
Harmonizing Laws and Politics: Combatting Environmental Pollution for Sustainable Development

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Abstract

This study explores the interplay among political factors, environmental pollution and sustainable development in sub-Saharan Africa (SSA). Drawing on an evaluation of the literature and empirical data, the study highlights the effect of political instability, corruption and weak governance on environmental degradation and sustainable development. The study applies the pooled ordinary least squares and the fixed effects; besides, to account for possible problems of endogeneity, the generalised method of moments (GMM) is utilized. The results show that environmental pollution worsens sustainable development, while political factors improve sustainable development. These outcomes imply that political factors are necessary to promote sustainable development because political factors allow definition of rules to protect the environment. Finally, the study proposes a policy aimed at promoting sustainable development, including strengthening environmental regulations, promoting renewable energy sources and encouraging public-private partnerships for sustainable development.

Keywords: Environmental pollution, renewable energy, clean energy, political factors, sustainable development

JEL Classification: Q01, Q42, Q52, H23

1. Introduction

Most academics agree that since the dawn of industrialization, human activity has been the primary source of most greenhouse gases (GHGs) in the atmosphere (Hallegatte *et al.*, 2016; Niang *et al.*, 2015; Osabohien *et al.*, 2024). Carbon footprints are rising as a result of production, construction, forest burning and degradation (Chindo and Abdul-Rahim, 2018; Y. Wang *et al.*, 2024; Mohamed *et al.*, 2024). A troubling phenomenon is the rise in greenhouse gas emissions, brought on by growing human activity and a geometric growth in population. These human activities that cause harm to the environment and climate have been referred to as carbon footprints or ecological footprints (Y. Wang *et al.*, 2024).

The carbon footprint, first put forth by Rees in 1992, satisfies every requirement for a thorough, growing and all-encompassing evaluation of ecological harm caused by humans (Adeleye *et al.*, 2021; Amowine *et al.*, 2021; Marti and Puertas, 2020; Mohamed *et al.*, 2024; Li *et al.*, 2024; Osabohien *et al.*, 2023). A comprehensive indicator of utilization of resources, the greenhouse gas emissions show the extent to which consumption exceeds sustainable levels (Caglar *et al.*, 2021; Safwat *et al.*, 2013). In sub-Saharan Africa (SSA), the total greenhouse gas emissions (kt of CO₂ equivalent) recorded an increase, moving from 1,978,043.183 kt of CO₂ equivalent in 2010 to 2,258,595.51 kt of CO₂ equivalent in 2020, representing an increase of 14.18% and an annual average increase of 1.42% (Adeleye *et al.*, 2021; Osabohien *et al.*, 2024). Facing this phenomenon, renewable energy sources must often be burned for human activity, which damages the ecosystem by releasing hazardous greenhouse gases (Kulu *et al.*, 2024; Minx *et al.*, 2013; Pearson *et al.*, 2017).

The effect of renewable energy adoption to curb greenhouse gas emissions is subject to good institutional quality. Referring to Acemoglu and Robinson (2010), institutions define and enforce regulations through public rules and regulatory constraints. Bhattacharya *et al.* (2017) argued that institutions enable governments to establish essential environmental policies. Key institutional indicators – such as corruption control, political stability, regulatory quality, rule of law and government effectiveness – are expected to play a significant role in shaping environmental policies and strategies aimed at reducing carbon emissions (Karim *et al.*, 2022; Degbedji *et al.*, 2024).

Scholars have found that carbon footprints are influenced by a range of economic, political, sustainable and demographic factors at different scales (national, regional or global). These carbon footprints are mainly CO₂ emissions and if action is not taken to reduce the greenhouse gas levels, additional greenhouse gas emissions will be generated (Dietz and Jorgenson, 2014). Therefore, the role of government in affecting environmental

quality is quite important (Mehmood, 2021). It is the duty of the government to formulate and carry out laws that promote resource sustainability and identify more effective strategies for attaining sustainable development (Sowman and Wynberg, 2014). Minimizing the unhygienic usage of power in commercial transactions reduces greenhouse gas emissions and enhances governance through developed regulations and effective administration. Transparency, stable governance, management of corruption and rule of law are thought to be significant considerations in this regard (Adu and Denkyirah, 2018).

The effects of greenhouse gas emissions, crude oil, renewable power sources and ecological impacts on the economy and its sustainability have all been studied (Dietz *et al.*, 2009). Research findings indicate a statistically substantial association between economic expansion and greenhouse gas emissions produced, as well as differences in the greenhouse gas magnitudes, or greenhouse gas emissions per GDP. A beneficial relationship between the pace of greenhouse gas emissions worldwide and international economic prosperity has been suggested (Garret, 2009). Using factors such as GDP per capita, capital stock, population, greenhouse gas emissions per capita, energy consumption per capita and financial growth, Saidi and Hammami (2015) looked into 58 countries from 1990 and 2012. They discovered an optimistic relationship between GDP per capita, energy use and greenhouse gas emissions per capita. Thus, achieving carbon sustainability in the face of greenhouse gases necessitates a strategy that can explain how organizations and social systems both influence and are influenced by the natural world (Dietz and Jorgenson, 2014; Liu *et al.*, 2007).

The degree to which the three elements of institutional quality – economic, political and institutional – are upheld determines the calibre of a country's institutions (Oyinlola *et al.*, 2020). Nonetheless, research has shown that countries with strong regulatory awareness enforce environmental protection laws more effectively than those with lax regulations (Pushak *et al.*, 2007). As a result, some research has examined how organizations contribute to achieving high environmental standards. For example, the panel vector error correction method was used in recent research by M. Khan and Rana (2021) to investigate the relationship between institutional excellence and greenhouse gas emissions. A panel cross-sectional ARDL was utilized by Z. Khan *et al.* (2021) to assess decentralized financing, organizational effectiveness and greenhouse gas emissions; a second-generation panel method was utilized by Obobisa *et al.* (2022) to analyse technological advancement, greenhouse gas emissions and institutions; a finite mixture method was employed by Wang and Yang (2022) to assess green complexity, governance and CO₂ greenhouse gas emissions; a system generalized method of moments was utilized by Ibrahim and Law (2016) to examine institutions, trade and CO₂ emissions. The present study aims to close the gap left by the previous exclusion of the six institutional quality measurement indicators from their analyses.

Africa's overall greenhouse gas emissions have spiked substantially over the past twelve years (Boden *et al.*, 2009), despite the region's relatively low level of greenhouse gas emissions (4% of global emissions; IPCC, 2022) relative to other countries. Additionally, Africa has been considered the most susceptible to environmental change and has experienced an imbalance of its effects (IEA, 2019).

Furthermore, as a result of the sudden rise in climate change brought on by the burning of fossil fuels and severe weather, it is becoming more difficult to actualize the objectives of sustainable development in Africa (Z. Khan *et al.*, 2021). For this reason, urgent attention is required (M. Ma *et al.*, 2020). Interestingly, it has been noted that emissions of carbon dioxide, which make up the majority of carbon emissions and are mostly caused by the usage of coal, natural gas and petroleum, are growing. Once more, multinational corporations have exploited Africa's lax environmental laws to their benefit, turning the continent into a hotbed of pollution by utilizing fossil fuels to generate their products and services there (Muhanji *et al.*, 2018).

Previous literature has inadequately considered the role played by political factors in the nexus between environmental degradation and sustainable development. To this end, the present study explores how institutions play a pivotal role in attaining sustainable development amid carbon footprints in SSA. The research specifically evaluates the effect of (i) political influences and (ii) environmental pollution on sustainable development. Similarly, given that institutional quality in SSA has recorded low performance according to the world governance statistics, actions to improve institutional quality can be useful to limit environmental depletion and in turn promote sustainable development. The objective of the paper is to analyse the role of political factors on the effect of environmental degradation on sustainable development in SSA. To do so, it addresses the following research questions:

- (1) What is the effect of environmental degradation on sustainable development?
- (2) Do political factors help lessen the negative effects of environmental degradation on sustainable development?
- (3) What institutional dimensions have more impact on the actualization of sustainable development?

To answer these research questions, the study utilizes a panel data on a subset of SSA countries from WDI and WGI and employing system GMM to adjust for endogeneity. The outcome of this paper can help Africa's governments to reinforce the quality of their institutions to better protect their environment. Indeed, mismanagement of the environment has led to loss of biodiversity and climate change, which has severe consequences for humans (health, agricultural activities, *etc.*). All of these are harmful for sustainable development

achievement. The remaining parts of the paper are organized as follows: Section 2 provides insights from related literature while Section 3 presents data and methods of analysis. Section 4 captures the results and discussion, and the last section concludes with policy implications of the study.

2. Insights from Theoretical and Related Empirical Literature

Development economists have focused a great deal on the impact of institutions (Beecroft *et al.*, 2020; Degbedji *et al.*, 2024; Ejemeyovwi *et al.*, 2018; Matthew *et al.*, 2021; Karakara and Osabuohien, 2021; Karim *et al.*, 2022) and thus, scholars (such as Wawrzyniak and Doryń, 2020; Karim *et al.*, 2022) have concluded that institutions play a pivotal role in promoting and achieving environmental sustainability. These scholars have theoretically examined how institutions act as a society rule of the game that help shape and sharpen human relations/interactions (North, 1992). This means that institutions could be an incentive for penalties that lead to sustainable development (Alonso and Garcimartín, 2013).

Institutions are said to be the fundamental cause of economic growth because they help structure property rights protection and if weak institutions exist, environmental destruction may be witnessed (Beecroft *et al.*, 2020; Cadoret and Padovano, 2016; Ejemeyovwi *et al.*, 2018). For instance, Aguirre and Ibikunle (2014) and Bhattacharya *et al.* (2017) contended that institutions that promote property rights protection support voluntary exchange and help governments design and implement sustainable development policies. The effectiveness of environmental policies depends on the efficacy of institutions, without which government policies will not bear the desirable outcome. Thus, political factors (good governance, democratic elements, *etc.*) in a country foster good environmentally benign living.

A country weak in law and politics is a source of regulatory risk, which dwells on risks that potentially affect a country's effort to implement environmental regulations at the economic and industrial levels, including those of compromising rules governing a country's environment (De la Torre and Neckar, 1988). However, good institutions such as rule of law, political stability and voice and accountability would lead to crafting and implementing good environmental policies that help achieve sustainable development. Other scholars have empirically examined institutions and environmental issues using samples of countries. For instance, Wawrzyniak and Doryń (2020) analysed how institutional quality affects greenhouse gas emissions for a panel of 93 emerging economies and found that the presence of strong institutions reduces environmental deterioration (CO₂).

In a similar study, Déés (2020) assessed the role of institutions in limiting environmental externalities by selecting 142 countries and adopting a non-linear framework. The author revealed that institutions such as quality regulations and the rule of law mitigate the effect of affluence on environmental degradation. Z. Khan *et al.* (2021) also considered a panel of 176 countries and discovered evidence in favour of the claim that inventiveness and high-quality institutions help in achieving sustainable development. Also, Haldar and Sethi (2021) found that institutions have a moderating influence on energy consumption and greenhouse gas mitigation for the countries analysed. They did this by using the system GMM, FMOLS, panel quantile regression and panel grouped mean techniques on a panel of 39 developing countries.

Again, Riti *et al.* (2021) looked at the impact of press freedom on environmental degradation across ten chosen countries between 1993 and 2016 by employing the pooled mean group technique. Their conclusion was that press freedom can reduce CO₂ emissions. In another study on sub-Saharan Africa, Yameogo *et al.* (2021) showed that regulatory effectiveness is a motivator to maintain an environment of high standards. They also concluded that corruption management is a core indicator of lessening environmental damage. Their findings were also confirmed by Karim *et al.* (2022), who concluded that greenhouse gas emissions may be significantly lowered by corruption control, rule of law and regulatory effectiveness in their study on 39 SSA countries. These findings were strongly alluded to by Asongu and Odhiambo (2021), who studied 44 SSA countries. They went further to demonstrate that the claim that there is an adverse association between institutions and CO₂ emissions is unfounded and unproven for SSA.

Martínez-Zarzoso (2008) examined countries across various income brackets from 1975 to 2003 and discovered that while urbanization had significant effects on greenhouse gas emissions for lower- and middle-income countries, it had an equally significant effect on greenhouse gas emissions for higher-income countries.

The impact of sustainable trade and institutional quality on greenhouse gas emissions was examined by Maji *et al.* (2023). Their empirical results cover 45 African countries between 2008 and 2020 and are centred on the generalized method of moments. The results showed that trade openness raises carbon emissions while institutional quality has little effect on them. On the other hand, greenhouse gas emissions reduced decreased by improving institutional quality with regard to sustainable trade. More specifically, a 1% increase in institutional quality regarding sustainable trade will result in a combined 0.04% reduction in greenhouse gas emissions.

There are other, country-specific empirical studies. For instance, Murshed (2020) studied Bangladesh by employing time-series data between 1971 to 2018 and evaluated the role of democracy in the EKC hypothesis. The author confirmed that the study country has the EKC; however, the author added that controlling for democracy lowers the income and deforestation threshold. Also, Dada and Ajide (2021) concluded that institutional quality enhances pollution abatement in Nigeria after employing the ARDL model for Nigeria. However, the authors indicated that on an ordinal scale of 0–10, a threshold level of 5.69 is needed to reduce environmental damage in Nigeria. Similar findings were reported by Yuan *et al.* (2021) for the Chinese industry.

While Maji *et al.* (2023) effectively examined the influence of sustainable trade and institutional quality on greenhouse gas emissions across 45 African countries, we expand the literature. For example, Yameogo *et al.* (2021) provided a regional perspective on the interconnections between institutional quality and environmental performance within the SSA context, highlighting how governance factors can amplify or mitigate environmental impacts. Such findings align closely with the analysis by Maji *et al.* (2023) and underscore the unique political and economic structures in African countries that influence institutional quality and environmental sustainability outcomes.

In addition, Jaffar *et al.* (2024) and Maji *et al.* (2023) explored the synergies between governance and environmental regulation, shedding light on how institutional factors such as regulatory quality and control of corruption can be pivotal in shaping sustainable development pathways. This perspective is essential as it highlights how governance enhances or constrains efforts towards carbon reduction and pollution control, particularly in trade-exposed sectors. Moreover, we expand the scope of the literature review to encompass studies on institutions and economic growth would further contextualize the impact of institutional quality on sustainable development. For instance, Degbedji *et al.* (2024) examined how robust institutional frameworks support economic expansion – a driver of sustainable growth. On the other hand, Sahan *et al.* (2024) discussed green behaviour and environmental sustainability.

Recent studies reinforce the critical role of political and institutional systems in shaping environmental and sustainability outcomes. Methodologically, Yang *et al.* (2024) advanced heterogeneous panel modelling using functional-coefficient quantile regression with latent group structures, offering tools relevant for comparative sustainability assessment. Thematically, Duan (2025) conceptualized sustainability as a balancing act across the energy–environment–development triad, consistent with SSA's governance challenges. Governance-linked performance effects are observed in Gao *et al.* (2025), who found that pay trans-

parency reforms enhance inventor productivity, and Wu *et al.* (2025), who documented the innovation effects of shareholder activism. Mugambiwa and Sibanda (2025) added a climate migration perspective, advocating risk-informed governance approaches for climate-driven displacement. From a circular-economy lens, Hu *et al.* (2026) analyzed lithium battery recycling enterprises in China, linking smart waste governance to public health. Jin *et al.* (2025) showed that decentralized fiscal expenditure improves sustainable development, reinforcing institutional arguments that political capacity conditions sustainability outcomes in.

3. Methodology

3.1 Model specification

The objective of this paper is to capture the effect of political factors and environmental pollution and other covariates on sustainable development. This research is one of the very first to evaluate this concept and proxy sustainable development with adjusted net savings. The empirical model hinges on the work by Adu and Denkyirah (2018), Asongu and Odhiambo (2021), Dada and Ajide (2021) and Karim *et al.* (2022). The baseline model is presented in Equation (1) in its double-log form.

$$\ln SD_{it} = \beta_0 + \beta_1 \ln PF'_{it} + \beta_2 \ln EP_{it} + \beta_3 L_{it} + \beta_4 \ln K_{it} + e \quad (1)$$

where *SD* means sustainable development (proxied by adjusted net savings), *PF'* is a covariate of political factors which include regulatory quality, government effectiveness, control of corruption, rule of law, voice and accountability, political stability and absence of violence. Besides, *EP* means environmental pollution measured by total greenhouse gas emissions, while *L* and *K* measures labour and capital, respectively and *e* is the stochastic term representing other variables not comprised in the model.

The study employs the pooled ordinary least squares (POLS) and the fixed effects. However, to control for endogeneity, the study applies the system generalized method of moments (GMM) in the estimation. We apply the POLS, fixed effects and system GMM by following Arellano and Bover (1995) as well as Blundell and Bond (1998) and Roodman (2009), who presented empirical evidence using system GMM, which performs well with highly persistent data under mild assumptions. Political factors in our study are judged to be persistent as Heid *et al.* (2012) noted in their study that democracy is persistent. Thus, our system GMM model specification is in Equation (2):

$$\ln SD_{it} = \beta_0 + \gamma \ln SD_{it-1} + \beta_1 \ln PF'_{it} + \beta_2 \ln EP_{it} + \beta_3 L_{it} + \beta_4 \ln K_{it} + e \quad (2)$$

where variables are as defined above, $\ln SD_{it-1}$ indicates the first lag of the dependent variable, sustainable development. Similarly, \ln is the natural logarithm of the variable, while the subscript it represent entities¹ and time, respectively. The variables, measurements and their respective causes are presented in table 1.

3.2 Rationale for the variables and “a priori” expectations

It is expected that political factors such as government effectiveness, rule of law, political stability, absence of violence, regulatory quality, voice and accountability and control of corruption may significantly influence sustainable development. Government effectiveness refers to the potential of a government to provide public services efficiently and effectively. It implies that government that is efficient and effective in delivering public services can contribute to sustainable development by providing basic amenities such as healthcare, education and infrastructure (Chaudhary and Kattel, 2015).

The rule of law ensures that laws are enforced fairly and equally and that the civil liberties of citizens are guarded. When the rule of law is strong, it can promote economic growth, reduce corruption and protect the environment, all of which are essential for sustainable development. Political stability and absence of violence are essential for creating an environment that is favourable to sustainable development (Lee and Strazicich, 2013). When a country experiences political instability or violence, it can lead to economic disruption, social unrest and environmental degradation (Dincer and Gokalp, 2015). Regulatory quality refers to the efficiency of rules in fostering economic growth while safeguarding the environment and public health. Good regulatory quality can promote sustainable development by ensuring that businesses operate in an environmentally responsible manner.

Voice and accountability refer to the capacity of citizens to partake in the decision-making process and hold their governments accountable.

When citizens participate in decision-making, they can advocate for policies that promote sustainable development. Control of corruption refers to the extent to which corruption is prevalent in a society. Corruption can hinder sustainable development by taking funds away from public services and infrastructure projects (Adegboye *et al.*, 2022). In summary, political factors such as government effectiveness, rule of law, political stability and absence of violence, regulatory quality, voice and accountability and the suppression of corruption

1 Algeria, Angola, Benin, Botswana, Burkina Faso, Central African Republic, Cameroon, Chad, Democratic Republic of the Congo, Egypt, Eritrea, Equatorial Guinea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Ivory Coast, Kenya, Liberia, Libya, Malawi, Morocco, Namibia, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Uganda, Tanzania, Togo and Zambia.

are critical to sustainable development. Understanding these issues and their influence on sustainable development is essential for policymakers and researchers seeking to promote sustainable development.

Furthermore, environmental pollution has been linked to various health problems, ecosystem degradation and climate change, which can undermine the persistent viability of economic and social development (Chaudhary and Kattel, 2015). Conversely, policies and institutions for environmental sustainability can promote sustainable development by regulating pollution, conserving natural resources and promoting renewable energy sources (Degbedji *et al.*, 2024). The rationale for the sustainable development model is built on the idea that economic growth must be balanced with environmental protection and social equity to ensure the long-term viability of development.

This approach recognizes that economic growth alone is not sufficient to achieve sustainable development and that environmental and social factors must also be considered (Imeokparia *et al.*, 2023). The association between sustainable development and environmental policies has been the subject of numerous research studies. For example, Dincer and Gokalp (2015) found that political stability and environmental policies were positively associated with sustainable development in Turkey. Lee and Strazicich (2013) also found that the rule of law, which includes environmental regulations, was positively associated with economic growth. Overall, environmental pollution and regulations and systems for sustainable development are critical factors in achieving sustainable development. The sustainable development model recognizes the importance of balancing economic growth with environmental protection and social equity to ensure long-term viability.

The control variables – labour and capital – are also critical factors in achieving sustainable development. The efficient use of labour and capital can enhance productivity, increase economic growth and improve social welfare (Kijima *et al.*, 2011). However, the unequal distribution of labour and capital can lead to social inequality, which can undermine sustainable development (Stiglitz, 2012). The sustainable development model recognizes the importance of promoting social equity by ensuring equal access to labour and capital. This approach involves policies and institutions that promote human capital development, equal avenue to credit and financial services and fair labour standards (UNDP, 2015).

Researchers have investigated at the association between labour and capital and sustainable development. For instance, Kijima *et al.* (2011) discovered that human capital development was positively associated with economic growth and environmental sustainability in Japan. Stiglitz (2012) also argued that reducing inequality in access to capital could promote sustainable development by increasing productivity and reducing poverty. Overall, labour and capital are critical factors in attaining sustainable development. The sustainable

development model recognizes the importance of promoting social equity by ensuring equal access to labour and capital.

Table 1: Definition of variables and sources

Variable	Source	Measurement
Sustainable development	WDI	Adjusted net savings (current USD)
Political factors		
Voice and accountability	WGI	Perceptions of the degree to which people in a country can choose their government, as well as the degree to which they can use their rights to free speech, association and the media. Range: –2.5 to 2.5 (WGI, 2023).
Rule of law	WGI	Sense of how much agents trust and follow social norms, especially regarding the strength of property rights, the police, courts and contract enforcement, as well as the probability of crime and violence. Range: –2.5 to 2.5 (WGI, 2023).
Political stability and absence of violence	WGI	Opinions about the probability of political unrest and/or violence with political motivations, such as terrorism. Range: –2.5 to 2.5 (WGI, 2023).
Regulatory quality	WGI	Opinions of the government’s capacity to create and carry out sensible laws and rules that allow and encourage the growth of the private sector. Range: –2.5 to 2.5 (WGI, 2023).
Government effectiveness	WGI	Views on the calibre of public services; the calibre of the civil service and its level of political influence resistance; the calibre of policy creation and execution; and the legitimacy of the government’s adherence to these programmes. Range: –2.5 to 2.5 (WGI, 2023).
Control of corruption	WGI	Opinions about the degree to which public authority is used for personal benefit, encompassing both small- and large-scale corruption and the “capture” of the state by leaders and special interests. Range: –2.5 to 2.5 range (WGI, 2023).
Control variables		
Labour	WDI	Labour force participation (% of total population ages 15+)
Capital	WDI	Gross fixed capital formation (using US dollars)
Total greenhouse gas emissions	WDI	Total greenhouse gas emissions (kt of CO ₂ equivalent)

Note: WDI means World Development Indicators, WGI means World Governance Indicators.

Sources: Authors’ own elaboration

3.3 Estimation techniques

The study used pooled OLS, fixed effects and GMM. Pooled OLS is a statistical technique that estimates the relationship between dependent and independent variables by minimizing the sum of squared errors. It assumes that the error term is independent and identically dispersed across all observations. This technique is commonly used in cross-sectional data analysis (Wooldridge, 2019). Fixed effects is a regression technique that controls for unobserved time-invariant variables that may affect the dependent variable. It assumes that these unobserved variables are correlated with the independent variable. This technique is commonly used in panel data analysis (Wooldridge, 2019).

GMM (generalized method of moments) is a statistical method that estimates the parameters of a model by matching the sample moments of the data with the population moments of the model. It is a flexible method that can handle various types of data, including panel data and time-series data (Arellano and Bover, 1995). These three techniques have their strengths and limitations, and their applicability depends on the type of data and research question. For example, pooled OLS is suitable for cross-sectional data analysis, while fixed effects are suitable for panel data analysis. GMM is flexible and can handle various types of data. In conclusion, selecting appropriate estimation techniques is crucial in EIA to ensure accurate and reliable assessments of environmental impacts. Pooled OLS, fixed effects and GMM are three commonly used techniques that have their strengths and limitations. Researchers should carefully consider which technique to use based on the type of data and research question.

4. Results and Discussion

4.1 Descriptive analysis

Table 2 summarizes the statistics of the variables utilized in the estimation. The mean of the adjusted net savings, which capture the sustainable development, is 7.28e+09 USD with a standard deviation of 1.20e+10. The data analysis shows globally that the mean of each variable of political factors is positive, meaning that control of corruption (1.846), government effectiveness (1.760), regulatory quality (1.755), rule of law (1.790), voice and accountability (1.893) and political stability (1.756) are improved in SSA countries. The average of the total greenhouse gas emissions is about 69,373.8 with a standard deviation of 113,051.3. This indicates disparities amongst African countries in terms of greenhouse gas emissions. On average, 61.92% of the total population aged 15+ participate in the labour market. The gross fixed capital formation average is 1.69e+10 USD.

Table 2: Summary statistics of variables

Descriptive statistics	Mean	Std. dev.	Minimum	Maximum
Adjusted net savings	7.28e+09	1.20e+10	9.84e+07	5.61e+10
Control of corruption	1.846	0.613	0.106	3.400
Government effectiveness	1.760	0.624	0.149	3.400
Regulatory quality	1.755	0.621	0.196	3.264
Rule of law	1.790	0.638	0.200	3.039
Voice and accountability	1.893	0.704	0.081	3.288
Political stability	1.756	0.894	0.258	3.611
Total greenhouse gas emissions	69,373.800	113,051.300	1371.038	560,857
Labour	61.927	11.127	34.637	82.783
Capital	1.69e+10	2.35e+10	1.07e+08	1.46e+11

Source: Authors' own calculations

4.2 Estimates of pooled ordinary least squares

The outcomes of the effect of political factors and environmental pollution on sustainable development using pooled ordinary least squares are reported in table 3. The outcomes reveal that all the model specifications are globally significant because the probability associated with the Fisher test is lower than 1%.

The analysis results reveal that all the political factors are favourably associated with sustainable development in SSA. Indeed, an increase of 1% in control of corruption, government effectiveness, regulatory quality, rule of law, voice and accountability and political stability improves sustainable development by 0.984%, 0.859%, 0.670%, 0.167%, 0.383% and 0.019%, respectively. The outcomes also show that total greenhouse gas emissions have a negative and substantial outcome on sustainable development for models (3), (4) and (5). Indeed, in columns (3), (4) and (5), an increase of 1% in total greenhouse gas emissions decreases sustainable development by 0.500%, 0.209% and 0.291%, respectively.

The control variables capital and labour show a positive correlation with sustainable development in the pooled ordinary least squares analysis. Indeed, an increase of 1% in cap-

ital increases sustainable development by 5.1811 (column 1), 4.9611 (column 2), 1.3809 (column 3), 0.678 (column 4), 0.614 (column 5) and 5.7011 (column 6). Finally, labour showed a noteworthy and beneficial relationship with sustainable development. In fact, an increase of 1% in labour increases sustainable development by 0.018% (column 2), 0.028% (column 6), while it decreases sustainable development by 1.311% (column 3).

Table 3: Estimates of pooled ordinary least squares analysis

Variables	1	2	3	4	5	6
Constant	19.279* (0.000)	19.229* (0.000)	-2.311 (0.416)	3.057*** (0.065)	3.040* (0.001)	18.647 (0.000)
Labour	0.016 (0.190)	0.018** (0.015)	-1.311* (0.006)	0.092 (0.745)	0.168 (0.386)	0.028** (0.013)
Capital	5.181* (0.000)	4.961* (0.000)	1.380*** (0.103)	0.678* (0.000)	0.614* (0.000)	5.701* (0.000)
EP	-8.960 (0.594)	-3.600 (0.969)	-0.500* (0.000)	-0.209* (0.000)	-0.291* (0.000)	-1.240 (0.347)
CC	0.984** (0.048)	-	-	-	-	-
GE	-	0.859** (0.028)	-	-	-	-
REQ	-	-	0.6709* (0.001)	-	-	-
RL	-	-	-	0.167** (0.027)	-	-
VA	-	-	-	-	0.383* (0.000)	-
PS	-	-	-	-	-	0.019*** (0.087)
R²	0.782	0.722	0.692	0.906	0.901	0.753
Prob > F	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***

Notes: The p -values of the variables are in brackets (); *, **, *** denote significance at 10%, 5% and 1% levels, respectively.

Source: Authors' own calculations

4.3 Fixed effects results

Table 4 reports the outcomes of the impact of political factors and environmental pollution on sustainable development. Before choosing the right outcomes, a Hausman test is carried out to discriminate between the fixed effects model and the random model. The probability associated with the Hausman test is lower than 0; this allows us to validate the fixed effects model. The outcomes show that all the model specifications are globally significant because the probability associated with the Fisher test is lower than 1%.

Table 4: Estimates of fixed effects model

Variables	Dependent variable: sustainable development (adjusted net savings)					
	1	2	3	4	5	6
Constant	18.949* (0.000)	11.013* (0.000)	10.546* (0.000)	8.808* (0.000)	12.627* (0.000)	10.318* (0.002)
Labour	0.273** (0.050)	-0.820 (0.202)	-0.649 (0.177)	-0.214 (0.633)	-0.092 (0.883)	-0.572 (0.326)
Capital	2.781* (0.000)	0.360*** (0.003)	0.330** (0.000)	0.392* (0.000)	0.309* (0.010)	0.293** (0.041)
EP	-0.890*** (0.061)	-0.532** (0.000)	-0.485*** (0.000)	-0.415* (0.000)	-0.186** (0.037)	-0.633** (0.037)
CC	0.261 (0.880)	-	-	-	-	-
GE	-	0.309** (0.018)	-	-	-	-
REQ	-	-	0.099** (0.029)	-	-	-
RL	-	-	-	0.035* (0.082)	-	-
VA	-	-	-	-	0.038 (0.862)	-
PS	-	-	-	-	-	0.052* (0.078)
Hausman	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
R²	0.557	0.698	0.822	0.891	0.820	
Prob > χ^2	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***

Notes: The variables are in their logged forms; *p*-values are reported in brackets. *, **, *** denote significance at 1%, 5% and 10% levels, respectively.

Source: Authors' own calculations

The analysis results reveal that all the political factors except corruption control and voice and accountability are significantly associated with sustainable development in SSA. Indeed, an increase of 1% in government effectiveness, regulatory quality, rule of law and political stability improves sustainable development by 0.309%, 0.099%, 0.035% and 0.052% respectively. The outcomes also show that total greenhouse gas emissions have a negative and substantial effect on sustainable development for all model specifications. Indeed, an increase of 1% in total greenhouse gas emissions decreases sustainable development by 0.890% (column 1), 0.532% (column 2), 0.485% (column 3), 0.415% (column 4), 0.186% (column 5) and 0.633% (column 6), respectively. The control variables capital and labour overall show a positive correlation with sustainable development. Indeed, an increase of 1% in capital increases sustainable development by 2.7811 (column 1), 0.360 (column 2), 0.330 (column 3), 0.392 (column 4), 0.309 (column 5) and 0.293 (column 6). Finally, labour shows a substantial and beneficial relationship with sustainable development. In fact, an increase of 1% in labour increases sustainable development by 0.273% (column 1).

4.4 GMM results

The outcomes of the effect of political factors and environmental pollution on sustainable development using the GMM technique are illustrated in table 5. The outcomes reveal that all the model specifications are globally significant because the probability associated with the Fisher test is lower than 1%. Similarly, the outcomes show the occurrence of first-order correlation (AR(1)) and the omission of second-order correlation (AR(2)). The Sargan test probability allows us to confirm that the instruments used are valid and correct the endogeneity problem. The lagged values of sustainable development are significant and positive, meaning that the past value of sustainable development is correlated with its current values. This denotes the persistence of the variable.

The analysis results reveal that all the political factors except corruption control are significantly associated with sustainable development in SSA. Indeed, an increase of 1% in government effectiveness, regulatory quality, rule of law, voice and accountability and political stability improves sustainable development by 0.049%, 0.015%, 0.012%, 0.017% and 0.043%, respectively. The outcomes also show that total greenhouse gas emissions have a negative and substantial impact on sustainable development for all model specifications. Indeed, an increase of 1% in total greenhouse gas emissions decreases sustainable development by between 0.011 and 0.690%. The control variables capital and labour show a positive correlation with sustainable development. Indeed, a 1% increase in capital improves sustainable development and by between 0.091 and 0.791%, while a 1% increase in labour increases sustainable development by 0.003% (column 2).

Table 5: GMM estimates

Variables	1	2	3	4	5	6
Constant	-0.175 (0.738)	-0.120 (0.808)	-0.048 (0.924)	0.114 (0.820)	0.353 (0.278)	-0.097 (0.844)
Labour	0.111 (0.229)	0.003** (0.024)	0.080 (0.352)	0.065 (0.449)	0.066 (0.312)	0.095 (0.291)
Capital	0.120*** (0.000)	0.7912*** (0.000)	0.112*** (0.000)	0.124*** (0.000)	0.091*** (0.000)	0.110*** (0.000)
EP	-0.017*** (0.002)	-0.6907** (0.036)	-0.018** (0.027)	-0.011* (0.049)	-0.039*** (0.004)	-0.020** (0.021)
CC	0.020 (0.390)	-	-	-	-	-
GE	-	0.049* (0.075)	-	-	-	-
REQ	-	-	0.015** (0.010)	-	-	-
RL	-	-	-	0.012** (0.033)	-	-
VA	-	-	-	-	0.017** (0.040)	-
PS	-	-	-	-	-	0.043* (0.075)
Prob > χ^2	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
AR(1)	-2.300 (0.020)	-1.610 (0.106)	-2.240 (0.025)	-2.260 (0.024)	-4.070 (0.000)	-2.390 (0.017)
AR(2)	-1.530 (0.125)	-2.180 (0.029)	-1.450 (0.146)	-1.890 (0.059)	-2.840 (0.004)	-2.860 (0.004)
Sargan test	0.651	0.692	0.683	0.640	0.687	0.619

Note: The variables are in their logged forms; *p*-values are reported in brackets. *, ** and *** denote significance at 10%, 5% and 1% levels, respectively.

Source: Authors' own calculations

4.5 Discussion of findings

Results using different estimation techniques show that environmental pollution worsens sustainable development while political factors improve sustainable development. This proves that the outcomes are robust. These outcomes imply that political factors are necessary to promote sustainable development because political factors allow definition of rules to protect environment (Degbedji *et al.*, 2024; Karakara and Osabuohien, 2021; Karim *et al.*, 2022; Wawrzyniak and Doryń, 2020).

The results of various estimation techniques consistently demonstrate that environmental pollution poses a significant challenge to sustainable development, whereas political factors generally have a positive impact. This robustness across estimation methods reinforces the validity of the findings. However, a deeper engagement with the nuanced aspects of these political factors provides additional insights. Specifically, while most political factors contribute positively to sustainable development, there is a notable exception of corruption control. Unlike other political variables, corruption control in this study does not align with positive sustainable development outcomes. This deviation invites a comparative analysis with findings from studies such as Karim *et al.* (2022), which reveal a distinct relationship between governance quality and reduced CO₂ emissions.

According to Karim *et al.* (2022), factors such as corruption control, regulatory quality and rule of law are crucial in reducing environmental degradation and enhancing sustainability outcomes. Their findings underscore that corruption control can indeed contribute to sustainability, primarily by mitigating actions that harm the environment, such as illegal emissions, unregulated industrial activities and weak enforcement of environmental standards. Thus, the findings of Karim *et al.* (2022) suggest that corruption control may be pivotal in aligning economic activities with sustainable practices by creating an environment of accountability that curbs harmful environmental behaviour.

This comparative perspective highlights the complexity of governance in sustainable development. Political factors such as rule of law and regulatory quality are vital for setting enforceable environmental standards, which foster sustainable practices across sectors. However, the contrasting role of corruption control observed in this study and Karim *et al.* (2022) suggests that its effectiveness may vary depending on the political context and the mechanisms through which corruption is managed. For instance, strong corruption control may bolster sustainable practices by ensuring that regulatory measures are applied fairly and consistently, thus limiting the scope for environmentally harmful activities. In contrast, if corruption control is weak or inconsistently enforced, it may undermine envi-

ronmental policies and dilute the impact of other political factors that support sustainable development.

Furthermore, political factors play a critical role in sustainable development by influencing the policies, governance structures and institutions needed to achieve long-term environmental, social and economic goals. Key political elements include political stability, government effectiveness, institutional quality and public accountability, each affecting sustainable development efforts in specific ways. On the other hand, political stability creates a conducive environment for long-term policies, investments and programmes essential for sustainable development. Governments in stable environments are more likely to establish consistent policies that attract foreign and domestic investments aimed at sustainable projects. Strong institutions and rule of law are fundamental to enforcing regulations, property rights and standards that encourage sustainable practices. Acemoglu and Robinson (2010) emphasized that effective institutions limit the influence of corruption and ensure compliance with environmental regulations, enabling governments to enforce policies such as emission control and sustainable resource management.

Effective political commitment and accountability to citizens ensure that sustainability objectives reflect public needs and ethical standards. Political will is crucial for implementing policies such as renewable energy incentives, sustainable agriculture and educational programmes. Public accountability mechanisms, such as transparency and civic participation, empower citizens to hold governments accountable for their environmental commitments, promoting policies that align with long-term sustainability. Political factors also include regulatory quality and international cooperation. Collaborative agreements, such as the Paris Agreement on climate change, require countries to meet shared environmental goals, which can be undermined by political resistance or weak regulatory frameworks. Political commitment to these international standards enables countries to coordinate action on shared sustainability issues such as climate protection and biodiversity conservation.

Our outcomes are consistent with several studies in literature which found that political factors are favourable to sustainable development. For instance, Wawrzyniak and Doryń (2020) found in 93 developing economies that the existence of robust institutions reduces environmental degradation (CO₂). Déés (2020) revealed that institutions such as the rule of law and regulatory quality mediate the relationship between income and environmental degradation. Z. Khan *et al.* (2021) likewise observed a group of 176 economies and supported the claim that innovation and quality institutions aid in achieving sustainable development. Also, Haldar and Sethi (2021) concluded on a panel of 39 developing countries that there is a restraint effect of institutions on energy consumption in the form of CO₂ abate-

ment. Riti *et al.* (2021) found that press freedom can lower greenhouse gas emissions.

Yameogo *et al.* (2021) showed in SSA that regulatory quality is an inducement to maintain a conducive environment. They also concluded that corruption control is a core measure of lessening environmental damage. Karim *et al.* (2022) showed that CO₂ emissions may be significantly lowered by corruption control, rule of law and regulatory quality in their study on 39 SSA countries. Dada and Ajide (2021) concluded that institutional quality enhances pollution abatement in Nigeria. However, the authors indicated that the minimum amount on an ordinal scale of 0–10 needed to reduce environmental pollution in Nigeria is 5.69. The outcome contrasts with those of Madji *et al.* (2023), who revealed that institutional quality has a neutral impact on carbon emissions but strengthening institutional quality towards green trade reduces carbon emissions.

The novelty of our study consists in the fact that we focused on law and the political dimension of institutions. Firstly, institutions are weaker where there is a lawless environment or weak laws. In such a situation, development could occur without recourse to the environment. Hence, lawlessness breeds environmental destruction, leading to unsustainable development. Secondly, political factors could affect sustainable development. Even if there are laws and institutions but the political will is very weak or the political power corrupted, then achieving sustainable development could be a mirage. A strong political will would not only help craft environmentally benign policies but also ensure their implementation. Hence, gaining an understanding of sustainable development within the purview of law and political factors is germane for Africa, given the fact that most African countries have weak governance structures, often experiencing military takeover of power.

5. Summary and Conclusion

Human activities have a profound and often adverse impact on the environment. Indeed, pollution from human activities has a negative impact on environmental quality. Thus, strong environmental policies are necessary to cope with the negative loop of environmental degradation and to achieve sustainable development. The study discussed how political factors such as political instability, corruption and weak governance have contributed to environmental degradation and hindered efforts towards sustainable development in sub-Saharan Africa (SSA). The study applied the pooled ordinary least squares, the fixed effects and, to control for possible problems of endogeneity, the generalised method of moments (GMM) was utilized. The results showed that environmental pollution worsens sustainable development, while political factors improve sustainable development.

These outcomes imply that political factors are necessary to promote sustainable development because political factors allow definition of rules to protect the environment. Indeed, respect for contracts in environmental protection hinges on the reinforcement of good institutional quality, notably control of corruption, voice and accountability, government effectiveness, political stability, rule and law and regulatory quality. Indeed, corruption can lead states to neglect environmental protection regulations, as they may prioritize personal or financial gains over environmental quality. In such cases, government officials may overlook environmental laws, accept bribes to allow harmful practices or fail to enforce penalties for violations. This lack of oversight undermines environmental health, allowing activities that can pollute air, water and soil, ultimately compromising public health and sustainability. In contrast, control of corruption can help respect environmental protection regulations thanks to penalties imposed.

Similarly, voice and accountability play a vital role in environmental outcomes, as they allow citizens to influence environmental policies, hold leaders responsible and foster transparency in government actions. When citizens have a strong voice and can hold officials accountable, they are better equipped to demand sustainable practices, stricter pollution controls and adherence to environmental regulations. Political stability is crucial for effective environmental protection and sustainable development. In politically stable environments, governments can develop and implement long-term environmental policies, enforce regulations and ensure consistent management of natural resources.

The rule of law is fundamental for effective environmental governance, as it establishes clear legal frameworks, ensures accountability and promotes sustainable resource management. When environmental laws and regulations are enforced fairly and transparently, they help limit pollution, protect biodiversity and manage natural resources responsibly. Finally, the study proposes policy recommendations aimed at promoting sustainable development in the region, including strengthening environmental regulations, promoting renewable energy sources and encouraging public-private partnerships for sustainable development. The discoveries of this study have important implications for policymakers, scholars and practitioners seeking to promote sustainable development in SSA.

This study is not without limitations. These limitations can serve future research. For example, SSA countries are grouped into integration zones to have common rules of development. So, future research can analyse the nexus between political factors, environmental degradation and sustainable development while focusing on these integration zones.

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