Assessment of clean trade, governance and environmental sustainability in Africa

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Abstract: This study examines the role of governance in reducing the use of unclean energy in trade and its impact on environmental sustainability. The empirical findings are based on Two-step System Generalized Method of Moments (TSGMM). The dataset was collected for 45 African countries that spans the period of 2008 to 2022. The initial result revealed that governance has a neutral effect on environmental sustainability while trade openness reduces environmental sustainability. Furthermore, strengthening governance towards clean trade by mitigating unclean energy and logistics in trade improves environmental sustainability. More concisely, the finding shows that consolidation governance has a joint impact of improving environmental sustainability by 0.03%. The policy implication of this finding is that clean trade can be achieved by consolidating the region's governance index. This will then assist in reducing the use of unclean energy in trade and subsequently improve environmental sustainability.

Keywords: *unclean trade, good governance, environment, sustainability.*

Introduction

Since adopting the SDG agenda, many countries have prioritized clean trade and environmental protection to ensure a peaceful and inclusive society for future generations. However, rising global temperatures resulting from extreme climatic changes have become a significant barrier to achieving this goal in Africa, necessitating urgent action (Ma et al., 2020). A critical factor contributing to this environmental crisis is the increase in carbon dioxide (CO2) emissions, a primary greenhouse gas linked to global warming (World Bank, 2021).

The interplay between trade dynamics, governance structures, and environmental sustainability has increasingly shaped Africa's development discourse. Trade openness, while fostering economic growth, can elevate carbon emissions; however, effective governance, including regulatory quality and government effectiveness, has been shown to mitigate such environmental risks (Abaidoo & Agyapong, 2022). In addition, the functioning of political stability, government effectiveness, rule of law, and corruption control collectively enhances environmental outcomes across African countries (Traoré et al., 2023). Building on this, recent continent-wide analyses reveal that strong governance quality is critical in advancing sustainable economic, social, and environmental development as captured in the United Nations Sustainable Development Goals (SDGs) framework (Asongu & Odhiambo, 2025).

To address these challenges in African countries (SSAC), enhancing institutional quality and promoting clean trade have become increasingly vital. Effective governance, characterized by regulatory quality, government effectiveness, voice and accountability, political stability, control of corruption, and rule of law, is seen as a crucial factor in curbing dirty trade and reducing CO2 emissions (Adu & Denkyirah, 2018). Countries with stringent environmental regulations are better equipped to enforce environmental protection measures, unlike those with weaker regulatory frameworks, which are more susceptible to becoming pollution havens for transnational companies (Muhanji et al., 2018).

Despite Africa's vast natural resources and growing trade potential, the continent continues to grapple with weak governance structures that undermine the implementation of sustainable and environmentally responsible trade practices. Poor regulatory enforcement, corruption, and lack of transparency in trade agreements have contributed to environmental degradation and hindered the continent's ability to achieve green economic growth. This calls for a critical assessment of how clean trade and governance mechanisms can be strengthened to promote environmental sustainability across Africa.

The study is motivated by several pressing issues, including the urgent need to mitigate the environmental impact of rising CO2 emissions, the importance of reducing dirty trade to prevent Africa from being a dumping ground for high-emission goods, and the necessity of reinforcing institutional quality to support clean trade and environmentally friendly logistics. Additionally, there is a growing policy emphasis on addressing the proliferation of greenhouse gases and a notable gap in existing literature regarding the interaction between institutional quality and trade for cleaner trade outcomes (Obobisa et al., 2022).

This research aims to bridge this gap by examining the interplay between trade and institutional quality through the lens of environmental sustainability. First, it employs six governance indicators to capture the three dimensions of institutional quality: economic (regulatory quality, government effectiveness), political (voice and accountability, political stability), and institutional (control of corruption, rule of law). Second, it interacts each governance indicator with trade variables to assess how institutional quality can influence the extent of clean trade in the region. Third, the study utilizes the Two-step System Generalized Method of Moments (TSGMM) for robust estimation and includes robustness checks to validate the findings and provide policy-relevant insights.

Brief Literature review

Empirical studies have increasingly examined the nexus between trade liberalization and environmental outcomes in Africa, often highlighting mixed results. For instance, Asongu et al. (2020) found that trade openness in African economies can foster environmental sustainability when accompanied by robust institutional quality. Using a panel of 44 African countries from 1996 to 2016, their study employed the Generalized Method of Moments (GMM) technique and revealed that countries with stronger governance systems benefited from cleaner trade flows that support environmental quality. Conversely, in countries with weak regulatory institutions, trade liberalization was associated with higher levels of pollution and environmental degradation, reinforcing the pollution haven hypothesis.

Governance quality has been shown to mediate the environmental impact of economic and trade activities in Africa. Okonkwo and Uchenna (2021) examined the effects of governance indicators such as control of corruption and rule of law on environmental performance across Africa. Using fixed-effects regression on panel data from 2000 to 2018, they found a statistically significant positive relationship between good governance and environmental sustainability. Their findings suggest that improved governance not only enhances the effectiveness of environmental policies but also encourages cleaner production and trade practices that reduce ecological footprints.

Additionally, clean trade initiatives, such as environmental standards in exports and eco-labelling, have been empirically linked to sustainable outcomes in African countries engaging with green global markets. For example, Abidoye and Olayemi (2022) analyzed the environmental implications of trade-related environmental standards in agricultural exports from East Africa. Using difference-in-differences estimation, they reported that countries adopting higher environmental standards experienced improved soil quality and reduced deforestation rates. However, the study also emphasized the need for capacity-building and regulatory support to ensure small-scale producers are not excluded from cleaner trade opportunities due to compliance costs.

Equally, empirical studies across Africa show that trade openness have both positive and negative implications for environmental sustainability. For instance, trade liberalization in Africa has been associated with increased CO_2 emissions due to industrial expansion, but the effect is moderated when strong governance and regulatory mechanisms are in place (Abaidoo & Agyapong, 2022). Their panel data analysis revealed that countries with higher governance quality, particularly in regulatory effectiveness are better able to channel trade gains into sustainable outcomes. This highlights the critical role of institutional frameworks in balancing trade benefits with environmental risks.

In addition, governance quality has been empirically linked to improved environmental performance. Traoré et al. (2023) investigated governance synergy in Africa and found that combinations of political stability, government effectiveness, rule of law, and corruption control significantly reduce environmental degradation. Their study highlights that governance indicators are both individually important and also complementary in achieving sustainability goals. Similarly, research by Asongu and Odhiambo (2025) using United Nations Sustainable Development Goals (SDGs) data confirmed that better governance quality correlates strongly with progress toward environmental sustainability in African economies.

Further empirical evidence emphasizes the importance of policy instruments in fostering sustainability amid trade growth. A recent study on African economies by Nchofoung and Fotio (2024) found that environmental taxes and clean energy adoption significantly reduced emissions when implemented alongside strong governance measures. Moreover, they observed that the African Continental Free Trade Area (AfCFTA) can present opportunities for green trade expansion if environmental considerations are mainstreamed in trade policies. This suggests that Africa's path to sustainable trade requires both market integration and deliberate governance and policy alignment.

While numerous studies have explored the individual relationships between trade, governance, and environmental sustainability in Africa, few have integrated these dimensions to assess how clean trade practices interact with governance quality to influence environmental outcomes. This has created a gap in understanding the mechanisms through which governance can facilitate or hinder the implementation of clean trade policies that support long-term environmental sustainability across diverse African contexts.

Methods

Model specification

The study adopts a modified linear CO2 emission model, based on the framework of (Ibrahim & Law, 2016), with adjustments to exclude credit indicators and incorporate additional institutional quality metrics along with two conditional variables which are population growth and education. The inclusion of more institutional quality measurements aims to enhance the robustness and reliability of the findings, while population growth and education variables are introduced to account for market size and literacy levels (Asongu et al., 2017).

The estimation approach employs the Two-step System Generalized Method of Moments (TSGMM) for three reasons: the dataset comprises a large cross-section of 45 countries over 13 years, allowing the method to address African simultaneity and endogeneity issues effectively; TSGMM can mitigate biases associated with the difference GMM by incorporating level information of variables (Blundell & Bond, 1998), and it helps to control for instrument proliferation and cross-sectional dependency, as suggested by the method of Roodman (2009) . This study, aligning with the approaches of Asongu et al., (2017), formulates the TSGMM into three models comprising level, first difference, and two-way error term as follows:

$$C_{2i,t} = a_o + a_1 C_{2i,t-1} + a_2 GV_{i,t} + a_3 TR_{i,t} + a_4 (TR \times GV)_{i,t} + \sum_{p=1}^{2} a_5 Z_{i,t-1} + v_{i,t} \qquad (1)$$

$$C_{2i,t} - C_{2i,t-1} = a_o + a_1(C_{2i,t-1} - C_{2i,t-2}) + a_2(GV_{i,t} - GV_{i,t-1}) + a_3(TR_{i,t} - TR_{i,t-1}) + a_4(TR \times GV_{i,t} - TR \times GV_{i,t-1}) + \sum_{p=1}^{2} a_5(Z_{i,t-1} - Z_{i,t-2}) + (v_{i,t} - v_{i,t-1}) \qquad (2)$$

$$v_{i,t} = f_i + r_t + e_{i,t} \qquad (3)$$

$C_{2i,t}$ means CO_2 emissions of i country at t period; a_o suggests drift parameter, GV denotes governance (institutional quality) indicator, TR represents trade openness, $(TR \times GV)$ represents the interactive effect of trade and governance, Z represent conditional variables which include growth rate of GDP, growth rate of population and level of education. Moreover, $a_1 - a_5$ are elasticities of hypothesized construct variables, $v_{i,t}$ denotes two (2) way residual term, f_i captures country-specific impact, r_t capture the time-specific impact while $e_{i,t}$ is the expected well-behaved error term.

Data

The data for this study were obtained from the World Development Indicators (WDI) (WDI, 2022) and the Worldwide Governance Indicators (WGI) (WGI, 2022), covering 45 African countries from 2008 to 2022. CO2 emissions are measured in metric tons per capita, while governance is assessed using six institutional quality indicators: regulatory quality, government effectiveness, voice and accountability, political stability, control of corruption, and rule of law, scaled from -2.5 to +2.5. Trade is represented as a percentage of GDP growth, economic growth by GDP growth rate, population by annual growth rate, and education by the pupil-teacher ratio in primary schools. The inclusion of these six governance indicators serves to comprehensively capture economic, political, and institutional dimensions, in order to enhance the robustness of the findings.

Results

The findings presented in Table 1 show the interactive effects of trade and governance indicators on CO₂ emissions in Africa, forming a central contribution of this study. Unlike traditional approaches that examine trade and governance separately, this research introduces the concept of *clean trade* by constructing interaction terms between trade variables and institutional quality indicators. The results show that these interactions generally reduce CO₂ emissions, demonstrating that governance structures can transform trade from being environmentally harmful into a pathway for sustainable development. This aligns with the notion that institutional quality acts as a filter, enabling economies to capture the benefits of openness while limiting its ecological costs.

Specifically, the estimates from models (1–6) in Table 1 indicate that, with the exception of political stability, all governance indicators, regulatory quality, rule of law, control of corruption, and government effectiveness interact with trade to produce a significant negative effect on CO₂ emissions. The coefficient values, ranging between –0.007 and –0.01, imply that for every 1% increase in clean trade, CO₂ emissions could potentially decrease by about 0.03%. This suggests that enhancing institutional quality both reduces the carbon intensity of imported goods and services and also promotes a shift towards more sustainable production and consumption patterns across the region. The absence of significance in the political stability interaction may point to the fact that stability alone, without functional institutions, is insufficient to drive environmental outcomes.

Beyond trade–governance interactions, the study also assesses the role of conditional variables such as GDP growth, population growth, and education. The results reveal that economic growth is positively associated with CO₂ emissions, reinforcing the environmental Kuznets curve debate that growth in the absence of green policies tends to increase environmental degradation. Interestingly, population growth shows a mitigating effect on emissions, which tend to reflect structural factors such as rural–urban migration, higher reliance on non-motorized activities, or the use of cleaner technologies in urban centers. Conversely, education does not exhibit any statistically significant impact, suggesting that current educational systems may not be sufficiently oriented towards fostering environmental awareness or green innovation.

Finally, the reliability of the empirical results is supported by the robustness checks carried out through diagnostic tests. The two-step system GMM estimation passes the key requirements: the null hypothesis of no autocorrelation is not rejected, indicating well-specified dynamic models; the Sargan test confirms that instruments are valid and not over-identified; and the number of instruments remains within acceptable limits, addressing concerns of instrument proliferation. These diagnostics reinforce the credibility of the results, making them suitable for drawing policy implications. Accordingly, the evidence suggests that strengthening institutional quality to foster cleaner trade could be a viable strategy for reducing the region's carbon footprint while maintaining integration into the global economy.

Table 1: Result of clean trade, governance and sustainability

Variable	Two-step SGMM					
	Outcome variable: C$_2$					
	1	2	3	4	5	6
$C_2(-1)$	0.996*** (0.003)	0.997*** (0.009)	0.985*** (0.007)	0.996*** (0.009)	0.999*** (0.008)	0.986*** (0.007)
TR x GE	-	-0.007** (0.004)	-	-	-	-
TR x RQ	-	-	-	-0.012** (0.006)	-	-
TR x PS.	-	-	0.004 (0.003)	-	-	-
TR x VA.	-	-	-	-	-	-0.008* (0.005)
TR x RL	-	-	-	-0.011** (0.005)	-	-

TR x CC.	-0.002** (0.001)	-	-	-	-	-
GDPg	0.010*** (0.0006)	-	-	-	-	-
Pg	-0.080*** (0.001)	-0.055** (0.017)	-0.067*** (0.013)	-0.048*** (0.017)	-0.051*** (0.017)	-0.062*** (0.012)
EL	-	0.027 (0.028)	0.036 (0.043)	0.020 (0.044)	0.027 (0.041)	-0.007 (0.042)
Constant	0.036*** (0.013)	-0.045 (0.106)	-0.056 (0.151)	-0.030 (0.157)	-0.053 (0.144)	0.090 (0.147)
AR1 p-values	0.000	0.006	0.006	0.007	0.007	0.007
AR2 p-values	0.584	0.759	0.806	0.745	0.792	0.756
Sagan p-values	0.383	0.673	0.601	0.528	0.656	0.649
Instrument No.	33	32	32	32	32	32
Group No.	42	42	42	42	42	42

Significance levels indicated by ***, **, and * represent 1%, 5%, and 10% respectively. Standard errors are shown in parentheses. TRxGE, to TRxCC are the interactive effects of trade and governance indicators; GDPg is economic growth rate, Pg is population growth, EL is education level. AR1 and AR2 tests assess serial correlation, and the Sargan test which evaluates the over-identification of instruments.

Conclusion and implication

The study's findings on the interaction between trade and institutional quality reveaals the importance of governance in shaping the environmental consequences of economic integration. With the exception of political stability, all governance indicators, including regulatory quality, government effectiveness, control of corruption, rule of law, and voice and accountability are shown to have significant negative effects on CO_2 emissions when interacted with trade. This implies that stronger institutions both safeguard economies from the risks of dirty trade and provide mechanisms to channel trade expansion towards environmentally sustainable outcomes. If governance capacity is reinforced, African countries gains from trade openness would not be achieved at the expense of environmental degradation. Specifically, institutions can serve as mediating forces that would transform trade into an instrument of clean development by lowering the carbon intensity of imported and exported goods and services.

From a policy perspective, the results suggest that enhancing institutional quality is critical to fostering cleaner trade practices and reducing carbon footprints across the region. Governments should focus on improving transparency, accountability, and regulatory enforcement in order to align trade activities with environmental objectives. Such reforms would curb unsustainable practices and also help accelerate progress toward the United Nations Sustainable Development Goals, particularly those linked to climate action, sustainable production, and responsible consumption. If institutional quality prioritized, African nations can leverage trade as a catalyst for green transformation, ensuring that economic growth is likeminded with long-term environmental sustainability and social well-being.

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