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Country-Level Environmental Performance: Investment, Education, and Research and Development

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Abstract: (1) Background: Environmental deterioration has increased in recent years and is a worldwide concern. This study aims to analyze the influence of the resources and capacities of countries on their environmental performance. (2) Methods: A cross-sectional study using secondary data was carried out quantitatively. A linear regression analysis was carried out to determine significant factors in countries' environmental performances. (3) Results: Education innovation and investment were associated with environmental performance; however, investment in a country did not affect the country's performance. (4) Conclusions: The scope of the proposed model was limited to the variables and countries of the secondary data analyzed, so future research can replicate this study using primary data. According to the results, the education of citizens can lead them to be more aware of their environment and pressure governments to generate positive changes for it.

Keywords: education; innovation; sustainability; environmental management; sustainable development goal; investment

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1. Introduction

In recent decades, population growth, changing lifestyles, agricultural practices, urbanization, and economic activities have increased the pressures on natural systems, exacerbating climate change, loss of biodiversity, and pollution worldwide. In the Brundtland Report in 1987, visibility was given to the deterioration of the environment and the role of individual human beings and wider society within it (United Nations 2021). Since then, there has been pressure on countries to take action to mitigate environmental damage.

In 2015, the United Nations proposed Sustainable Development Goals to enhance environmental quality (United Nations 2015). However, given the current trends, it is inferred that we are far from achieving these goals. Transformation of the current conditions is necessary to promote sustainability (Leal Filho et al. 2020). To achieve these objectives, a strategic process that involves the public and private sectors, governments, companies, and citizens is necessary, as stated by Chams and García-Blandón (2019). Governments must create specific and compelling environmental policies to achieve economic growth while safeguarding environmental health. They are responsible for mitigating environmental harm, and it is imperative to ensure coherence and consistency in these policies, as Almeida et al. (2017) emphasized.

The challenges countries face require excellent capacity for innovation and education that generates inclusive growth that respects the environment (Castizo 2021). Environmental education, on the other hand, increases awareness and knowledge about environmental problems. It gives citizens and policymakers the necessary tools to make informed decisions and responsible actions to improve the environment and people's quality of life (United States Environmental Protection Agency 2022). Innovation is a critical component

of sustainable development that enables us to find new technologies and ways to solve environmental issues.

As the COVID-19 pandemic worsened, it exposed the connection between biodiversity loss and the rise in infectious diseases. This situation directly affected people's health and access to necessary resources, making them more vulnerable (Castizo 2021). In the initial stages of the pandemic, as a result of social distancing and confinement, a positive impact was perceived. However, in the long term, repercussions for the environment have been found (Rojas 2021).

Alam et al. (2019) suggest that investment in research and development (R and D) is a critical factor in reducing environmental impacts while maintaining a company's economic performance, according to the natural-resource-based approach (NRBV). Companies can attain sustainable competitive advantages by dedicating their resources and capabilities to eco-friendly commercial activities. As per Ezzi and Jarboui's statement, companies can contribute to lowering carbon emissions caused by their energy consumption while producing goods and services, thus assisting their respective countries in reducing environmental harm (Ezzi and Jarboui 2016).

Ezzi and Jarboui (2016) discovered a strong and positive relationship between research and development and social performance. However, the relationship between the two variables is harmful regarding environmental performance. This indicates that companies need to pay more attention to the environment and its needs, such as the need to conserve and protect natural resources, despite innovative strategies having a solid and positive impact on financial and social performance.

Sibanda et al. (2023) posit that an individual's human capital, measured with years of schooling and educational performance, positively impacts environmental performance. Specifically, their research reveals that education and health outcomes are essential predictors of environmental stewardship. Ismail and Hilal (2023) concur with Sibanda et al.'s (2023) findings, adding that knowledge and information on environmentally friendly behavior play a pivotal role in promoting measures that reduce environmental degradation and promote sustainable practices. Therefore, understanding the interplay between human capital and environmental performance and the role of education and knowledge is crucial for devising effective policies for environmental sustainability.

Following the above ideas, the questions guiding this research are as follows: How are countries' environmental performances associated with investment, education, and research and development? What is the most relevant factor associated with countries' environmental performances: investment in education or research and development?

Utilizing the resource-based theory, one can identify various factors, including resources and capabilities, that impact an organization's environmental performance (Barney 1991). This analysis can be applied at a country level as well. This way, understanding the significant factors that will help the country mitigate environmental damage is possible. From this theoretical framework, the resources and capacities of the countries could affect their environmental performance. Therefore, this research analyzed the relationship between countries' environmental performances and investment, education, and research and development. Some investigations have found socioeconomic and institutional factors that influence countries' environmental performances, emphasizing controlling corruption (Gallego-Alvarez et al. 2014). According to this research, a country's innovation and education levels are critical to achieving a positive environmental performance. Additionally, this study is founded on a well-known theoretical framework for organizational research, which forms the basis for analyzing at a country level using a systemic approach.

2. Theoretical Framework

A resource-based theoretical perspective proposes that an organization's resources and capabilities influence its sustainable competitive advantage (Barney 1991; Penrose 2009). Barney (1991) proposes three types of resources: physical, human, and organizational. Madhani (2010) distinguishes two categories of resources and capabilities: tangible

and intangible. Tangible includes financial, physical, technological, and organizational resources, while intangible comprises human capital, innovation, and reputation (Madhani 2010). In comparison, Brumagim (1994) postulates four levels of resources. The first is production resources. The second comprises administrative resources; the third includes learning resources; and the fourth is strategic-vision resources. In studies in recent years, across organizations, it has been confirmed that resources and capabilities lead to a competitive advantage such as in environmental performance (Singh et al. 2020; Rehman et al. 2021; Shibin et al. 2020; Awan et al. 2023; Sahoo et al. 2023). Therefore, the resources of organizations lead to better environmental performances.

Since the study seeks to understand countries' environmental performances, it is necessary to use a systemic approach. From a systemic approach, a country can be seen as an organization since both are complex systems with elements that interact in a coordinated manner, as proposed by general systems theory, where the system is delimited but has a relationship with the environment (Bertoglio 1982; Ríos and Santillán 2016). In this way, a country achieves a positive environmental performance through its resources and capabilities.

Regarding the studies carried out on countries, there are different determinants of environmental performance. For example, research has shown that investment directly affects financial development and economic prosperity (Sethi et al. 2022). Higher levels of education in countries have also been found to reduce the negative environmental impact (Yin et al. 2021). Adedoyin et al. (2020) indicate that the research and development of a country influence its environmental sustainability. Following the above, the resources and capacities of a country are viewed as investments in production resources, education is seen as a learning resource, and research and development is a strategic vision resource.

2.1. Investment and Environmental Performance

The relationship between investment and performance is generally positive in terms of economic performance. However, relating investment to environmental performance is not necessarily favorable. In their longitudinal study, Adeel-Farooq et al. (2018) find that investment in the green sector deteriorates countries' environmental performances in Asia. However, their results reveal that a country's economic growth positively affects their environmental performance.

Another study carried out in developing countries has found that the effect of investment on environmental performance varies, and sometimes it improves environmental quality, and other times, it harms it (Hassaballa 2013). Also, Li et al. (2019) find heterogeneous results regarding investment and environmental performance, since, in developing countries, they do not find an effect of investment on environmental performance. However, in the case of developed countries, they find this effect to be positive.

Specifically, when talking about environmental investments, Li and Ramanathan (2020) have shown that they positively affect environmental performance. Their study even revealed that when regions have significant foreign investment, the effect on the environmental performance is more positive. Accordingly, the following hypothesis is postulated:

Hypothesis 1. *Investment is related to countries' environmental performances.*

2.2. Education and Environmental Performance

The global innovation landscape is changing rapidly due to the COVID-19 pandemic, which has generated supply chain crises and the acceleration of digital transformation. Added to this are the troubled geopolitical climate, the tightening of monetary policies, and evident climate change (World Intellectual Property Organization 2022). In this context, where the world seeks to recover from the pandemic, innovation is essential to overcome challenges.

For the above, education is the appropriate vehicle to generate a truly shared responsibility and innovate within society. Improving how things are carried out through

innovation can lead to achieving sustainability. According to Lee et al. (2017), innovation in education is about implementing things radically differently from the ground up. Improving the current quality of education requires a conscious, constant, and creative effort, which will produce individuals who can drive positive change in the future and work towards a sustainable world.

As income rises, it is claimed that pollution decreases due to an increased value placed on the environment by people. Therefore, improvements in regulatory institutions are needed (Dasgupta and De Cian 2016). Dasgupta et al. (2002) claim that when income increases, pollution decreases as people value the environment more and regulatory institutions become more effective. Attaining Sustainable Development Goal 4, which provides quality education and requires higher education, significantly empowers young individuals with the necessary skills to tackle imminent environmental and societal issues (United Nations 2023).

Sustainable development is the key to securing a future. Sustainable development ensures social equity, economic, and environmental performance. Therefore, the synergy between innovation and education is fundamental, implying that all agents collaborate. To learn about sustainable development, students will need to work on real-world issues with real-world solutions, where the development of potential means to achieve ecologically, economically, and socially sustainable development is achieved, and collective and solidarity values are strengthened, according to Steiner and Posch (2006) and UNESCO (2020).

According to UNESCO (2020), it is necessary to rethink what, where, and how things are learnt to develop the knowledge, skills, values, and attitudes that allow all human beings to make informed decisions and adopt both individual and collective measures on pressing issues locally, nationally, and globally contributing to a more sustainable world. In this permanent and integral learning process, innovation is a crucial factor in transforming contents into contextualized and problematized educational practices that can mobilize students, and prompting practicing academics to action–reflection–action initiatives on the challenges posed by transformations for sustainability (Jacobi et al. 2016).

Fletcher (2023) believes that education has a critical role to play in the fight against climate change. According to the research, individuals with higher levels of education are more likely to perceive climate change as a genuine threat. Dasgupta et al. (2002) suggest that the international community can contribute to reducing the environmental impact by providing funding for necessary training, policy reforms, information gathering, and public environmental education. According to the authors, there are two crucial factors in this regard. The first is to support programs that offer easily accessible public information about polluters, pollution damage, local environmental quality, and the cost of pollution reduction. The second is to aid in developing solid regulatory institutions, including cost-effective measures to reduce pollution. Thus, the following hypothesis is proposed:

Hypothesis 2. *Education is related to countries' environmental performances.*

2.3. Research and Development, Innovation, and Environmental Performance

Research and development (R and D) and innovation are crucial in balancing financial performance and sustainable development responsibilities (Ezzi and Jarboui 2016). Ezzi and Jarboui (2016) suggest that innovative companies are better equipped to tackle environmental challenges than non-innovative ones. Research and development, as demonstrated since the early 2000s by Darroch and McNaughton (2002) as well as recent research by Lin (2017), Alam et al. (2019), and Al Halbusi et al. (2023), enables companies to innovate and adapt to environmental changes, leading to improved financial performance. According to Hsu et al. (2021), green innovation plays a significant role in the impact of environmental performance to promote new ecological strategies and public policies.

Sarpong et al. (2023), Holt et al. (2021), Xu et al. (2021), and Ganda (2019) agree that R and D is the key driver of sustainable innovations. However, this investment must be aligned with developing R and D talent and learning institutions for R and D to

yield significant and lasting benefits. Without this alignment, even substantial R and D investments may not yield the advanced innovations we need (Sarpong et al. 2023).

When analyzing the environmental performance of companies, it has been proven that research and development causes a decrease in energy consumption and the intensity of carbon emissions since technologies with greater energy efficiency are promoted (Alam et al. 2019; Carrión-Flores and Innes 2010). From the systemic approach, a country can be considered an organization, and, therefore, the following hypothesis is proposed:

Hypothesis 3. *Research and development are related to countries' environmental performances.*

3. Materials and Methods

A database was used that corresponded to the published statistics of the World Intellectual Property Organization and the Global Innovation Index 2021. The sub-pillars of education, research and development, investment, and environmental performance proposed in this index were considered variables (World Intellectual Property Organization 2021). The database published by The World Bank in 2021 was used as the control variable (World Bank Group 2022). Data from 132 countries included in the index database spanning East Asian and Pacific regions, Europe and Central Asia, Latin America and the Caribbean, the Middle East and North Africa, North America, South Asia, and Sub-Saharan Africa (Table 1).

Table 1. Data description.

Region	Frequency
Central and Southern Asia	**10**
Low-income group	1
Lower middle-income group	7
Upper middle-income group	2
Europe	**39**
High-income group	29
Lower middle-income group	2
Upper middle-income group	8
Latin America and the Caribbean	**18**
High-income group	4
Lower middle-income group	3
Upper middle-income group	11
Northern Africa and Western Asia	**19**
High-income group	8
Low-income group	1
Lower middle-income group	4
Upper middle-income group	6
Northern America	**2**
High-income group	2
South East Asia, East Asia, and Oceania	**17**
High-income group	7
Lower middle-income group	6
Upper middle-income group	4

Table 1. *Cont.*

Region	Frequency
Sub-Saharan Africa	**27**
High-income group	1
Low-income group	11
Lower middle-income group	12
Upper middle-income group	3
Total	**132**

The education variable is evaluated using sub-pillar 2.1 of the index, which focuses on an economy's education and is determined using a score. This sub-pillar comprises expenditure on education, government funding/pupil, school-life expectancy, reading, math, and science scales, and pupil–teacher ratio. Data from sub-pillar 2.3 were taken to measure the research and development variable. This variable represents the research and development (R and D) level conducted and is measured uing scores. It is integrated from Sections 2.3.1 to 2.3.4 of the Global Innovation Index 2021, corresponding to researchers and gross expenditure on R and D, global corporate R and D investors, and university rankings. The sub-pillar 4.2 scores comprised the data taken for the investment variable. This sub-pillar is integrated from Sections 4.2.1 to 4.2.4 of the Global Innovation Index 2021 (ease of protecting minority investors, market capitalization, venture capital investors, and venture capital recipients). The environmental performance variable was measured using data from sub-pillar 3.3, which is an ecological sustainability score. This sub-pillar is integrated from Sections 3.3.1 to 3.3.3 of the Global Innovation Index 2021 (purchasing power parity gross domestic product (USD PPP GDP) per total energy supply, a gauge of how close countries are to established environmental policy targets, and the number of ISO 14001 certificates issued, per billion USD PPP GDP) (World Intellectual Property Organization 2021). The control variable was GDP per capita growth (percentage).

To answer the research question and carry out the hypotheses tests, partial correlation analyses, and linear regression analyses were carried out to obtain the best model of the analysis and thus determine the significant factors of the model. A correlation analysis is necessary to evaluate the linear association between the variables. However, it is recommended that we perform a partial correlation analysis if the association is affected by other variables for which control variables are used (Cordero et al. 2014). In this case, GDP was used as a control variable. As a result, three models were obtained where the dependent variable was environmental performance. The first model's independent variables were education, research and development, and investment. In the second model, the independent variable was research and development.

Moreover, the third model's independent variables were research and development and education. We assume that we must carry out a linear regression analysis since the variables not present multicollinearity.—(García et al. 2006; Baños et al. 2019). For this, the variance inflation factor was used, and the lower this value, the lower the multicollinearity between the variables (Baños et al. 2019). The criterion was that the calculated values were less than 10 (Kleinbaum et al. 2013; López-Roldán and Fachelli 2016). The SPSS package 29 was used in the data analysis.

4. Results

As a first stage for hypothesis testing, partial correlation analyses were performed to assess the influence of education, research and development, and investment on environmental performance. Table 2 shows the descriptive statistics of the variables. As the results show in Table 3, the environmental performance had a significant relationship with each study variable when the GDP controls the effects of the associations. The highest correlation coefficient was 0.548, corresponding to the relationship between environmental

performance and research and development. Hypothesis 1 was tested because the investment was related to the environmental performance. Also, hypotheses 2 and 3 were tested. The environmental performance was related to education and research and development.

Table 2. Descriptive statistics.

Variable	Mean	Standard Deviation	N
Environmental performance	30.8847	12.60278	131
Investment	34.3766	16.99941	131
Research and development	19.5113	23.73309	131
Education	48.3437	14.72364	131
GDP	4.9492	4.21733	131

Table 3. Partial correlations analyses.

			Investment	Research and Development	Education
Control variable GDP	Environmental performance	Correlation	0.214	0.548	0.410
		Signification (bilateral)	0.015	0.000	0.000
		Degrees of freedom	128	128	128

Control variable: GDP per capita growth.

As a second stage for deepening the results, linear regression analyses were performed to assess the influence of education, research and development, and investment on environmental performance. Table 4 shows the analysis of the variance results of each model tested. As shown in Table 5, investment did not have a significant regression coefficient ($\beta = 0.021$, $p = 0.785$). Although education ($\beta = 0.261$, $p = 0.004$) and research and development ($\beta = 0.394$, $p = 0.000$) had a significant regression coefficient (model 1). The coefficient of determination (R^2) indicates the degree to which the independent variables explained the dependent variable (Cohen et al. 2013). In this case, the value obtained was 0.337, which implies that education, research and development, and investment explain environmental performance by 33.7%.

Table 4. Analysis of variance.

Model		Sum of Squares	Degrees of Freedom	Mean Squares	F Value	*p* Values
1	Regression	7271.022	3	2423.674	23.010	0.000 [a]
	Residual	13,376.874	127	105.330		
	Total	20,647.896	130			
2	Regression	6306.678	1	6306.678	57.105	0.000 [b]
	Residual	14,357.294	130	110.441		
	Total	20,663.972	131			
3	Regression	7263.154	2	3631.577	34.729	0.000 [c]
	Residual	13,384.742	128	104.568		
	Total	20,647.896	130			

[a]-predictor variable: (constant) research and development, education, investment. [b]-predictor variable: (constant) research and development. [c]-predictor variable: (constant) research and development, education.

Table 5. Results of the linear regression analysis.

Model	Independent Variable	Standardized Beta	t Values	*p* Values	VIF Values	R^2	Durbin-Watson
1	Constant	15.443	4.384	0.000		0.337	1.965
	Education	0.261	2.966	0.004	1.523		
	Research and development	0.394	4.359	0.000	1.598		
	Investment	0.021	0.273	0.785	1.207		
2	Constant	25.175	21.265	0.000		0.300	1.909
	Research and development	0.552	7.557	0.000	1.000		
3	Constant	15.778	4.796	0.000		0.342	1.957
	Research and development	0.400	4.602	0.000	1.491		
	Education	0.265	3.049	0.003	1.491		

R^2—determination coefficient.

A hierarchical linear regression analysis was carried out to expand upon our results and identify the best model that explains the environmental performance, resulting in two models, 2 and 3. In both models, the independent variables had a positive effect and were meaningful. However, of these, model 3 was the one that explained the environmental performance to a greater extent, 34.2% (R^2 = 0.342), since model 2 had a lower coefficient of determination (R^2 = 0.300).

In model 2, research and development had a significant regression coefficient (β = 0.552, p = 0.000). In model 3, education (β = 0.265, p = 0.003) and research and development (β = 0.400, p = 0.000) had a significant regression coefficient, implying that only these variables determine the countries' environmental performance. Comparing these last two models, the variable with a higher degree of explanation in environmental performance is research and development, since when education is added in model 3, the change in R^2 is 0.043. This value is much lower than when only research and development alone explain the environmental performance. In addition, the magnitude of the effect of research and development (β2 = 0.552, β3 = 0.400) is greater than that of education (β3 = 0.265) on countries' environmental performances.

5. Discussion

The research results show that the countries' education, research and development, and investment were associated with environmental performance; however, only education and research and development were factors that positively influenced the countries' environmental performance, unlike investment in the countries. Regarding hypotheses 1 and 2, it has been confirmed that education and variables similar to an investment, such as economic wealth, influence environmental performance (Gallego-Alvarez et al. 2014). In this study, even though the economic variable, investment, was related to environmental performance, it was not a factor influencing environmental performance. Gallego-Alvarez et al. (2014) used secondary data from the Environmental Performance Index, unlike this research, which uses data from the Global Innovation Index 2021. The studies are conducted over several years, and changes in environmental performance factors may indicate an evolution of these factors. These results could imply that a few years ago, countries needed to have economic resources to create infrastructure or allocate resources to improve the environment. In contrast, with the results of this research, it can be inferred that when countries are innovative, measured as research and development, it results in a significant improvement in their performance, since they no longer only need economic resources but also the development of technologies, products, or other resources through research to reduce environmental damage. Something that stands out in the comparison of the study by Gallego-Alvarez et al. (2014) and this study is that education continues to be a relevant

factor in improving the environment, which makes sense, since as long as the population has an education, it is expected that there will be more research and development.

Regarding hypothesis 3, when comparing the results of this research with a similar one by Almeida et al. (2017), it is confirmed that innovation-related variables are associated with environmental performance. These results indicate that technology positively affects environmental performance, while this study indicates that research and development also positively affect countries' environmental performance. The difference in years between the research by Almeida et al. (2017) and this research is less than between the research by Gallego-Alvarez et al. (2014). Therefore, innovation has become more critical in environmental performance in recent years.

In the face of climate change, innovation is crucial, since it creates a positive change in the current state of affairs. It is the key to developing new products, services, and processes that favor environmental care and the sustainability of resources and our planet. Environmental innovation is a tool that allows the development of models for both the mitigation of and adaptation to climate change, with criteria and restrictions with a sustainable approach. Organizations have confirmed that research and development have a considerable role in reducing adverse environmental effects (Lee and Min 2014). Specifically, it has been proven that research and development towards the development of green technologies, reduction in energy consumption, carbon emissions, and green innovation have a positive effect on environmental performance (Alam et al. 2019; Awaworyi Churchill et al. 2019; Sahoo et al. 2023; Uyar et al. 2023). Furthermore, when analyzing countries, innovation is a variable that positively affects environmental performance (Pujiati et al. 2023).

According to Casas et al. (2017) and Castizo (2021), education and research and development are critical factors in agreements and actions to innovate and address rapidly developing environmental and sustainability problems. However, according to Casas et al. (2017), building science for sustainability implies training scientists with new visions and aligning governmental and non-governmental institutions, social organizations, and academic institutions at different scales to facilitate their interaction.

A broad vision and a willingness for disciplinary interaction are required to achieve research and development that allows innovation and addresses the complexity of systems. Scientists and academics value the contribution of natural and social sciences because there are no sciences that are better than others; they are different scientific fields that can complement each other and add more value to solving problems (Casas et al. 2017) and education is vital. It is also important to highlight that research and development in education focused on sustainable development are critical factors for the empowerment of students, academics, and society in general for the acceleration of sustainable solutions (UNESCO 2020).

6. Conclusions

The results imply that countries can be analyzed as organizations from a systemic point of view and that, according to their resources and capabilities, they have a competitive advantage according to the resource-based theoretical perspective. According to the results, countries' resources that are associated with environmental performance are investment as a production resource, education as a learning resource, and research and development as a strategic vision resource.

We conclude that the education of citizens can lead to a greater awareness of the environmental damage caused by their actions and those of others. That, among other things, could cause more significant pressure on governments so that they generate changes in favor of the environment. The education of citizens could be the first way for countries to reduce their environmental damage. Promoting research and development in countries is often necessary, since this could generate innovative solutions to reduce environmental damage and mechanisms that address or reverse major global problems such as climate change. Specifically, promoting research and development focused on developing green technologies and innovation is encouraged because, as confirmed by organizational studies,

it has positively affected environmental performance. Since the study uses the resource-based theoretical perspective framework from a systemic approach, it is expected that similar results will also be found at a country level.

While it is true that the differences between developing and developed countries puts the balance towards the latter to generate more remarkable changes for sustainability for their resources, it is also possible for developing countries to move towards sustainability. Although developing countries often do not have the necessary economic resources to improve their investment in education, they can align their public policies towards education and sustainability (environmental policies). Haque and Ntim (2018) confirmed that the development and implementation of environmental policies improve environmental performance, with which it is possible to take advantage of their budget and achieve sustainability. Countries can use the results of this study as a basis for developing public policies aimed at research and development for the environment and education.

Furthermore, these countries may complement education with other educational modalities supported by information technologies to combat a lack of education.

Given that education could generate pressure on governments to change their public policies, it is recommended that future research analyzes stakeholder theory. With this, they can analyze citizens' roles in the environmental performance of countries considering education as a moderating variable, as well as analyze how innovation reduces the negative impact on the environment and what the determinants of this are. Furthermore, it is suggested that the scope for future research could be expanded by considering more actors and critical factors, such as institutions, the environment, energy, and climate change, which could contribute to achieving a transition towards sustainable development. This study could be analyzed through secondary data between countries or primary data analyzing only one country or group.

The study's main limitation was that it was a cross-sectional study, which limits its scope, since it only shows results from one year. Therefore, the results could be affected by other elements, such as the effect of the COVID-19 pandemic, which has been documented to be an accelerator towards the green transition. The results of this study should be considered with caution. Future research can carry out a longitudinal study to analyze the behavior of the variables over the years and that will enable evaluation of the effects before and after the COVID-19 pandemic.

This research has implications for public policy and decision-makers, since the results show that the countries' education, research, and development influence how they take measures to stop environmental deterioration. For this reason, governments are encouraged to establish or modify policies and strategies that promote education in their citizens and strengthen research and development in their countries, and with this, they can generate innovative strategies to benefit the environment.

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