Assessing the role of top down and bottom-up institutional change in shaping the environmental performance of developing countries.

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Abstract
The literature analysing the effect of institutions on environmental quality remains quite controversial. However, very little is known about the effect of institutional change on environmental performance. In this vein, the origin of change to the best of our knowledge has not yet been considered in the literature. By using secondary panel data over the period 2000-2020, we attempt a top-down and bottom-up approach to institutional change and analyse their effects on environmental performance in developing countries. Top down measures are political alternation and constitutional change from Bjornskov and Rode (2020), bottom up institutional change is measured using political, social protests and strikes from the ACLED dataset, while environmental performance is measured by the environmental performance index provided by the Yale centre for environmental law and policy. Based on the Driscoll-Kraay fixed effects ordinary least square methodology, we find that the top-down and bottom-up approaches of institutional change increase environmental performance in developing countries. These results remain robust when controlling for endogeneity. Further, we found that this effect is mediated through human capital, foreign direct investments and renewable energy. These results therefore recommend the importance of institutional change for better environmental performance.

Keywords: Institutional change, bottom up IC, top down IC, Political alternation, constitutional change, political and social protests, strikes, environmental performance, Developing countries.

Introduction

Environmental performance has got considerable attention from the literature following changes in climatic conditions and its negative repercussions all over the world. The importance of environmental performance (EP) for development is real as it constitutes three of the 17 objectives of the sustainable development goal agenda 2030.[1] As a result of growing ecological pressure linked to increasing demand for energy, food, water and other resources, and decreasing bio capacity, the majority of developing countries are experiencing ecological deficits. Some researchers previewed that almost half of the world's wild species could become extinct in the coming decades if the inverse relationship between economic growth and biodiversity continues (Ullah and Kim, 2021). It is therefore important to determine the factors affecting environmental performance. The literature identifies historical, economic, social, as well as institutional factors explaining different components of EP including CO2 emissions, ecological footprint, biodiversity, and air quality (Wang et al., 2017; Halkos et al., 2015; Ryden et al., 2020). A recent literature considers the production pattern and unsustainable consumption as important factors for environmental deterioration (Ahmed and Wang, 2019; Ahmed et al., 2020; Omojolaibi and Nathaniel, 2020). Even though this literature is legitimate mostly for developing countries, the issue on the governance of biodiversity, resilience to climate change, and assurance of ecosystem vitality among others remain of paramount importance and therefore necessitate appropriate institutional reforms. Our study is part of the body of works analysing the influence of institutions on environmental quality. The objective of this study is to analyse the effect of IC on EP by making a distinction between top down and bottom-up approaches to IC[2]. The literature on the effect of IC on EP is very scarce. We borrow from existing studies on democracy to establish a relation. Theoretically, Payne (1995) established that democratic accountability influences EP. Bottom up IC could influence EP thanks to the ecological awareness along with freedom of speech which enables the general public to protest and pressurise the democratic government to enforce stringent environmental laws which may promote ecological performance (Farzin and Bond, 2006).

Our study contributes to this literature in three main aspects. First this study uses a recent measure of EP. We use the environmental performance index (EPI) provided by the Yale Centre for environmental law and policy which, unlike existing measures, considers a multifaceted aspect of EP by considering both environmental health policy components, climate change, and ecosystem vitality indicators that existing studies do not use. Indeed, existing studies in their analysis limited environmental measures to ecological footprint, biodiversity, or CO2 emissions which does not provide a more holistic analysis of the concept of environmental performance. Second, compared to existing studies, this study considers IC rather than institutions by making a distinction between top down and bottom-up approach to IC. To the best of our knowledge, this study is the first to make such analysis. This distinction might be of interest for one main reason. On one hand, top down IC generally provides the de jure institutional laws that could enable better EP, and on the other hand, the political leaders might be geared towards rent seeking action which could not favour the protection of the environment. Meanwhile, bottom up IC engendered by the population demand for healthier environment through protests and strikes reflects the de facto and effective application of

[1] Goals 13, 14, and 15 are directly related to indicators of environmental performance including both environmental health and ecosystem vitality.

[2] Top down IC is an IC which is initiated by the top leadership while the bottom up IC emanates from the population (Easterly, 2008).

good environmental habits which could boost more environmental quality. Third, we test three main transmission channels namely, human capital, foreign direct investments, and renewable energy using structural equation modelling. Indeed, the effect of IC on EP could be mediated through these three channels. For instance, on one hand, the literature on the effects of institutions in general, and IC in particular show that IC have an effect on education, foreign direct investment, as well as energy consumption (Ansell, 2008; Persson Thunqvist et al., 2019; Dunning, 2004; Sabir et al., 2019; Uzar, 2020; Chen et al., 2021). On the other hand, part of the literature admits that human capital (Ahmed and Wang, 2019; Ahmed et al. 2020), foreign direct investment (Li et al., 2019; Wang et al., 2016; To et al., 2019), and renewable energy consumption (Shafiei and Salim, 2014; Hanif, 2018; Ahmed et al., 2022) do have significant effects on environmental performance.

To assess the effect of institutional change on environmental performance, we rely on a panel data set for the period 2000-2020 using the fixed-effect estimator with corrected standard deviations of Driscoll and Kraay (1998). This estimator has the advantage over the traditional fixed-effects estimator of correcting for heteroscedasticity and autocorrelation of residuals on one hand, and takes into account the interdependence of individuals when the period of study is long, on the other hand. As robustness tests, we account for endogeneity using the generalised method of moments and instrumental variable quantile regressions, to correct potential simultaneity and consider the effect of IC on the whole distribution of EP rather than the mean. Our results show a positive effect of both top down and bottom-up institutional change on environmental performance, suggesting that EP increases as the institutional environment changes. This result remains robust to alternative estimation techniques. The results also confirm our intuitions concerning the transmission channels.

The organisation of this paper is as follows. The second introduces the methodology and data. The third section presents the empirical results, while the final section concludes.

2. Methodology and data source

The aim of this study is to examine the effect of institutional change on environmental performance by making a distinction between top-down and bottom-up institutional change on a panel of 100 developing countries over the period 2000-2020. For this purpose, the empirical strategy consists of presenting the model specification and data, and identification strategy.

2.1 Model specification

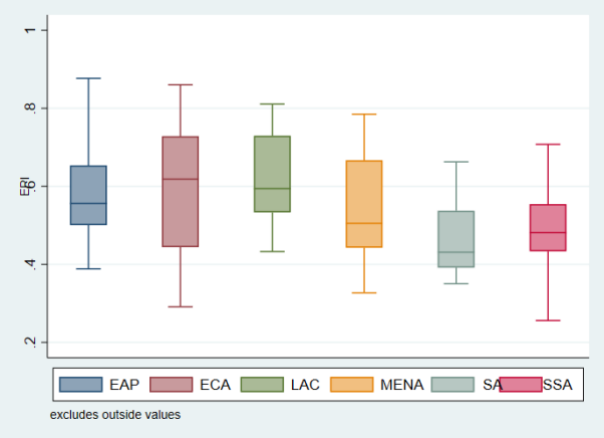
To examine the relationship between institutional change and environmental performance, the specification of the model is as follows:

$$EPI_{it} = \alpha_0 + \alpha_1 EPI_{it-1} + \alpha_2 IC_{it} + \beta_j X_{it} + \mu_i + \gamma_t + \varepsilon_{it} \qquad (1)$$

EPI_{it}, is an indicator of the environmental performance of country i at period t, IC_{it} , captures institutional change, X_{it} is the vector of control variables, μ_i the individual specific effect, γ_t the temporal specific effect, ε_{it} the error term, and α_k and βj the parameters of the model. To measure environmental performance, we use the environmental performance index from the Yale centre for environmental law and policy. The index is composed of 11

main indicators each composed of different variables which include climate change mitigation, biodiversity and habitat, fisheries, acid rain, agriculture, ecosystem services, water resources, air quality, waste management, sanitation and drinking water, and heavy metals. The index ranges between 0 (low performance) and 1(high performance). Figure 1 represents the distribution and level of the environmental performance by regions in our sample.

Figure 1: Distribution of the environmental performance index by region in developing countries.



Source: Authors' construction

The main exogenous variable is institutional change measured using two approaches namely top down and bottom-up approaches. The top down approach to IC is that change that emanates from the top leader while the bottom-up approach is that which derives from the population (Easterly, 2008). In this study, we approximate top down approach to IC using political alternation and constitutional change obtained from Bjornskov and Rode (2020). The variable alternation obtained is a dummy variable that determines whether power has changed peacefully with the present institution as a result of elections, while constitutional change captures whether a new constitution has been implemented. The Bottom-up approach is proxy using Political and social protests and strikes from the ACLED[3] database based on the works of Mondjeli and Fokou (2022).

The control variables are *natural resources, GDP per capita, Urbanisation, trade openness, legal origin, and democracy*. Total benefits from natural resources measure the sum of the profits from oil, natural gas, coal, minerals and forests to GDP. We expect natural resources to reduce EPI (-). GDP per capita measures the country's income level and level of economic development. Greater amounts of GDP per capita are generally correlated with high level of pollution in developing countries which tend to reduce environmental. We expect GDP per capita to reduce EPI (-). Urbanisation captures the proportion of the population living in urban areas. Trade openness measures the sum of imports and exports registered by a given country expressed as a percentage of its GDP. Legal origin is a binary variable that takes the value of 1 if a country practice the British common law and 0 otherwise. Democracy is an assessment of the political regime of a country. The variable polity 2 obtained from the polity IV dataset is a proxy for the transition of a country from less democratic (-10) to more democratic (+10).

[3] Armed conflict location and event database.

Data on legal origin are obtained from Laporta et al. (1998) while data on natural resources and GDP per capita, trade openness, and urbanisation are obtained from the World Bank development indicators (WDI).

2.2. Identification Strategy

To estimate this econometric model, we first apply the fixed effects Ordinary Least Square regressor technique of Driscoll and Kraay (1998). The advantage of this technique is to take into account the heterogeneities between groups and especially to correct the potential heteroscedasticities and autocorrelations that may exist between variables while taking into account the cross-sectional dependencies within the groups. Also, this estimator is able to handle missing values and does not impose any restriction on the limiting behaviour of the number of individuals with respect to the temporal dimension of the panel. In addition, the Driscoll-Kraay fixed-effect estimator has the advantage of proposing a non-parametric variance-covariance matrix that generates not only consistent standard errors under the assumptions of homoscedasticity and autocorrelation but also standard errors that are robust to cross-sectional dependence. The Driscoll-Kraay standard deviation estimation thus ensures that the covariance matrix estimator is consistent regardless of the cross-sectional dimension and eliminates the deficiencies of other large-scale consistent covariance matrix estimation methods (Hoechle, 2007). Although this estimator is interesting, it has the limitation of not correcting for endogeneity.

Theoretically, an endogeneity problem can arise in this model due to simultaneity[4], omitted variable bias, or measuring errors. To solve the simultaneity bias, the two-step system generalised method of moments of Blundell and Bond (1998) combined with Windmeijer's (2005) standard error corrections is used. For more robustness, we employ the instrumental variable quantile regression which is considered to be more robust as compared to the GMM estimations. Indeed, added to the point that this technique solves endogeneity bias using internal instruments just as the GMM, it has the particularity of considering the effect on EPI at different levels rather than the average effect as well as control for unobserved confounders. Indeed, introduced by Harding and Lamarche (2009) the instrumental variable quantile regression technique with fixed effect has the advantage to examine the effect of institutional change at different quantiles of the conditional distribution of environmental performance while accounting for unobserved factors that may possibly impact the EP and are correlated with IC. We test the effect of IC on EPI considering the 5^{th}, 10^{th}, 15^{th}, 25^{th}, 50^{th}, 75^{th}, 85^{th}, and 95^{th} quantile.

3. Empirical Results

In this section, we deal with the presentation and analysis of the results obtained. First we start by the presentation of the baseline results of the effect of top down and bottom institutional change on environmental performance. Second, we proceed by providing a series of robustness and sensitivity test including controlling for potential endogeneity. Third we test

[4] This is an endogeneity bias that arise when many variables in the model are determined at the same time or influence each other.

for the potential transmission channels through which institutional change influence environmental performance using structural equation modelling.

3.1. *Baseline line results*

Table 1 below presents the baseline results obtained of the effect of institutional change on environmental performance respectively for top down and bottom-up institutional change. Columns 1 and 2 present the effect of political alternation and constitutional change on EPI while columns 3-6 present the results of the effect of political protests, social protests, political strikes, and social strikes. The results obtained in column 1 show that political alternation increases environmental performance in developing countries at 1% level of significance. These results suggest that as power change peacefully after elections, the political leader has the ability to increase EP by 3.7% everything remaining constant. Theoretically, based on the public choice developments this result can be justified by the fact that political alternation that gives rise to a leftist political leader would favour policies that aimed at improving the institutional quality and so does the environmental performance. Indeed, better EP arises from a good governance in terms of biodiversity conservation and climate change mitigation (Samimi et al., 2012). On factual basis, climate change and pollution constitute a present and long-term problem faced by both developed and developing countries which raise great attention both to political leaders and researchers. As such, a new political leader would likely favour policies that aimed at improving the environmental quality of his or her country rather than doing anything else. On the empirical plan, borrowing from the literature on democracy and environmental indicators, this result corroborates with those of Ryden et al. (2020) which found that democracy is an important instrument for biodiversity conservation and management. Similar results are obtained by Ahmed et al. (2022) according to which democracy enables ecological sustainability through a reduction in ecological footprint. Regarding the effect of constitutional change, we found no significant effect on EP. As to what concern the bottom up measures of IC, we found that political protests, social protests, and political strikes are significant in increasing the EP of developing countries at least at 10%. The results validate the hypothesis according to which citizens greatly contribute in improving the EP of their environments. Indeed, Almeida and Garcia-Sanchez (2017) argue that demographic as well as social factors help to foster environmental quality thanks to the awareness of citizens and organisations who give great interest to ecological issues.

As to what concern the control variables, we found that GDP per capita growth, natural resources and British legal origin reduce EP while trade openness, democracy, and urbanisation have a positive effect on EP. In particular, we find that GDP per capita growth has a strong negative effect (1%) on EP in line with the environmental kuznet curve hypothesis according to which the expansion of economic activities contribute to environmental pollution for developing countries (Grossman and Krueger, 1995; Lee et al., 2009). We found that natural resources reduce EP. Indeed, the management of natural resources is associated to rent seeking behaviours. As such, political elites would care more about the revenues obtained from the extraction of these resources (for example forestry) rather than the conservation of biodiversity. Moreover, trade openness increases EP when dealing with bottom-up measures of IC. This result corroborates the findings of Managi et al. (2009) who show that trade openness have beneficial effects on the environment in OECD countries. Democracy increases EP in all regressions which confirm the arguments of Li and Reuveny (2006) according to which,

democracy enables the provision of environmental public goods as well as biodiversity conservation thanks both to the political leader and the citizens via their participation in civil society organisation and political parties.

Table 1: Effect of institutional change on environmental performance: Baseline estimations

	Top down IC		**Bottom-up IC**			
VARIABLES	Political alternation	Constitutional change	Political protests	Social protests	Political strikes	Social strikes
Alternation	0.037***					
	(0.011)					
Constitutional change		0.026				
		(0.021)				
Political protests			0.006***			
			(0.002)			
Socio-eco protests				0.003**		
				(0.001)		
Political strikes					0.031*	
					(0.017)	
Socio-eco strikes						0.002
						(0.003)
GDP per capita growth	-0.004	-0.004	-0.003**	-0.003***	-0.003**	-0.003***
	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
Total natural resources rent	-0.004**	-0.004**	-0.002	-0.002	-0.002	-0.001
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Trade openness	-0.000	-0.000	0.001***	0.001**	0.001***	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urbanisation	-0.005	-0.005	0.022**	0.021*	0.019*	0.020*
	(0.007)	(0.007)	(0.011)	(0.011)	(0.011)	(0.011)
Democracy	0.008***	0.011***	0.022***	0.022***	0.023***	0.024***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
British legal origin	0.005	-0.013	-0.133***	-0.134***	-0.141***	-0.147***
	(0.030)	(0.030)	(0.028)	(0.029)	(0.028)	(0.028)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.631***	0.647***	0.448***	0.461***	0.470***	0.466***
	(0.042)	(0.039)	(0.040)	(0.040)	(0.040)	(0.041)
Observations	1,177	1,177	1,045	1,045	1,045	1,045
R-squared	0.431	0.430	0.551	0.550	0.540	0.537
Number of countries	64	64	61	61	61	61

*Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

3.2. Robustness tests

In this study, as part of robustness analysis, we account for endogeneity by using the two-step GMM and the instrumental variable quantile estimations techniques.

(i) Robustness using two-step GMM

To tackle the endogeneity issue, we use the two-step system GMM of Blundell and Bond (1998) combined with Windmeijer's (2005) standard error corrections. This technique has the particularity of solving endogeneity bias related to simultaneity. The regressions satisfy the specification tests (AR (1), AR (2), and Hansen tests). There is no evidence of a second serial correlation, but there is strong evidence of a first serial correlation.
Moreover, the regressions pass the Hansen test and confirm the validity of the instruments. Lagged EP is statistically significant at the 1% level in all specifications, showing that EP is a path-dependent process for these developing countries. Neglecting this lagged dependent variable will compound the effect of other variables with the path-dependent effect. Too many instruments can seriously weaken and bias Hansen's test of identification restrictions. As suggested by Roodman (2009)[5], we pay close attention to the choice of the number of instruments in order to reduce the risk of instrument over-identification in the model. The system GMM presented in Table 2 generates a maximum of 24 instruments, which is less than the number of countries, and the regression results are therefore free of instrument proliferation. Regarding the estimated coefficients associated with top down and bottom-up measures, we find that political alternation and constitutional change has a significant positive effect on EP meanwhile, only the political protest and social strikes dimensions of bottom-up IC are significant. On a global perspective, these results are robust to the baseline results confirming the thesis that institutional change, both top down and bottom-up favours environmental performance.

Table 2: Effect of institutional change on environmental performance: GMM estimations

	Top down IC		**Bottom-up IC**			
VARIABLES	Political alternation	Constitutional change	Political protests	Social protests	Political strikes	Social strikes
L.EPI2	0.903***	1.165***	0.780***	0.957***	0.977***	0.861***
	(0.044)	(0.172)	(0.111)	(0.049)	(0.059)	(0.050)
Alternation	0.022**					
	(0.009)					
Constitutional change		0.813**				
		(0.405)				
Political protests			0.015*			
			(0.008)			
Socio-eco protests				0.001		
				(0.002)		
Political strikes					0.065**	
					(0.030)	

[5] The number of instruments should be less than the number of countries.

Socio-eco strikes						0.006
						(0.004)
GDP per capita growth	0.002**	0.000	0.001	0.001*	0.001*	-0.001
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Total natural resources rents	0.046*	-0.057	-0.019	-0.007	-0.014	0.038***
	(0.024)	(0.063)	(0.035)	(0.007)	(0.011)	(0.012)
Trade openness	-0.001*	0.001	-0.000	-0.001*	-0.000	0.000
	(0.000)	(0.002)	(0.001)	(0.000)	(0.000)	(0.001)
Urbanisation	0.031*	-0.016**	-0.000	-0.003	-0.001	0.012
	(0.019)	(0.007)	(0.006)	(0.003)	(0.006)	(0.009)
Constant	-0.364*	0.299	0.221	0.121*	0.131*	-0.260**
	(0.186)	(0.357)	(0.222)	(0.060)	(0.067)	(0.105)
Observations	1,311	1,311	1,026	1,026	1,026	1,026
Number of countries	74	74	61	64	64	64
No. instruments	16	14	24	12	14	20
AR1p	4.39e-09	0.0274	0.0213	0.00854	0.0115	0.0339
AR2p	0.171	0.226	0.353	0.174	0.240	0.646
Hansen p	0.128	0.673	0.865	0.728	0.395	0.343

*Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

(ii) Using the instrumental variable quantile regression technique

As earlier mentioned, the effect of IC on EP may differ at different levels or percentage of environmental performance which renders the quantile regression method appropriate when dealing with heterogeneous characteristics of the sample. Specifically, the quantile regressions provided in tables 3-8 below provides a more complete statistical analysis as it considers both low, medium, and upper levels effect on environmental performance. Instruments considered are the lagged exogenous variables of the model. Regarding the effect of political alternation, we find a statistically significant effect at 1% and 5% level of significance from the 5^{th} to 50^{th} quantile and insignificant for the rest. These results indicate that political alternation is associated with high environmental performance only among highly environmental performing countries. These results clearly demonstrate the importance of quantile regression technique as it provides a more complete statistical picture between political alternation and environmental performance. Similar results are obtained regarding the effect of constitutional change. The later just affects EP at much lower quantiles (5^{th}, 10^{th}, and 15th). The more we move further, the less significant is the effect, meaning that the introduction of a new constitution encouraging the conservation of biodiversity, less pollution among others could only foster EP in countries having a minimum of EP settled. Regarding bottom up measures, only the protests dimension is found to be significant. Indeed, political protests increase environmental performance at all interval at least at 5% significance level (exception to the 5^{th} quantile). Regarding social protests, we found significant effect only at the 85^{th} and 95^{th} quantile

The intuition behind such results is that the population's desire to reduce environmental pollution and degradation through both political and social protests results in better environmental performance mainly in countries having a low EPI (upper quantiles representing low performance).

Table 3: Effect of political alternation on environmental performance: IV quantile regressions

*Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

VARIABLES	(1) 5th	(2) 10th	(3) 15th	(4) 25th	(5) 50th	(6) 75th	(7) 85th	(8) 95th
Alternation	0.036**	0.035***	0.033***	0.031***	0.027**	0.021	0.019	0.016
	(0.014)	(0.013)	(0.012)	(0.012)	(0.012)	(0.015)	(0.017)	(0.020)
GDP per capita growth	0.001	0.000	-0.001	-0.002**	-0.004***	-0.009***	-0.010***	-0.012***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Total natural resources rent	-0.002***	-0.002***	-0.002***	-0.002***	-0.001***	-0.001	-0.001	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Trade openness	0.001***	0.001***	0.001***	0.001***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urbanisation	0.000	-0.003	-0.006**	-0.010***	-0.016***	-0.028***	-0.032***	-0.037***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.004)	(0.004)	(0.005)
Democracy	0.005***	0.005***	0.004***	0.004***	0.004***	0.003**	0.003*	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
British legal origin	-0.022*	-0.023**	-0.024**	-0.026***	-0.028***	-0.033***	-0.035***	-0.037***
	(0.013)	(0.012)	(0.011)	(0.010)	(0.009)	(0.010)	(0.011)	(0.013)
Constant	0.323***	0.361***	0.407***	0.458***	0.543***	0.716***	0.767***	0.840***
	(0.024)	(0.020)	(0.018)	(0.016)	(0.015)	(0.017)	(0.019)	(0.022)
Observations	1,177	1,177	1,177	1,177	1,177	1,177	1,177	1,177

Table 4: Effect of constitutional change on environmental performance: IV quantile regressions

VARIABLES	(1) 5th	(2) 10th	(3) 15th	(4) 25th	(5) 50th	(6) 75th	(7) 85th	(8) 95th
Constitutional change	0.049**	0.043*	0.037*	0.030	0.018	-0.007	-0.014	-0.024
	(0.024)	(0.022)	(0.021)	(0.020)	(0.021)	(0.030)	(0.034)	(0.039)
GDP per capita growth	0.001	0.000	-0.001	-0.002**	-0.004***	-0.009***	-0.010***	-0.011***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Total natural resources rents	-0.002***	-0.002***	-0.002***	-0.002***	-0.001***	-0.001*	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Trade openness	0.001***	0.001***	0.001***	0.001***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urbanisation	-0.001	-0.004	-0.007***	-0.011***	-0.017***	-0.029***	-0.033***	-0.038***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)
Democracy	0.007***	0.007***	0.007***	0.006***	0.005***	0.004***	0.004***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
British legal origin	-0.021*	-0.023*	-0.024**	-0.026***	-0.029***	-0.035***	-0.037***	-0.040***
	(0.013)	(0.012)	(0.011)	(0.010)	(0.009)	(0.010)	(0.011)	(0.013)
Constant	0.338***	0.382***	0.422***	0.473***	0.557***	0.728***	0.776***	0.846***
	(0.026)	(0.019)	(0.018)	(0.015)	(0.014)	(0.015)	(0.017)	(0.020)
Observations	1,177	1,177	1,177	1,177	1,177	1,177	1,177	1,177

*Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Table 5: Effect of political protests on environmental performance: IV quantile regressions

VARIABLES	(1) 5th	(2) 10th	(3) 15th	(4) 25th	(5) 50th	(6) 75th	(7) 85th	(8) 95th
Political protest	0.009*	0.008**	0.008**	0.008***	0.008***	0.007***	0.007***	0.006**
	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)
GDP per capita growth	0.004	0.003	0.002	0.001	-0.000	-0.002	-0.003	-0.004
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Total natural resources rents	0.001	0.001	0.001	0.000	0.000	-0.000	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Trade openness	0.001*	0.001**	0.001**	0.000	0.000	0.000	-0.000	-0.000
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Urbanisation	-0.013	-0.013	-0.013*	-0.012**	-0.012**	-0.012	-0.012	-0.011
	(0.013)	(0.009)	(0.007)	(0.006)	(0.006)	(0.008)	(0.010)	(0.013)
Democracy	-0.003	0.000	0.003	0.005***	0.007***	0.011***	0.013***	0.015***
	(0.004)	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.003)
British legal origin	0.075*	0.050	0.033	0.018	0.003	-0.025	-0.043	-0.060
	(0.043)	(0.031)	(0.023)	(0.018)	(0.017)	(0.025)	(0.033)	(0.042)
Constant	0.235***	0.323***	0.387***	0.441***	0.493***	0.595***	0.660***	0.723***
	(0.057)	(0.046)	(0.037)	(0.032)	(0.037)	(0.056)	(0.069)	(0.084)
Observations	1,045	1,045	1,045	1,045	1,045	1,045	1,045	1,045

*Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Table 6: Effect of socio-economic protests on environmental performance: IV quantile regressions

VARIABLES	(1) 5th	(2) 10th	(3) 15th	(4) 25th	(5) 50th	(6) 75th	(7) 85th	(8) 95th
Socio-eco protests	-0.005	-0.002	-0.001	-0.000	0.001	0.003	0.005**	0.007**
	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
GDP per capita growth	0.003	0.002	0.001	0.000	-0.001	-0.002	-0.003	-0.004
	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)
Total natural resources rents	0.001	0.001	0.001	0.001	0.001	0.000	0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Trade openness	0.001**	0.001**	0.001*	0.000	0.000	-0.000	-0.000	-0.001
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Urbanisation	-0.014	-0.013	-0.013*	-0.012**	-0.012**	-0.011	-0.010	-0.009
	(0.012)	(0.008)	(0.007)	(0.006)	(0.006)	(0.007)	(0.009)	(0.012)
Democracy	-0.003	0.001	0.002	0.005***	0.007***	0.010***	0.014***	0.017***
	(0.004)	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.004)
British legal origin	0.095**	0.061**	0.048**	0.027	0.009	-0.021	-0.050	-0.076*
	(0.041)	(0.029)	(0.025)	(0.019)	(0.017)	(0.022)	(0.031)	(0.041)
Constant	0.262***	0.358***	0.394***	0.454***	0.504***	0.587***	0.667***	0.742***
	(0.055)	(0.040)	(0.037)	(0.034)	(0.039)	(0.054)	(0.070)	(0.087)

Observations	1,045	1,045	1,045	1,045	1,045	1,045	1,045	1,045

*Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Table 7: Effect of political strikes on environmental performance: IV quantile regressions

VARIABLES	(1) 5th	(2) 10th	(3) 15th	(4) 25th	(5) 50th	(6) 75th	(7) 85th	(8) 95th
Political strikes	0.026	0.021	0.017	0.013	0.009	0.002	-0.003	-0.008
	(0.018)	(0.013)	(0.012)	(0.014)	(0.017)	(0.025)	(0.033)	(0.040)
GDP per capita growth	0.003	0.002	0.001	-0.000	-0.001	-0.002	-0.004	-0.005
	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)
Total natural resources rents	0.001	0.001	0.001	0.000	0.000	-0.000	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Trade openness	0.001**	0.001**	0.001**	0.000	0.000	-0.000	-0.000	-0.001
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Urbanisation	-0.010	-0.011	-0.012*	-0.013**	-0.014**	-0.015*	-0.016	-0.017
	(0.012)	(0.009)	(0.007)	(0.006)	(0.006)	(0.008)	(0.011)	(0.014)
Democracy	-0.003	-0.000	0.002	0.005***	0.007***	0.011***	0.014***	0.017***
	(0.004)	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.004)
British legal origin	0.088**	0.063**	0.043*	0.022	0.005	-0.029	-0.056	-0.080*
	(0.040)	(0.030)	(0.023)	(0.017)	(0.016)	(0.024)	(0.034)	(0.046)
Constant	0.237***	0.320***	0.385***	0.455***	0.510***	0.620***	0.709***	0.786***
	(0.058)	(0.045)	(0.039)	(0.033)	(0.038)	(0.058)	(0.074)	(0.098)
Observations	1,045	1,045	1,045	1,045	1,045	1,045	1,045	1,045

*Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Table 8: Effect of socio-economic strikes on environmental performance: IV quantile regressions

VARIABLES	(1) 5th	(2) 10th	(3) 15th	(4) 25th	(5) 50th	(6) 75th	(7) 85th	(8) 95th
Socio-eco strikes	-0.009	-0.007	-0.007	-0.005	-0.004	-0.002	-0.001	0.001
	(0.007)	(0.005)	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)
GDP per capita growth	0.002	0.001	0.000	-0.001	-0.001	-0.003	-0.004*	-0.005*
	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)
Total natural resources rents	0.002	0.001	0.001	0.001	0.000	-0.000	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Trade openness	0.001	0.001	0.000	0.000	0.000	-0.000	-0.000	-0.001
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Urbanisation	-0.006	-0.009	-0.010	-0.012*	-0.014**	-0.016**	-0.018*	-0.020
	(0.013)	(0.009)	(0.008)	(0.007)	(0.006)	(0.008)	(0.010)	(0.013)
Democracy	-0.002	0.002	0.003	0.005***	0.007***	0.011***	0.014***	0.017***
	(0.004)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.003)
British legal origin	0.105***	0.065**	0.056**	0.033*	0.011	-0.023	-0.051*	-0.076*

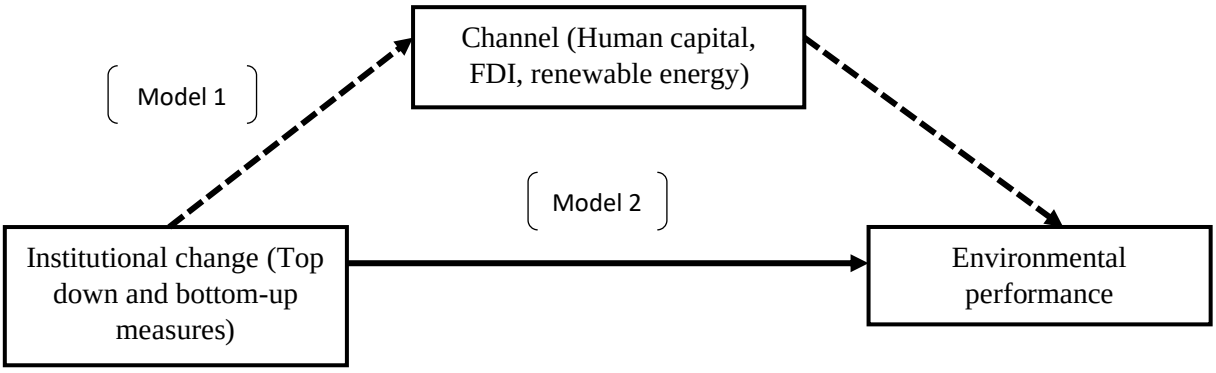
	(0.038)	(0.026)	(0.023)	(0.018)	(0.017)	(0.023)	(0.030)	(0.040)
Constant	0.235***	0.358***	0.389***	0.461***	0.527***	0.634***	0.719***	0.797***
	(0.061)	(0.044)	(0.038)	(0.034)	(0.038)	(0.054)	(0.067)	(0.090)
Observations	1,045	1,045	1,045	1,045	1,045	1,045	1,045	1,045

*Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

3.3. Analysis of transmission mechanisms

In this subsection, we discuss the potential channel of transmissions that influence the relation between institutional change and environmental performance. The results presented in section 3 support the conclusion that both top down and bottom-up IC influence EP of developing countries. However, we postulate that this effect is mediated through human capital (education), economic globalisation (measured by foreign direct investments), and renewable energy. The approach considered here involves the estimation of structural equation models (SEM) describing the transmission mechanisms, as illustrated in Figure 2. The main advantage of this method is that it allows path analysis by specifying a set of linear equations representing hypothesised relations among latent and non-latent variables. Precisely, the SEM specifies causal relations between variables and describes their direct and indirect effects using a path diagram. Building on this methodology, we first assess the effects of IC (β_1) on the mediators, namely human capital, FDI, and renewable energy as specified in Model 1. Next, the direct effect (β_3) is estimated by compiling the effect of IC on EP while controlling for the mediators (β_2) in Model 2. Therefore, the indirect effect is given by the product of β_1 and β_2. This term also reflects the size of the mediation, which essentially depends upon the extent to which IC indicators influence the mediators and the extent to which the mediators affect EP. Human capital is measured using the human capital index from the Penn World Table, foreign direct investments correspond to the net inflows of FDI expressed as a percentage of GDP, while renewable energy is captured by the renewable energy consumption expressed as a percentage of total final energy consumption. Data on FDI and renewable energy are got from the world development indicators.

Figure 2. Modelling the transmission channel of elite turnover effect on WPI



Note. In model 1: $Channel = \alpha_1 + \beta_1 IC + \mu_{it}$
In model 2: $EPI = \alpha_2 + \beta_2 channel_{it} + \beta_3 IC_{it} + \varphi_{it}$
Thus, Direct effect = β_3; indirect effect = $\beta_1 * \beta_2$ and total effect = $\beta_1 * \beta_2 + \beta_3$

The results of SEM estimations are reported in Tables 9, 10, and 11. The first part of the table presents the results of Model 1 estimates, and the second part depicts the results of Model 2 regressions. Regarding the human capital channel (Table 9), the results suggest that the effect of most indicators of IC is indirect through human capital in affecting environmental performance at one 1% significance level (models 1 and 2). Precisely, the results of the model 1 assessment show that all IC variables (exception to political strikes) increase human capital. Secondly, human capital has a significant effect on environmental performance (see the results of Model 2). Below Table 9, we report a formal assessment of the mediation effects on several statistical approach. Several mediation tests are considered to analyse if the indirect effect of IC on EP through the influence of human capital is statistically different from zero. The Sobel test statistic for political alternation and political strikes for example has a P-value less than 5%, suggesting that the null hypothesis of no mediation is rejected. The results are similar when using alternative mediation tests (Delta and Monte Carlo). It has also been pointed out that the usage of bootstrap confidence intervals does not alter the results. Indeed, the evidence presented implies that the mediation effect of human capital is material with about 54% and 56%% of the total effect of political alternation and social strikes respectively on EP. As to what concern the FDI and renewable energy transmission channel (Tables 10 and 11), the results show a negative effect of IC on both channels (model 1) as well as a negative effect of both mediators on the environmental performance of developing countries (model 2). For instance, concerning renewable energy, the indirect effect (Sobel test for ex) is negative and significant at least at 10% for all bottom up measures. Meanwhile, for top down IC, only the effect of political alternation transit through renewable energy to affect EP. Even though this relation seems to be counter-intuitive, the negative relation could, however, be justified by the fact that developing countries level of access to basic electricity is low and majority of these countries still rely on fossil fuels and other non-renewable resource energy. As such the percentage of renewable energy consumed is low compared to non-renewable energy resulting to a deterioration of the environment. Indeed, as the costs of the later outweigh the benefits of the former, the resulting EP follows a downward trend. Similarly, the relation existing between FDI and EP confirms the theoretical foundation that multinational corporations even though they increase GDP, the amount of pollution arising from industrial and even primary sector activities is high which contributes negatively to the environmental performance of the host country. Overall, the results suggest that even though the indirect effect of IC on EP is significant for the mediators considered, the contribution of the indirect effect remains low mostly for FDI and renewable energy.

Table 9: Assessing the mediating effect of human capital

	Political alternation	Const. change	Political protest	Social protest	Political strikes	Social strikes
Model 1 (dependent variable: Human capital)						
Institutional change	0.453***	0.199*	0.010**	0.010***	0.056	0.029***
	(0.029)	(0.102)	(0.005)	(0.002)	(0.042)	(0.007)
Constant	2.034***	2.283***	1.832***	1.808***	1.848***	1.806***
	(0.022)	(0.015)	(0.022)	(0.023)	(0.021)	(0.023)
Model 2 (Dependent variable: EPI)						
Human capital	0.109***	0.125***	0.116***	0.117***	0.120***	0.124***

	(0.007)	(0.006)	(0.011)	(0.011)	(0.011)	(0.011)
Institutional change	0.043***	0.036**	0.002	0.001	0.012	-0.002
	(0.007)	(0.016)	(0.001)	(0.001)	(0.012)	(0.002)
Constant	0.288***	0.272***	0.292***	0.289***	0.287***	0.283***
	(0.013)	(0.012)	(0.019)	(0.019)	(0.020)	(0.020)
Observations	1,273	1,273	1,200	1,200	1,200	1,200
Bootstrap replications	500	500	500	500	500	500

	Political alternation	Const. change	Political protest	Social protest	Political strikes	Social strikes
Mediation test						
Delta	0.049***	0.025 ***	0.001***	0.001***	0.007***	0.004***
	(0.004)	(0.013)	(0.001)	(0.000)	(0.005)	(0.001)
Sobel	0.049***	0.025 ***	0.001***	0.001***	0.007***	0.004***
	(0.004)	(0.013)	(0.001)	(0.000)	(0.005)	(0.001)
Monte Carlo	0.049***	0.025 ***	0.001***	0.001***	0.007***	0.004***
	(0.004)	(0.013)	(0.001)	(0.000)	(0.005)	(0.001)
Composition of the effect						
Indirect	0.049***	0.025 ***	0.001***	0.001***	0.007***	0.004***
	(0.004)	(0.013)	(0.001)	(0.000)	(0.005)	(0.001)
Direct	0.043***	0.036**	0.002	0.001	0.012	-0.002
	(0.007)	(0.016)	(0.001)	(0.001)	(0.012)	(0.002)
Total effect	0.092***	0.011***	0.003	0.002***	0.018**	0.002
	(0.007)	(0.022)	(0.002)	(0 .001)	(0.015)	(0.002)
% of the total effect mediated	**54%**	**227%**	**38%**	**56%**	**36%**	**185%**

Table 10: Assessing the role of foreign direct investment

	Political alternation	Const. change	Political protest	Social protest	Political strikes	Social strikes
Model 1 (dependent variable: FDI)						
Institutional change	-0.657**	-2.351***	-0.072	-0.072***	-0.719**	-0.213***
	(0.302)	(0.552)	(0.062)	(0.027)	(0.363)	(0.062)
Constant	4.443***	4.148***	3.973***	4.145***	3.889***	4.173***
	(0.248)	(0.147)	(0.291)	(0.321)	(0.268)	(0.313)
Model 2 (Dependent variable: EPI)						
Human capital	-0.001**	-0.002***	-0.002*	-0.002*	-0.002**	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Institutional change	0.101***	-0.007	0.003*	0.002***	0.018	0.002
	(0.006)	(0.024)	(0.002)	(0.001)	(0.013)	(0.002)
Constant	0.511***	0.565***	0.506***	0.502***	0.511***	0.509***
	(0.006)	(0.005)	(0.007)	(0.007)	(0.007)	(0.008)
Observations	1,433	1,433	1,225	1,225	1,225	1,225
Bootstrap replications	500	500	500	500	500	500

	Political alternation	Const. change	Political protest	Social protest	Political strikes	Social strikes
Mediation test						
Delta	0.001	0.004**	0.0001	0.0001*	0.001**	0.0004*
	(0.001)	(0.002)	(0.001)	(0.000)	(0.001)	(0.001)
Sobel	0.001	0.004**	0.0001	0.001	0.001**	0.0004*
	(0.001)	(0.002)	(0.001)	(0.000)	(0.001)	(0.001)
Monte Carlo	0.001	0.004**	0.0001	0.001	0.001**	0.0004*
	(0.001)	(0.002)	(0.001)	(0.000)	(0.001)	(0.001)
Composition of the effect						
Indirect	0.001	0.004**	0.0001	0.0001	0.001**	0.0004*
	(0.001)	(0.002)	(0.001)	(0.000)	(0.001)	(0.001)
Direct	0.101***	-0.007	0.003*	0.002***	0.018	-0.002
	(0.006)	(0.024)	(0.002)	(0.001)	(0.013)	(0.002)
Total effect	0 .101***	-0.003	0.003	0.002***	0.020	0.002
	(0.006)	(0.024)	(0.002)	(0 .0007)	(0.013)	(0.002)
% of the total effect mediated	**1%**	**117%**	**4%**	**5%**	**7%**	**20%**

*Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Table 11: Assessing the mediating effect of renewable energy

	Political alternation	Const. change	Political protest	Social protest	Political strikes	Social strikes
Model 1 (dependent variable: Renewable energy)						
Institutional change	-5.212***	4.610	-0.839**	-1.066***	-3.683	-1.093*
	(1.588)	(6.080)	(0.345)	(0.239)	(4.985)	(0.569)
Constant	8.796***	6.064***	2.219***	5.192***	0.876***	2.337***
	(1.329)	(0.766)	(1.506)	(1.553)	(1.412)	(1.656)
Model 2 (Dependent variable: EPI)						
Renewable energy	-0.001***	-0.001***	-0.001***	-0.000***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Institutional change	0.095***	0.003	0.003	0.002***	0.018	0.002
	(0.007)	(0.020)	(0.002)	(0.001)	(0.012)	(0.002)
Constant	0.539***	0.592***	0.532***	0.528***	0.541***	0.540***
	(0.008)	(0.006)	(0.014)	(0.015)	(0.014)	(0.014)
Observations	1,444	1,444	1,243	1,243	1,243	1,243
Bootstrap replications	500	500	500	500	500	500

	Political alternation	Const. change	Political protest	Social protest	Political strikes	Social strikes
Mediation test						
Delta	0.004***	0.004	0.0004*	0.0005**	0.002***	0.001*
	(0.001)	(0.006)	(0.0002)	(0.0002)	(0.003)	(0.0003)
Sobel	0.004***	0.004	0.0004*	0.0005**	0.002***	0.001*
	(0.001)	(0.006)	(0.0002)	(0.0002)	(0.003)	(0.0003)
Monte Carlo	0.004***	0.004	0.0004*	0.0005**	0.002***	0.001
	(0.001)	(0.006)	(0.0002)	(0.0002)	(0.003)	(0.0003)
Composition of the effect						
Indirect	0.004***	0.004	0.0004*	0.0005**	0.002***	0.001*
	(0.001)	(0.006)	(0.0002)	(0.0002)	(0.003)	(0.0003)
Direct	0.095***	0.003	0.003	0.002***	0.018	-0.002
	(0.007)	(0.020)	(0.002)	(0.001)	(0.012)	(0.002)
Total effect	0.099***	-0.001	0.003	0.002***	0.020***	0.002
	(0.007)	(0.022)	(0.002)	(0 .001)	(0.013)	(0.002)
% of the total effect mediated	**4%**	**326%**	**14%**	**23%**	**11%**	**28%**

*Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Conclusion

The aim of this study is to empirically examine the effect of institutional change (IC) on environmental performance (EP) in developing countries over the period 2000–2020. Specifically, we estimate the effect of top down and bottom-up IC using different methods including Driscoll-Kraay fixed effects, GMM, and IV-quantile estimation techniques. Results highlight that both top down and bottom-up IC positively influence the EP of the developing countries considered. Moreover, we test some transmission channels through which IC affects EP in developing countries. The results indicate that this effect of IC passes through human capital, foreign direct investment and renewable energy consumption. Based on our findings, we recommend an institutional change both from a top down and a bottom-up perspective. As the former ensures the formal establishment of laws and regulations aimed at protecting the environment, the latter assures a de facto improvement in the environmental conditions of these countries. Moreover, policy makers should lie more attention on the environmental education of the population given that human capital development plays an important role in the achievement of environmental sustainability. All these, would go a long way in achieving sustainable development.

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