



# The Impact of Governance Indicators on Environmental Sustainability in Türkiye

## Türkiye’de Yönetişim Göstergelerinin Çevresel Sürdürülebilirliğe Etkisi

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### Abstract

**Aim:** This study aims to analyze the institutional determinants of environmental sustainability in Türkiye. In particular, the effects of governance indicators such as government effectiveness, political stability, regulatory quality, rule of law and anti-corruption on environmental sustainability are investigated. The study makes an original contribution to the literature by discussing the role of governance on environmental outcomes in the context of an emerging economy.

**Method:** In this study, annual data for Türkiye for the period 1996-2023 are used; the stationarity levels of the variables are tested with ADF and PP unit root tests, and then the long-run relationship between the variables is analyzed with the Johansen cointegration test. Model estimation is performed by Fully Modified Ordinary Least Squares (FMOLS) method and the long-run causality between variables is evaluated.

**Results:** The findings reveal that governance indicators have significant effects on environmental sustainability. While indicators such as government effectiveness, regulatory quality and rule of law have a supportive effect on environmental sustainability, weakness in the fight against corruption stands out as a factor that increases environmental degradation. These results show that institutional structures are decisive for the success of environmental policies in Türkiye.

**Conclusion:** The findings of the study reveal that environmental sustainability is directly related not only to economic variables but also to governance structure and institutional capacity. In this context, governance reforms need to be implemented to increase the effectiveness of environmental policies. In developing countries like Türkiye, strengthening institutional structures in environmental policy design processes should be considered as a key priority.

### Keywords

Governance, Environmental Sustainability, FMOLS, Türkiye, Carbon Emission

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Geliş/Received: 30.05.2025  
Kabul/Accepted: 13.04.2026

## Öz

**Amaç:** Bu çalışma, Türkiye’de çevresel sürdürülebilirliği etkileyen kurumsal belirleyicileri analiz etmeyi amaçlamaktadır. Özellikle yönetim göstergeleri olarak hükümet etkinliği, politik istikrar, düzenleyici kalite, hukukun üstünlüğü ve yolsuzlukla mücadele gibi unsurların çevresel sürdürülebilirlik üzerindeki etkileri araştırılmıştır. Çalışma, gelişmekte olan bir ekonomi bağlamında yönetişimin çevresel çıktılar üzerindeki rolünü tartışarak literatüre özgün bir katkı sunmaktadır.

**Yöntem:** Çalışmada, 1996–2023 dönemine ait yıllık Türkiye verileri kullanılmış; değişkenlerin durağanlık düzeyleri ADF ve PP birim kök testleriyle test edilmiş, ardından değişkenler arasındaki uzun dönemli ilişki Johansen eşbütünlük testi ile analiz edilmiştir. Model tahmini Fully Modified Ordinary Least Squares (FMOLS) yöntemiyle gerçekleştirilmiş ve değişkenler arasındaki uzun dönemli nedensellikler değerlendirilmiştir.

**Bulgular:** Elde edilen bulgular, yönetim göstergelerinin çevresel sürdürülebilirlik üzerinde anlamlı etkiler yarattığını ortaya koymaktadır. Hükümet etkinliği, düzenleyici kalite ve hukukun üstünlüğü gibi göstergeler çevresel sürdürülebilirliği destekleyici yönde etkide bulunurken, yolsuzlukla mücadeledeki zayıflık çevresel bozulmayı artırıcı bir unsur olarak öne çıkmaktadır. Bu sonuçlar, Türkiye özelinde kurumsal yapıların çevre politikalarının başarısında belirleyici olduğunu göstermektedir.

**Sonuçlar:** Çalışmanın bulguları, çevresel sürdürülebilirliğin yalnızca ekonomik değişkenlerle değil, yönetimsel yapı ve kurumsal kapasiteyle de doğrudan ilişkili olduğunu ortaya koymaktadır. Bu bağlamda, çevresel politikaların etkinliğini artırmak için yönetim reformlarının hayata geçirilmesi gerekmektedir. Türkiye gibi gelişmekte olan ülkelerde çevre ile ilgili politika tasarım süreçlerinde kurumsal yapıların güçlendirilmesi temel öncelik olarak değerlendirilmelidir.

## Anahtar Kelimeler

Yönetişim, Çevresel Sürdürülebilirlik, FMOLS, Türkiye, Karbon Emisyonu

## Introduction

Climate change is not only an environmental risk to developing countries, like Türkiye, but also a multifaceted phenomenon with direct consequences for economic growth, social welfare, and sustainable development goals. Türkiye’s industrialization pattern, urbanization, and energy consumption-driven growth model has caused an astronomical increase in greenhouse gas emissions, particularly carbon dioxide (CO<sub>2</sub>). In this context, the approach that sustainable development policies must be supported not only by technological and economic capacity but by institutional and governance capacity is taking increasing importance (Williams & Siddique, 2008).

Governance is not only associated with the effective policy-making and implementation of public authorities but also with the capacity of the people to implement their rights. The World Governance Indicators (WGI) formulated by the World Bank try to quantify this framework in six dimensions: government effectiveness, political stability, regulatory quality, rule of law, control of corruption, and voice and participation (Kaufmann, Kraay & Mastruzzi, 2005). These indicators have assumed great significance among the determinants of environmental performance, especially in developing nations. For the economies of emerging markets such as Türkiye, institutional weakness in the governance structures has been discovered to limit the efficiency of environmental policies and have a negative effect on long-term environmental improvement (Thomas, 2010).

Empirical studies in the literature have examined the effects of governance indicators on environmental performance in different facets. Government effectiveness defines the quality of public services and whether environmental policies are practicable, and regulatory quality being high enables market-friendly environmental policies to be imposed (Kaufmann & Kraay, 2008). Control of corruption is considered an important element in preventing violations of environmental policies, and the rule of law enables environmental commitments to be put into practice (Knack, Kugler & Manning, 2003). Measured specifically for Türkiye, these indicators of governance play a decisive role not only in the success of environmental policy but also in the success of international climate commitments.

However, there are also various criticisms regarding the conceptual validity of governance indicators. There are serious arguments that the indicators do not provide sufficient depth on the complex institutional arrangements in developing countries and they are time and context insensitive in their measurement (Arndt, 2009; Thomas, 2010). This necessitates a careful and contextual analysis of the indicators for countries with changing institutions like Türkiye.

This study utilizes CO<sub>2</sub> emissions growth in the case of Türkiye as the dependent variable and attempts to empirically analyze how governance indicators such as government effectiveness, political stability, regulatory quality, rule of law, and control of corruption affect such emissions. The study provides an opportunity to examine the success of Türkiye's environmental sustainability policies based on a governance perspective. It also aims to illustrate to what extent the governance quality and institutional framework are decisive for the successful fulfillment of international commitments under the Paris Climate Agreement.

In this case, the importance of the study lies in trying to explain what role the governance structures have in Türkiye's climate change mitigation efforts. Understanding the impact of institutional quality, economic and technological tools, on environmental performance is of strategic importance in designing more coherent and sustainable environmental policy. Furthermore, this study aims to provide insightful information to Turkish policymakers on green reforms that can be designed based on governance indicators.

## Related Literature

The intersection of governance and sustainable environments has been the subject of growing focus in recent years in development economics literature, public administration, and environmental policy. Although traditional environmental impact studies typically credit CO<sub>2</sub> emissions to economic growth, industrialization, and use of energy, among others, empirical studies in recent years suggest that the quality of governance may also be a controlling factor of environmental states (Kaufmann, Kraay & Mastruzzi, 2005; Williams & Siddique, 2008; Thomas, 2010). Governance actions such as government effectiveness, regulatory quality, rule of law, and anti-corruption efforts provide important mechanisms both towards the feasibility of environmental policies and the development of environmental awareness. In this context, the lack of research addressing the dynamics between governance and CO<sub>2</sub> emissions within the Turkish context renders current research increasingly important.

Evidence on the impact of governance determinants on environmental outcomes highlights the central importance of institutional capacity in emission reductions, particularly in developing countries. In their studies in the Sub-Saharan African countries, Asongu and Odhiambo (2020) found that governance quality mitigates the negative impacts of CO<sub>2</sub> emissions on sustainable human development. This study confirms that governance indicators of the rule of law and anti-corruption dampen the environmental impacts and good governance is essential in achieving sustainable development goals. Likewise, Szetela and others (2022), in their study of resource-based countries, confirmed that utilizing renewable energy reduces CO<sub>2</sub> emissions and that said impact is further dampened by the quality of governance (namely the rule of law and accountability). Sadaoui et al. (2022), for the MENA region, examined the role of natural resources as a mediator in the connection between the governance indicators and CO<sub>2</sub> emissions. The results of the analysis based on the System GMM method established that good governance alone is inefficient in preventing CO<sub>2</sub> emissions, but this is mitigated in countries endowed with natural resources and that the governance begins to deliver positive environmental outcomes.

In a panel data analysis in West Africa, Ifelunini et al. (2023) found that government effectiveness and regulatory quality have statistically significant and negative effects on reducing CO<sub>2</sub> emissions. The evidence suggests the central role of governance in determining environmental performance. Similarly, Mehmood et al. (2023) emphasize that sound governance strategies can limit carbon emissions and smooth the implementation of environment-friendly policies. Findings highlighting the fact that environmental degradation speeds up in countries where government effectiveness is low in combating corruption show that the sustainability of such policies depends upon governance capacity. Similarly, a study conducted by Tang et al. (2024) compared BRICS country BRICS governance

indicators' impact on environmental indicators and concluded that the "government effectiveness" and "corruption control" indicators particularly had a significant impact on declining CO<sub>2</sub> emissions. These findings once again reaffirm that effective governance is the driving force behind the success of green policies in developing nations.

Ronaghi and Scorsone (2023), in their examination of the environmental impacts of the COVID-19 pandemic, indicated that good governance plays an important role in CO<sub>2</sub> emissions. Through their study using the World Bank's governance indicators, they emphasized that policy-based good governance has determinantal effects on managing crises as well as long-term environmental protection. It was noted that the decline in economic activity during the pandemic period generated a temporary decline in CO<sub>2</sub> emissions, but a structural and reform-oriented one needs to be put in place for the decline to be long-lasting. In addition, the same study observes that good practices in governance have positive effects not only on environmental performance but also on social and economic performance. Here, it is explained that the CO<sub>2</sub> emissions cannot be attributed to economic growth but are also closely related to the solidity of institutional arrangements.

Studies in the Asian context also refer to governance. Bakhsh and others (2021) while examining the impact of foreign direct investment on CO<sub>2</sub> emissions in Asian countries found that institutional quality and technological innovation had a significant effect on this relationship. In their study, "they uncovered that institutional indicators such as the rule of law, corruption control, and regulatory quality, all of which are sub-dimensions of the governance quality, have a mitigating effect on the negative relationship between FDI and CO<sub>2</sub> emissions." This confirms that effective institutions and appropriate public policies constitute an essential element of environmental sustainability. In a research in China, Wang and colleagues (2021) examined the long-term causality between governance factors and CO<sub>2</sub> emissions, with particular focus laid on the emission-reducing effects of regulatory quality and rule of law. They established that sound institutional setups enhance the enforceability of environmental regulations and thus have the decisive effect of reducing greenhouse gas emissions. Again in China, Wang and co-authors (2022) depicted that the performance of carbon market applications is determined by factors of governance including regulation quality, ability to oversee, and rule of law. The research points out that market-based green instruments do not require economic rationality but governance trust and administrative capacity to function.

In another study on China's urbanization, Liu et al. (2023) referred to the negative effects of urbanization on environmental sustainability but suggested that such effects can be bounded by strong governance institutions. The study emphasizes that the effectiveness of governance, especially at the local level, is decisive and that local governments achieve more in attaining environmental gains than regulatory intervention by the central government. Here, it is considered that the development of local government capacity is of supreme importance for emission control policies in countries with a centralized structure, such as Türkiye.

Zhang et al. (2023), in their evaluation of how governance, technology, and environmental policy interact, employed artificial neural networks and multiple linear regression models to examine the nexus between governance indicators and CO<sub>2</sub> emissions. In this study, they established that governance supported by strong institutional frameworks can curb carbon emissions by improving the efficiency of investment in renewable energy. This study demonstrates that there exists a complementary relationship between technology and institutional capacity and that both these parameters must be examined together in order for environmental policies to be successful. Similarly, Dash et al. (2024) examined the world's leading 12 carbon-emitting nations and demonstrated the CO<sub>2</sub> emission-reducing effects of green energy consumption and governance quality. The research, which used panel data and decision tree models, found that industrialization, economic growth, and urbanization have emissions-increasing effects; however, governance indicators such as government effectiveness, regulatory quality, and control of corruption have negative and statistically significant effects on emissions. One of the intriguing findings of the research is that green innovation is not statistically significant in reducing emissions. This emphasizes that technical ability alone is insufficient to ensure environmental sustainability, pointing to the significance of institutional structures in policy implementation.

In conclusion, the literature shows that governance quality is a determinative factor shaping the trend and pattern of CO<sub>2</sub> emissions. Empirical evidence from various country cases shows that environmental sustainability is directly connected not only to economic or technological determinants but also to the way institutional quality impacts the formulation and implementation of public policy. In this regard, our study of the relationship between governance indicators and CO<sub>2</sub> emissions in Türkiye fills a central gap in the literature and illustrates the value of integrating environmental policy and institutional capacity.

## Data and Methodology

This study utilizes several governance-related indicators provided by the Worldwide Governance Indicators (WGI) project to examine their impact on CO<sub>2</sub> emissions growth<sup>1</sup>. The dependent variable is the growth rate of CO<sub>2</sub> emissions, while the independent variables represent distinct dimensions of governance performance.

Control of Corruption reflects perceptions of the extent to which public power is exercised for private gain. It captures both petty and grand corruption, as well as state capture by elites and private interests. Government Effectiveness represents the perceived quality of public services, the civil service, policy formulation and implementation, and the credibility of the government’s commitment to policies. Political Stability and Absence of Violence/Terrorism gauges perceptions of the likelihood of political instability or politically motivated violence, including terrorism. Regulatory Quality measures perceptions regarding the government’s ability to formulate and implement sound policies and regulations that support private sector development. Finally, Rule of Law captures perceptions of confidence in the rules of society, including contract enforcement, property rights, police efficiency, and judicial independence<sup>2</sup>.

**Table 1.** Descriptive Statistics

	CO <sub>2</sub>	corruption	government	law	regulatory	stability
Mean	102.9253	49.64318	56.26811	48.39575	58.50452	15.58720
Maximum	196.8952	61.61137	68.26923	57.21154	66.82465	27.66990
Minimum	25.36846	34.90566	41.50943	32.54717	43.39623	4.761905
Std. Dev.	56.97431	8.459560	7.286559	7.461545	6.233937	5.975935

As shown in Table 1, the descriptive statistics provide a preliminary understanding of the central tendencies and dispersion within the data. The average value of CO<sub>2</sub> emissions growth stands at approximately 103, with a considerable standard deviation, indicating significant variability in emissions growth among observations. Among governance indicators, Government Effectiveness has the highest mean score, suggesting relatively better performance in this area across countries, whereas Political Stability shows the lowest mean, indicating that instability and violence remain widespread issues.

<sup>1</sup> CO<sub>2</sub> emissions growth refers to the percentage change in total carbon dioxide (CO<sub>2</sub>) emissions relative to the baseline year of 1990 for Türkiye. The indicator measures the annual change in emissions originating from the agriculture, energy, waste, and industrial sectors, excluding emissions from Land Use, Land-Use Change and Forestry (LULUCF). Emissions are standardized to carbon dioxide equivalent (CO<sub>2</sub>-eq) values using the Global Warming Potential (GWP) coefficients reported in the Intergovernmental Panel on Climate Change Fifth Assessment Report (AR5). Negative values indicate that the emission level in the given year is lower than the emission level recorded in the base year of 1990. The variable corresponds to the dataset identifier EN.GHG.CO2.ZG.AR5.

<sup>2</sup> One of the governance indicators, Voice and Accountability, has been excluded from the analysis to avoid potential multicollinearity issues, as it exhibits a high correlation (above 0.9) with the Rule of Law variable (see Table A1 in the Appendix). Given the relatively small sample size, including highly correlated regressors may distort coefficient estimates and reduce the model’s reliability. The Rule of Law indicator is retained in the analysis because it more directly reflects the enforceability of environmental regulations, a central dimension of the governance–environment nexus examined in this study.

The dispersion levels, as indicated by the standard deviation values, are generally moderate across governance indicators, suggesting that while some countries exhibit strong institutional quality, others still face considerable deficiencies. Notably, Control of Corruption and Rule of Law exhibit relatively higher variability, which may reflect differing institutional conditions and enforcement mechanisms across countries and over time.

The range of values confirms substantial cross-sectional variability. Such variation calls for investigating the long-term consequences of these aspects of governance for the growth of CO<sub>2</sub> emissions, as the differences between nations could have large environmental implications. In general, descriptive statistics summarised in Table 1 are evidence that institutional quality heterogeneity is anticipated to be one of the major determinants of differences in CO<sub>2</sub> emissions growth performance across nations. The data used are for the period 1996-2023 years, and they are drawn from World Bank (2025a, b). Before the estimation of the model was done, unit root tests were used to determine the stationarity levels of the series.

To this end, for this instance, the Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979) and Phillips-Perron (PP) (Phillips & Perron, 1988) tests, which are mostly employed in the literature, were implemented. The two tests established that the majority of the variables under consideration were first-order integrated [I(1)]. This allows for the series to be tested in long-run relations and allows for the environment to apply cointegration tests. Following the unit root tests, Johansen cointegration test was also used to examine long-run equilibrium relationships among the variables (Johansen, 1988; Johansen & Juselius, 1990).

The Johansen method is a robust technique for revealing long-run relationships' structural characteristics, particularly in macroeconomic models, as it can identify more than a single cointegration vector in multi-variable systems. The employment of the method in the paper allows one to test longer-term relationships between the indicators of governance and CO<sub>2</sub> emissions growth more soundly. Measuring the level of integration of the variables with the ADF and PP tests, and subsequently, long-run cointegrating relationships with the Johansen procedure, supports the empirical findings of the research to a higher degree.

The FMOLS estimator, developed by (Phillips & Hansen, 1990), corrects for both serial correlation and endogeneity in cointegrated systems. It modifies the standard OLS estimator by incorporating semi-parametric corrections. The FMOLS model is specified in equation (1).

$$Y_t = \beta_0 + \beta_1 X_{1t} + \dots + \beta_k X_{kt} + e_t \tag{1}$$

where  $Y_t$  is the dependent variable,  $X_{kt}$  are the independent variables, and  $e_t$  is the error term. The FMOLS estimator adjusts the OLS coefficients using long-run covariance matrices to eliminate bias due to endogeneity.

The key feature of FMOLS is the use of a long-run variance-covariance matrix  $\Omega$ , which captures the contemporaneous correlation and serial dependence structure of the regressors and the error term. Elements of this matrix, such as  $\Omega_{21}$  and  $\Omega_{22}$ , are used to correct the OLS estimator.

## Empirical Results

This section presents the findings of econometric analyses examining the long-term effects of governance indicators on CO<sub>2</sub> emissions growth. Before proceeding to the model estimation, the stationarity properties of the variables with time series data structure were tested. Determining whether the variables are stationary at the level or in their differences is a critical prerequisite for the cointegration method to be used. For this purpose, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests, which are widely used in the literature, were applied.

**Table 2.** Unit Root Test Results

	ADF				PP			
	constant		cons+trend		cons		cons+trend	
	stat	p	stat	p	stat	p	stat	p
CO <sub>2</sub>	-0.4184	0.8924	-3.2038	0.1056	-0.1929	0.9282	-2.8215	0.2022
corruption	-0.6959	0.8314	-0.8353	0.9493	-0.7683	0.8121	-0.8353	0.9493
government	-0.4128	0.8934	-0.5692	0.9728	-0.6223	0.8496	-0.5692	0.9728
law	0.1917	0.9669	-1.1632	0.8981	0.1917	0.9669	-1.1121	0.9082
regularity	-1.3653	0.5825	-1.5341	0.7897	-0.187	0.929	-0.9741	0.9313
stability	-1.5315	0.5028	-2.229	0.4558	-1.5315	0.5028	-2.205	0.4681
d(CO <sub>2</sub> )	-5.0515	0.0004	-4.9292	0.0029	-6.4585	0.0000	-6.3073	0.0001
d(corruption)	-4.8146	0.0007	-5.0454	0.0021	-4.8146	0.0007	-5.0476	0.0021
d(government)	-4.6957	0.0009	-5.3864	0.001	-4.6892	0.001	-5.5245	0.0007
d(law)	-4.2885	0.0025	-4.943	0.0027	-4.2885	0.0025	-4.9594	0.0026
d(regularity)	-2.2653	0.1902	-2.1911	0.4737	-4.7366	0.0009	-5.0724	0.002
d(stability)	-5.0233	0.0004	-5.0099	0.0023	-5.0231	0.0004	-5.0101	0.0023

Table 2 reports the test results and shows that the variables are not stationary at the level, i.e., are unit root. The first differences of the variables, however, present both the ADF and PP test results in substantial support of the stationarity hypothesis and show the series to be first-order integrated [I(1)]. The high level of similarity in the results obtained through the ADF and PP tests increases the robustness of the results. Consistently, it was concluded that Johansen cointegration test could be employed to check for the long-run relationship between the variables. Conducting these tests and confirming that the variables are at the appropriate level of integration is a key step towards enhancing the econometric robustness of the research.

**Table 3.** Johansen Cointegration Test

No. of CE(s)	Trace Statistic	Critical Value	Prob.
None *	170.2948	95.75366	0.0000
At most 1 *	104.6654	69.81889	0.0000
At most 2 *	58.77171	47.85613	0.0034
At most 3 *	30.26575	29.79707	0.0441
At most 4	11.81822	15.49471	0.1659
At most 5	0.999543	3.841465	0.3174

The results of the Johansen cointegration test were applied to determine whether there is a long-run equilibrium relationship between the variables<sup>3</sup>. According to the findings presented in Table 3, the trace statistic tests the null hypothesis as “there is no cointegration vector”, “there is at most one cointegration vector”, “there are at most two cointegration vectors” and “there are at most three cointegration vectors”, respectively.

According to the test results, for the first four null hypotheses (None, At most 1, At most 2, At most 3), the trace statistic is higher than the corresponding critical value and the significance level

<sup>3</sup> The reported Johansen cointegration results are based on a two-lag specification without a deterministic trend. Alternative model specifications were also examined. In particular, one-lag and trend-included models were estimated, and all specifications consistently indicated the presence of at least one cointegration relationship among the variables, confirming the robustness of the findings.

is below 5%. This implies that the null hypotheses should be rejected and there are at least four cointegration relationships in the system. However, in the fifth and sixth hypotheses (At most 4, At most 5), the trace statistic is below the critical value and the significance level is above 5%; therefore, it is accepted that there are no additional cointegration vectors after this point.

As a result, at least four significant long-run cointegration relationships are found among the variables in the model. This finding reveals that there is a strong and persistent equilibrium relationship between governance indicators and growth in CO<sub>2</sub> emissions and supports the long-run forecasting power of the model. This result from the Johansen test suggests that the econometric model is based on long-term structural relationships, consistent with both theoretical expectations and previous stationarity analyses.

**Table 4.** FMOLS Results

Variables	Coefficient	Std. Error	Prob.
government	-0.454742	0.111173	0.0006
regularity	-0.914392	0.132544	0.0001
law	-1.840162	0.140121	0.0003
stability	-1.791497	0.092665	0.0013
corruption	2.037563	0.072617	0.0028
constant	136.7629	6.467775	0.0000
trend	4.695321	0.101968	0.0000
R-squared	0.969824		
Adj. R-squared	0.960772		
S.E. of regression	11.08261		

The results of the FMOLS regression are perfectly consistent with the main objective of the study in terms of estimating the impacts of governance indicators on CO<sub>2</sub> growth rate. As per the findings, the government effectiveness, regulatory quality, rule of law, and political stability variables have a significant negative impact on CO<sub>2</sub> growth. This means that environmental management can be handled more effectively in high institutional capacity countries and thus allows the amount of emissions currently and the growth rate of the same to be controlled. More concretely, rule of law and a good regulatory framework ensure not only that environmental policies can be enforced but also continuously are enhanced and become more efficient in the long term. This gives a structural advantage that prevents CO<sub>2</sub> emissions from growing rapidly.

On the other hand, the positive and statistically significant effect of the control of corruption variable on CO<sub>2</sub> growth appears counterintuitive from a theoretical perspective, as stronger anti-corruption mechanisms are generally expected to improve environmental outcomes. One possible explanation is that fragmented governance processes and institutional vulnerabilities in the fight against corruption may weaken the effectiveness of environmental regulations and allow environmentally harmful economic activities to expand more rapidly. In developing economies, corruption can undermine monitoring and enforcement mechanisms, thereby facilitating higher emission growth despite the existence of formal environmental policies. At the same time, improvements in transparency and monitoring associated with governance reforms may lead to more accurate reporting of emissions that were previously underreported. From an econometric perspective, this result may also reflect the strong interrelationships among governance indicators included in the model, which may create multicollinearity and influence the estimated coefficients. In addition, the potential bidirectional relationship between institutional quality and environmental performance may introduce endogeneity concerns that cannot be fully eliminated within the FMOLS framework. Therefore, this finding should be interpreted with caution and may also reflect underlying structural dynamics or methodological limitations.

The significance of the constant term and trend variable in the model reveals that there was also a structural increase trend in CO<sub>2</sub> growth during the analyzed period, independent of governance.

This indicates that environmental pressure is not only driven by institutional factors but also by other economic and socio-political variables that accumulate over time.

Overall, the model's high explanatory power reveals that the CO<sub>2</sub> emissions growth is directly related to governance quality. In this context, it is evident that in countries like Türkiye, which follow growth-oriented development strategies, CO<sub>2</sub> growth rates can be controlled not only through technical and economic tools but also by strengthening the governance structure. The study's findings indicate that for long-term and sustainable environmental sustainability, government effectiveness, the rule of law, and regulatory quality must be addressed and strengthened together.

## Discussion and Conclusion

As one of the rare empirical studies analyzing the impact of governance indicators on environmental sustainability in Türkiye, this study makes important contributions to both the academic literature and policymakers. The main starting point of this study is the recent approach that carbon emissions cannot be explained only by classical macro variables such as economic growth, energy consumption or industrialization; the quality of institutional structures and governance capacity are also determinant in this process.

The findings obtained with the FMOLS method reveal that governance indicators such as government effectiveness, regulatory quality, rule of law and political stability can significantly reduce CO<sub>2</sub> growth, while weaknesses in corruption control have the opposite effect. These results clearly show that Türkiye needs not only technical solutions but also a strong governance infrastructure to achieve its carbon emission reduction targets.

The present findings are in line with numerous previous studies that point to similar relationships in different country groups (Asongu & Odhiambo, 2020; Dash et al., 2024; Zhang et al., 2023). However, this study makes a unique contribution to the literature by separately assessing the effects of different components of governance on CO<sub>2</sub> growth in the Turkish context. Moreover, it provides a deeper understanding of the mechanisms between institutional quality and environmental performance through an empirical modeling framework that examines how these indicators interact with environmental outcomes, not only at the governance-index level. The high resolution analysis of this relationship in developing countries such as Türkiye makes the study more valuable at both theoretical and practical levels.

At the policy level, the findings suggest that improving environmental sustainability in Türkiye requires not only technical measures but also stronger institutional capacity and governance reforms. In particular, improving government effectiveness, regulatory quality, and the rule of law would enhance the enforcement of environmental regulations and strengthen the implementation of emission reduction policies. Strengthening monitoring and compliance mechanisms for environmental regulations, particularly in energy-intensive and industrial sectors, could help ensure that existing environmental standards are effectively applied.

In addition, anti-corruption measures and greater transparency in the use of public resources are essential for increasing the credibility and effectiveness of environmental governance. Transparent public procurement processes and improved oversight of environmental projects may help prevent regulatory capture and ensure that environmental policies are implemented more effectively.

Another important policy implication concerns the role of institutional coordination. Effective environmental governance requires stronger cooperation between central government institutions, regulatory agencies, and local authorities. In this context, empowering local governments and improving their administrative capacity in environmental monitoring and policy implementation could contribute to more effective and locally responsive environmental management.

Finally, integrating governance reforms with climate policy strategies could help Türkiye better align its environmental policies with its international climate commitments. Strengthening institutional quality alongside technological and economic instruments may play a critical role in achieving long-term emission reduction targets and supporting sustainable development.

The limitations of the study should not be overlooked. First, the governance indicators used in the analysis are perception-based indices and may therefore contain a certain degree of subjectivity. Second, the empirical model focuses primarily on governance-related variables and does not explicitly incorporate commonly used macroeconomic control variables such as GDP growth, energy consumption, or urbanization. Although these variables are widely used in environmental economics studies, the relatively limited time-series sample size (1996–2023) constrains the inclusion of additional regressors without reducing the degrees of freedom and potentially weakening the reliability of the econometric estimates. In this respect, excluding such variables may introduce omitted-variable bias, as these factors may be associated with both CO<sub>2</sub> emissions growth and governance indicators. However, the model adopts a parsimonious specification in order to maintain estimation reliability in a small-sample context. Future studies could address this issue by employing larger datasets and incorporating additional macroeconomic controls to further test the robustness of the findings. In addition, the positive coefficient obtained for the corruption control variable indicates that the relationship between anti-corruption mechanisms and environmental performance may be more complex than expected. While several theoretical and econometric explanations are discussed in the paper, this result suggests that the governance–environment nexus may involve country-specific institutional dynamics. Therefore, future research could investigate this relationship in greater detail by applying alternative econometric approaches or extended datasets to provide a deeper understanding of how corruption control interacts with environmental sustainability.

In conclusion, this study fills an important gap in the literature by analyzing the effects of the quality of governance on the growth of CO<sub>2</sub> emissions in Türkiye and provides concrete recommendations for decision makers to strengthen the institutional foundations of sustainable development policies. The path to sustainability is not only through technological transformation but also through institutional soundness.

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## Özet

*Çalışma, Türkiye'de çevresel sürdürülebilirliğin kurumsal belirleyicilerini, özellikle yönetim göstergelerine atıfta bulunarak incelemektedir. Çevresel bozulmanın ve daha da önemlisi karbondioksit (CO<sub>2</sub>) emisyonlarının gelişmekte olan ekonomilerin karşı karşıya olduğu kritik bir sorun olduğunu belirleyen araştırma, kurumsal düzenlemelerin ve yönetim kalitesinin bu etkileri kontrol etmeye yardımcı olup olamayacağını belirlemeyi amaçlamaktadır. Hızlı sanayileşme, kentleşme ve enerji yoğun büyüme yaşayan bir gelişmekte olan ülke olan Türkiye, yönetişimin çevresel performansı nasıl etkilediğini anlamak için ilginç bir örnek teşkil etmektedir.*

*Çalışma, çevresel sürdürülebilirliğin sadece gelir artışı veya endüstriyel üretim gibi ekonomik değişkenlerden değil, aynı zamanda kurumsal kapasiteden de etkilendiği konusunda akademik çevrelerde giderek artan bir fikir birliği olduğunu vurgulamaktadır. Dünya Bankası'nın Dünya Çapında Yönetişim Göstergeleri'nin (WGI) altı boyutundan (ses ve hesap verebilirlik, hükümet etkinliği, düzenleme kalitesi, hukukun üstünlüğü, yolsuzluğun kontrolü ve siyasi istikrar) araştırma, en önemli beş göstergeye odaklanmaktadır. Bunlar arasında hükümet etkinliği, siyasi istikrar, düzenleyici kalite, hukukun üstünlüğü ve yolsuzluğun kontrolü yer almaktadır. Bu göstergelerin her birinin çevre politikalarının tasarlanması, uygulanması ve yürürlüğe konması üzerinde etkili olacağı varsayılmaktadır.*

*Kurumsal kalitenin çevre performansı üzerindeki etkili rolünü ortaya koyan yoğun bir uluslararası literatür bulunmaktadır. Sahra Altı Afrika, MENA ve Asya'daki gelişmekte olan ülkeleri kullanan ampirik kanıtlar, daha yüksek kaliteli kurumların genellikle daha düşük emisyon ve daha iyi çevre performansı ile bağlantılı olduğunu göstermektedir. Ancak, Türkiye bu konuda henüz araştırılmamıştır. Bu boşluğu doldurarak, çalışma, gelişmekte olan pazarlarda yönetim ve çevresel sürdürülebilirliğin kesişimine ilişkin literatüre benzersiz bir katkı sağlamaktadır.*

*Metodolojik olarak, araştırma 1996-2023 dönemi için Türkiye'ye ait yıllık zaman serisi verilerini kullanmaktadır. Birim kök testleri (ADF ve PP), değişkenlerin birinci dereceden entegre olduğunu doğrulayarak, değişkenler arasındaki uzun vadeli ilişkileri belirlemek için Johansen koentegrasyonunun kullanılmasını mümkün kılmaktadır. Tamamen Modifiye Edilmiş En Küçük Kareler (FMOLS) tahmini, yönetim göstergelerinin CO<sub>2</sub> emisyonlarının artışına uzun vadeli etkisini yakalamak için kullanılır ve bu, küçük örneklerde bile tutarlı sonuçlar üretir.*

*Ekonometrik model, çok yönlü bir yönetim-çevre ilişkisi tespit etmektedir. Hükümetin etkinliği, düzenlemenin kalitesi, siyasi istikrar ve hukukun üstünlüğünün CO<sub>2</sub> emisyonlarının artışı üzerinde istatistiksel olarak anlamlı ve olumsuz etkileri olduğu ortaya çıkmıştır. Bu, yönetişimin bu yönlerindeki iyileştirmelerin çevre politikasının uygulanması ve etkinliğinin temelini oluşturduğunu göstermektedir. Özellikle, düzenlemenin kalitesi ve hukukun üstünlüğü özellikle güçlü itici güçler olarak ortaya çıkmakta ve çevre çerçevelerinin istikrarlı hukuk sistemleri ve verimli düzenleyici kurumlar tarafından desteklendiğinde daha iyi işlediğini göstermektedir.*

*Tersine, yolsuzluk kontrolü, CO<sub>2</sub> emisyonlarının artışı ile pozitif ve istatistiksel olarak anlamlı bir korelasyon göstermektedir. Bu ters sonuç, parçalanmış yönetişimin bir göstergesi olarak yorumlanmaktadır. Yolsuzlukla mücadele kampanyalarının zayıf olduğu veya yarım yamalak uygulandığı durumlarda, çevre düzenlemeleri kaçınılmakta veya seçici bir şekilde uygulanmakta, bu da çevresel bozulmanın artmasına yol açmaktadır. Bu bulgu, özellikle gelişmekte olan ülkelerde kurumsal eksikliklerin resmi politika çerçevelerini tehlikeye atabileceği yönündeki literatürdeki argümanları desteklemektedir.*

*Modelin yüksek açıklayıcı gücü ( $R^2 = 0,97$ ), Türkiye'de yönetişimin kalitesinin CO<sub>2</sub> emisyonlarındaki büyümenin ana belirleyicisi olduğunu göstermektedir. Bulgular, teknik ve ekonomik kontrollerin emisyonları sınırlamak için yetersiz olduğu, kaliteli kurumsal düzenlemelerin de gerekli olduğu argümanını doğrulamaktadır. Ayrıca, modelde önemli bir trend değişkeninin varlığı, alışkanlık haline gelmiş tüketim kalıpları veya küresel ekonomik süreçler gibi diğer yapısal belirleyicilerin de uzun vadede CO<sub>2</sub> artışını etkilediğini göstermektedir.*

*Sonuç olarak, çalışma Türkiye'de yönetişimin çevresel sürdürülebilirlik performansının itici gücü olduğunu göstermektedir. Çalışma, yönetişimin iyileştirilmesinin sadece idari bir reform değil, ülkenin*

çevre ve iklim hedeflerine ulaşmak için stratejik bir zorunluluk olduğunu göstermektedir. Rapor, kurumsal zayıflıkların, özellikle yolsuzluk ve hukukun üstünlüğünün uygulanmasıyla ilgili olanların giderilmesinin mevcut çevre politikalarını etkili hale getirebileceğini önermektedir. Türkiye'nin Paris Anlaşması da dahil olmak üzere uluslararası iklim taahhütlerini yerine getirmesi için, yönetim reformu teknolojik yenilik ve ekonomik planlamaya ayak uydurmalıdır.

Politika açısından etkileri çok derindir. Hukukun üstünlüğü, kamu sektörünün performansı ve düzenleyici öngörülebilirlik, sürdürülebilir kalkınmanın itici güçleri olabilir. Yerel yönetimlerin güçlendirilmesi ve kamu kaynaklarının kullanımında şeffaflığın artırılması da daha kapsayıcı ve etkili bir çevre yönetimi sağlayabilir. Son olarak, bu çalışma, yönetim göstergelerinin algıya dayalı doğası ve toplu ulusal verilerin kullanımı gibi kendi sınırlılıklarını da kabul etmektedir. Bunlar, ayrıştırmış bölgesel çalışmalar veya sektörel yönetim değerlendirmeleri gibi gelecekteki araştırmalar için olanaklar sunmaktadır.

Son olarak, bu araştırma Türkiye'de çevresel sürdürülebilirliğe giden yolun ekonomik ve teknolojik çözümlerin yanı sıra kurumsal dayanıklılığı da içermesi gerektiğini vurgulamaktadır. Böylelikle, gelişmekte olan ülke bağlamlarında yönetim-çevre ilişkisini daha nüanslı bir şekilde anlamaya katkıda bulunmaktadır.

## APPENDIX

**Table A1.** Correlation Matrix

	CO <sub>2</sub>	corruption	government	stability	regularity	law	voice
CO <sub>2</sub>	1						
corruption	-0.2175	1					
government	-0.2407	0.8263	1				
stability	-0.5595	0.1735	0.245	1			
regularity	-0.5156	0.7169	0.7245	0.0383	1		
law	-0.6547	0.7642	0.8135	0.571	0.7271	1	
voice	-0.7379	0.6794	0.7088	0.6792	0.5753	0.9148	1