first empirical evidence on the effects of local politics on tree cover loss in Turkey. Therefore, it is linked with scholarly works that analyze the impact of local governments on green spaces.[16] Second, it gives credence to the argument that local governments in Turkey are important actors despite their limited role in the design of environmental policies.[17] Lastly, by showing an empirical association between AKP rule and tree loss, this paper argues that even with the narrow definition of environmentalism (preservation of green spaces), AKP municipalities perform worse than others.

2 Politics and tree loss

Many factors can affect tree loss, ranging from human factors, such as population pressures and economic activities, to climatic factors like precipitation and temperature. The direction of these factors is mostly clear. For instance, we know that population pressures and economic activities increase deforestation.[18]

[13]Steven Levitsky and Lucan A Way, *Competitive Authoritarianism: Hybrid Regimes after the Cold War* (Cambridge University Press, 2010); Berk Esen and Sebnem Gumuscu, "Rising competitive authoritarianism in Turkey," *Third World Quarterly* 37, no. 9 (2016): 1581–1606.

[14]Torsten Persson, Gerard Roland, and Guido Tabellini, "Separation of Powers and Political Accountability," *The Quarterly Journal of Economics* 112, no. 4 (1997): 1163–1202; Daron Acemoglu, James A Robinson, and Ragnar Torvik, "Why do Voters Dismantle Checks and Balances?," *Review of Economic Studies* 80, no. 3 (2013): 845–875; Serkant Adiguzel, "Institutional Gridlock and Democratic Backsliding: explaining popular support for aspiring autocrats," *Working Paper, Duke University*, 2020,

[15]Esra Gürakar and Erik Meyersson, "State discretion, political connections and public procurement: Evidence from Turkey," *Unpublished manuscript. Retrieved from https://erikmeyersson. com/research*, 2016, Esra Çeviker Gürakar, *Politics of favoritism in public procurement in Turkey: Reconfigurations of dependency networks in the AKP era* (Springer, 2016).

[16]Jesse C Ribot, Arun Agrawal, and Anne M Larson, "Recentralizing while decentralizing: how national governments reappropriate forest resources," *World development* 34, no. 11 (2006): 1864–1886; Maria Carmen Lemos and Arun Agrawal, "Environmental governance," *Annual review of environment and resources* 31 (2006); Marco Elıas Cisneros Tersitsch, Krisztina Kis-Katos, and Nunung Nuryartono, *Palm oil and the politics of deforestation in Indonesia*, technical report (Ruhr Economic Papers, 2020).

[17]Orhan, "Yerel Yönetimler ve Kuresel İklim Değişikliği."

[18]Helmut J Geist and Eric F Lambin, "Proximate Causes and Underlying Driving Forces of Tropical Deforestation-Tropical forests are disappearing as the result of many pressures, both local and regional, acting in various combinations

Politics is also one of the primary factors affecting tree loss; however, how it affects the environment is less clear cut, unlike others.

Although politics is recognized as an essential contributor to tree loss, disagreement exists in how it affects. For instance, many argued that democracy makes political leaders more responsive to the popular demands for environmental protection.[19] Since democracy forces the leaders to heed the needs of the masses,[20] it is theoretically plausible that tree loss should be more severe in authoritarian countries. Parallel to this logic, local and global environmental organizations started focusing on decentralization and community-based forest management as a good institutional reform that can prevent tree loss.[21] By "democratizing" the environmental governance, decentralization aims to include locals, who are most likely to be affected by the destruction of green spaces, to decision-making processes.

However, others point out that democracy is not always the panacea for the environment. On the contrary, patronage politics could bring about further tree loss, especially in settings with competitive elections since forests can be used as resources for political purposes to satisfy the private interests in exchange for votes.[22] Re-election incentives make politicians more willing to sacrifice trees for votes,[23] creating "political logging cycles".[24] Therefore, the relationship between democracy and the environment is not clear in the literature.[25]

In addition to democracy's ambiguous role in the environment, decentralization and community-based forest management, which are seen as "democratizing" the environmental governance, may not be as effective as theorized primarily because of politics. States use a variety of strategies to obfuscate reform attempts for decentralization, making such institutional changes ineffective.[26]

What is the implication of these conflicting results on Turkey? With Turkey becoming more authoritarian, one could argue that the government faces fewer electoral pressures and, therefore, they will

in different geographical locations," *BioScience* 52, no. 2 (2002): 143–150; HB Günşen and E Atmiş, "Analysis of forest change and deforestation in Turkey," *International Forestry Review* 21, no. 2 (2019): 182–194.

[19]Scott Barrett and Kathryn Graddy, "Freedom, growth, and the environment," *Environment and development economics*, 2000, 433–456; Y Hossein Farzin and Craig A Bond, "Democracy and environmental quality," *Journal of Development Economics* 81, no. 1 (2006): 213–235.

[20]John Stuart Mill, *Considerations on Representative Government*, `https://www.gutenberg.org/files/5669/5669-h/5669-h.htm#link2HCH0003`, [Online; accessed 1-April-2019], 2004 [1861].

[21]Jacqueline M Klopp, "Deforestation and democratization: patronage, politics and forests in Kenya," *Journal of Eastern African Studies* 6, no. 2 (2012): 352.

[22]Ibid.

[23]Sharon Pailler, "Re-election incentives and deforestation cycles in the Brazilian Amazon," *Journal of Environmental Economics and Management* 88 (2018): 345–365; Cisneros Tersitsch, Kis-Katos, and Nuryartono, *Palm oil and the politics of deforestation in Indonesia*.

[24]Robin Burgess et al., "The political economy of deforestation in the tropics," *The Quarterly Journal of Economics* 127, no. 4 (2012): 1707–1754.

[25]Meilanie Buitenzorgy and Arthur PJ Mol, "Does democracy lead to a better environment? Deforestation and the democratic transition peak," *Environmental and Resource Economics* 48, no. 1 (2011): 59–70.

[26]Ribot, Agrawal, and Larson, "Recentralizing while decentralizing: how national governments reappropriate forest resources."

be less likely to sacrifice the environment in return for votes. However, this argument is unconfounded for two reasons. Firstly, Turkey's regime is best characterized as "competitive authoritarian".[27] In these regimes, elections are still competitive despite being unfair.[28] Hence, re-election pressures do not fade away in competitive authoritarian regimes. Secondly, the absence of checks and balances brings about greater flexibility for AKP local governments to cater to private interests at the expense of the environment. It is easier for a municipality to illegally transfer a green space to a politically-connected businessperson when no judicial oversight exists. Moreover, with the politically captured media, the public is also unable to check such rent-seeking behavior effectively. Therefore, one could expect more tree loss in AKP municipalities than others due to their greater flexibility in rent-seeking.

But, what are the specific actions municipalities can take that cause tree losses? Although municipalities are not the primary actors in the design of environmental policies, they are important actors when it comes to the execution of these policies.[29] Moreover, municipalities play direct roles in preserving green spaces in the urban areas since they are responsible for taking care of green spaces within their jurisdiction. Both the municipal law (*5993 Sayılı Belediye Kanunu*) and the metropolitan municipal law (*5216 sayılı Büyükşehir Belediye Kanunu*) make clear that municipalities are responsible for green spaces.[30]

Moreover, municipalities can directly affect tree cover within their boundaries due to their authority in city development plans. They can modify existing plans and create rents that can come at the expense of the environment. These changes in development plans can be taken to the courts, which can be an effective check against the possible damages to the public interest. However, when the judiciary loses its independence, it is harder to exercise judicial review, making such checks ineffective.

In short, municipalities are critical actors that can affect the fate of green spaces within their jurisdictions. Since AKP municipalities have more leeway to cater to private interests as Turkey becomes more authoritarian, we should see that districts with AKP municipalities are more likely to have tree loss than non-AKP municipalities.

3 Tree loss in Turkey

Turkey witnessed severe deforestation over the last decades. Between the years 2001 and 2019, Turkey suffered a 5 percent decrease in tree cover.[31] However, no study, to my knowledge, investigated the role of politics in such decline. Günşen and Atmiş analyze the determinants of forest change at the

[27] Levitsky and Way, *Competitive Authoritarianism: Hybrid Regimes after the Cold War*.

[28] The government suffered a massive blow by losing Istanbul and Ankara in March 2019 local elections. This shows the competitive characteristics of the elections despite their unfairness.

[29] Orhan, "Yerel Yönetimler ve Kuresel İklim Değişikliği."

[30] Toprak, "Türkiye'nin çevre politikasında yerel yönetimlerin rolü: yerel yönetim bütçesinin incelenmesi."

[31] See `https://www.globalforestwatch.org/dashboards/country/TUR`

province level and find that urbanization and industrialization are essential factors that explain forest loss.[32] However, they do not consider politics as a relevant variable in their analyses. Moreover, their unit of analysis is the province (*il*), while this paper conducts the analyses at the district level (*ilçe*), which is more granular. Moreover, they use data from the General Directorate of Forestry, which might be subject to government biases and does not cover green areas in urban settings since it is a dataset on forests. Instead, this paper uses granular satellite data (30-meter resolution) and is not subject to government bias. Moreover, it covers all green areas in the country, including green spaces in urban settings.

Some studies also used satellite data to analyze changes in tree and land cover in Turkey. However, these studies are extremely local in nature and either focus on a specific forest[33] or a specific province.[34] They track only one unit over time and ignore politics as a relevant factor. Instead, this paper combines different districts over time and creates a panel dataset of tree loss to analyze the relationship between tree loss and politics.

4 Empirical Strategy

I rely on high-resolution spatial data to test the relationship between AKP municipalities and tree loss. The dependent variable, *tree loss*, comes from Hansen et al.[35] They use Landsat data to compile high-resolution global maps of tree cover change. The satellites use remote sensing technology to collect high-resolution reflectance characteristics of the ground. Each pixel reflects lights in a different way. For instance, water reflects lights differently than forests. Based on these reflectance characteristics, each pixel is classified.[36] The resulting dataset is better than the official government statistics, if it exists at all, for two reasons. Firstly, government statistics are not fine-grained most of the time and lack the level of granularity provided by the satellite data. They are aggregated at the levels of administrative units–such as provinces–causing a significant amount of information loss since differences within administrative units are masked as a result of such aggregation. Secondly, satellite data offers unified, unbiased global data,

[32] Günşen and Atmiş, "Analysis of forest change and deforestation in Turkey."

[33] Günay Çakir, Fatih Sivrikaya, and Sedat Keleş, "Forest cover change and fragmentation using Landsat data in Maçka State Forest Enterprise in Turkey," *Environmental Monitoring and Assessment* 137, nos. 1-3 (2008): 51–66; F Sivrikaya et al., "Evaluating land use/land cover changes and fragmentation in the Camili forest planning unit of northeastern Turkey from 1972 to 2005," *Land Degradation & Development* 18, no. 4 (2007): 383–396; Sedat Keleş, Fatih Sivrikaya, and Günay Çakir, "Temporal changes in forest landscape patterns in Artvin forest planning unit, Turkey," *Environmental monitoring and assessment* 129, nos. 1-3 (2007): 483–490.

[34] Mustafa Güler, Tahsin Yomralıoğlu, and Selcuk Reis, "Using landsat data to determine land use/land cover changes in Samsun, Turkey," *Environmental monitoring and assessment* 127, nos. 1-3 (2007): 155–167.

[35] Matthew C Hansen et al., "High-resolution global maps of 21st-century forest cover change," *Science* 342, no. 6160 (2013): 850–853.

[36] Louis R Iverson, Robin Lambert Graham, and Elizabeth A Cook, "Applications of satellite remote sensing to forested ecosystems," *Landscape ecology* 3, no. 2 (1989): 131–143.

while government data can be distorted. Sometimes it can be impossible to compare government data when the data collection processes differ across administrative units.

Since the tree loss data is high resolution (around 30 meters), I aggregated them at the district (*ilçe*) level. In particular, I calculated the percentage of tree loss of the total net land.[37] That is, for each district and year, I first counted the number of pixels–each is around 625 m^2–that witnessed tree loss.[38] Then I divided this by the total number of pixels (the total net land) and multiply by 100 to get the percentage of tree loss per year for each district. I use this variable, *Total % Tree Loss*, as my main dependent variable in the analysis.

Although our unit of analysis is a municipality, I used the districts as the units because, to my knowledge, no map of municipalities, from which we can understand the boundaries, exists. On the other hand, we know district boundaries, and we can simply calculate tree loss within these defined boundaries. Using districts complicates the analysis because municipalities exist within districts. This is a problem when municipalities within the same district have mayors from different political parties. To overcome this problem, I used a weighted ratio variable to measure the AKP local rule's intensity. In particular, I divided the number of voters that live under AKP municipalities by the total number of voters within each district. This weighted ratio variable takes into account differences in municipality sizes. For instance, in a district with two municipalities, if AKP mayor is running a municipality twice as large than the non-AKP municipality, the AKP local rule variable will be $\frac{2}{3}$ in this weighted specification, as opposed to $\frac{1}{2}$. Although I use this weighted AKP local rule variable as my main independent variable in the analyses below, I also show that the results are robust to different specifications. Also, note that each district has exactly one municipality in provinces with metropolitan status after the change in the metropolitan municipal law in 2014.

Politics, of course, is not the only factor that can explain the differences we see in tree loss across districts. The most important factor is probably the climate. Some parts of the country, such as Central Anatolia, have less dense green areas than the rest. To control for the climatic factors, I use three different variables. Firstly, all the model specifications below include province dummies (province fixed effect). This makes sure that we are only comparing provinces within themselves, and we are not comparing across provinces. Hence, fixed-effect models make sure that we are not comparing Artvin with Yozgat. Province fixed effect also absorbs any uncontrolled time-invariant heterogeneity across provinces that could explain tree loss differences. Secondly, I use high-resolution temperature and precipitation data, which is available from 1960 at a monthly level for the whole world with around 20 km spatial resolution.[39] Using these

[37] It is "net" since I excluded permanent water bodies such as rivers, lakes, reservoirs from the calculations.

[38] Although the resolution is 30 meters, this is the value you would get at the Equator. It gets smaller as one moves towards the poles, and the resolution is around 25 meters in Turkey.

[39] Stephen E Fick and Robert J Hijmans, "WorldClim 2: new 1-km spatial resolution climate surfaces for global land areas," *International Journal of Climatology* 37, no. 12 (2017): 4302–4315.

monthly data, I constructed the average temperature range (maximum-minimum temperature in Celcius) and average precipitation (in mm) for every district.

Apart from the climatic factors, human activities themselves also profoundly impact tree loss. Population growth and economic activities are essential factors that can damage the tree cover. Moreover, certain industrial activities, such as mining, are more detrimental to the environment than others. To control for these human activities, I constructed four different variables. Using data from the Turkish Statistical Institute, I created the average population growth variable for each district. To proxy for general economic activities, I use nightlight data since we do not have a local gross domestic product (GDP) measures at the district level. The literature has shown that nightlights are a good proxy for economic activities, and many empirical studies employed nightlight data to proxy for economic growth in cases where official statistics do not exist or are not reliable.[40] To control for specific economic sectors known to be particularly detrimental for forests, mining and tourism, I employed two different variables. For the mining sector, I used data from the Turkish Statistical Institute's Workplace survey, which was last conducted in 2002 and created the "mining share" variable, defined as the ratio of the number of workplaces in the mining sector over the total number of workplaces in a given district. Although this data is not up-to-date, it gives us a good baseline to account for differences across mining practices. Moreover, since economic activities cluster in geographic spaces[41] places with higher mining activities will probably continue to do so across years. For the tourism sector, I used a dummy variable that takes the value one if the district is on the Mediterranean or Aegean shores. To the extent that tourism affects tree loss adversely, we should see that these coastal districts lose more trees than the rest of the country.

Lastly, I control for fires using high-resolution firing data from NASA.[42] It records every fire captured by the satellites and I counted the total number of fires within each district across years.

5 Descriptive Analysis

Since local elections took place in 2004, 2009, and 2014, I present results aggregated in three periods: 2004-2008, 2009-2013, and 2014-2018. The map in Figure 1 shows tree loss within these three periods in İstanbul and its surroundings. The devastating effect of the new airport can easily be noticed.

FIGURE 1 ABOUT HERE

Figure 1: İstanbul tree loss map

[40] J Vernon Henderson, Adam Storeygard, and David N Weil, "Measuring economic growth from outer space," *American economic review* 102, no. 2 (2012): 994–1028; Yingyao Hu and Jiaxiong Yao, *Illuminating economic growth* (International Monetary Fund, 2019); Ayşegül Düşündere Taşöz, "1992-2018 Dönemi için Gece Işıklarıyla İl Bazında GSYH Tahmini: 2018'de 81 İlin Büyüme Performansı," *Türkiye Ekonomi Politikaları Araştırma Vakfı*, 2019,

[41] Paul R Krugman, *Geography and trade* (MIT press, 1991).

[42] The data is available here: `https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms/active-fire-data`

The worst-performing districts concerning tree-losses are shown in Table 1. The highest loss, 8.55 percent of its total net land, took place in Istanbul-Arnavutkoy, due to the environmentally devastating effects of the new airport. Istanbul's Eyup and Cekmekoy districts are also among the worst performers. Kirklareli-Vize also made the list, a district well known for its Istranca Forests.[43]

We can also see the overall trends in Istanbul districts in Figure 2. In addition to Arnavutkoy, Eyup, and Cekmekoy, many other districts also witness a significant amount of tree losses (more than 2.5 percent of their total net land).[44]

TABLE 1 ABOUT HERE

Table 1: Districts with the highest tree loss rates

FIGURE 2 ABOUT HERE

Figure 1: Total Tree Loss in Istanbul Districts (more than 2.5% loss highlighted)

Lastly, we can see the total tree loss between 2004 and 2018 for each district in Figure 3 below.[45]

FIGURE 3 ABOUT HERE

Figure 3: Total Tree Loss Map of Turkey

6 Results

I constructed a panel dataset for each district for three election periods: 2004-2008, 2009-2013, and 2014-2018. For each period, I calculated the total tree loss for each district. Then, I estimated the following linear model:

$$TreeLoss_{it} = \gamma AKP_{it} + \mathbf{X}\beta + \alpha_j + \theta_t + \epsilon_{it}$$

where $TreeLoss_{it}$ is the percentage of tree loss for district i within the period t, $t \in \{2004-2008, 2009-2013, 2014-2018\}$. AKP_{it} is the share of AKP-controlled municipalities (weighted by voters) in a given district i in period t. $\mathbf{X}$ is a set of controls as summarized in the Empirical Strategy section above. α_j is the set of province dummies (province fixed effect), and θ_t is the set of period dummies (time fixed effect). Note that although I use province fixed effects in all specifications, I only use time fixed effects in some specifications to show that the results are robust to alternative specifications. Two-way fixed effects models are difficult to interpret because the model's estimates are a combination

[43] Local environmental protests from this district have also made into the news. See, for instance, `https://www.hurriyet.com.tr/yerel-haberler/kirklareli/vize/koyluler-istranca-ormanlarina-kil-ocagi-ced-t-40968583`

[44] See Appendix for similar plots for Ankara and Izmir (Figure 4 and Figure 5).

[45] Categories are the deciles of the total tree loss distribution.

of variation in the over-time and cross-sectional effects.[46] That is why our preferred model only uses province level fixed effect. The standard errors are clustered at the district level for all specifications.

The main results are presented in Table 2. In the first two models, I only use the province and time fixed effects. I add the important covariates in the next four models. The results show that the coefficients for AKP are reasonably stable and robust to different model specifications. In the last two models, I also control for baseline green areas since regions with already poor in terms of green spaces will have fewer trees to lose in the first place.

The results show that AKP local rule increases tree loss by around 0.05 percent. Although this coefficient seems small in magnitude, note that this is the share of net land in the whole district, including both settled and unsettled areas. Because the overall tree loss between 2001 and 2019 was 5 percent in Turkey and our results do not consider the effect of the central government, we can say that such loss is substantial. For an average-sized district, this loss is equal to around 44 hectares or an area of 62 football pitches combined. Or, equivalently, this average loss is around 2.5 percent of İstanbul's Beşiktaş district.

Moreover, these results do not consider the effect of central government on the environment, which is plausibly more devastating. Since the actions of the central government can affect tree cover in non-AKP municipalities as well, these results are underestimating the AKP's real effect on the tree cover by making AKP and non-AKP municipalities look similar in terms of tree cover.

When we look at the other variables, we see that their effects are mostly in the expected direction. In our preferred model, which is Model 5, we see that districts with higher mining firms in 2002 are more likely to witness tree loss, and its effect on tree loss is substantial. In the sample, many districts, such as Çanakkale-Bozcaada, Adana-Feke, and Bolu-Gerede, have zero shares of mining enterprises in 2002 while the maximum mining share is in Kastamonu-Küre (7.2 percent). Holding everything else constant, going from minimum (0) to maximum value (0.072) of mining share increases tree loss by around 0.33 percent (0.072×4.61), which is a sizeable effect.

Another variable that captures human activities is nightlight difference, which is a good proxy for economic activities within a district. Since the nightlight data series changed after 2013[47], I standardized the nightlight values for each period to make them comparable across different periods. Then, I calculated their difference, and I used this differenced variable in the regressions to proxy for economic growth. The results in Model 5 show that 1 unit (which is going from no light to maximum level light since the values are standardized) difference in nightlight brings about a 0.3 percent increase in tree loss.

[46] Jonathan Kropko and Robert Kubinec, "Interpretation and identification of within-unit and cross-sectional variation in panel data models," *PLoS One* 15, no. 4 (2020): e0231349.

[47] National Centers for Environmental Information (NOAA) produced DMSP-OLS Nighttime Lights Time Series for the period between 1992-2013. After 2013, higher-quality data (VIRRS) is available supplied by NASA and NOAA's Suomi National Polar Partnership (SNPP) satellite.

Among the climatic factors, we see that temperature range is positively correlated with tree loss, suggesting that places that witness higher variability in temperature witnessed more tree losses. Average Precipitation, on the other hand, is not correlated with tree loss once baseline green share is controlled for (as in Model 5 and 6).

Lastly, and unsurprisingly, we see that the total number of fires is positively correlated with tree loss. The average number of fires per period is around 60 per district, while Mardin-Kızıltepe has the highest number with 4456 fires recorded for the period 2014-2019, which is a clear outlier. Due to the right-skewed distribution of the number of fires, I use logged total number of fires as our variable. The results in Table 2 show that, holding everything else constant, going from no fire to the maximum number of total fires suggest an increase in tree loss by around 0.18 percent.

TABLE 2 ABOUT HERE

Table 2: The relationship between tree loss and local AKP rule

In Table 3, I show that our main result is robust when we remove outliers (the first two models). In addition to eliminating outliers, I also removed the biggest three provinces from the sample since the tree loss dynamics in İstanbul, Ankara, and İzmir might be systematically different from the rest of the country. Reassuringly, the results hold although the coefficients for AKP are slightly smaller in these cases.

TABLE 3 ABOUT HERE

Table 3: The relationship between tree loss and local AKP rule: Additional Results

In the Appendix, I also show that the results are robust when we remove outliers and the biggest ten provinces or when we remove outliers and the central districts from the sample (Table 4). Moreover, the results are substantively similar when we measure AKP rule differently. Instead of using the (weighted) ratio of municipalities held by AKP, in Table 5, I used a binary variable that takes the value one if more than half of the voters live under AKP municipalities within a given district. We see that the substantive results hold.

7 Conclusion

This paper provided the first systemic empirical analysis of the relationship between local governments and tree loss in Turkey. The results show that tree loss in districts with AKP-municipalities is higher than non-AKP municipalities. These results are robust to including a different set of controls and model specifications. By providing an empirical analysis, this paper aims to contribute to the debates on AKP's impact on the environment in general.

Although the results show that AKP municipalities are more likely to witness tree loss, it does not show *why* this is the case. One plausible mechanism is rent-seeking: AKP municipalities are more flexible in terms of catering to private interests at the expense of the environment when judicial oversight does not work, and when the media is politically captured.

It could also be that AKP might be more willing to sacrifice the environment in exchange for economic development. Pro-developmental logic, which is willing to sacrifice the environment in exchange for economic growth, is persistent in Turkey's political movements. However, it could be that for some parties, such as AKP, the tradeoff is more biased towards economic growth, making them willing to sacrifice "more" of the environment in return for "less" economic growth. The empirical analysis presented in this paper is unable to disentangle these different mechanisms, and future studies should focus more on identifying distinct mechanisms that affect tree loss.

Since this paper only focused on the local governments, it does not take into account of the central government's effect on tree cover. Therefore, these results probably underestimate the true relationship between the AKP rule and tree cover in Turkey.

Lastly, it should be kept in mind that these results should not be interpreted as the "causal" effect of AKP on tree loss since the research design does not allow us a clear causal identification strategy. A better strategy would be to do the analysis at the municipality level instead of district-level since this could enable us to use the regression discontinuity design (RDD) using close elections. However, to the best of my knowledge, municipality-level shapefiles, from which we can identify municipal boundaries, do not exist for Turkey. Therefore, it is impossible to locate the exact tree loss within the boundaries of each municipality. Instead, as the second-best strategy, I used district shapefiles to track changes in tree loss over time for each district. Future studies can employ better identification strategies such as RDD at the municipality level if identifying municipality borders becomes possible.

8 Appendix

TABLE 4 ABOUT HERE

Table 4: The relationship between tree loss and AKP local governance: removing 10 big cities and central districts

TABLE 5 ABOUT HERE

Table 5: The relationship between tree loss and AKP local governance: using binary independent variable

FIGURE 4 ABOUT HERE

Figure 4: Total Tree Loss in Ankara Districts (more than 0.2% loss highlighted)

FIGURE 5 ABOUT HERE

Figure 5: Total Tree Loss in Izmir Districts (more than 2.5% loss highlighted)

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Tables for Politics and Tree Cover Loss: Evidence from High-Resolution Satellite Data

Serkant Adiguzel*

June 29, 2020

Table 1: Districts with the highest tree loss rates

Province	District	Tree Loss (% of Total Land)	No. of Municipalities	No. of AKP Municipalities	Period
Istanbul	Arnavutkoy	8.55	1	1	2014-2018
Hatay	Yayladagi	6.00	4	2	2009-2014
Mugla	Bodrum	5.13	11	1	2004-2009
Kirklareli	Vize	5.06	4	1	2004-2009
Yalova	Armutlu	4.44	1	1	2014-2018
Izmir	Buca	4.35	1	0	2014-2018
Istanbul	Eyup	4.31	1	1	2014-2018
Istanbul	Cekmekoy	4.19	1	1	2014-2018
Tekirdag	Cerkezkoy	4.11	5	2	2004-2009
Izmir	Seferihisar	3.87	1	0	2009-2014

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Table 2: The relationship between tree loss and local AKP rule

	Dependent variable: Total % Tree Loss					
	(1)	(2)	(3)	(4)	(5)	(6)
AKP	0.065***	0.055**	0.057***	0.050**	0.054***	0.048**
	(0.024)	(0.024)	(0.022)	(0.022)	(0.019)	(0.019)
Ave. % Pop Growth			0.002	0.002	0.002	0.001
			(0.001)	(0.001)	(0.001)	(0.001)
Mining Share (2002)			5.427***	5.383***	4.613**	4.550**
			(1.951)	(1.940)	(2.281)	(2.246)
Average Temp. Range (in C)			−0.023	−0.031	0.047***	0.037**
			(0.018)	(0.019)	(0.017)	(0.018)
Average Precipitation (in mm)			0.005***	0.005**	0.002	0.001
			(0.002)	(0.002)	(0.002)	(0.002)
Total No. of Fires (log)			0.014*	0.015*	0.021***	0.020***
			(0.007)	(0.008)	(0.007)	(0.007)
Nightlight Diff.			0.503***	0.272*	0.363***	0.195
			(0.135)	(0.149)	(0.124)	(0.137)
Coastal District			0.045	0.035	0.116	0.106
			(0.117)	(0.118)	(0.109)	(0.110)
Baseline Green (share)					1.290***	1.301***
					(0.154)	(0.156)
Constant	0.403***	0.368***	0.262	0.381	−0.502*	−0.323
	(0.133)	(0.133)	(0.321)	(0.342)	(0.300)	(0.316)
Province Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Period Dummies	No	Yes	No	Yes	No	Yes
Observations	2,776	2,776	2,742	2,742	2,742	2,742
R^2	0.332	0.340	0.380	0.385	0.442	0.447
Adjusted R^2	0.312	0.320	0.359	0.364	0.423	0.428
Residual Std. Error	0.474 (df = 2694)	0.471 (df = 2692)	0.427 (df = 2653)	0.426 (df = 2651)	0.406 (df = 2652)	0.404 (df = 2650)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 3: The relationship between tree loss and local AKP rule: Additional Results

	Dependent variable: Total % Tree Loss			
	No Outliers		No Outliers & No Big Three City	
AKP	0.036***	0.030**	0.032**	0.025*
	(0.013)	(0.013)	(0.013)	(0.013)
Ave. % Pop Growth	0.001	0.0005	0.0003	0.00005
	(0.001)	(0.001)	(0.001)	(0.001)
Mining Share (2002)	2.899*	2.955*	2.658*	2.728*
	(1.550)	(1.557)	(1.476)	(1.481)
Average Temp. Range	0.034***	0.027**	0.022**	0.014
	(0.011)	(0.011)	(0.011)	(0.011)
Average Precipitation (in mm)	0.002***	0.001	0.002***	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Total No. of Fires (log)	0.012***	0.012**	0.008*	0.007
	(0.005)	(0.005)	(0.005)	(0.005)
Nightlight Diff.	0.221**	0.092	0.459***	0.149
	(0.098)	(0.108)	(0.153)	(0.166)
Coastal District	0.025	0.016	0.088	0.083
	(0.064)	(0.065)	(0.070)	(0.070)
Baseline Green (share)	0.771***	0.782***	0.571***	0.579***
	(0.095)	(0.096)	(0.084)	(0.085)
Constant	−0.243	−0.103	−0.080	0.074
	(0.182)	(0.187)	(0.182)	(0.187)
Province Dummies	Yes	Yes	Yes	Yes
Period Dummies	No	Yes	No	Yes
Observations	2,563	2,563	2,357	2,357
R^2	0.538	0.545	0.527	0.536
Adjusted R^2	0.521	0.528	0.509	0.518

Note: *p<0.1; **p<0.05; ***p<0.01

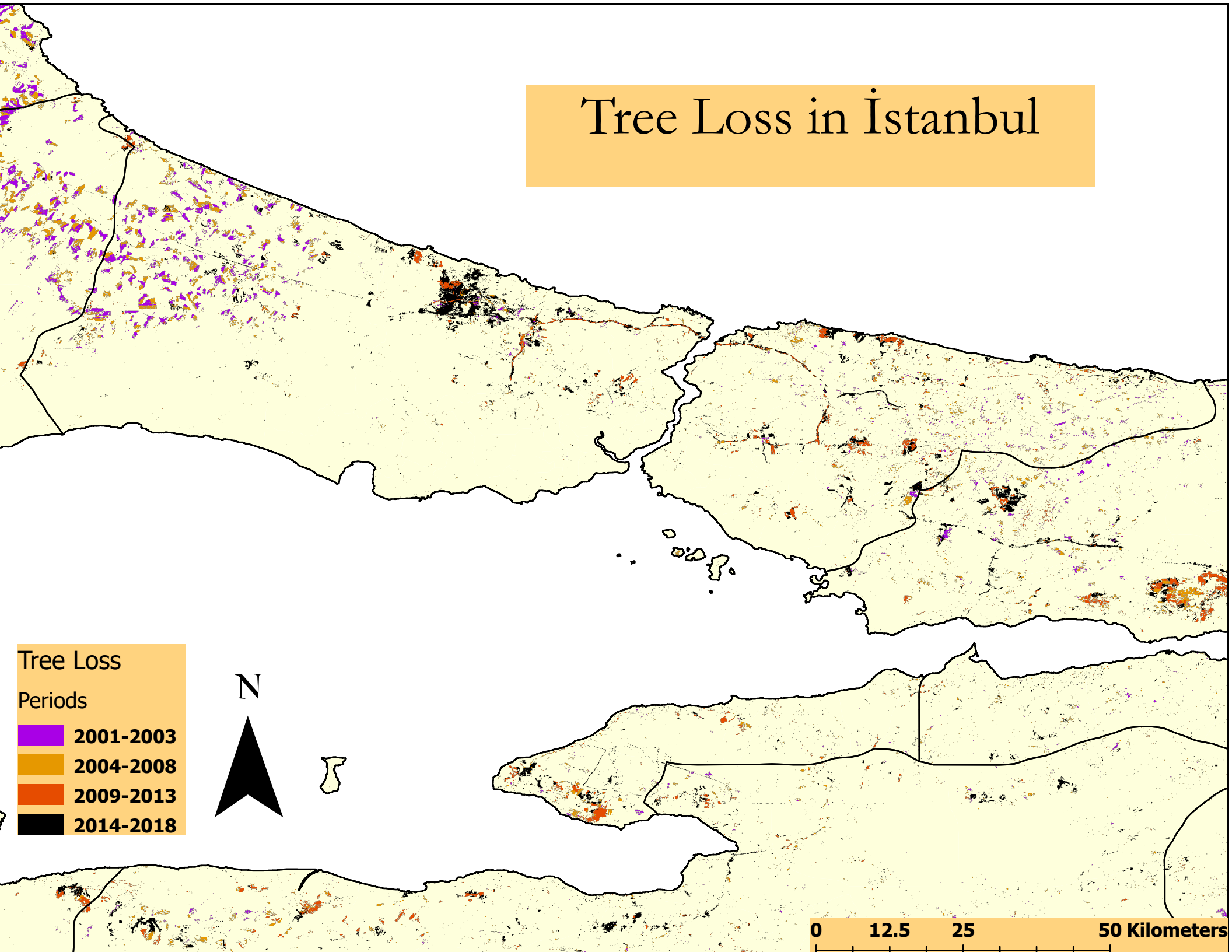
Table 4: The relationship between tree loss and AKP local governance: removing big 10 cities and central districts

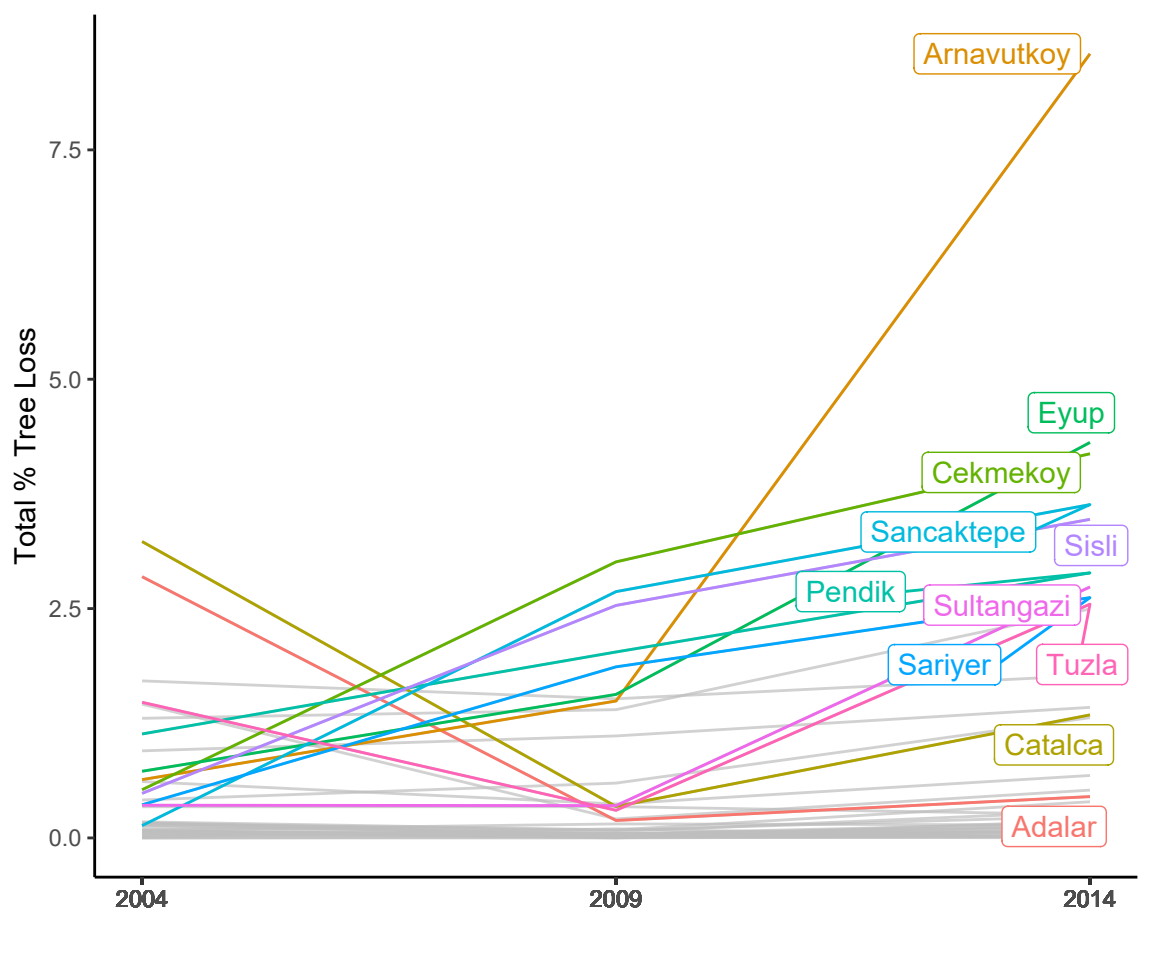
	Dependent variable: Total % Tree Loss			
	No Outliers+ No Big 10 City		No Outliers+No Central District	
AKP	0.039***	0.034**	0.043***	0.037**
	(0.013)	(0.013)	(0.014)	(0.014)
Ave. Pop Growth	0.0003	0.0001	0.001	0.001
	(0.0004)	(0.0004)	(0.001)	(0.001)
Mining Share (2002)	1.820	1.840	2.909*	2.975*
	(1.304)	(1.301)	(1.548)	(1.557)
Average Temp. Range	0.016	0.009	0.039***	0.032***
	(0.012)	(0.013)	(0.011)	(0.011)
Average Precipitation	0.002**	0.0005	0.002**	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Total No. of Fires (log)	0.007	0.006	0.012**	0.012**
	(0.005)	(0.005)	(0.005)	(0.005)
Nightlight Diff.	0.329**	0.028	0.238**	0.117
	(0.160)	(0.170)	(0.102)	(0.111)
Coastal District	0.093	0.085	0.028	0.020
	(0.082)	(0.083)	(0.065)	(0.065)
Baseline Green (share)	0.499***	0.507***	0.787***	0.800***
	(0.083)	(0.083)	(0.095)	(0.097)
Constant	−0.302**	−0.183	−0.296	−0.160
	(0.152)	(0.158)	(0.181)	(0.185)
Province Dummies	Yes	Yes	Yes	Yes
Period Dummies	No	Yes	No	Yes
Observations	2,076	2,076	2,356	2,356
R^2	0.527	0.534	0.533	0.541
Adjusted R^2	0.508	0.515	0.515	0.522
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 5: The relationship between tree loss and AKP local governance: using binary dependent variable

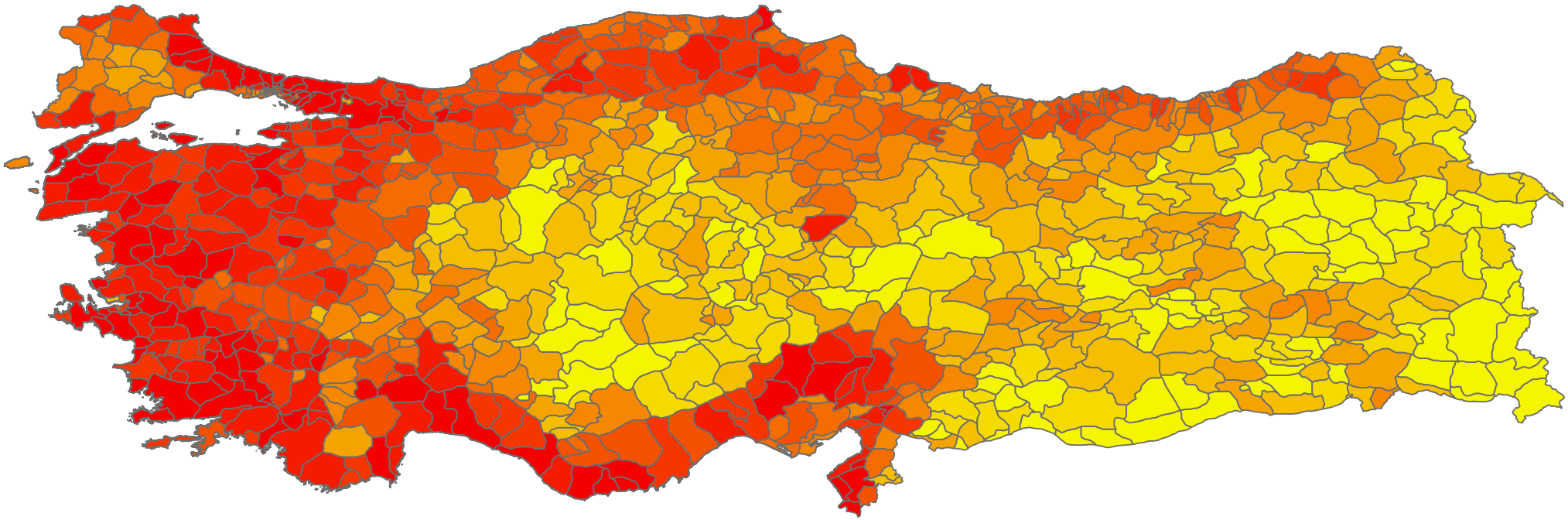
	Dependent variable: Total % Tree Loss				
	Full Data	No Outliers		No Outliers & No Big 3	No Outliers & No Central Dist.
AKP	0.037**	0.029***	0.024**	0.026**	0.033***
	(0.017)	(0.011)	(0.011)	(0.012)	(0.012)
Ave. Pop Growth	0.002	0.001	0.0005	0.0003	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Mining Share (2002)	4.609**	2.907*	2.961*	2.664*	2.911***
	(2.300)	(1.555)	(1.562)	(1.554)	(0.975)
Average Temp. Range	0.047***	0.034***	0.027**	0.023**	0.039***
	(0.017)	(0.011)	(0.011)	(0.011)	(0.008)
Average Precipitation	0.002	0.002***	0.001	0.002**	0.002***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Total No. of Fires (log)	0.020***	0.012***	0.012**	0.008	0.012***
	(0.007)	(0.005)	(0.005)	(0.005)	(0.004)
Nightlight Diff.	0.371***	0.223**	0.094	0.462***	0.242***
	(0.124)	(0.098)	(0.108)	(0.102)	(0.087)
Coastal District	0.114	0.024	0.015	0.088	0.027
	(0.108)	(0.064)	(0.064)	(0.065)	(0.030)
Baseline Green (share)	1.289***	0.770***	0.782***	0.570***	0.786***
	(0.155)	(0.095)	(0.096)	(0.095)	(0.050)
Constant	−0.494*	−0.240	−0.100	−0.077	−0.293**
	(0.299)	(0.182)	(0.187)	(0.180)	(0.126)
Province Dummies	Yes	Yes	Yes	Yes	Yes
Period Dummies	No	No	Yes	No	No
Observations	2,742	2,563	2,563	2,357	2,356
R^2	0.441	0.537	0.544	0.527	0.533
Adjusted R^2	0.422	0.521	0.528	0.509	0.515

Note: *p<0.1; **p<0.05; ***p<0.01


Tree Loss in İstanbul
Tree Loss
Periods
2001-2003
2004-2008
2009-2013
2014-2018
N
0
12.5
25
50 Kilometers


Arnavutkoy
Eyup
Cekmekoy
Sancaktepe
Sisli
Pendik
Sultangazi
Sariyer
Tuzla
Catalca
Adalar
Total % Tree Loss
7.5
5.0
2.5
0.0
2004
2009
2014

Total Tree Loss in Turkey (2004-2018)

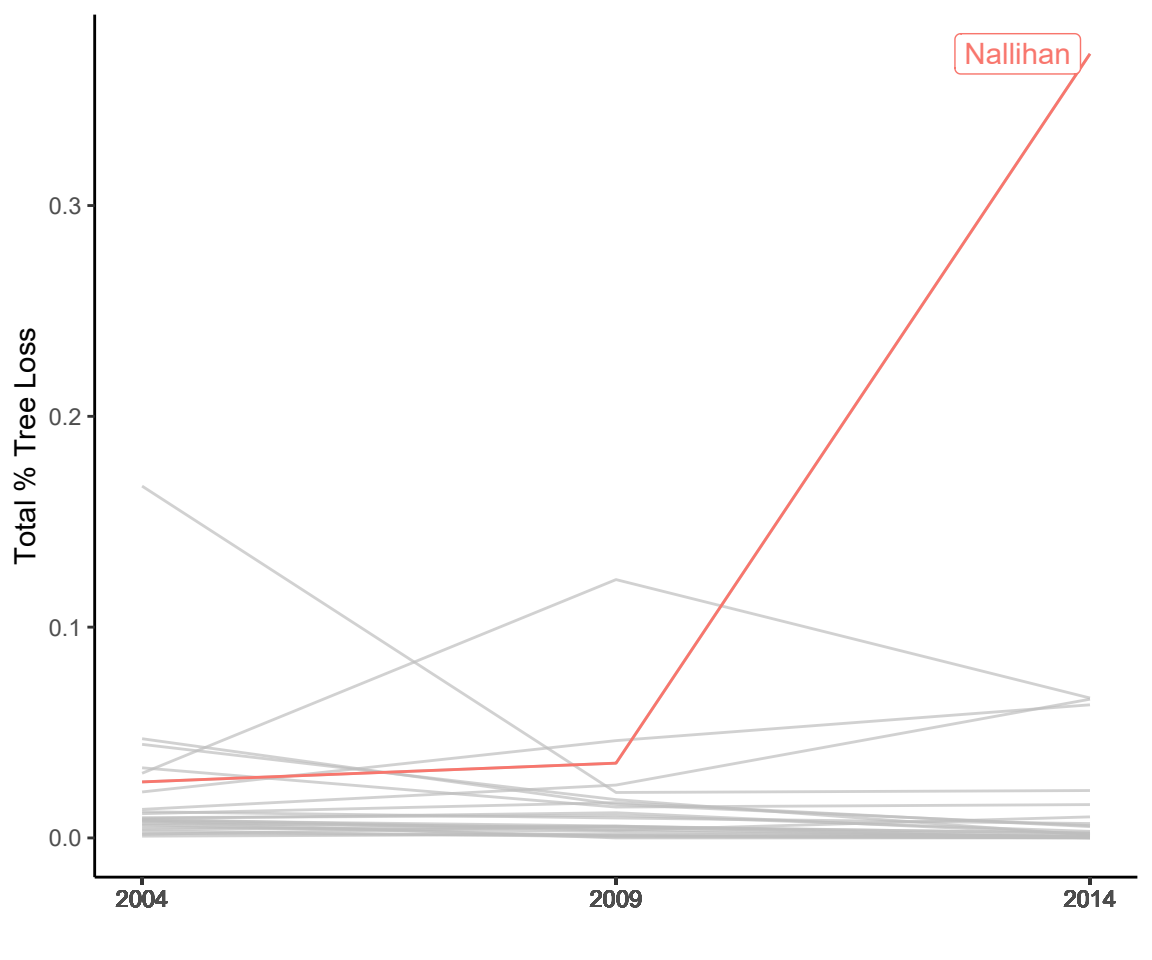


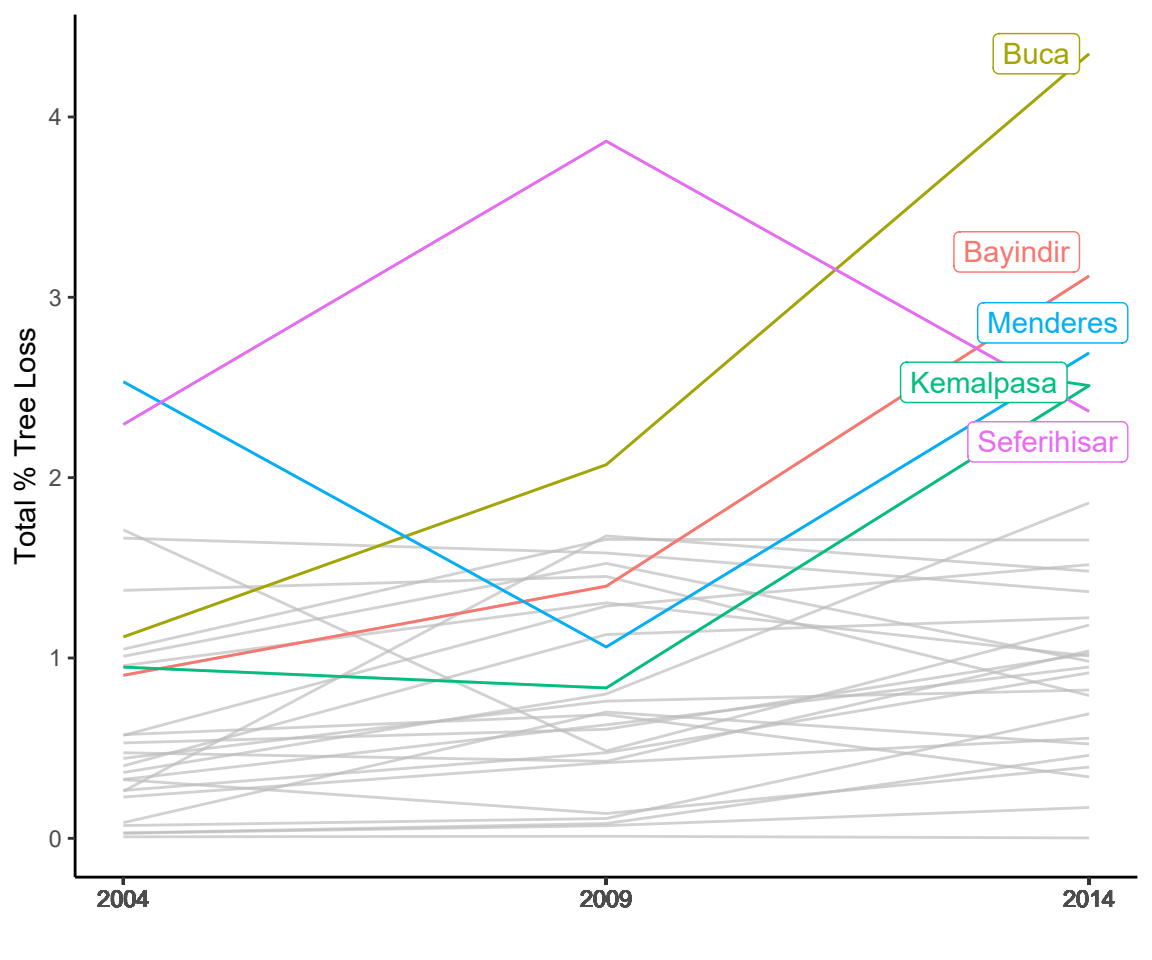
Total Loss (%)

- ≤0.003587
- ≤0.011353
- ≤0.030533
- ≤0.074277
- ≤0.212685
- ≤0.397474
- ≤0.767386
- ≤1.489119
- ≤2.633902
- ≤10.675377

N

0 137.5 275 550 Kilometers


Nallihan
Total % Tree Loss
0.0
0.1
0.2
0.3
2004
2009
2014


Buca
Bayindir
Menderes
Kemalpasa
Seferihisar
Total % Tree Loss
0
1
2
3
4
2004
2009
2014