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DOES ENVIRONMENTAL DEGRADATION POSE A THREAT TO HUMAN DEVELOPMENT? EVIDENCE FROM MOMENT QUANTILE REGRESSION WITH A FIXED EFFECT[3]

This study examines the extent to which environmental degradation (END) threatens human development (HD) in 40 developing countries from 1998 to 2021. The study uses the method of moment quantile regression with a fixed effect to evaluate the heterogeneous impact of END on the conditional distribution of HD. We also use fully modified OLS and dynamic OLS estimators for robustness. The findings indicate that environmental deterioration is associated with lower HD in developing nations in our sample, with the lowest HD in countries at the lower level of HD. The study also found evidence that institutional quality moderated the detrimental impact of ecological degradation on HD in developing nations. Furthermore, we established evidence of bidirectional causality between END and HD. Moreover, financial development, institutional quality, government spending, and remittances positively impact HD. Thus, we provide policy implications that will promote the adoption of clean technology and increase renewable energy consumption to achieve sustainable human development.

Keywords: Human development; Environmental degradation; Climate change; Quantile regression
JEL: O15; Q54; C3

1. Introduction

Although human development report shows that the human population is better educated, has increasing access to primary healthcare services, and enjoys higher living standards (HDR, 2022), the situation in many developing countries is deteriorating due to devastating environmental degradations that pose a significant threat to human progress (Sadiq et al., 2022; Kamalu, Wan Ibrahim, 2023). Human development is all about enlarging people's opportunities and freedom "to do and be" what they aspire to in life, which improves their well-being (Robeyns, Byskov, 2020). The Human Development Report (2022) indicates that

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climate change affects all facets of human life and is considered one of the most significant challenges to human development globally. The report provided a measure of human development that combined the country's achievements in education, health, and decent living, known as a human development index (HDI). Thus, the climate change phenomenon threatens the basic sustenance of the human population globally, even worse in developing countries (Abbass et al., 2022; Cheng, Wen, Yang, 2022). The Global Climate Risk Index (2021) report shows that developing countries are among the worst hit by climate change, even though many emit less. Thus, environmental degradation wreaks havoc in developing countries, reversing the progress achieved in human development over the years (Eckstein, Kunzel, Schafer, 2023).

The current trend of the greenhouse effect continues to raise the level of global temperature, which causes higher evaporation of water to the sky, leading to heavy rainfall, extreme floods, destruction of the ecosystem, and landslides that deteriorate the living conditions of people (Dickerson, Cannon, O'Neill, 2022). Despite the Paris Agreement (2015) to reduce carbon emissions in the world, the level of environmental degradation is the apparent reality, displacing the human population and ecological footprint, which constitutes a significant threat to food security and quality of life, especially in developing countries (World Bank, 2023). However, the 17 interconnected global targets enshrined in the Sustainable Development Goals (SDGs) focused directly or indirectly on promoting human development. The goals of no poverty (SDG 1), zero hunger (SDG 2), good health and well-being (SDG 3), quality education (SDG 4), and decent work and economic growth (SDG 8) are all directly geared towards achieving higher human development (UNSDG, 2019). Nevertheless, the distribution of the HDI is uneven, especially in developing countries, where countries such as Argentina, Malaysia, UAE, and Qatar have higher rankings than others like Afghanistan, Nigeria, Guinea, and Yemen (HDR, 2022). In addition, an effective and efficient institution can mitigate greenhouse emissions and improve human development (Acheampong, Adams, Boateng, 2019; Sun, Zhang, Gao, 2023).

This study looks at how environmental degradation (END) undermines human development (HD) in developing nations. We posit that the consequences of END on HD in developing nations are not homogeneous because of disparities in GDP per capita, human capital development, critical health services, and quality regulation. In order to investigate these heterogeneities, rather than focusing on the homogenous impact of END on the conditional distribution of human development in developing nations, we employ the Method of the Moment Quantile Regression (MM-QR) with fixed effect by Machado and Silva (2019). Moreover, previous literature that examines the nexus between ED and HD ignores the role of institutions (Dickerson, Cannon, O'Neill, 2022; Ding, Beh, 2022; Tariq, Xu, 2022) However, institutions play a vital role in mitigating carbon emissions and promoting the adoption of clean energy to facilitate energy transition (Adedoyin, Erum, Bekun, 2022) Therefore, this study uses institutional quality to moderate the END-HD nexus in developing countries.

2. Literature Reviews

The literature explains a connection between quality environment and human well-being not only in impoverished countries, but also in established and growing economies (Koengkan, Fuinhas, Silva, 2021; Liu et al., 2022; Pata, Yurtkuran, 2023). The capability approach as a theoretical framework provides an avenue for analysing determinants of human development (Schlosberg, 2012). Thus, this study uses the capability approach as a framework to examine the heterogeneous effect of END on HD in developing countries. The capability approach, as conceived in the work of Sen (1979) questioned the traditional economics model for its inability to identify what activities human beings can undertake "doings" and the type of humans to be "beings" to achieve their full potential in life. Although Sen (1979) did not list the capabilities needed by individuals, the work of Nussbaum (2000) provides ten capabilities, among which environment is one, that every human being needs to achieve higher human development. Hence, this study argued that environmental degradation depletes the natural environment and reduces the size of ecological footprints, severely hindering sustainable development goals. Furthermore, the capability approach recognizes the critical role of institutions in promoting inclusive growth, equitable income distribution, and a quality environment (Brackel, 2021).

Literature provides theoretical connections between environmental degradation and per capita income growth as multidimensional and indirect. Most of the models uses a growth model that is closely akin to the Solow model, which can predict carbon emission intensities, cost of abatement, and nonlinearity issues. According to the EKC theory, there is an inverse U-shaped relationship between GDP growth and environmental degradation. This hypothesis states that environmental quality deteriorates with a country's initial GDP per capita increase. However, as countries become wealthy and prioritize environmental protection, environmental quality starts to increase above a certain economic threshold (Brock, Taylor, 2010). In order to come up with a different model, Brock and Taylor (2010) emphasised that the available evidence is divergent from the EKC theoretical model and, therefore, provides a model which leverages technological progress and diminishing return of capital goods. They also argued that EKC fails to predict the actual time that emission reduction will set in because the transition from agrarian to a services-based economy and income-driven policy, intensify changes in economic growth and abatement cost, which determines the threshold. On the other hand, environmental transition hypothesis posits that economic development in a society pass through structural shift in all the sectors of the economy and environment. As the economy expand, and transitioned from primary to industrial base, and services industry, use of resources increases, which increases environmental degradation and subsequently decreases (Pel, 2022). In another theoretical explanation by the proponent of limit to growth limit theory contends that scarce resources and environmental constraints impose intrinsic limits on GDP growth, otherwise, the quest for economic growth may exert pressure on natural resources, destroy ecological space, and limit the possibility of achieving sustainable development (Jatav, Nayak, Narang, 2021).

The empirical literature shows that environmental degradation negatively affects human development (Shanty et al., 2018; Asongu, Odhiambo, 2019; Shahzad, 2020; Banday, Kocoglu, 2022; Sadiq et al., 2022; Kamalu, Ibrahim, 2023). Other studies found that the use of renewable energy significantly reduces environmental degradation and promotes human

development (Sasmaz et al., 2020; Adekoya, Olabode, Rafi, 2021; Wang et al., 2021). The study by Tariq and Xu (2022) reveals that green energy consumption promotes welfare and income per capita in the emerging market. Also, quality environmental laws negatively affect income but positively affect human well-being. Dickerson, Cannon and O'Neill (2022) show that increasing C02 emissions promote food insecurity, malaria, diarrheal, and water crises. Moreover, Elmassah and Hassanein (2022) reported that resource endowment negatively affects well-being. Using the method of dynamic common correlated effect; Kousar et al. (2020) reveal that good governance enhances the effect of renewal of energy consumption and water crisis on ED in South Asia. Another study by Koengkan, Fuinhas and Silva (2021) found that economic growth and energy consumption promote the greenhouse effect in Caribbean countries, while Venkatraja (2021) show that GDP growth increases energy consumption, subsequently environmental degradation. Rasoulinezhad, Taghizadeh-Hesary and Taghizadeh-Hesary (2020) found that fossil fuel consumption raises death rates, negatively affecting human development in Commonwealth member countries.

Few studies showed negligible negative consequences on human development, despite the majority of prior research examining the direct relationship between ED and HD (Dickerson, Cannon, O'Neill, 2022). Also, many previous empirical studies examine the long-run estimators while ignoring the heterogeneous nature of the cross-sections. As a result, WE address these gaps by investigating the effect of ED on the conditional distribution of HD in developing countries using the MM-QR estimator with a fixed effect. In addition, the study uses institutional quality as an interaction term to moderate the impact of END on HD in developing countries. Furthermore, the study will propose a vital policy framework that will facilitate the mitigation of carbon emissions and adaptation of renewable to achieve SDGs of no poverty, zero hunger, good health and well-being, quality education, and environmental action, among others.

3. Methodology

This study examines the heterogeneous effect of END on the conditional distribution of HD in developing countries. Data from 40 developing nations, spanning the years 1998 to 2021, are used in the study. Four degrees of HD have been identified by the Human Development Report (HDR): low HD, medium HD, high HD, and very high HD. We use these four levels of HD to represent lower (q25), medium (q50), high (q75), and very high (q95) quantiles. Throughout this study, HD is the dependent variable; the variable of interest is the ED. The control variables chosen are based on the literature and include financial development, institutional quality, government final consumption expenditure, and inflation. The study uses the Method of Moment Quantile Regression (MM-QR) with a fixed effect proposed by Machado and Silva (2019). We also employ Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square (DOLS) by Pedroni, (2000) for robustness.

Table 1. Data and Measurement

s/n	Sample size: 40 countries (1998-2021) Variables	Measurement	Sources
1	Human development	Human Development Index (HDI)	UNDP
2	Environmental degradation	CO2 emission per capita	WDI
3	Institutional quality	Average of rule of law, control of corruption and regulatory quality	WGI
4	Financial development	Credit to the private sector	WDI
5	Government expenditure	Government final consumption expenditure (% GDP)	WDI
6	Inflation	Consumer Price Index	WDI
7	Remittance	Remittance inflow	KNOMAD

NB: WDI stand for World Development Indicators, WGI is World Governance Indicators KNOMAD is The Global Knowledge Partnership on Migration and Development

Source: created by the Authors.

3.1. Estimation Strategy

The estimating technique for the current study consists of division in steps. In the initial step, the study performed numerous diagnostic checks, such as descriptive statistic tests, homogeneity tests, cross-sectional dependence tests, panel unit root tests, and panel cointegration tests. In the second step, the study uses the method of the moment quantile regression (MM-QR) with a fixed effect using *mmqreg* (Stata) to estimate the heterogeneous impact of environmental degradation on the conditional distribution of human development. Also, the study uses FMOLS and DOLS estimators for robustness.

3.2. Diagnostic Tests

This study uses a homogenous test to determine the nature of the slope coefficient of the variables. The study will use the Pesaran and Yamagata (2008) homogeneity test that uses Hausman statistics to determine the nature of the slope coefficient. The null hypothesis is that slope coefficients are homogenous. We also use the Pesaran (2015) cross-sectional dependency (CD) test and Breusch and Pagan, (1980) Langrange multiplier (LM) test to test CD among the cross-sections. The null hypothesis is that cross-sections are independent. When the null is rejected, the study has to use second-generation methods that account for CD. The next diagnostic check is the unit root test. This study uses a combination of first-generation and second-generation panel unit root tests to determine the stationarity nature of the data. We use Maddala and Wu (1999) as a first-generation test and second-generation test based on Cross-dependency Im, Pesaran and Shin (CIPS) by Pesaran, (2007). The last test is the panel cointegration test. This study uses a second-generation panel cointegration test based on Westerlund's (2007) specification. The cointegration test determines whether variables have a long-run relationship. In other words, whether the variables move together in the long run.

3.3. Method of the Moment Quantile Regression (MM-QR)

The work of Machado and Silva (2019) considers a situation that explores conditional means, using a moment condition with a fixed effect rather than the usual long-run mean. The MM-QR technique has the advantage of allowing the use of methods that are only suitable for estimating conditional means by differencing out individual effects in panel data models while giving more insights on the impact of regressors on the conditional distribution of the regressed variable. In addition, the MM-QR method identifies the same conditional quantiles as provided in the standard quantile regression based on the check function by Koenker and Bassett, (1978) but differs in accounting for cross-sectional dependency. However, under the necessary conditions, the normal predictors are fundamentally robust. The MM-QR based on a random variable is provided in the following equation:

$$Y_{i,t} = \gamma_i + X'_{i,t}\beta + (\alpha_i + W'_{i,t}\delta)\mu_{i,t} \quad (1)$$

The dependent variable is HD; X stand for the regressors; α_i and δ are the parameters to be estimated; W is a distribution of unobserved random variables orthogonal to the regressors, consistent with the moment condition of Machado and Silva (2019), with i = 1… n as an individual cross-section with fixed effect. Therefore, the MM-QR model is specified by following the work of Amegavi, (2021) as follows:

$$Q_y(\tau|X_{i,t}) = [\gamma_i + \alpha_i\rho(\tau)] + X'_{i,t}\beta + W'_{i,t}\delta\rho(\tau) \quad (2)$$

In equation (2), $Q_y(\tau|X_{i,t})$ stands as a nth quantile distribution of a dependent variable, where $X_{i,t}$ is a variable of interest and $W_{i,t}$ stands as the vector of other regressors that are part of but normalized to follow the moment condition set out in the Machado and Silva (2019).

3.4. FMOLS and DOLS Estimators

We use the Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square (DOLS) estimators to achieve robust results. The result from the panel cointegration tests will pave the way for this study to use the FMOLS and DOLS estimators when the null hypothesis of no cointegration is rejected (Tugcu, 2018). The cointegrating estimators follow Pedroni's (2001) group mean specification. Thus, the econometric equation is provided as follows:

$$\begin{aligned} QHDI_{i,t}(\tau_k|\gamma_i, X_{i,t}) &= \gamma_i + \beta_{1\tau}END_{i,t} + \beta_{2\tau}IN_{i,t} + \beta_{3\tau}FD_{i,t} + \beta_{4\tau}GE_{i,t} + \beta_{5\tau}IF_{i,t} \\ &\quad + \beta_6 IR_{i,t} + \mu_{i,t} \end{aligned} \quad (3)$$

Equation (3) is the conditional distribution of human development (HD) measured by the human development index (HDI). We employ the use of four quantile groups based on low human development (q25), medium HD (q50), high HD (q75) and very high HD (q95); END is the environmental degradation, IN is the institutional quality, FD stand for variable financial development, GE is the government expenditure, IF is the inflation and IR is the Remittance inflows; to are the parameters of nth quantile group, is the intercept, and is the typical error term.

$$QHDI_{i,t}(\tau_k|\gamma_i, X_{i,t}) = \gamma_i + \beta_{1\tau}ED_{i,t} + \beta_{2\tau}IN_{i,t} + \beta_{3\tau}FD_{i,t} + \beta_{4\tau}GE_{i,t} + \beta_{5\tau}IF_{i,t} + \beta_6 RI_{i,t} + \beta_7(ED * IN)_{i,t} + \mu_{i,t} \quad (4)$$

Where the ED $*$ IN is an interaction term between END and IN on the conditional distribution of HD. And β_7 is the parameter of the interaction term.

4. Results and Discussions

Examining how environmental deterioration affects the conditional distribution of human development in forty developing nations is the primary goal. The selection of these nations is predicated on the availability of comprehensive data spanning from 1998 to 2021. The MM-QR estimator with a fixed effect, like in Machado and Silva (2019), is employed in this work. We also use FMOLS and DOLS estimators to estimate the long-run coefficients for robustness. In Table 1, descriptive statistics show that all the variables are in logarithm form except institutional quality (INS) and have equal observations of 1425 each, which means that this study has strongly balanced data. The mean and standard deviations are within the required range, and the maximum observations for each variable showed no signs of outliers. The results in Table 3 present the diagnostic checks carried out in this study. Firstly, the results show that the null hypotheses of cross-sectional independence are rejected at 1% in the LM and Pesaran CD tests, which confirmed the cross-sectional dependency in all the study variables. The existence of cross-sectional dependence necessitates the application of second-generation methods that account for CD to achieve consistent and efficient estimators.

Secondly, in Table 3 the results of the Shapiro-Wilk test failed to accept the null hypotheses of normality; hence, the data is far from the normal distribution. Thirdly, in the same Table 3, the result failed to accept the null hypothesis of homogeneity; hence, the study variables have heterogeneous slope coefficients. The findings of unit root tests in Table 4 for both Maddala and Wu, as well as the CIPS tests, failed to reject the null hypothesis of unit root at the level for all the variables but failed to accept the null at the first difference. Thus, the unit root test results mean that all the variables are stationary at the first difference I (1). Table 5 also shows the results of Westerlund cointegration tests, which reject the null hypothesis of no cointegration in all four statistics (Gt, Ga, Pt, and Pa), indicating that the variables have a long-run relationship.

Table 2. Descriptive statistics

Variable	OBS	Mean	Std. Dev.	Min	Max
LHDI	960	-0.501	0.228	-1.427	-0.192
LEND	960	0.227	1.178	-2.969	2.731
INS	960	-0.460	0.111	-0.798	-0.387
LFD	960	3.473	0.226	3.143	3.868
LGS	960	2.635	0.040	2.577	2.759
LINF	960	1.928	0.491	1.372	3.418
LIR	960	0.733	1.602	-5.404	3.541

L attached to variables means logarithm form.
Source: generated by authors.

Table 3. Diagnostics Tests

Variables	Breusch-Pagan LM Test	Pesaran CD Test	Shapiro-Wilk Test	Homogeneity Test
LHDI	35676.7***	188.069***	0.889***	Delta 27.379***
LEND	15201.2***	52.460***	0.967***	Adj. 33.208***
INS	18400.6***	98.393***	0.567***	
LFD	23084.6***	102.60***	0.910***	
LGS	7740.1***	23.321***	0.920***	
LINF	5961.5***	55.198***	0.829***	
LIR	23846.7***	133.78***	0.945***	

*Note: ***, **&*stand for 1%, 5% &10% level of significance. L attached to variables means logarithm form.*
Source: generated by authors

Table 4. Panel Unit Root Tests

	Maddala and Wu Test		CIPS Test	
Variables	Level	First Difference	Level	First Difference
LHDI	57.891	150.82**	2.835	-3.574***
LEND	110.773	285.69***	2.638	-3.582***
INS	63.702	577.06***	32.554	33.935***
LFD	30.746	953.62***	33.935	32.154***
LGS	64.693	605.25***	22.771	41.674***
LINF	69.587	335.67***	32.721	33.521**
LIR	84.881	248.40***	30.614	24.429***

*Note: ***, **&*stand for 1%, 5% &10% level of significance. L attached to variables means logarithm form.*
Source: generated by authors

Table 5. Westerlund Cointegration test

Statistics	Gt	Ga.	Pt	Pa
Values	--3.441***	-3.511**	-7.259***	-3.524***

*Note: ***, **&*stand for 1%, 5% &10% level of significance. L attached to variables means logarithm form*
Source: generated by authors

4.1. Results of the Baseline Model

Table 6 presents the results of the MM-QR estimator based on the conditional distribution of HD as a dependent variable. The results reveal that environmental degradation (END) has a negative effect on human development (LHDI) at a 1% level across all the quantiles (q25, q50, q75, q95), but the coefficient of lower quantile (0.184) is higher. The negative coefficients of LEND mean that lower carbon emission is associated with higher HD, but the level of association is higher in countries with a low level of HDI. The results are similar to the findings in Table 8 obtained with the FMOLS and DOLS; hence it is robust. Moreover, our finding is consistent with the results of Asongu and Odhiambo (2019), Adekoya, Olabode and Rafi (2021), Aguir (2022), Tariq and Xu (2022); but contrary to the results of Akram et al. (2021), Dickerson, Cannon and O'Neill (2022) that found an insignificant negative effect of END on HD. Thus, our results show that higher END has a higher association with a lower HD, which means that ecological degradation negatively affects the human population, the ecosystem and natural resources, and displaces the human population, which has a serious negative impact on human development.

Furthermore, the results of control variables in Table 6 reveal that financial development (LFD) has positive and significant coefficients at 5% in low quantiles. (q25), and at 10% in the medium quantile (q50); whereas positive but insignificant in countries with the high (q75) and very high (q95) level of human development. The positive and significant coefficients in countries with low and medium human development means that increases in the amount of credit to the private sector promote investment and business activities, creating jobs, income, and economic growth, hence, higher human development (Kamalu et al., 2019; Matekenya, Moyo, Jeke, 2020). The insignificant positive coefficient means that increasing financial development does not significantly affect HD in countries with high and very high HD. This is because developing countries with high and very high HD have relatively developed financial markets; thus, the rate of return on investments in these countries is low compared with the countries with a low level of HD that are considered to have a low level of financial development.

Table 6. Results for MM-QR estimator

Dependent variable: Human development (LHDI)						
Variables	Location	Scale	Q25	Q50	Q75	Q95
LEND	0.163***	-0.023***	-0.184***	-0.164***	-0.143***	-0.119***
LFD	0.172*	-0.118**	0.281**	0.176*	0.070	0.053
LINS	-0.009	0.001	-0.008	0.009**	0.020***	0.061***
LGS	0.031**	0.047	-0.012	0.030***	0.072***	0.121**
LINF	-0.010	0.001	-0.011*	-0.017*	-0.066*	-0.098**
LIR	0.019***	-0.010	0.027***	0.019***	0.010***	0.001*
CONS	-1.354**	-0.193	-1.176	-1.347**	-1.520**	-1.720

*Note: ***, **&*stand for 1%, 5% &10% level of significance. L attached to variables means logarithm form*
Source: generated by authors.

Furthermore, the results in Table 6 reveal that institutional quality has a positive and significant effect on HD in medium quantile (at 5%), high quantile (at 1%), very high quantile (at 1%), and insignificant at lower quantile. The findings are consistent with the capability approach, which considers institutional quality to have a profound positive effect on human development through the efficient allocation of resources, protection of property rights, enforcement of contracts, and provision of quality regulations (Bass, Nicholson, Subrahmanian, 2013; Robeyns, Byskov, 2020). However, the insignificant negative coefficient in countries with low human development results from poor governance, higher corruption, and mismanagement bedevilling least developing countries, which takes resources away from basic services that increase human development. The results of another control variable in Table 6 indicate that government spending (LGS) has a significant positive effect on HD in countries with medium, high, and very high human development and is negative and insignificant in countries with low HD. The result is consistent with the literature that increasing government spending stimulates economic activities, increases money in circulation and delivery of essential services, which promote human development (Thesari, Lizot, Trojan, 2021; Nurvita et al., 2022).

Table 6 clearly shows that inflation (LINF) has a negative and substantial influence on HD at all quantiles, but the effect is stronger in nations with very high HD. These findings suggest that reduced inflation benefits HD in emerging nations, with a stronger effect in countries

with very high HD. Additionally, Table 6's results show that remittance inflows (LIR) have a significant and positive impact on HD across all quantiles at 1%. This means that increasing remittance inflows to developing nations promotes the growth of human capital, investment, and access to healthcare, all of which are beneficial to HD. Still, the effect is higher in countries with low HD (Kamalu, Wan Ibrahim and Ahmad, 2022).

Table 7. MM-QR Results for the Interaction Model

DV: LHDI Variables	Location	Scale	Q25	Q50	Q75	Q95
LEND	0.148***	-0.017**	0.164***	0.149***	0.133***	0.115***
LFD	0.175*	-0.120**	0.286**	0.178*	0.071	-0.053
INS	-0.007	-0.005	-0.003*	-0.007	-0.011	-0.017**
LGS	0.030	0.049	0.016	0.028*	0.072	0.122
LINF	-0.010	0.001	-0.011**	-0.010	-0.009	-0.007
LIR	0.019***	-0.010***	0.027***	0.019***	0.010***	0.003
LEND*INS	-0.031	0.013	-0.043**	-0.032*	-0.020***	-0.067**
CONS	-1.349	-0.199	-1.164	-1.343**	-1.522**	-1.728*

*Note: ***, **&*stand for 1%, 5% &10% level of significance. L attached to variables means logarithm form*
Source: generated by authors.

4.2. Result of the Interaction Model

In Table 7, the results of the interaction model (LEND*INS) show negative and significant coefficients for each quantile, with higher coefficients in highly developed nations. The findings indicate that robust institutions lessen the detrimental impact of environmental degradation on human development, however, this effect is more pronounced in nations with extremely high levels of development. In addition, the results show that whenever there are quality institutions that formulate and implement sound environmental policies and enforce quality regulations, it will mitigate environmental degradation and significantly promote human development. In addition, the finding is robust when we use the FMOLS and DOLS estimators in Table 8. Therefore, the higher coefficient in countries with very high levels of human development (q95) indicates that the quality of governance in those countries is higher than in countries with low and medium levels of human development (HDR, 2022). Thus, those countries with higher human development may have better regulations, effective rule of law, and control of corruption and mismanagement, which promote mitigations, control environmental degradation, and improve quality of life.

Table 8. Results for FMOLS and DOLS Estimators

DV: LHDI	FMOLS		DOLS	
Variables	Baseline	Interaction	Baseline	Interaction
LEND	0.0364***	0.0939***	0.0874***	-0.3562*
LFD	0.2879***	0.2875***	0.2157***	0.0133
INS	0.0109**	0.1263*	0.1160**	1.7591**
LGS	0.1231***	0.1296***	0.0891*	0.2023
LINF	-0.0219***	-0.0215***	-0.0121	0.0455**
LIR	0.0018**	0.0008	0.0085***	-0.0208
LEND*INS		-0.1431**		-1.1114**
Adj. R-squared	-5.6753	-10.1973	0.9826	0.9842

*Note: ***, **&*stand for 1%, 5% &10% level of significance. L attached to variables means logarithm form*
Source: generated by authors.

4.3. Panel Causality Results

Table 9. Dumitrescu and Hurlin, (2012) panel causality results

Null (H0)	W-statistics	Direction	Null (H0)	W-statistics	Direction
LEND ≠ LHDI	4.461***		LRI ≠LEND	3.521***	
	(6.54)	↔		(3.76)	↔
LHDI ≠ LEND	5.222*		LEND ≠ LIR	3.961**	
	(8.79)			(5.06)	
LINS ≠ LHDI	4.832**		LFD ≠ LINS	1.541**	
	(9.64)	↔		(-2.09)	↔
LHDI ≠ LINS	6.963***		LINS ≠ LFD	0.422***	
	(13.94)			(-5.41)	
LFD ≠ LHDI	5.244***		LGS ≠ LINS	0.033	
	(8.86)	↔		(-6.56)	
LHDI ≠ LFD	6.904***		LINS ≠ LGS	2.033	
	(13.77)			(-0.64)	
LGS ≠ LHDI	2.752		LINF ≠ LINS	17.503***	
	(1.48)			(45.13)	↔
LHDI ≠ LGS	9.871***	→	LINS ≠ LINF	4.1584**	
	(22.55)			(-2.76)	
LINF ≠ LHDI	4.983		LRI ≠ LINS	8.516***	↔
	(4.12)			(18.54)	
LHDI ≠ LINF	3.988		LINS ≠ LRI	5.753***	
	(5.14)			(10.36)	
LIR ≠ LHDI	4.983		LGS ≠ LFD	5.942***	
	(8.09)			(10.93)	↔
LHDI ≠ LIR	4.915		LFD ≠ LGS	10.866***	
	(7.88)			(25.50)	
LINS ≠ LEND	3.471***	→	LINF ≠ LGS	1.727	
	(3.61)			(-1.55)	
LEND ≠ LINS	4.54		LGSI ≠ LINF	2.816*	→
	(5.78)			(1.68)	
LFD ≠ LEND	4.804		LRI ≠ LGS	3.023**	
	(7.55)			(2.28)	↔
LEND ≠ LFD	4.569		LGS ≠ LRI	3.142**	
	(8.86)			(2.83)	
LGS ≠ LEND	2.009		LRI ≠ LINF	2.225	
	(-0.72)			(-0.08)	
LEND ≠ LGS	8.566***	→	LRI ≠ LINF	7.948***	→
	(18.69)			(16.86)	
LINF ≠ LEND	3.764				
	(4.48)				
LEND ≠ LINF	2.772*	→			
	(8.63)				

*Note: ***, **&*stand for 1%, 5% &10% level of significance. L attached to variables means logarithm form*
Source: generated by authors.

The study uses Dumitrescu and Hurlin (2012) panel Granger non-causality heterogenous panel method to test the cause and effect between the variables. Due to the lack of long-time series data, we cannot provide causality results for each quantile. Thus, based on the results in Table 9, there is a bidirectional causality between environmental degradation (LEND) and human development (LHDI). Also, a bidirectional causality exists between institutional

quality (INS) and LHDI, and between financial development (LFD) and LHDI. The results show unidirectional causality running from LHDI to government spending (LGS), and from INS to LEND, as well as LEND to LGS. Furthermore, the results reveal bidirectional causality between remittance inflows and LEND, and between LFD and INS. Another bidirectional causal link is reported inflation (LINF) and INS, LRI and INS, as well as LGS and LFD.

5. Conclusion and Policy Implications

5.1. Conclusion

This study assesses whether human development in developing nations is threatened by environmental degradation. It also looks at how institutional quality in emerging nations influences the relationship between environmental degradation (END) and human development (HD). The research utilizes the FMOLS and DOLS for robustness, the MM-QR estimator with fixed effect, and data from 40 developing countries between 1998 and 2021. Based on the results reported, this study concludes that the association of END and HD are heterogeneous in developing countries. Thus, the findings prove that lower END has a higher association with HD in developing countries in our sample countries, but the impact is higher in countries with low HD. Moreover, the results confirmed that institutional quality moderates the negative effect of END on HD, with a more substantial impact in countries with very high HD. Also, the evidence established that financial development, institutional quality, government spending, and remittance inflows promote HD in countries at all levels, except for institutional quality and government spending, which are negative and insignificant in countries with low HD. In addition, we found a bidirectional causality between environmental degradation and human development, with the stronger causal link running from environmental degradation to human development. Interestingly, the results are robust when we use the FMOLS and the DOLS estimators. Hence, END poses a significant threat to the success recorded in HD in developing countries.

5.2. Policy Implications

The evidence established in this study holds significant policy implications for policymakers in developing countries. Going with the findings of this study, policies, programs, and regulations that can promote the mitigation of carbon emissions, energy transitions, and sustainable resource utilization must be given priority by all policymakers to sustain the continuous improvement in human development in developing countries. The prominent policy options offered by the environmental experts in the Paris Agreement (2015) have to do with reducing the global temperature to the pre-industrial era, the transition from non-renewable to renewable energy, and the adaptation of green and clean technology in all the sectors of the economy. Therefore, policymakers in developing countries should invest heavily in renewable energy to propel the energy transition from fossil fuel consumption that degrades our environment to renewable energy use that has negligible environmental harm. Although energy transition requires enormous capital investment, especially wind turbines and geothermal sources, the focus should be on abundant solar energy, which can be

generated at a personal, household, or community level. Furthermore, an environmental tax can be an effective policy instrument to exert pressure on corporations to utilize green technology or pay as they emit, which may restrict the utilisation of unclean technology. In addition, policymakers should introduce incentives such as subsidies or concessions to firms to invest in green technology to reduce carbon emissions and lower environmental degradation for better sustainable human development. Also, public campaigns in all media channels should be vigorously used to create awareness of the need for behavioural change to reduce environmental pollution, deforestation, bush burning, and ecosystem destruction to achieve sustainable use of resources for sustainable development.

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Appendix A

s/n	List of Countries				
1	Albania	16	Ecuador	31	Niger
2	Algeria	17	Egypt, Arab Rep.	32	Nigeria
3	Armenia	18	Gabon	33	Pakistan
4	Azerbaijan	19	Guatemala	34	Paraguay
5	Bangladesh	20	India	35	Philippines
6	Bolivia	21	Jamaica	36	Senegal
7	Botswana	22	Jordan	37	South Africa
8	Brazil	23	Kenya	38	Tanzania
9	Burkina Faso	24	Kyrgyz Republic	39	Togo
10	Cambodia	25	Malaysia	40	Tunisia
11	Cameroon	26	Mali		
12	China	27	Mauritius		
13	Colombia	28	Mexico		
14	Congo R	29	Moldova		
15	Dominican Republic	30	Morocco		