Chapter 10

Corruption Perception in the Light of Green Transition Indicators

Szilárd Malatyinszki[a], *Botond Géza Kálmán*[a], *Szonja Jenei*[b], *Kobla Sewornu Afadzinu*[c] *and Zsuzsanna Zugor*[d]

[a]*Economic Research Institute and Department of Economics and Management, Faculty of Economics, Kodolányi János University, Székesfehérvár, Hungary*
[b]*Department of Management and Marketing, Kautz Gyula Faculty of Economics, Széchenyi István University (SZE), Győr, Hungary*
[c]*Doctoral School in Economics, University of Szeged, Szeged, Hungary*
[d]*Chancellor's Office, Kodolányi János University, Székesfehérvár, Hungary*

Abstract

Purpose: This study explores the relationship between green transition areas that promote sustainability and the perceived level of corruption across 41 countries.

Need for the study: Corruption undermines sustainability efforts and environmental governance, creating a need to understand its interaction with green transition indicators.

Methodology: The study uses data from the Bertelsmann Stiftung (BS) Sustainable Governance Indicators (SGI) 2022 report and Transparency International's Corruption Perceptions Index (CPI), deploying statistical methods to examine how environmental policy and participation in international treaties affect corruption.

Findings: State performance in environmental policy significantly influences corruption perception, with effects enhanced by international cooperation. Gross greenhouse gas emissions emerge as the most influential indicator, negatively affecting corruption perception by increasing its presence.

Sustainable Development and Green Innovation:
Managing Risk through Interdisciplinary Approaches and Policy Strategies, 219–236

doi:10.1108/978-1-83608-462-420251010

Practical implications: These findings call for integrating anti-corruption measures into environmental policy frameworks, fostering international collaboration, and enhancing transparency to advance sustainable development and reduce corruption risks.

Keywords: Corruption; sustainability; environmental policy; green transition indicators

JEL codes: D73; P28; P18; N50

Introduction

The United Nations (2018) has estimated that corruption imposes an economic burden of at least 5% of the global gross domestic product (GDP) annually, with more than $1 billion exchanged in bribes around the world each year. This widespread issue disrupts social, economic, and institutional stability in virtually every country. While the economic and political consequences of corruption are widely acknowledged, its effects in specific sectors such as environmental and resource management are not as thoroughly understood. Within industries like agriculture, forestry, fisheries and the management of protected areas and wildlife, corruption has deeply entrenched itself. These illicit practices compromise both ecological and economic systems, ultimately creating negative repercussions for social well-being. Combatting systemic corruption in these sectors requires targeted policy strategies based on collective action theory, emphasising collaborative solutions to reduce its pervasive impacts (Tacconi & Williams, 2020). Governments bear the primary responsibility for achieving a balance between environmental sustainability and economic growth. Sustainable development is inherently linked to a nation's financial systems, regulatory policies, and institutional frameworks. The interplay of these factors illustrates the importance of stringent environmental policies, greater adoption of renewable energy technologies, and robust anti-corruption measures. By implementing comprehensive regulatory frameworks, governments can mitigate environmental harm while fostering sustainable growth. A well-functioning institutional structure is crucial in this context, as it provides the foundation for effective policy enforcement and sustainable development practices (Balsalobre-Lorente et al., 2023).

The complex connections among corruption, renewable energy use, economic development and carbon emissions highlight the long-term challenges of sustainability. Evidence points to a strong correlation between corruption and carbon dioxide emissions, as well as between economic growth and environmental degradation. While international trade and renewable energy adoption contribute to mitigating climate challenges, the negative influence of corruption often offsets these benefits. Effective governance, therefore, is essential to manage the interplay of these variables and ensure positive environmental outcomes (Leitão, 2021). An important study by Iglesias Troche and Martí Trull (2020) analysed the relationship between the Corruption Perception Index and greenhouse gas emissions, finding that corruption significantly impacts environmental performance. Their findings reveal a particularly strong correlation when measuring emissions against GDP per $1,000, as opposed to considering temporal changes. Between 1990 and 2008, countries with lower corruption levels achieved greater reductions in greenhouse gas emissions compared to highly corrupt nations. This finding emphasises the role of good governance in addressing climate challenges. Further research demonstrates that countries with moderate corruption levels are better equipped to utilise climate finance for emission reduction efforts than those with severe corruption problems. For instance, a one-point improvement in the Corruption Perception Index increases the likelihood of reducing emissions by 2.46%. However, underdeveloped nations often fail to exploit climate finance opportunities fully, limiting the effectiveness of such initiatives in mitigating climate change (Lyeonov et al., 2023). Interestingly, while corruption generally correlates negatively with CO_2 emissions across different income groups, high-income nations show a positive association, suggesting unique dynamics in these contexts.

Institutional quality, which encompasses the degree of corruption, plays a critical role in determining per capita emissions. Corruption exacerbates production inefficiencies and leads to emissions 'leakage', where production relocates from wealthier to lower-income countries to circumvent stringent regulations. This form of moral corruption undermines global emission reduction efforts by shifting the burden to nations with weaker regulatory frameworks (Devlina & Sahu, 2022). Transparent governance, characterised by reduced corruption, has been shown to significantly lower air pollution levels, both directly by enforcing regulations and indirectly through economic growth stimulation (Liu & Dong, 2021). Additionally, corruption has been identified as a key driver of environmental crimes such as illegal deforestation and hazardous waste dumping, further illustrating its profound impact on environmental health (Ngamkaiwan, 2023). The intersection of corruption and public policies, particularly those related to environmental regulation, has received increasing attention over the past few decades. Corruption weakens societal well-being by reducing the effectiveness of environmental policies and restricting access to public resources. Research highlights the critical role of institutional trust in mediating the influence of corruption. Trustworthy institutions foster a balance between industrial and environmental interests, thereby mitigating corruption's impact on regulatory frameworks. A robust institutional system not only facilitates the implementation of effective environmental policies but also strengthens international cooperation. This collaboration is essential for developing governance frameworks capable of reducing corruption on a global scale (Dincer & Fredriksson, 2018; Pellegrini & Vujic, 2003).

Morse (2006) undertook a comprehensive exploration of the relationship between corruption and environmental sustainability, focussing on how perceptions of corruption influence the progress of environmental protection measures. His research concluded that perceived corruption explains up to 20% of the variability in environmental indicators. Specifically, countries with higher levels of perceived corruption tend to exhibit weaker climate policies. This connection is particularly evident in nations with loose, market-oriented climate strategies, where corruption is closely linked to industries benefiting from substantial environmental tax exemptions and other financial advantages. Interestingly, this relationship holds even in countries with traditionally strong governance structures characterised by high levels of trust and low corruption (Rafaty, 2018). Despite numerous political economy theories and documented examples of corruption in resource management, efforts to combat such practices remain largely ineffective. This ineffectiveness continues to pose significant threats to both environmental sustainability and the economic systems integral to achieving it (Leitão, 2016).

The concept of green consumption emphasises the environmentally conscious use of goods and services, aiming to minimise harm to ecosystems. However, corruption can disrupt this process by inflating production costs or undermining public accountability for sustainable practices. For instance, corrupt practices may lead to weaker implementation of policies designed to promote green consumption (Lu & Li, 2023). Energy productivity and efficiency, often used as benchmarks for sustainability, are also heavily influenced by corruption control. Research by Akorli and Adom (2023) highlights that in African nations with lower energy efficiency, reducing corruption significantly enhances energy performance, showcasing how effective governance is key to fostering sustainable energy transitions.

The green transition – a shift towards renewable energy and sustainable practices – depends on well-implemented regulatory frameworks. Corruption and bureaucratic inefficiencies often undermine these efforts, hindering progress in achieving ecological balance. A longitudinal study spanning 30 years (Xu et al., 2024) revealed that while green transitions improve biocapacity, addressing corruption and improving bureaucratic quality are essential to achieving ecological sustainability.

Corruption's impact on the carbon footprint is complex and multifaceted. While it may lead to a temporary reduction in emissions, its long-term effects often result in higher overall emissions. Additionally, corruption consistently exacerbates the ecological footprint, a phenomenon closely tied to political instability. Key factors accelerating environmental degradation include rapid urbanisation, increased foreign direct investment (FDI), and rising energy consumption. To combat these challenges, strengthening political stability and implementing robust anti-corruption measures are imperative (Asif et al., 2023). Research by Dada et al. (2023) examining 25 years of data further emphasises this point. They found that corruption-driven shadow economies, alongside financial development, economic growth, and urbanisation, significantly increase the ecological footprint. Conversely, they found that trade openness mitigates environmental harm. Their findings also revealed that while urbanisation and economic growth diminish biocapacity, a strong financial system can mitigate the shadow economy's negative effects on environmental degradation. Waste management presents another critical issue where corruption is a significant factor. In developed economies, wealthier nations often transfer waste disposal to lower-income countries, where regulatory compliance is less expensive. Corruption facilitates this process, as low-income officials in these nations may accept bribes to overlook environmental violations. A game theory analysis by Cesi et al. (2019) demonstrated that corruption enables illegal waste disposal and encourages higher waste production, echoing the Jevons (1865) paradox. This paradox, established over 150 years ago, illustrates how increased efficiency in resource use often leads to higher overall consumption.

Urban solid waste management, a vital public service, has also been scrutinised for its connection to corruption. Italy, which ranks high in corruption among European nations, has faced persistent challenges in managing waste, especially during crises. Studies have shown that regions with higher levels of corruption generate more waste per capita, requiring additional financial and logistical resources for treatment. Such behaviour creates opportunities for criminal activity, undermining public administration and harming citizens. However, no significant differences were observed in selective waste collection rates or landfill utilisation across these regions (Romano et al., 2021). Electronic waste recycling is another area heavily impacted by corruption. Due to the hazardous nature of electronic waste for both human health and the environment, strict regulations govern this sector. Nonetheless, illegal recycling practices persist, particularly in developing nations where informal processing dominates. Policymakers aim to integrate informal recycling into formal systems, often through financial incentives. However, these subsidies can inadvertently foster corruption. To address this, government authorities are increasingly establishing interface organisations that redirect illegally recycled components into legitimate reuse channels, reducing the environmental and health risks associated with informal recycling (Williams et al., 2013).

After analysing the existing body of literature, the researchers developed the following key questions for their study:

Q1. How can the sample analysed in this study be described in terms of the environmental sustainability indicators identified in the literature?

Q2. What impact do the chosen environmental sustainability indicators have on shaping perceptions of corruption?

Methods

The authors utilised statistical analysis to address the research questions, drawing data from the BS SGI 2022 database. This dataset, publicly accessible at https://www.sgi-network.org/2022/, provides extensive information on governance and sustainability metrics for 41 EU and Organisation for Economic Co-operation and Development (OECD) countries. It serves as a valuable resource for understanding governance effectiveness and environmental performance across nations. The database includes an index evaluating the effectiveness of anti-corruption efforts, as well as several sustainability-related indicators. Among these are measures of environmental policy performance, material footprint, and participation in multilateral environmental agreements (MEAs). The authors specifically selected indicators that directly relate to corruption, such as those addressing the trade of emission quotas and decision-making processes in environmental policies.

Using the BS methodology, these indices are constructed from statistical data and scored on a scale from 1 to 10, where higher values indicate stronger performance. A score of five serves as the theoretical midpoint, offering a benchmark for evaluating relative performance. This standardised scoring system ensures consistency and comparability across countries, allowing for meaningful cross-national analysis. For their study, the authors focussed on a subset of SGI indices most relevant to the research objectives. These indicators, detailed in Table 10.1, form the analytical basis for examining the relationship between corruption perception and environmental sustainability. By leveraging this rich dataset, the authors aimed to uncover critical insights into how governance and sustainability interact, shedding light on the dynamics that influence corruption and environmental outcomes.

To analyse corruption levels, the authors relied on time-series data from Transparency International's CPI, a well-established measure that reflects the perceived levels of corruption in various countries. This index served as the dependent variable in their statistical modelling framework. The research process began with the generation of descriptive statistics, which provided a comprehensive summary of the dataset's key features. As part of the preliminary analysis, the authors assessed

Table 10.1. Indicators Used by Authors.

Index Name	Definition
Corruption Prevention	This indicator examines the measures implemented by governments and societies to ensure that public officials and politicians refrain from engaging in bribery. It focusses on the mechanisms established to uphold the ethical conduct and integrity of officeholders
Environmental Policy	This indicator evaluates governmental efforts to conserve natural resources and reduce pollution. It addresses three core aspects: the level of ambition reflected in the government's environmental policies, the tangible outcomes of these initiatives, and the extent to which environmental considerations are integrated into broader policy frameworks
MEAs	This metric assesses the percentage of a country's participation in global and regional MEAs, reflecting its commitment to collaborative international environmental efforts
Material Footprint	This indicator measures the total volume of raw materials extracted to meet the consumption needs of a population. Measured as material footprint per capita, it is typically higher in wealthier nations, which often rely on resources from other countries to sustain their elevated living standards

Source: Authors' own.

the normality of the sample distribution using the Shapiro–Wilk test (Shapiro & Wilk, 1965) and evaluated homoscedasticity – the assumption of equal variance across the dataset – using Levene's test (Levene et al., 1960). These diagnostic tests were essential for determining whether parametric statistical techniques could be applied or whether nonparametric methods would be more appropriate for further analyses.

Building on these foundational steps, the authors sought to understand the relationship between environmental sustainability metrics and corruption prevention efforts. To address this, they constructed a regression model in which the CPI served as the dependent variable, representing corruption levels. The independent variables included various environmental indices, chosen for their potential influence on corruption dynamics. The regression analysis aimed to uncover both the magnitude and direction of these relationships, exploring how environmental factors impact efforts to reduce corruption. By structuring the model in this way, the researchers could assess whether robust environmental policies and practices correlate with improved governance and reduced corruption, providing valuable insights into the interconnectedness of sustainability and governance.

Results

Table 10.2 shows the results of the descriptive statistics. The analysis included data from 41 countries, with no missing values, ensuring a comprehensive dataset. The Shapiro–Wilk (1965) test was employed to evaluate the normality of the indices.

Table 10.2. Descriptive Statistics for the Sample.

	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Shapiro–Wilk's *p***
Corruption_ Prevention – mean	6.41	6.39	6.51	6.56	6.54	6.44	6.32	6.24	6.34	0.958
Multilateral_ Environmental_ Agreements – mean	7.33	7.33	6.66	6.46	6.88	6.71	6.79	6.81	6.93	<0.001
Material_ Footprint – mean	5.82	5.88	5.93	5.91	5.98	5.91	5.88	5.91	5.95	0.028
Environmental_ Policy – mean	5.98	6.07	6.07	6.15	6.05	6.12	6.17	6.17	6.22	0.051
N	41	41	41	41	41	41	41	41	41	–
Missing	0	0	0	0	0	0	0	0	0	–

Source: Authors' own.

Most indices met the normality assumption; however, the 'MEAs' indicator was an exception, failing the normality test with a significance level of $p<0.001$. Due to this, the study adopted non-parametric statistical methods, which are more suitable for datasets that do not meet normality requirements. An examination of the Corruption Prevention indicator shows that all countries achieved results above the theoretical midpoint, indicating generally positive trend. While this suggests progress in efforts to prevent corruption, it also indicates the need for further advancements to strengthen governance and integrity across the board. Both the Environmental Policy indicator and the MEAs indicator exceeded the theoretical average, reflecting strong international engagement and commitment to environmental protection initiatives. These results suggest that the examined countries actively participate in and fulfil their roles within global environmental agreements, demonstrating their alignment with international sustainability goals.

The Material Footprint indicator also scored above the theoretical average. However, this higher value is a cause for concern, unlike the previous indicators. It indicates an excessive use of natural resources, resulting in an unsustainably large ecological footprint. This finding underscores the need for improved resource management practices and more sustainable consumption patterns, particularly in wealthier nations that contribute disproportionately to global resource extraction and consumption. The findings, illustrated in Fig. 10.1, reveal a mixed picture of sustainability performance among the analysed countries. While progress is evident in areas like corruption prevention and environmental policy, challenges remain in reducing material consumption and promoting long-term environmental sustainability. These results emphasise the importance

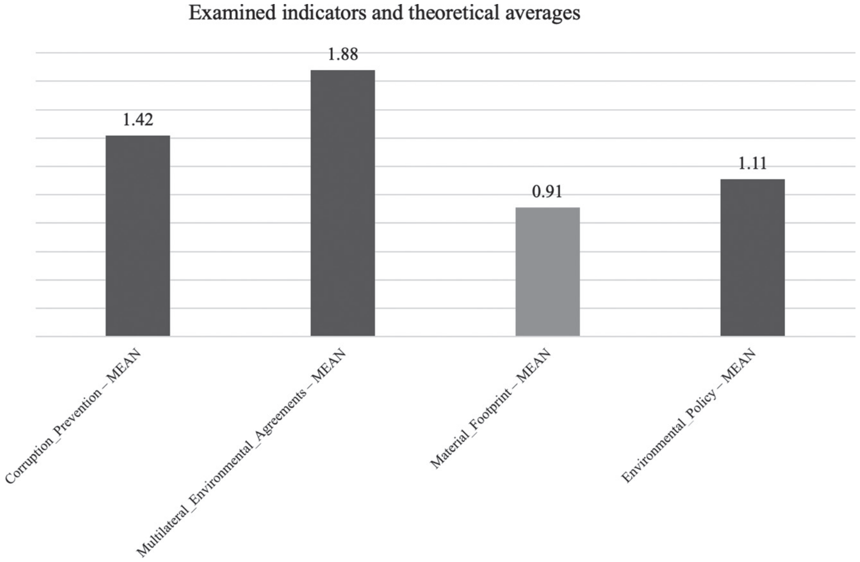

Fig. 10.1. Favourable (Dark Teal) and Unfavourable (Red) Indicator Averages.
Source: Authors' own.

of addressing resource overuse and aligning national policies with global efforts to combat environmental degradation and ensure sustainable development.

Tables 10.3 and 10.4 present the details of the regression model. The model explains 49.4% of the variation in corruption prevention as influenced by environmental indicators (R^2=0.494). The results indicate a good fit, with statistical significance confirming that the observed effects are not due to chance (p<0.001). Additionally, the variance inflation factor values for the variables range from 1.12 to 5.33, well within the acceptable limit of 10, ensuring no issues with multicollinearity.

Table 10.4 highlights that environmental policy and material footprint have a significant impact on corruption prevention. Effective compliance with environmental policy plays a critical role in enhancing corruption control, primarily by reducing the risk of exploitation through legal loopholes. Additionally, the influence of environmental policy is likely strengthened by the involvement of MEAs, which promote international cooperation and provide a framework for enforcing stricter environmental standards. This interconnectedness illustrates the value of aligning environmental governance with anti-corruption measures to achieve better outcomes.

Discussion

The interplay between corruption and environmental sustainability emerges as a critical area of inquiry, particularly in the context of achieving green transition goals. The present study advances our understanding by demonstrating the nuanced relationships between environmental policy, MEAs, material footprints,

Table 10.3. Overall Test Results of Regression Model.

	Overall Model Test					
Model	***R***	***R*²**	***F***	***df*1**	***df*2**	***p***
1	0.703	0.494	90.6	3	359	< 0.001

Source: Authors' own.

Table 10.4. Regression Model Coefficients.

Predictor	**Estimate**	**SE**	***t***	***p***
Model Coefficients – Corruption_Prevention				
Intercept	2.7554	0.6307	4.369	< 0.001
Environmental_Policy	0.4928	0.0536	9.199	<0 .001
Material_Footprint	0.1767	0.0247	7.162	< 0.001
Multilateral_Environmental_Agreements	0.0504	0.0546	0.923	0.356

Source: Authors' own.

and corruption perception. This discussion synthesises the findings of the study with extant literature to contextualise the implications and provide a foundation for future research directions.

Influence of Environmental Policy on Corruption Perception

The study underscores the paramount role of environmental policy in shaping perceptions of corruption. The regression model reveals that robust environmental policies significantly enhance the effectiveness of corruption prevention mechanisms. These findings align with Balsalobre-Lorente et al. (2023), who highlighted that stringent environmental policies, coupled with economic and institutional advancements, can mitigate ecological footprints. The ability of environmental policies to close legal loopholes appears to be a critical factor, as it diminishes opportunities for corrupt practices to exploit ambiguities in regulatory frameworks.

Moreover, the integration of environmental aspects into broader policy agendas fosters transparency and accountability, thereby reducing the scope for corruption. This is consistent with Liu and Dong (2021), who found that the integrity of institutional frameworks directly correlates with reductions in pollution and corruption. The present findings reinforce the argument that comprehensive environmental policies are not only pivotal for ecological outcomes but also integral to governance quality. Additional evidence from Rafaty (2018) highlights that nations with stringent environmental regulations exhibit higher public trust in governance and lower perceived corruption, emphasising the dual benefits of proactive policy frameworks.

A growing body of literature emphasises the role of stringent environmental standards in curbing opportunities for rent-seeking and collusion. For example, Dincer and Fredriksson (2018) observed that countries with robust environmental regulatory frameworks tend to have lower levels of corruption due to reduced discretionary power among public officials in environmental permitting processes. This finding shows the potential for environmental policies to establish systematic checks that preclude corrupt practices.

Furthermore, effective environmental policy aligns with sustainable development goals (SDGs), particularly those that emphasise institutional strength and transparency. This linkage is evident in studies by Xu et al. (2024), which demonstrated that green electricity transitions and environmental regulatory quality are significantly impeded in contexts of high corruption. By fostering an environment of accountability, environmental policies protect natural resources and contribute to institutional credibility.

Environmental policies' intersection with digital governance innovations offers another promising dimension. The integration of digital tools in monitoring emissions and enforcing compliance has proven effective in reducing opportunities for corruption. According to Shang et al. (2025), digital transparency mechanisms in environmental governance have increased accountability and curbed bribery in high-risk sectors. This technological approach provides a template for enhancing policy effectiveness while minimising corrupt interference.

The interplay between public participation and environmental governance is also crucial. Public participation in policy formulation and implementation fosters transparency and accountability, reducing the scope for malpractice. Lyeonov et al. (2023) demonstrated that countries with higher levels of civic engagement in environmental decision-making report lower corruption indices and improved environmental outcomes. Thus, policies that encourage public oversight and participation are essential in the fight against corruption.

Lastly, policies must address the role of the private sector in environmental governance. Corporate compliance with environmental standards is often influenced by the stringency of regulations and the likelihood of enforcement. According to Lu and Li (2023), businesses operating under robust regulatory environments are more likely to adopt ethical practices, thereby reducing corrupt transactions associated with environmental non-compliance.

MEAs and Corruption

The study's findings underline the importance of MEAs as instruments for fostering international accountability and combating corruption. These agreements establish normative frameworks that promote transparency, thereby reducing opportunities for corruption in environmental governance. However, the study indicates that their direct impact is less significant than that of robust national environmental policies. Bäckstrand et al. (2017) similarly highlight that MEAs often require integration into domestic governance systems to achieve meaningful outcomes. Nations with weak institutional capacities may struggle to enforce MEA provisions, thereby allowing corruption to persist, particularly in sectors like resource management and emissions regulation.

Beyond fostering regulatory frameworks, MEAs play a critical role in knowledge dissemination and institutional learning. Countries participating in MEAs can adopt global best practices and leverage innovative solutions for environmental challenges. As emphasised by Chayes and Chayes (1995), compliance with MEAs often hinges on the ability of international institutions to provide technical support and capacity-building for member states. By embedding global standards into local governance contexts, MEAs help create an environment less conducive to corruption, particularly in resource-intensive sectors.

However, translating MEAs into actionable outcomes remains challenging, as disparities in their implementation often reflect governance issues at the national level. Purdon (2015) suggests that such disparities may stem from insufficient regulatory capacity, lack of political will, or conflicting economic interests. Moreover, Böhringer and Löschel (2006) caution that the economic incentives tied to MEA participation might sometimes create opportunities for rent-seeking behaviour, thereby inadvertently fostering corruption.

In addition, MEAs' impact on corruption may also depend on the transparency of international institutions themselves. Gupta and Mason (2016) argue that ensuring accountability within MEAs requires robust mechanisms for monitoring and reporting compliance. Without such mechanisms, MEAs risk being undermined by non-compliance and corrupt practices within participating states.

Broader Implications for Environmental Governance

The implications of MEAs extend beyond corruption control to addressing the complexities of transboundary environmental challenges. These agreements foster collaboration among nations, enabling collective action to tackle issues like climate change, biodiversity loss, and pollution. Biermann, Betsill, et al. (2010) and Biermann, Zelli, et al. (2010) emphasise that MEAs function as essential instruments for building global partnerships and promoting shared environmental goals. Their success, however, hinges on the synergy between international frameworks and domestic governance. Weak institutional capacities at the national level often undermine the implementation of MEA objectives, as highlighted by Gupta et al. (2016), who note that disparities in governance structures across nations present significant barriers to uniform enforcement.

Strengthening the interface between international and domestic governance systems is critical. For MEAs to achieve their full potential in reducing corruption and promoting sustainable development, they must be tailored to the specific needs of participating countries. Adaptive governance, as explained by Hovi et al. (2009), provides flexibility in how MEAs are put into action, allowing them to fit different institutions and levels of ability. This approach minimises corruption risks by aligning MEA commitments with the realities of local governance contexts.

A recurring theme in this discussion is the role of institutional capacity in mediating the effectiveness of MEAs. Countries with robust institutions are better equipped to translate MEA commitments into actionable policies, reducing corruption risks and enhancing environmental outcomes. Conversely, nations with weak institutions often struggle with enforcement, creating opportunities for corruption to thrive. As noted by Ostrom (2010), institutional diversity and polycentric governance systems can offer resilience by distributing authority and creating multiple layers of accountability.

The study underscores the importance of integrating anti-corruption strategies into broader environmental governance frameworks. This aligns with findings by Persson et al. (2019), who argue that addressing corruption in environmental governance requires targeted reforms, such as enhancing transparency, fostering civic engagement, and strengthening judicial systems. For instance, participatory governance models, which involve multiple stakeholders in decision-making processes, have been shown to improve accountability and reduce corruption. The OECD (2018) highlights that such models are particularly effective in ensuring that MEA implementation aligns with national priorities and public interests.

Financial mechanisms, including international funding and climate finance, are pivotal in supporting MEA implementation. However, they also introduce risks of mismanagement and corruption. Climate finance, in particular, is vulnerable to diversion and inefficiencies in countries with limited regulatory oversight. Transparency International (2020) identifies several best practices for mitigating these risks, such as establishing independent audit mechanisms and implementing stringent reporting requirements.

Integrating financial governance reforms into MEA frameworks can further enhance their impact. For example, mechanisms like performance-based funding, which ties financial disbursements to measurable outcomes, can incentivise transparency and reduce corruption. As Cavanagh et al. (2020) note, such approaches ensure that resources are allocated effectively, aligning financial incentives with environmental and governance objectives.

Emerging technologies, including blockchain and digital monitoring systems, present new opportunities for enhancing MEA implementation. Blockchain, with its capacity for secure and transparent record-keeping, has been proposed as a tool for improving the traceability of financial flows and environmental data. As suggested by Kaza et al. (2018), blockchain could be used to track carbon credits, ensuring that they are not subject to fraudulent practices.

Similarly, remote sensing technologies and AI-driven analytics can provide real-time monitoring of environmental indicators, facilitating compliance with MEA commitments. These technologies enable early detection of non-compliance and corruption, allowing for timely interventions. For example, Li et al. (2019) demonstrate the effectiveness of satellite-based monitoring in tracking deforestation, a critical metric in biodiversity-related MEAs.

Addressing Equity and Justice within MEA Frameworks

Equity and justice considerations are integral to the success of MEAs. The disproportionate impact of environmental degradation on low-income nations underscores the need for equitable resource-sharing mechanisms. MEAs must address these disparities to ensure their legitimacy and efficacy. As noted by Newell et al. (2017), equity-focussed approaches, such as differentiated responsibilities and capacity-building initiatives, can enhance the inclusivity and fairness of MEA frameworks.

The inclusion of indigenous knowledge systems and local expertise in MEA implementation is another critical aspect of equity. Indigenous communities often possess unique insights into sustainable resource management, which can complement scientific approaches. Integrating these perspectives, as highlighted by Folke et al. (2021), can strengthen MEA frameworks by making them more contextually relevant and culturally sensitive.

Future Research and Policy Directions

The findings call for a more comprehensive understanding of the interplay between MEAs, corruption, and environmental governance. Future research should explore the long-term impacts of MEA implementation on governance quality and corruption control, particularly in resource-dependent economies. Comparative studies examining MEA efficacy across different institutional and cultural contexts could provide valuable insights into best practices and areas for improvement.

Additionally, policymakers should prioritise capacity-building initiatives that enhance the ability of low-income nations to implement MEAs effectively. This includes providing technical assistance, fostering knowledge exchange, and ensuring equitable access to financial resources. Collaborative approaches that involve governments, civil society, and the private sector are essential for addressing the systemic challenges identified in this study.

Material Footprint and Governance Challenges

The material footprint indicator provides valuable insights into the intersection of resource consumption and corruption. High material footprints, as observed in affluent nations, signal disproportionate resource extraction, often from lower-income countries. This dynamic creates fertile ground for corruption, as highlighted by Devlina and Sahu (2022), who discussed emissions leakage and its moral implications. The current study reinforces the necessity for equitable resource management practices and stringent oversight mechanisms to address these disparities.

The relationship between material footprints and corruption underscores the systemic challenges in balancing economic growth with sustainability. For instance, Akorli and Adom (2023) demonstrated that energy efficiency transitions are heavily influenced by regulatory quality and corruption control. These findings collectively underscore the critical need for policies that promote resource efficiency while ensuring transparency in governance structures.

Broader Implications for Green Transition

The broader implications of this study are profound, especially in light of global green transition efforts. The findings highlight that the effectiveness of environmental sustainability initiatives is inextricably linked to the governance environment. Corruption not only undermines environmental objectives but also erodes public trust and institutional credibility, creating a vicious cycle that impedes progress.

Several studies corroborate this perspective. Asif et al. (2023) and Rafaty (2018) emphasise the dual role of political stability and anti-corruption measures in fostering effective climate policies. The current findings suggest that addressing corruption is not merely a governance issue but a prerequisite for achieving SDGs.

The study also draws attention to the role of financial incentives in shaping green transitions. While such incentives aim to encourage compliance and innovation, they can inadvertently become sources of corruption if not carefully managed. The literature, including Xu et al. (2024) and Williams et al. (2013), highlights the risks associated with subsidies and other financial mechanisms in sectors like renewable energy and recycling. Establishing robust oversight frameworks is therefore imperative to mitigate these risks and ensure that financial resources are directed towards genuine sustainability objectives.

Future Research Directions

While the study provides critical insights, it also opens avenues for further research. The limited explanatory power of the regression model (49.4%) suggests that additional factors influence the relationship between environmental indicators and corruption perception. Future research could explore the role of variables such as political culture, public awareness, and technological advancements in shaping these dynamics.

Another promising direction is the examination of sector-specific corruption within the green transition. As noted by Romano et al. (2021) and Cesi et al. (2019), sectors like waste management and electronic recycling are particularly susceptible to corrupt practices. Understanding the unique challenges and vulnerabilities of these sectors could inform targeted anti-corruption strategies.

Lastly, longitudinal studies that track changes in corruption perception over time in response to environmental policy interventions would provide valuable insights into causality and long-term impacts. Such studies could also incorporate comparative analyses across regions and income groups to identify best practices and contextual factors.

Conclusion

State institutions play a crucial role in advancing environmental sustainability, relying on effective legislation and law enforcement to implement policies successfully. Significant financial resources are often allocated to support the green transition, funding initiatives such as renewable energy, conservation, and waste management. However, these resources can also become targets for corruption, undermining their intended purpose and outcomes. This study demonstrates a strong connection between environmental sustainability indicators and perceived levels of corruption. The proposed model explains nearly 50% of this relationship, highlighting the critical role of effective environmental policy in shaping corruption perceptions. Participation in international environmental agreements further reinforces this effect, as global cooperation and coordinated actions strengthen governance and contribute to reducing corruption and improving its perception. Stronger anti-corruption measures impose stricter regulatory environments, increasing the risks and costs associated with legal violations and profiteering. As these measures take hold, privileges tied to political connections and corrupt practices are eroded. In response, companies often shift their focus to socially responsible initiatives to rebuild their reputation or distance themselves from past misconduct. The fight against corruption also enhances external oversight and increases stakeholder scrutiny, driving companies to improve their corporate social responsibility performance. Furthermore, anti-corruption efforts liberate resources previously misused through corrupt practices, enabling firms to reinvest in socially and environmentally beneficial activities. By dismantling corrupt systems and fostering transparency, anti-corruption measures pave the way for improved governance, stronger societal trust, and enhanced sustainability outcomes.

References

AQ1

Akorli, C. D., & Adom, P. K. (2023). The role of corruption control and regulatory quality in energy efficiency transition tendencies in Africa. *iScience*, *26*(3), 106262. https://doi.org/10.1016/j.isci.2023.106262

Asif, K., Sabir, S., & Qayyum, U. (2023). Corruption, political instability, and environmental degradation in South Asia: A comparative analysis of carbon footprint and ecological footprint. *Journal of the Knowledge Economy*, *15*, 4072–4096. https://doi.org/10.1007/s13132-023-01133-y

Bäckstrand, K., Kuyper, J. W., Linnér, B. O., & Lövbrand, E. (2017). Non-state actors in global climate governance: From Copenhagen to Paris and beyond. *Environmental Politics*, *26*(4), 561–579. https://doi.org/10.1080/09644016.2017.1327485

Balsalobre-Lorente, D., Topaloglu, E. E., Nur, T., & Evcimen, C. (2023). Exploring the linkage between financial development and ecological footprint in APEC countries: A novel view under corruption perception and environmental policy stringency. *Journal of Cleaner Production*, *414*, 137686. https://doi.org/10.1016/j.jclepro.2023.137686

Biermann, F., Betsill, M. M., Gupta, J., Kanie, N., Lebel, L., Liverman, D., Schroeder, H., & Siebenhüner, B. (2010). Earth system governance: A research framework. *International Environmental Agreements: Politics, Law and Economics*, *10*(4), 277–298. https://doi.org/10.1007/s10784-010-9137-

Biermann, F., Zelli, F., Pattberg, P., & Van Asselt, H. (2010). The architecture of global climate governance: Setting the stage. In F. Biermann, P. Pattberg, & F. Zelli (Eds.), *Global climate governance beyond 2012. Architecture, agency and adaptation* (pp. 15–24). Cambridge University Press. https://portal.research.lu.se/en/publications/the-architecture-of-global-climate-governance-setting-the-stage

Böhringer, C., & Löschel, A. (2006). Promoting renewable energy in Europe: A hybrid CGE approach. *Energy Journal*, *27*(3), 135–150. https://doi.org/10.5547/ISSN0195-6574-EJ-VolSI2006-NoSI2-7

Cavanagh, C., Benjaminsen, T. A., & Vedeld, P. (2020). Climate finance and carbon colonialism: The political economy of forest carbon in sub-Saharan Africa. *Geoforum*, *117*, 132–141. https://doi.org/10.1016/j.geoforum.2020.08.010

Cesi, B., D'Amato, A., & Zoli, M. (2019). Corruption in environmental policy: The case of waste. *Economia Politica*, *36*(1), 65–78. https://doi.org/10.1007/s40888-017-0087-x

Chayes, A., & Chayes, A. H. (1995). *The new sovereignty: Compliance with international regulatory agreements*. Harvard University Press. https://doi.org/10.4159/9780674262638

Dada, J. T., Ajide, F. M., Arnaut, M., & Adeiza, A. (2023). On the shadow economy-environmental sustainability nexus in Africa: The (ir)relevance of financial development. *International Journal of Sustainable Development & World Ecology*, *30*(1), 6–20. https://doi.org/10.1080/13504509.2022.2115576

Devlina, R. R. R., & Sahu, S. K. (2022). Corruption and carbon emission: An empirical investigation. *International Journal of Green Economics*, *16*(4), 355–388. https://doi.org/10.1504/IJGE.2022.129000

Dincer, O. C., & Fredriksson, P. G. (2018). Corruption and environmental regulatory policy in the United States: Does trust matter? *Resource and Energy Economics*, *54*, 212–225. https://doi.org/10.1016/j.reseneeco.2018.10.001

Folke, C., Polasky, S., Rockström, J., Galaz, V., Westley, F., Lamont, M., Österblom, H., & Steffen, W. (2021). Our future in the anthropocene biosphere. *Ambio*, *50*(4), 834–869. https://doi.org/10.1007/s13280-021-01544-8

Gupta, A., & Mason, M. (2016). *Transparency in global environmental governance: Critical perspectives*. MIT Press. https://muse.jhu.edu/pub/6/edited_volume/book/33383

Gupta, J., van Asselt, H., & Biermann, F. (2016). *Cross-cutting issues: International environmental law and governance in the anthropocene*. Edward Elgar Publishing.

Hovi, J., Sprinz, D. F., & Underdal, A. (2009). Implementing long-term climate policy: Time inconsistency, domestic politics, international anarchy. *Global Environmental Politics*, *9*(3), 20–39. https://doi.org/10.1162/glep.2009.9.3.20

Iglesias Troche, I., & Martí Trull, N. (2020). *Are greenhouse gas emissions correlated with corruption?: A study on the relation between pollution and corruption through the Kyoto Protocol participants* [Universitat Pompeu Fabra]. http://repositori.upf.edu/handle/10230/46464

Jevons, W. S. (1865). *The coal question; An inquiry concerning the progress of the nation, and the probable exhaustion of our coal-mines* (1st ed.). MacMillan and Co. http://archive.org/details/coalquestionani00jevogoog

Kaza, S., Yao, L. C., Bhada-Tata, P., & Woerden, F. V. (2018). *What a waste 2.0: A global snapshot of solid waste management to 2050*. World Bank Publications. https://doi.org/10.1596/978-1-4648-1329-2

Leitão, A. (2016). Corruption and the environment. *Journal of Socioeconomics*, *5*(3), 1–5. https://doi.org/10.4172/2167-0358.1000173

Leitão, N. C. (2021). The effects of corruption, renewable energy, trade and CO_2 emissions. *Economies*, *9*(2), Article 2. https://doi.org/10.3390/economies9020062

Levene, H. (1960). Robust tests for equality of variances. In I. Olkin et al. (Eds.), *Contributions to probability and statistics: Essays in Honor of Harold Hotelling* (pp. 278–292). Stanford University Press. https://www.semanticscholar.org/paper/Robust-tests-for-equality-of-variances-Levene/3eb99d37fef7c5b23ea3ecb4e1a7de65b0af59ed

Li, T., Wang, D., Zhang, L., & Chen, X. (2019). Satellite monitoring of forest loss and recovery to support sustainable development goals. *Remote Sensing*, *11*(19), 2219. https://doi.org/10.3390/rs11192219

Liu, Y., & Dong, F. (2021). Haze pollution and corruption: A perspective of mediating and moderating roles. *Journal of Cleaner Production*, *279*, 123550. https://doi.org/10.1016/j.jclepro.2020.123550

Lu, J., & Li, H. (2023). The impact of environmental corruption on green consumption: A quantitative analysis based on China's Judicial Document Network and Baidu Index. *Socio-Economic Planning Sciences*, *86*, 101451. https://doi.org/10.1016/j.seps.2022.101451

Lyeonov, S., Toušek, Z., Bozhenko, V., & Erdeiné, K.-G. S. (2023). The impact of corruption in climate finance on achieving net zero emissions. *Journal of International Studies*, *16*(1), 142–159. https://www.ceeol.com/search/article-detail?id=1172309

Morse, S. (2006). Is corruption bad for environmental sustainability? A cross-national analysis. *Ecology and Society*, *11*(1), 1–22. https://www.jstor.org/stable/26267783

Newell, P., & Mulvaney, D. (2017). The political economy of the "just transition": The politics of fossil fuel phase-out. *Energy Research & Social Science*, *38*, 36–44. https://doi.org/10.1016/j.erss.2017.10.008

Ngamkaiwan, C. (2023). Secondary green crime: Bangkok's PM2.5 pollution and policy corruption. *International Journal for Crime, Justice and Social Democracy*, *12*(4), 65. https://doi.org/10.5204/ijcjsd.2857

Ostrom, E. (2010). Polycentric systems for coping with collective action and global environmental change. *Global Environmental Change*, *20*(4), 550–557. https://doi.org/10.1016/j.gloenvcha.2010.07.004

Pellegrini, L., & Vujic, S. (2003). *Corruption, economic development and environmental policy*. Institute for Environmental Studies. https://www.feem-web.it/ess/ess03/students/pellegr.pdf

Persson, A., Weitz, N., & Nilsson, M. (2019). Follow-up and review of the sustainable development goals: Alignment vs. internalization. *Review of European, Comparative & International Environmental Law*, *28*(1), 59–68. https://doi.org/10.1111/reel.12219

Purdon, M. (2015). Advancing comparative climate change politics: Theory and method. *Global Environmental Politics*, *15*(3), 1–26. https://doi.org/10.1162/GLEP_a_00301

Rafaty, R. (2018). Perceptions of corruption, political distrust, and the weakening of climate policy. *Global Environmental Politics*, *18*(3), 106–129. https://doi.org/10.1162/glep_a_00471

Romano, G., Masserini, L., & Lombardi, G. V. (2021). Environmental performance of waste management: Impacts of corruption and public maladministration in Italy. *Journal of Cleaner Production*, *288*, 125521. https://doi.org/10.1016/j.jclepro.2020.125521

Shang, W., Li, H., Ni, X., Chen, T., & Liu, T. (2025). BlockGuard: Advancing digital copyright integrity with blockchain technique. *Computers and Electrical Engineering*, *122*, 109897. https://doi.org/10.1016/j.compeleceng.2024.109897

Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). *Biometrika*, *52*(3–4), 591–611. http://links.jstor.org/sici?sici=0006-3444%28196512%2952%3A3%2F4%3C591%3AAAOVTF%3E2.0.CO%3B2-B

Tacconi, L., & Williams, D. A. (2020). Corruption and anti-corruption in environmental and resource management. *Annual Review of Environment and Resources*, *45*, 305–329. https://doi.org/10.1146/annurev-environ-012320-083949

Transparency International. (2020). *Corruption risks in climate finance: Challenges and solutions*. https://www.transparency.org

United Nations. (2018, September 10). Global cost of corruption at least 5 per cent of world gross domestic product, secretary-general tells security council, citing world economic forum data. *Meetings Coverage and Press Releases*. https://press.un.org/en/2018/sc13493.doc.htm

Williams, E., Kahhat, R., Bengtsson, M., Hayashi, S., Hotta, Y., & Totoki, Y. (2013). Linking informal and formal electronics recycling via an interface organization. *Challenges*, *4*(2), Article 2. https://doi.org/10.3390/challe4020136

Xu, R., Pata, U. K., & Dai, J. (2024). Sustainable growth through green electricity transition and environmental regulations: Do risks associated with corruption and bureaucracy matter? *Politická Ekonomie*, *10*(10), 1–23. https://doi.org/10.18267/j.polek.1420