“Do environmental protection investments contribute to environmentally-oriented SDGS?”

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DO ENVIRONMENTAL PROTECTION INVESTMENTS CONTRIBUTE TO ENVIRONMENTALLY-ORIENTED SDGs?

Abstract

The most vital problems of humanity mentioned in SDGs are the consequences of climate change and biodiversity loss and problems with access to water and forest resources. Although there is a deep understanding of the problems, there are reasons that do not allow finding swift solutions, and the increasing funding gap for the relevant SDGs is one of them. This study aims to establish the connection between environmental protection investments and the achievement of environmentally oriented sustainable development goals across 31 European countries (26 EU Member States, 3 EFTA Countries, and Ukraine as a Candidate to EU). The paper employed the PLS-SEM approach. The obtained results proved that the accumulated amount of environmental protection investments does not have a statistically significant relationship with the integral indicators of SDG 6 "Clear water and sanitation," SDG 13 "Climate action," and SDG 15 "Life on land" (the coefficient of determination, the path coefficient, and the reliability coefficients were insignificant). The study of a similar relationship between the level and the directions of SDGs 6, 13, and 15 achievements also did not reveal any significant results. As the last step of the analysis, the hypothesis about a relationship between environmental protection investments and Environmental Performance Index components was also rejected. Therefore, the statistical significance and relevance of the analyzed indicators were not confirmed. Based on this, a conclusion was made about the insufficiency of investment resources for environmental protection to overcome the gap in achieving environmentally-oriented SDGs.

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INTRODUCTION

The modern world is in a state of imbalance. At the same time, with the highly rapid globalization and technological progress of humanity, global environmental problems are becoming increasingly acute and irreversible. This is confirmed by The Global Risks Report (WEF, 2022), according to which one of the most significant risks for the next ten years are climate change, extreme weather conditions, and loss of biodiversity. Furthermore, according to the Intergovernmental Panel on Climate Change (IPCC, 2018), under unchanged conditions, there is a high threat of reaching a critical temperature level of 1.5 degrees above preindustrial levels shortly between 2030 and 2052.

Global environmental threats are not new to humanity, as international organizations have expressed their concerns for a long time. The United Nations Framework Convention on Climate Change (UNFCCC), signed in 1992 and considered a rather important doc-

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ument, aims to stabilize greenhouse gas concentrations and ensure the transition to low-carbon and more circular economies, which imposed specific environmental and economic obligations on its signatories. Its implementation is monitored within the framework of The Kyoto Protocol (signed in 2005) and later the Paris Agreement (signed in 2015) and highlighted at the annual Conferences of the Parties (COP), in particular COP27, held in 2022 in Egypt. Despite this, the fulfillment of the environmental obligations of the countries is still questionable.

The 2030 Agenda for Sustainable Development is in close connection with the Paris Agreement, which formed the well-known 17 Sustainable Development Goals (SDGs), among which a number of environmentally oriented ones stand out: SDG 6 "Clear water and sanitation," SDG 13 "Climate action," SDG 14 "Life below water," and SDG 15 "Life on land."

According to UNEP (2016), the need for investment to overcome climate change in developing countries was estimated to be between 140 and 300 billion US dollars per year. According to the World Bank, the established value for water supply, sanitation, and hygiene services was USD 74 billion to USD 166 billion per year (Hutton & Varughese, 2016). At the same time, it should be clear that these numbers were relevant for the pre-pandemic period. The consequences of the COVID-19 pandemic and the global economic crisis are considered catastrophic, as they nullify previous achievements in sustainable development and freeze potential financial opportunities for recovery. The OECD notes that the financial gap in financing the SDGs in 2020 was to increase by 70% to 4.2 trillion USD (OECD, 2020).

For the environmentally-oriented SDGs, the COVID-19 pandemic had significant negative consequences. Even though some scientists noted positive effects in the early stages of the pandemic, such as a short-term improvement in air quality and a reduction in CO2 emissions (Shulla et al., 2021), today, these indicators are returning to pre-pandemic levels. Financial issues carry the most significant threat because the increase in the level of debt obligations, especially for developing countries, has led to the redistribution of financial resources from environmental programs and funds to more priority ones, in particular, to overcome the consequences of the pandemic and ensure economic stabilization.

1. LITERATURE REVIEW AND HYPOTHESES

Achieving SDGs is undoubtedly one of the most global issues, raised not only at the level of international organizations but also in the scientific community (Martínez-Alier et al., 2010; Costanza et al., 2016; Stafford-Smith et al., 2017). At the same time, a particular emphasis is placed on ecologically-oriented goals, particularly those that affect climate change and loss of biodiversity (Okoyeuzu & Ukpere, 2022).

At the end of 2021, the Scopus scientometric database contained more than 265,000 documents for the search query "sustainable development." Kazuhiko et al. (2017) noted that since 2006, such a branch of science as Sustainability Science has separated, with a large number of interdisciplinary publications and studies to compile the ways to achieve the SDGs (Messerli et al., 2019).

A separate issue is measuring progress in achieving the SDGs, which could provide an overall picture of global efforts and compare countries with each other. At the level of international organizations such as the United Nations and the World Bank, separate indicators that are components of specific SDGs are presented. The Sustainable Development Solutions Network (SDSN) and the Bertelsmann Stiftung have developed their own integrated SDG Index (Sachs et al., 2022), which allows cross-country analysis for 163 countries of the world for 2015–2022. To implement more applied ideas of scientific analysis, there are self-calculated composite SDG indices suggested by Costanza et al. (2016), Guijarro and Poyatos (2018), and Koilo (2020). Another well-known measure of the level of sustainable development aimed at assessing the ecosystem's ecological health and viability is the Environmental Performance Index (Wendling et al., 2020). At the same time, a high correla-

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tion between this index and the SDG Index was established by Schmidt-Traub et al. (2017).

Despite the current understanding of the importance of sustainable development and its implementation in program documents in most countries, achieving SDGs is becoming increasingly unrealistic, and the financial gap is deepening. At the same time, some scientists noted that it is necessary to take into account not only the costs of achieving SDGs but also the "cost of inaction," which is predicted to be 1.5% of GDP for SDG 6, 2.2% of GDP for SDG 13, and SDG 15 – 11.1% of GDP (Black Rock, n.d.).

These financial security problems are growing due to global economic and social crises and geopolitical instability. Therefore, there is a need to find new options for using financial resources, in particular, sustainable finance (Migliorelli, 2021; Bhatnagar & Sharma, 2022; Hesham, 2017) and relevant sustainability reporting (Maama & Gani, 2022; Mynhardt et al., 2017; Sukhonos & Makarenko, 2017).

Doumbia and Lauridsen (2019) noted that to solve the problem of the financial gap in achieving SDGs, the world community needs to move from the scale of "billions" to "trillions." At the same time, it is necessary to attract internal financial resources (in the form of tax revenues and private savings) and external private and state flows in the form of investments and official development assistance (ODA). The Addis Ababa Agenda Action is quite comprehensive in this regard, which also considers separate external and internal sources for financing SDGs. In particular, they justify the need to strengthen the financing of public services to achieve SDGs (UN & KPMG, 2015).

An increase in domestic financial resources, mainly due to environmental taxes, is quite promising. Thus, Piluso and Le Heron (2022) and Tchapchet-Tchouto et al. (2022) proved their multiplicative positive impact (on the example of the corporate carbon tax) on economic growth in the country. A separate instrument that has become widely used in the world is green bonds. They are used by both supranational and national institutions to direct efforts in achieving SDGs (Aggarwal & Pathak, 2021; Versal & Sholoiko, 2022; Prajapati et al., 2021).

Filho et al. (2022) showed that the achievement of SDGs should be considered not only from the point of view of expenditure, but also from an investment approach. Thus, achieving SDGs is quite closely related to responsible or ESG investing (Sparkes & Cowton, 2004; Renneboog et al., 2008; Plastun et al., 2020). Apalkova et al. (2021) proved that investment projects have significant advantages due to their environmental effects. In the example of developing countries, the positive impact of foreign direct investment on SDGs was noted (Aust et al., 2020). Yang et al. (2020) investigated the place of environmental protection investment in the social responsibility of business, which has a positive effect on the financial performance of companies.

Despite existing studies, they remain fragmented, and the financial gap in achieving the SDGs is increasing. At the same time, the list of proposed financial instruments is quite broad, which does not allow an idea about their effectiveness in current conditions.

All this helps to state the purpose of this study, which is to establish a connection between environmental protection investments and the achievement of environmentally-oriented SDGs on the example of European countries. This will allow assessing the extent to which investment is an essential tool for getting back on track to achieve progress in SDGs and to form specific guidelines for the future. To achieve this goal, the following hypotheses were set:

H1: Environmental protection investments have a direct positive impact on environmentally-oriented SDG scores, in particular SDGs 6, 13, and 15.

H2: Environmental protection investments have a direct positive impact on the conditions and achievement of SDGs 6, 13, and 15.

H3: Environmental protection investments have a direct positive effect on the Environmental Performance Index.

2. METHODOLOGY

The data on environmental protection investments and the achievement of sustainable development goals were aggregated (Appendix A, Table A1) for 30 European countries, including 27 EU Member States (excluding Cyprus due to lack of data), EFTA Countries (excluding Liechtenstein due to the lack of data), as well as Ukraine as a candidate for admission (the complete list is given in Appendix A, Table A2). The information base of the study was provided by:

- Eurostat (2022) database and State Statistics Service of Ukraine (2022) for accumulating data on environmental protection investments by environmental protection activity;
- Sustainable Development Report (Sachs et al., 2019, 2022), which contains data on integrated SDG scores, reflects trends regarding the level of achievement in SDGs 6, 13, and 15; SDG 14 was excluded from the list because there were no data on it for most of the countries;
- Socioeconomic Data and Applications Center (Wendling et al., 2020), which contains data on the Environmental Performance Index.

The study was conducted using the data for 2019, as it is the latest year with data on environmental protection investments at Eurostat available. The Environmental Performance Index is used for 2020, because it is compiled every 2 years, and data for 2019 has not been published yet.

Environmental protection investments are distributed based on the Classification of environmental protection activities (CEPA) and include the following subtypes (Eurostat, n.d.):

- CEPA 1 – Protection of ambient air and climate;
- CEPA 2 – Wastewater management;
- CEPA 3 – Waste management;
- CEPA 4 – Protection and remediation of soil, groundwater, and surface water;
- CEPA 5 – Noise and vibration abatement;
- CEPA 6 – Protection of biodiversity and landscapes;
- CEPA 7 – Protection against radiation;
- CEPA 8 – Environmental research and development;
- CEPA 9 – Other environmental protection activities.

To establish the connection between environmental protection investments and the achievement of sustainable development goals (SDGs 6, 13, and 15), it is proposed to use the PLS-SEM method, which reveals cause-and-effect relationships between variables by studying their dispersion (Chin et al., 2020). All calculations were performed on RStudio using the statistical computing language R, which contains the necessary modules for building PLS-SEM models.

PLS-SEM is based on two constructs: structural and measurement, which make it possible to form the necessary relationships between variables and to register the directions of possible interactions. The structural construct is also called inner and involves forming a relationship between several latent variables (variables that cannot be actually measured). These variables can be both exogenous (conditionally independent of disturbances in the system) and endogenous (conditionally dependent). Mathematically, it can be represented as (Bollen & Noble, 2011):

$$\eta_i = \alpha_\eta + \mathrm{B}\eta_i + \Gamma\xi_i + \zeta_i, \quad (1)$$

where ηi – vector of latent endogenous variables for unit i; α_η – vector of intercept terms for the equations; B – coefficient matrix for the latent endogenous variables; Γ – coefficient matrix for the influence of latent exogenous on the latent endogenous variables; ξ_i – vector of latent exogenous variables; ζ_i – vector of disturbances.

Measurement of outer construct involves identifying the relationship between observable variables (raw data) and latent variables (Hair et al., 2021) and can be represented mathematically as (Bollen & Noble, 2011):

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$$y_i = \alpha_y + \Delta_y \eta_i + \varepsilon_i, \quad (2)$$

$$x_i = \alpha_x + \Delta_x \zeta_{i\varepsilon_i} + \partial_i, \quad (3)$$

where y_i – vectors of the observed indicators of latent endogenous variables for unit i; x_i – vectors of the observed indicators of latent exogenous variables, vector of intercept terms for the equations; $\alpha_{y,x}$ – contercept vectors; $\Delta_{y,x}$ – matrices of regression coefficients giving the impact of the latent variables on observed indicators; ε_i, ∂_i – unique factors.

To assess the level and direction of SDG achievement, a scale or dashboard as a part of the Sustainable Development Report methodology (Lafortune et al., 2018) was used, which was converted into a numerical measurement on a scale from 0 to 3 (Table 1).

Table 1. Scale for assessing the level and direction of SDG achievement

Indicator	Survey	Characteristics	Numerical scale
Level of SDG achievement	green	Goal Achievement	3
	yellow	Changes remain	2
	orange	Significant challenges	1
	red	Major challenges	0
Direction of SDG achievement	↑	On track or maintaining achievement	3
	↗	Moderately Increasing	2
	→	Stagnating	1
	↓	Decreasing	0

3. RESULTS AND DISCUSSION

At the first step of the study, descriptive statistics for environmental protection investments and SDGs 6, 13, and 15 scores were provided (Table 2). Figure 1 allows comparing the goals selected.

Table 2. Descriptive statistics of environmental protection investments and SDGs 6, 13, and 15 scores

	Mean	Sd	Median	Mad	Min	Max	Range	Skew	Kurtosis	Se
*inv*1	67.5	196.4	7.9	11.6	0.0	1067.0	1067.0	4.4	19.4	35.9
inv2	363.1	656.3	77.0	114.2	0.0	3214.4	3214.4	2.9	9.3	119.8
*inv*3	177.2	308.8	39.3	51.9	0.0	1389.6	1389.6	2.4	5.9	56.4
inv4	74.2	153.1	15.6	21.5	0.0	629.5	629.5	2.8	6.9	28.0
*sd*1	87.0	4.8	87.7	4.4	78.0	95.5	17.5	–0.2	–0.9	0.9
sd2	86.5	8.2	88.4	5.0	54.4	95.6	41.2	–2.1	5.6	1.5
sd3	78.3	12.9	82.5	11.3	34.5	93.3	58.8	–1.4	2.1	2.4

Source: Sachs et al. (2019).

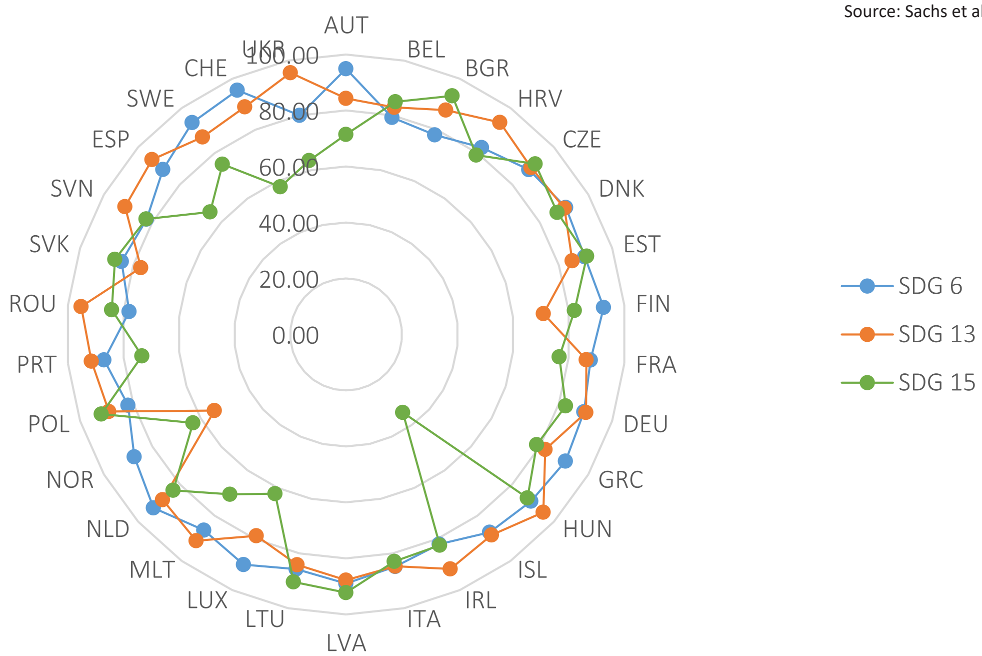

Figure 1. SDG 6, 13, and 15 for the selected countries in Europe for 2019

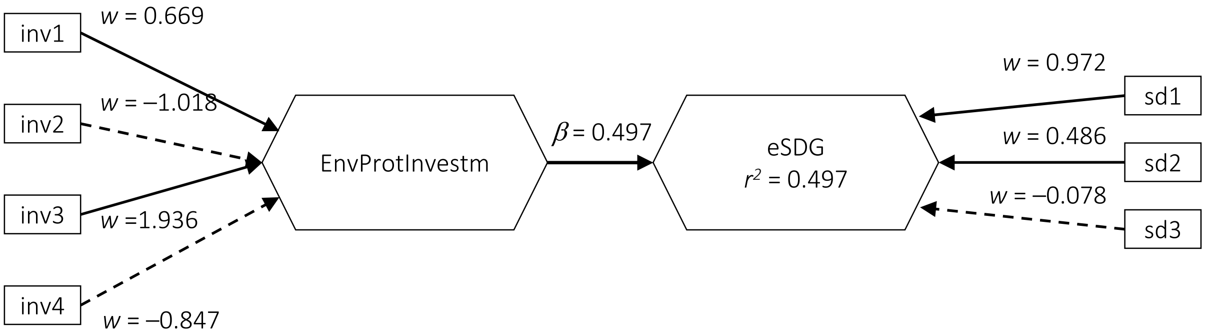

Figure 2. Path diagram measuring the relationship between environmental protection investments and SDGs 6, 13, and 15 scores

Based on the data presented in Table 2, it is possible to compare the average median, maximum, and minimum value of the selected indicators, their variation and symmetry, etc. For example, for indicators of environmental protection investments, the average values range from 67.5 million euros for *inv1* to 363.1 million euros for *inv2*. At the same time, the range of variation for these indicators is quite extensive: from 0 to 1067.0 million euros for *inv1*, from 0 to 3214.4 million euros for *inv2*, from 0 to 1389.6 million euros for *inv3*, from 0 to 629.5 million euros for *inv4*.

On average, the SDG 6 and SDG 13 scores are at about the same level, and the achievement of SDG 15 is slightly lower. The analysis of the ranges shows that values range from 78.0 (Romania) to 95.5 (Switzerland) for SDG 6, from 54.4 (Norway) to 95.6 (Ukraine) for SDG 13, and from 34.5 (Iceland) to 93.3 (Bulgaria) for SDG 15.

This allows proceeding to a direct analysis to establish a connection between environmental protection investments by environmental protection activity and SDGs 6, 13, and 15 scores. The results are presented in Figure 2 as a path diagram. The main indicators of the model adequacy and the statistical significance of its variables are given in Table 3. The *inv5* indicator was removed from the model to eliminate multicollinearity.

Table 3. Reliability coefficients for *H1*

Reliability coefficients	alpha	rhoC	AVE	rhoA
EnvProtInvestm	**0.792**	0.223	0.107	**1.000**
eSDG	–0.491	0.266	0.303	**1.000**

Note: Values in bold indicate significant values.

The obtained results indicate the low quality of the constructed model. The coefficient of convergent validity is 49.7%, and the coefficient of determination is only 24.7%. This indicates the low level of connection and correlation of the constructs among themselves. Furthermore, the reliability coefficients do not meet the threshold values, which is also an indication of the poor quality of the model. Further investigation of the relationship does not make sense, so *H1* is rejected.

The next stage is testing the second hypothesis about the connection between environmental protection investments and the level and direction of SDGs 6, 13, and 15 achievements (the results of its conversion into a numerical scale are provided in Appendix B). This made it possible to form two additional constructs: *eSDGlevel* and *eSDGdirection*, which compile the relevant indicators for SDGs 6, 13, and 15 (Figure 3).

Table 4. Reliability coefficients for *H2*

Reliability coefficients	alpha	rhoC	AVE	rhoA
EnvProtInvestm	**0.792**	0.512	0.218	**1.000**
eSDGlevel	–0.366	0.161	0.350	**1.000**
eSDGdirection	–0.211	0.421	0.311	**1.000**

Note: Values in bold indicate significant values.

The built model, like the previous one, shows a low level of connection and correlation between the constructs. Reliability coefficients also indicate the problem of the model about the direct positive impact of environmental protection investments on the level and direction of SDGs 6, 13, and 15 achievements. Thus, *H2* is rejected.

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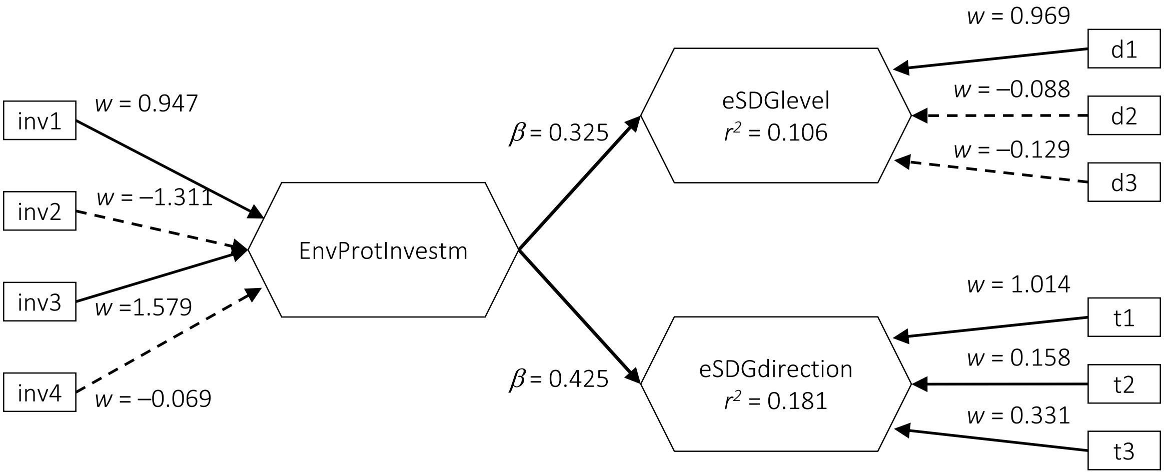

Figure 3. Path diagram measuring the relationship between environmental protection investments and the level-and direction of SDGs 6, 13, and 15 achievements

In the third stage, the third hypothesis about the connection between environmental protection investments and the Environmental Performance Index was tested as one of the alternative indicators of the international assessment of counteracting climate change, ensuring environmental health and ecosystem viability.

The values of EPI and its two principal components (environmental health and ecosystem vitality) for selected countries in 2020 are shown in Figure 4. The values are significantly differentiated between selected countries. Thus, the leaders in 2020 are Denmark, Luxembourg, and Switzerland, whose EPI value exceeded 80. The lowest values were obtained by Poland, Bulgaria, and Ukraine, whose values were less than 61. According to the Environmental Health indicator, the leaders were such Scandinavian countries as Finland, Norway, and Sweden; according to the Ecosystem Vitality indicator – Denmark, Luxembourg, and Romania.

For the analysis, two constructs *EnvHealth* and *EcosVitality* were formed according to the two main components of EPI. Each of them is affected by particular indicators (for example, air quality, sanitation and drinking water, heavy metals, waste management etc.); details are depicted in Appendix A. According to the actions at the previous stages, a path diagram with model adequacy indicators was obtained using RStudio (Figure 5, Table 5).

Source: Wendling et al. (2020).

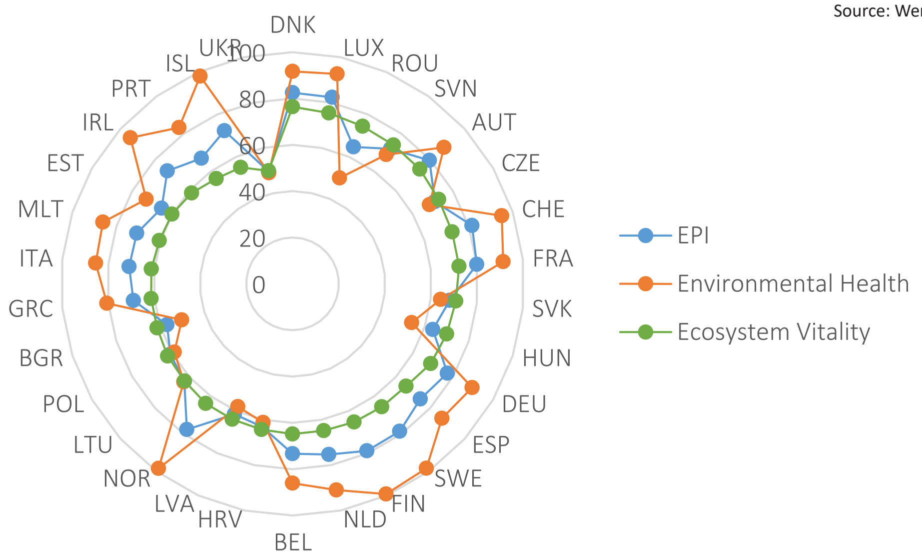

Figure 4. Environmental Performance Index for the selected European countries in 2020

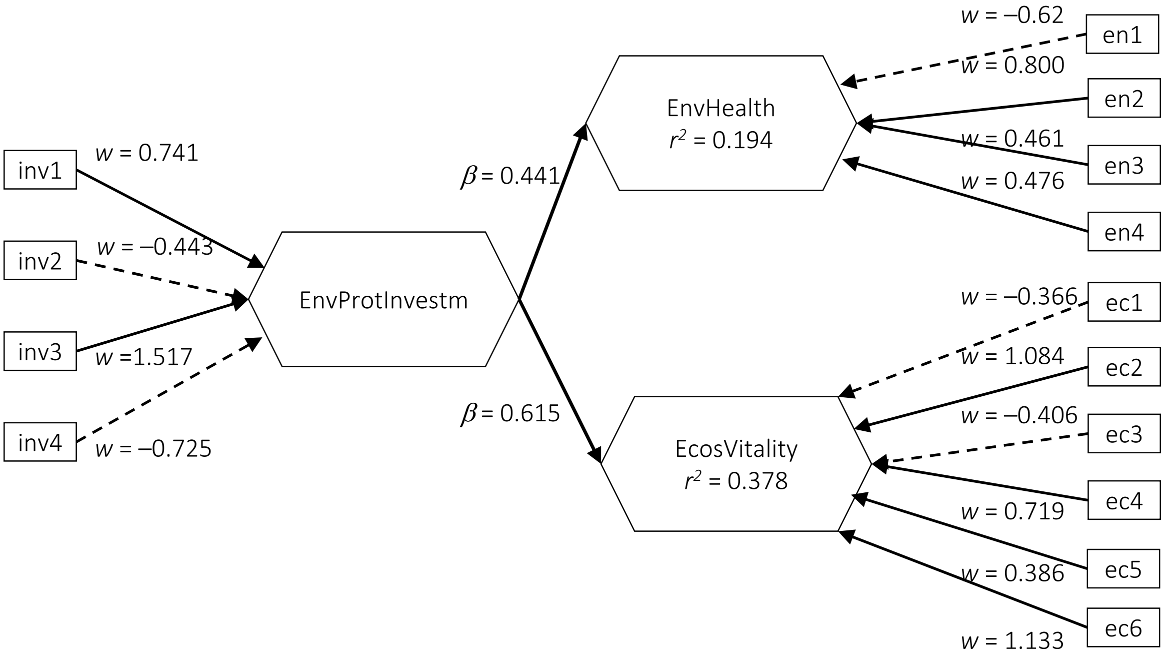

Figure 5. Path diagram measuring the relationship between environmental protection investments and Environmental Performance Index

Table 5. Reliability coefficients for *H3*

Reliability coefficients	alpha	rhoC	AVE	rhoA
EnvProtInvestm	**0.792**	0.589	0.285	**1.000**
EnvHealth	**0.872**	**0.847**	**0.587**	**1.000**
EcosVitality	0.333	0.309	0.115	**1.000**

Note: Values in bold indicate significant values.

This model showed the best results among previously analyzed ones. It has a higher coefficient of determination, convergent validity, and reliability coefficients. For a more thorough analysis of the quality of the model, the statistical significance and relevance of the indicators were analyzed in Table 6.

The results show no statistically relevant significance for the built model. Therefore, *H3* is also rejected. However, despite the conducted analysis on the connection between environmental protection investments and achieving sustainable development goals, there are limitations and knowledge gaps to be further investigated. The study was conducted based on a group of European countries, particularly valid EU members and their partners and candidates, which have an integrated vector for achieving sustainable development goals and environmental policy in particular. This common trait allowed analyzing such specific indicators as environmental protection investments, divided by environmental protection activity types. On the other hand, in most studies on a similar topic, such as Khalil et al. (2022), the emphasis is placed more locally: for example, the impact of environmental, social, and governance (ESG) investments on performance indicators of a specific business, in particular its market share.

Another limitation of this paper is the chosen period of the study, which covers 2019, i.e., the year before the COVID-19 pandemic. As previously mentioned, most forecasts indicate a worsening financial gap in achieving the SDGs. However, due to the lack of official statistical data at Eurostat for the post-war period, the scale of changes has not been assessed. Zhang et al. (2022), on the example of China, proved that COVID-19-associated shocks cause significant financial constraints for businesses, which ESG performance indicators help to overcome.

Despite these limitations, this study fills a gap in the literature regarding the empirical grounding of the influence of environmental investments on achieving sustainable development goals and provides a basis for further research in this direction.

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Table 6. Statistical significance and relevance of indicators

Indicators connections	Original Est.	Bootstrap Mean	Bootstrap SD	T Stat.	2.5% CI	97.5% CI
inv1 → EnvProtInvestm	0.741	0.394	0.775	0.956	–1.504	1.777
inv2 → EnvProtInvestm	–0.443	–0.191	1.322	–0.335	–2.912	2.774
inv3 → EnvProtInvestm	1.517	1.033	1.093	1.388	–1.325	2.698
inv4 → EnvProtInvestm	–0.725	–0.500	1.358	–0.533	–3.078	2.793
en1 → EnvHealth	–0.620	–0.300	1.161	–0.534	–2.258	2.284
en2 → EnvHealth	0.800	0.598	1.168	0.685	–2.047	2.468
en3 → EnvHealth	0.461	0.238	0.645	0.715	–1.369	1.206
en4 → EnvHealth	0.476	0.232	0.699	0.681	–1.188	1.455
ec1 → EcosVitality	–0.366	–0.297	0.553	–0.661	–1.206	0.989
ec2 → EcosVitality	1.084	0.749	0.682	1.590	–0.911	1.981
ec3 → EcosVitality	–0.406	–0.246	0.442	–0.918	–1.038	0.678
ec4 → EcosVitality	0.719	0.559	0.733	0.982	–1.273	1.799
ec5 → EcosVitality	0.386	0.180	0.527	0.733	–1.025	1.152
ec6 → EcosVitality	1.133	0.729	0.554	1.043	–0.650	1.558
EnvProtInvestm → EnvHealth	0.441	0.518	0.241	1.825	–0.544	0.788
EnvProtInvestm → EcosVitality	0.615	0.653	0.389	1.581	–0.808	0.916

CONCLUSION

The purpose of this paper was to study the relationship between environmental protection investments and the achievement of sustainable development goals using the example of 30 European countries based on structural modeling. The critical indicators were the environmental protection investments by five environmental protection activities, ecological SDGs 6, 13, and 15 scores and trends, and the environmental performance index. In addition, the relationship between observable and latent variables, as well as between latent variables, was investigated with the help of path diagrams using the PLS-SEM methodology.

The obtained results proved the following vital points. First, the selected five environmental protection investments did not have a statistically significant and adequate dependence on SDG 6, 13, and 15 scores (*H1* was rejected), as well as the level and direction of their achievement (*H2* was rejected) or Environmental Performance Index (*H3* was rejected). Thus, the conducted empirical analysis proves the inability to overcome the existing gap in achieving sustainable development goals through investment alone, even with a specific environmental orientation. Despite the numerous efforts of the international community, inscribed in the Paris Agreement framework and updated at COP27, it is necessary to intensify interaction further and establish cross-sectoral cooperation to achieve the environmentally significant SDGs with the participation of a broader range of stakeholders.

AUTHOR CONTRIBUTIONS

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Methodology: Anna Vorontsova.
Project administration: Zhanna Oleksich, Nataliia Ovcharova.
Supervision: Anna Vorontsova.
Validation: Oleksandra Rieznyk, Alla Treus, Nataliia Ovcharova.
Visualization: Oleksandra Rieznyk, Alla Treus.
Writing – original draft: Anna Vorontsova, Zhanna Oleksich.
Writing – review & editing: Oleksandra Rieznyk, Alla Treus.

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APPENDIX A

Table A1. Description of the input data

	Variables	Symbols
Latent variable: Environmental Protection Investments by environmental protection activity		**EnvProtInvestm**
Observed variables	Protection of ambient air and climate; protection and remediation of soil, groundwater and surface water; noise and vibration abatement; protection against radiation (CEPA 1, 4, 5, 7), million euro	inv1
	Wastewater management (CEPA 2), million euro	inv2
	Waste management (CEPA 3), million euro	inv3
	Protection of biodiversity and landscapes (CEPA 6), million euro	inv4
	Environmental research and development; other environmental protection activities (CEPA 8, 9), million euro	inv5
Latent variable: ecological SDG		**eSDG**
Observed variables	Goal 6 Score	sd1
	Goal 13 Score	sd2
	Goal 15 Score	sd3
Latent variable: level and direction of SDGs 6, 13, 15 achievements		**eSDGlevel, eSDGdirection**
Observed variables	Goal 6 Dashboard	d1
	Goal 13 Dashboard	d2
	Goal 15 Dashboard	d3
	Goal 6 Trend	t1
	Goal 13 Trend	t2
	Goal 15 Trend	t3
	Goal 6 Dashboard	d1
	Goal 13 Dashboard	d2
	Goal 15 Dashboard	d3
	Goal 6 Trend	t1
	Goal 13 Trend	t2
	Goal 15 Trend	t3
Latent variable: EPI components: Environmental Health, Ecosystem Vitality		**EnvHealth, EcosVitality**
Observed variables	Air Quality	en1
	Sanitation and Drinking Water	en2
	Heavy Metals	en3
	Waste Management	en4
	Biodiversity and Habitat	ec1
	Ecosystem Services	ec2
	Climate Change	ec3
	Pollution Emissions	ec4
	Agriculture	ec5
	Water Resources	ec6

Table A2. List of countries analyzed in this study

Groups	Countries	Abbreviations
26 EU Member States	Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain Sweden.	AUT, BEL, BGR, HRV, CZE, DNK, EST, FIN, FRA, DEU, GRC, HUN, IRL, ITA, LVA, LTU, LUX, MLT, NLD, POL, PRT, ROU, SVK, SVN, ESP, SWE
EFTA Countries	Iceland, Norway, Switzerland	ISL, NOR, CHE
Candidates to EU	Ukraine	UKR

APPENDIX B

Table B1. Results of the level (L) and direction (D) assessment of SDGs 6, 13, and 15 achievements

Country	SDG 6		SDG 13		SDG 15		SDG 6	SDG 13	SDG 15	SDG 6	SDG 13	SDG 15
	L	D	L	D	L	D	L	L	L	D	D	D
AUT		↑		→		↗	2.00	0.00	2.00	3.00	1.00	2.00
BEL		↑		→		↑	1.00	0.00	2.00	3.00	1.00	3.00
BGR		↗		↗		↑	2.00	1.00	3.00	2.00	2.00	3.00
HRV		↑		↗		↗	2.00	1.00	2.00	3.00	2.00	2.00
CZE		→		→		↑	2.00	0.00	2.00	1.00	1.00	3.00
DNK		↑		↗		↑	2.00	1.00	2.00	3.00	2.00	3.00
EST		→		→		↑	2.00	0.00	2.00	1.00	1.00	3.00
FIN		↑		↗		↑	2.00	0.00	2.00	3.00	2.00	3.00
FRA		↗		→		↗	2.00	0.00	2.00	2.00	1.00	2.00
DEU		↑		→		↑	2.00	0.00	2.00	3.00	1.00	3.00
GRC		↗		↗		↗	2.00	0.00	2.00	2.00	2.00	2.00
HUN		↑		→		↑	1.00	0.00	3.00	3.00	1.00	3.00
ISL		↗		↓		→	1.00	0.00	1.00	2.00	0.00	1.00
IRL		↑		↓		↑	1.00	0.00	2.00	3.00	0.00	3.00
ITA		↑		↗		↑	2.00	0.00	2.00	3.00	2.00	3.00
LVA		→		→		↑	1.00	1.00	2.00	1.00	1.00	3.00
LTU		↗		↓		↑	1.00	0.00	2.00	2.00	0.00	3.00
LUX		↑		↗		↗	2.00	0.00	1.00	3.00	2.00	2.00
MLT		↑		→		.	2.00	2.00	1.00	3.00	1.00	0.00
NLD		↑		↓		↑	2.00	1.00	2.00	3.00	0.00	3.00
NOR		↗		→		↑	2.00	0.00	1.00	2.00	1.00	3.00
POL		→		→		↑	2.00	0.00	3.00	1.00	1.00	3.00
PRT		↗		↓		↗	1.00	0.00	2.00	2.00	0.00	2.00
ROU		↗		↑		↑	1.00	2.00	3.00	2.00	3.00	3.00
SVK		↓		↗		↑	2.00	0.00	2.00	0.00	2.00	3.00
SVN		↗		↗		↑	1.00	0.00	2.00	2.00	2.00	3.00
ESP		↑		→		→	2.00	0.00	2.00	3.00	1.00	1.00
SWE		↑		↗		↑	2.00	0.00	2.00	3.00	2.00	3.00
CHE		↑		↗		↗	2.00	1.00	1.00	3.00	2.00	2.00
UKR		↑		↑		→	1.00	2.00	1.00	3.00	3.00	1.00

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