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Environmental wellbeing in the context of sustainable development: Evidence from post-communist economies

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Considering diverse national contexts, there are differences in the capacity of countries in terms of their ability to attain sustainability in its three main dimensions. The present study puts the economic, social, and environmental indicators face-to-face from 19 post-communist economies across the 2006–2020 period. It emphasizes the main vulnerabilities at the level of the analyzed countries, concentrates on these weak points, and offers concrete explanations regarding the main social and economic factors, exerting a negative influence on them. Consequently, placing climate and energy, with their major components, i.e., energy use, energy savings, greenhouse gases, and renewable energy, at the center of the analysis, as the major weak points of environmental wellbeing within the analyzed group of countries, the nature of the influence of human and economic wellbeing upon each of them is evidenced using panel data-specific methods (pooled, fixed, and random effects). The general results obtained showed the following: 1) the components of environmental wellbeing registered a different evolution among post-communist economies; 2) climate and energy components were the main vulnerabilities in terms of environmental sustainability; 3) these environmental components were closely linked to both components of economic and social dimensions; and 4) the determinants of energy use, energy savings, greenhouse gases, and renewable energy were different in the selected group of countries. This study draws attention to the fact that the patterns of development applied in the group of post-communist economies seem to strengthen sustainable goals, especially with regard to economic and human wellbeing. Moreover, while directing its focus on the main urgent environmental vulnerabilities and encouraging their strengthening by not putting the economic dimension in the center of interest, it supports the theoretical perspective of sustainable wellbeing, based on sustainability and ecological economics.

KEYWORDS

environmental performance, natural resources, climate & energy, human and economic wellbeing, post-communist economies, panel data models

Introduction

Background

Ideally, the best system is the one achieving the overarching goal of a world that is simultaneously prosperous, equitably shared, and ecologically sustainable (Costanza et al., 2016). Although this perspective is well-known among researchers, practitioners, public institutions, and also citizens, the damage caused by humanity to the environment are still a huge global problem. Dasgupta (2021, p. 110) have explained the potential threat regarding the extent to which human actions interfere with the environment, focusing on issues such as the increase of industrial output and energy use, with all their repercussions, methane-producing cattle population, fishing, carbon and sulfur dioxide emissions, soil acidification, and eutrophication of freshwater lakes and marine dead zones as consequences of nitrogen and phosphorus overload. In such a context, the paradox is that all free services provided by ecosystems, known as drivers of wellbeing and without which there could be no economy at all, have been systematically excluded from any conventional notion and measurement of development and growth until recent years (Fioramonti et al., 2022, p. 2). Different authors assume that humans are "locked-in," "trapped," and "in a very real sense addicted to the current regime" (Costanza et al., 2017; Roth, 2019). As Khan et al. (2022) emphasize, economic growth is one of the primary macroeconomic aggregates and is generally achieved due to its capacity to generate positive externalities in a nation. In the same way, the implicit assumption underlying the Sustainable Development Goals (SDGs) is this desire for continual global economic growth as the only viable route for i) reducing carbon emissions, ii) eliminating global poverty, and more generally (iii) ensuring that development is sustainable (Dasgupta, 2021, p. 119). This would mean that sustainable development assumes conversion of the negative influences of economic and human dimensions upon the environment into positive ones, and the high levels of the first ones translate into the high levels of the last ones. This is the starting point of our study investigating the manner in which the conventional sustainable development theory applies in practice at the macro level, in a specific group of countries, i.e., post-communist economies.

Different authors have convincingly argued that this path of development is not really as "sustainable" as it should be and tried to find and suggest different directions, leaving aside the general theory of sustainable development. Accordingly, new perspectives of wellbeing based on the theoretical background of sustainability and ecological economics have gained interest across relevant scientific literature. In such a context, development means the sustainable progress of human wellbeing, while being fully aware that growth may produce negative effects. Moreover, the focus is laid on the connections between people (society, with its two dimensions, *i.e.*, social and economic) and the rest of nature (*i.e.*, environmental dimension) (Costanza et al., 2015). One such representative approach is that of Prescott-Allen (2001), proposing what is called "The Wellbeing of Nations" as a new method of measuring human and ecosystem wellbeing, together with a first assessment of 180 countries and four indices. In the same way, another important initiative intensively followed in this study is that of Van De Kerk and Manuel (2008), who proposed the Sustainable Society Index, measuring three dimensions of wellbeing, i.e., human, economic, and environmental. Completing this perspective and assuming that it is more consistent with the comprehensive nature of the SDGs than the concept of sustainable development, Kubiszewski et al. (2022, p. 2) start from the dependence of society on the wellbeing of the ecological life support system (Bai et al., 2016; Costanza et al., 2018; Kubiszewski et al., 2013), arguing that global society's overall goal should be sustainable wellbeing. Accordingly, emphasizing the fact that humans are part of nature, and not outside it (Hernández-Blanco et al., 2022; Costanza, 2020), the harmonious development of the human–nature dimension becomes the basis and prerequisite for the development of human–society and human–human dimensions (Prescott-Allen, 2001, p. 5), with the final goal of a high level of sustainable wellbeing. Nevertheless, the natural capital is not capable of generating human wellbeing in isolation, with its interaction between the human, social, and built capitals (Costanza et al., 2014) being necessary. In addition, another concept, i.e., the "wellbeing economy" (WE), meaning an economy that pursues human and ecological wellbeing instead of material growth, according to Fioramonti et al. (2022, p.1), is gaining support among policymakers, business, and civil society. Arguing their idea and positioning it into an actual context, the authors emphasize that the global COVID-19 pandemic reveals the "crucial importance of human and ecological wellbeing, not only in and of itself but also as a (pre)condition for any form of social and economic activity" (Fioramonti et al., 2022, p. 2). At the same time, the lessons learned should be attentively observed and understood, as offering a "tremendous window of opportunity for system change" (Fioramonti et al., 2022, p. 2). This idea is reconfirmed in the new context of the war in Ukraine and its large negative impact at the global level.

More precisely, the lack of care toward environmental wellbeing leads to different negative consequences on the general level of wellbeing in a society. As they do not appear on the short run, they become more dangerous globally. For example, the multidimensional and interconnected effects generated by climate change have the capacity to increase susceptibility to damage and crises (Chen et al., 2020; Liu et al., 2022; Zhang et al., 2021; Allam et al., 2022). Apart from this, the issues of energy poverty (Goyens, 2020) and energy bill increases (Graff and Carley, 2020) are more urgent than ever (Jiang et al., 2021, p.5), especially during the period of COVID-19 and the Ukrainian war and its effects, with Russian restrictions

being a consequence of the international response to it. At the general level, it is known that high levels of energy use underpin ecological crises (Haberl et al., 2011; Steffen et al., 2015), resource scarcity, and geopolitical instabilities (Büchs and Koch, 2019). This perspective is very real and available nowadays, which requires us to find solutions or, at least, ameliorate existing threats (Millward-Hopkins et al., 2020). However, more than two-thirds of anthropogenic greenhouse gas emissions are related to the energy sector (IEA, 2018, p. 3). In such a context, renewable energy appears as a means to decarbonize economies. Different studies have pointed out the fact that, in the context in which energy seems to be the main element for the manufacture of goods and services, economic growth can be promoted through renewable energy, which can generate a sustainable process (Khan et al., 2021a; Khan et al., 2021b). However, considering the society-wide rebound effects, solutions are even more complex than they appear at first sight. In addition, among other different political recommendations for increasing sustainability (for example, Khan et al., 2022, Khan et al., 2021a; Allam et al., 2022; Zhao et al., 2020; Liu et al., 2022), some of the most appropriate points in this discussion might be the following: 1) changing the productive matrix, with technological improvements that enable us to achieve clean and sustainable production processes; 2) defining mechanisms and policies to promote green economic growth; 3) encouraging the adoption of digital technologies; 4) improving social and environmental awareness and providing education to people; 5) increasing population control strategies for tackling the environmental, economic, and societal challenges; and 6) redefining and reassessing contemporary urban policy based on urban models, such as the compact city, the eco-city, the sustainable city, the smart city, or the 15-minute city. Accordingly, as also assumed by Bourcet (2020, p. 1), to address environmental crises with a substantial impact on societies, it is essential to understand the empirical determinants of these environmental issues (including those related to greenhouse gases, energy use and savings, and renewable energy) for public policy guidance and to foster future research.

Sustainable Society Index and its link to Sustainable Development Goals

With regard to wellbeing and its measuring tools, it must be stated that, at the general level, this is a complex concept, widely debated and analyzed across scientific literature from different domains. However, it is not sufficiently understood or clearly defined as it is a relative concept similar to poverty, sustainability, and development. Accordingly, the endeavor of evaluating it is not a simple one, neither at the individual and family nor at the community levels and, even more so at the regional or national levels. Such different attempts have been undertaken in diverse studies, evolving from simpler indicators to much more complex parameters, integrating into their composition diverse issues belonging to specific pillars of being, including the economic, social, or environmental factors (Witulski and Dias, 2020).In this context, although defining wellbeing certainly is difficult, if taking into consideration its complexity, as with other multiple concepts from the socio-economic field, the tentative strategy to evaluate it should be encouraged and supported. Even though vague or unclear, the image offered by analyzing this type of data could represent a perspective of the status of wellbeing in a certain context, possibly offering directions of action, recommending suggestions in this regard, points of investment orientation from the lens of principle vulnerabilities, and the main determining factors regarding it. In this respect, it is a gain to valorize the work, for example, of Van De Kerk and Manuel (2008), with their Sustainable Society Index, or the latter one, of Kowalski and Veit (2021), who continued the efforts of these earlier studies in searching for a sustainable path. In the context in which this process of investigation additionally clarifies how to attain a higher level of wellbeing in the analyzed context, the demarche to attaining its aim and its utility is completely justified. Figure 1 details the human, economic, and environmental dimensions of sustainability covered by the SSI, providing a large set of indicators (*i.e.*, 21), which come from a large number of reliable sources (see Figure 1). It has to be pointed out that the Sustainable Society Index was confirmed by the Joint Research Centre of the European Commission as an index that is "well-structured and guaranteeing a control process to ensure transparency and credibility of the results" (Gallego-Álvarez et al., 2015).

The SSI is based on 21 indicators grouped into seven categories (*i.e.*, basic needs, personal development and health, well-balanced society, transition, economy, natural resources, and climate and energy) and three dimensions (*i.e.*, human wellbeing, economic wellbeing, and environmental wellbeing). Table 1 includes the description of all indicators used in the SSI framework.

As Figure 2 shows, the previously presented indicators follow the Sustainable Development Goals and also the framework of ecological economics, with specific principles, such as sustainable scale (meaning the necessity of staying within planetary boundaries), efficient allocation (in order to build a living economy), and fair distribution of resources (capable of protecting the capabilities for flourishing) (Daly, 2014; Costanza et al., 2016; Sangha et al., 2022). As Costanza et al. (2016), p. 355) assumed, the agreed UN SDGs are a major achievement for the development of shared goals for the whole of humanity, while including economic, social, and environmental elements. However, the goals are not independent of each other, interacting and distinctively contributing to what should generally mean a high level of wellbeing in a society. Accordingly, linking development with the state and the use of natural resources can help us improve

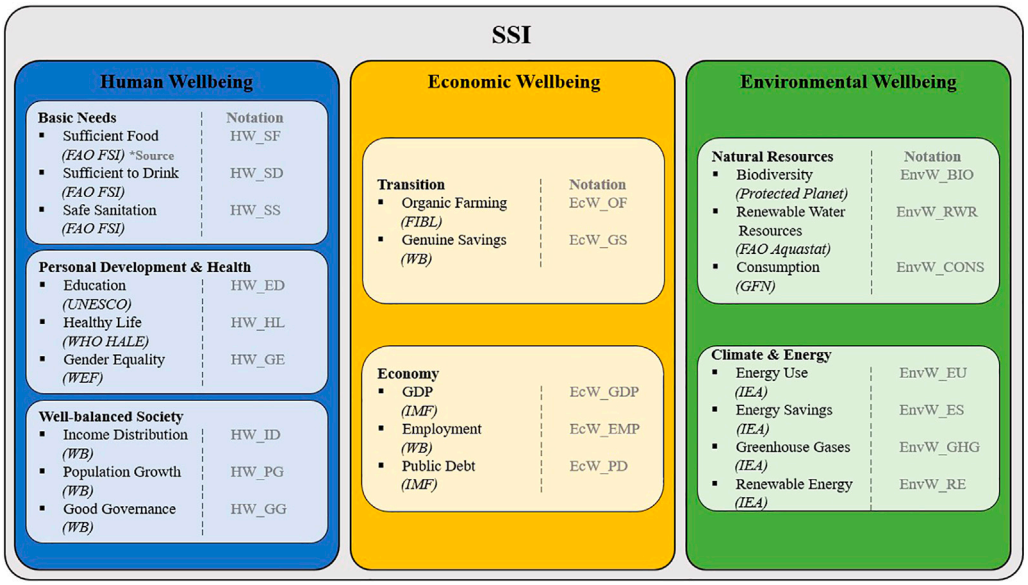

FIGURE 1
Sustainable Society Index (SSI) framework (Van De Kerk and Manuel, 2008).

human wellbeing while staying within planetary boundaries (Sangha et al., 2022, p. 8). Therefore, the recommendation is to develop national economies that are embedded in society, which is itself embedded in natural systems (Costanza et al., 2013). Nevertheless, as pointed out in different studies (Kibria et al., 2022; Fioramonti et al., 2022; Costanza et al., 2013; Costanza, 2020), knowledge of the interactions between dimensions is still conceptual, while the need of understanding each interaction between the economy, society, and nature is a certitude.

Answering the aforementioned requirement, Figure 3 presents the main results obtained in previous studies, using the SSI framework and analyzing the relationship between environmental, human, and economic wellbeing, while placing the environment at the center of the discussion, with the main aim of observing the influence of other dimensions. From a general perspective, it could be observed that the environment is still highly affected by the components of human and economic dimensions, the most frequent manner of influencing it being negative. In detail, the social indicators related to health, population growth, and good governance are shown to register the most constant negative influence across the analyzed levels (*i.e.,* stages of national development, EU countries, CEECs, Romania) on environmental wellbeing, while the economic indicators regarding employment and public debt appear to be the most significant effects. Regarding GDP, it has been observed that there is an insignificant influence on environmental wellbeing in all analyzed contexts. As a consequence, at least according to these results, it seems that the economic growth measured through this indicator does not produce damage to the environment anymore. A possible explanation is related to the samples chosen for analysis, i.e., especially those from developed or emerging economies. In this regard, we turn our attention to the environmental Kuznets curve (EKC), which posits an inverted-U relationship between pollution, as a representative indicator of environmental degradation and economic growth (Stern, 1998; Dasgupta et al., 2002; Dinda, 2004; Dogan and Inglesi-Lotz, 2020; Hatmanu et al., 2022). These facts are highlighted in other literature in the field, which also emphasizes that people value the environment more highly in developed countries than the developing ones, where jobs and income are influential on personal actions (Dasgupta et al., 2002, pp. 147–148; Dinda, 2004, p. 432; Stern, 1998, p. 174). In this way, not only in the context of increased research knowledge on environmental quality and regulation (Dasgupta et al., 2002, p. 152) but also in our perception of increasing financial possibilities in more advanced countries, we need to explore the ways we register progress, from one development stage to another, as this is not a static but a dynamic process.

Until recently, as a general overview, economic indicators have included factors that affect environmental wellbeing the most, while social indicators, especially concerning basic needs such as education, gender equality, and income distribution, have succeeded in neutralizing their influence on the environment. Moreover, a basic organizing principle of ecological economics focuses on the complex

TABLE 1 Description of SSI indicators.

Indicator	Description
Human wellbeing—basic needs	
HW_SF	Prevalence of undernourishment (% of population)
HW_SD	People using at least basic drinking water services (% of population)
HW_SS	People using at least basic sanitation services (% of population)
Human wellbeing—Personal Development & Health	
HW_ED	Gross enrollment ratio, primary and secondary, both sexes (%)
HW_HL	Life expectancy at birth, total (years)
HW_GE	Gender gap index—based on 14 indicators aggregated into four categories: economic participation and opportunity; educational attainment; political empowerment; and health and survival
Human wellbeing—well-balanced society	
HW_ID	Ratio of income share held by lowest 10% to income share held by highest 10%
HW_PG	Population growth (annual %)
HW_GG	Sum of the values of the six worldwide governance indicators—voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and control of corruption
Economic wellbeing—transition	
EcW_OF	Organic area share of total farmland (%)
EcW_GS	Adjusted net savings, including particulate emission damage (% of GNI)
Economic wellbeing—economy	
EcW_GDP	GDP per capita, PPP (current international $)
EcW_EMP	Unemployment, total (% of total labor force) (modeled ILO estimate)
EcW_PD	General government liabilities or debt + loans or net lending
Environmental wellbeing—Natural Resources	
EnvW_BIO	10-year change of forest areas and the size of protected land areas as a percentage of the total land area of a country
EnvW_RWR	Annual water consumption as a percentage of the total available renewable water resources, including internal and external (flowing in from neighbor countries) water resources
EnvW_CONS	Ecological footprint minus carbon footprint, once it is already included in this index by the emission of greenhouse gases (gha per person)
Environmental wellbeing—Climate and Energy	
EnvW_EU	Total energy consumption includes the consumption of petroleum, dry natural gas, coal, net nuclear, hydroelectric, and non-hydroelectric renewable electricity (MTOE)
EnvW_ES	Change in energy usage within 5 years in percentage
EnvW_GHG	CO_2 per capita
EnvW_RE	Renewable energy consumption (percentage of total final energy consumption)

interrelationships between ecologically, socially, and economically sustainable wellbeing, seeking to improve general levels of wellbeing and maintain the resilience of highly interconnected socio-ecological systems (Costanza et al., 2014; Costanza, 2020). With this principle in mind, our study attempted to explore this and contribute to the field by examining a small part of what it assumes in a specific context. The next section details the main objectives of the study and its research hypotheses.

Main objectives and research hypotheses

In a situation in which the conversion of the negative influences of economic and human dimensions upon the environment into positive ones is being assumed by the conventional sustainable development theory, our study proposes to investigate the manner in which it applies in practice at the macro level, in post-communist economies, focusing on the most vulnerable aspects of environmental

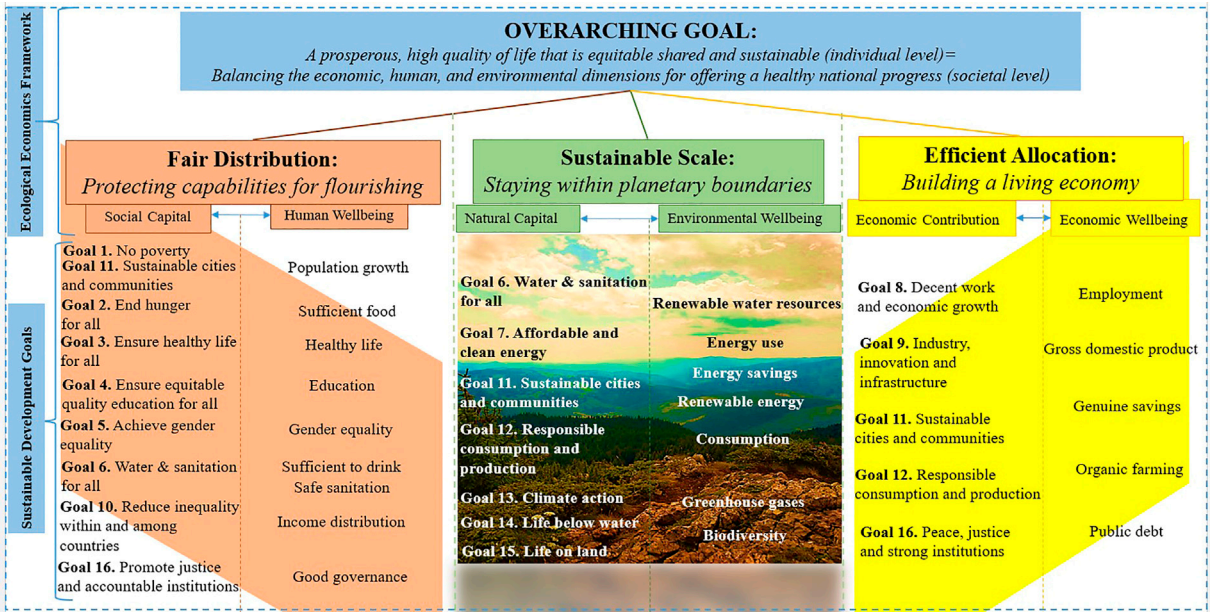

FIGURE 2
Coverage of the Sustainable Development Goals in the case of the Sustainable Society Index (SSI) framework (Van De Kerk and Manuel, 2008).

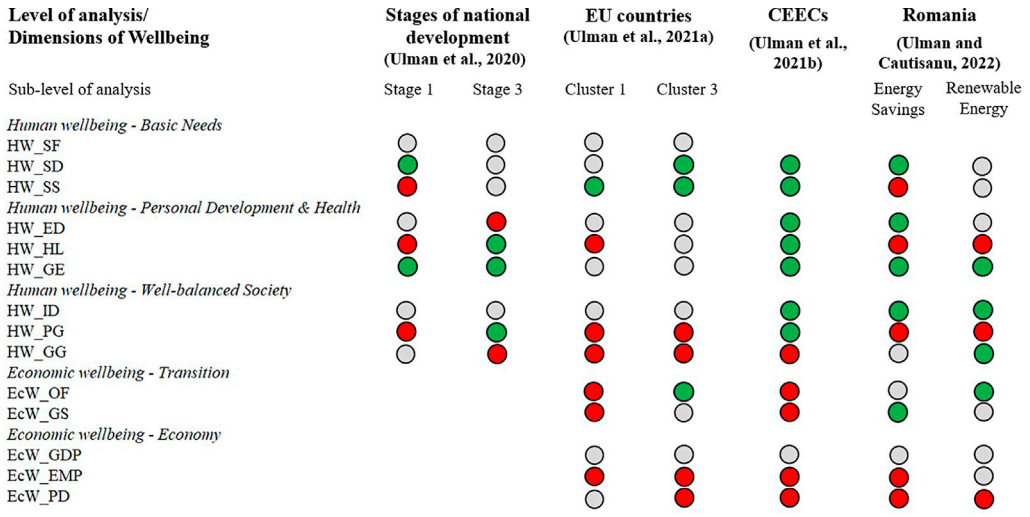

FIGURE 3
Synthesis of main results obtained from previous studies using the SSI framework.

wellbeing and their main socio-economic factors. We aim to explore whether this path of development is as "sustainable" as it should be. Should it not fully realize sustainability, we further aim to find and suggest different directions by concentrating on wellbeing as opposed to economic concerns.

Starting from the overall context and the brief motivation of our research endeavor, and considering the major goal of our study, we outline our objectives in Figure 4. To respond to them, we established three hypotheses (see Figure 4).

In a precise way, our study intends to clarify the meaning of sustainability in post-communist countries: 1) positioning them

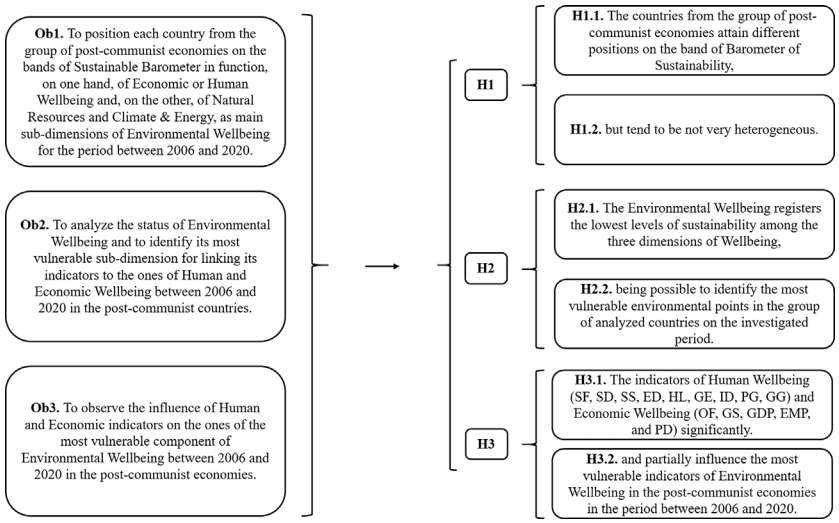

FIGURE 4
Main objectives and hypotheses of the study.

on the bands of the sustainable barometer; 2) emphasizing their weak environmental points; and 3) finding out the main socio-economic factors that affect these environmental vulnerabilities. By identifying the negative influences of economic and human components on the environment we aim to highlight specific directions of action for alleviating them. However, the evolution of post-communist countries involves specific social and economic conditions, which generate a particular pattern related to their sustainable development. Investigating such country cases, our approach adds to understanding of wellbeing and sustainable concepts in these contexts. More generally, through its findings, it might be stated that this attempt supports more recent perspectives of wellbeing based on the theoretical background of sustainability and ecological economics. This approach encourages the strengthening of environmental and human dimensions, while not placing economic interest at the center.

Data and methods

Our analysis was focused on sustainable development across the 19 post-communist economies (Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Germany, Hungary, Latvia, Lithuania, Macedonia, Moldavia, Montenegro, Poland, Romania, Slovenia, Serbia, Slovakia, and Ukraine), using data collected between 2006 and 2020 from the official website of the Sustainable Society Index (SSI). The motivation for the selection of this group of countries was based on the fact that for more the 3 decades, they have been making efforts to escape the shadow of their common past under a communist regime and have been undergoing significant structural changes that aim to promote democracy and improve developmental objectives. Moreover, given the relationship between the dimensions of sustainability (*i.e.*, economic, human, and environmental), their approach to transformation has focused on building a strong economic basis, while the roles of social cohesion and environmental protection have been downplayed.

To measure the stage of sustainable wellbeing of the 19 post-communist countries that are considered here, we used data from the SSI framework because it is a composite index, which encompasses indicators of all three major domains of sustainability. The values of SSI elements have a variation range between 1 and 10. If a country is 100% sustainable for indicator x, it will be scored 10, otherwise, if the country is not sustainable at all for indicator x, it will be scored 1.

The SSI data were integrated into the approach proposed by Prescott-Allen (2001) in their endeavor to measure the wellbeing of nations. According to this study, the crux of wellbeing follows the idea that humans are part of nature, as their wellbeing depends on the natural capital for the provision of diverse ecosystem services, such as food, water, and climate regulation, and protection from natural phenomena, recreation, and inspiration, among many others (Costanza et al., 2015, Costanza et al., 2017; Daly, 2014; Hernández-Blancet al., 2020). Adapting to this theory, Figure 5 reveals the manner in which sustainable wellbeing may be attained.

The oversimplified categorization proposed by Prescott-Allen (2001) and illustrated in the previous figure is completed, according to the same author, by the Barometer of Sustainability. It emphasizes five levels of sustainability (*i.e.*, good, fair, medium, poor, and bad), described in Table 2.

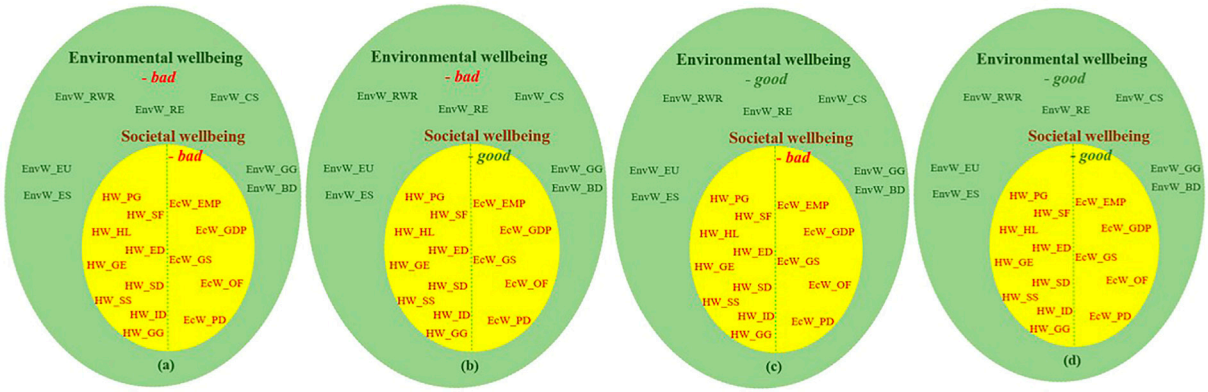

FIGURE 5
Egg of wellbeing (adapted after Prescott-Allen, 2001, p. 5). **(A–C)** emphasize an unwell and unsustainable society, while **(D)** emphasizes a sustainable society.

TABLE 2 Five bands of the Barometer of Sustainability proposed by Prescott-Allen (2001), applied for the SSI.

Band	Point		Definition
	Range	Top	
Good	10–8.1	10	Desirable performance, objective fully met
Fair	8–6.1	8	Acceptable performance, objective almost or barely met
Medium	6–4.1	6	Neutral or transitional performance
Poor	4–2.1	4	Undesirable performance
Bad	2–1	2	Unacceptable performance

Accordingly, starting from the range of variation for the elements of the SSI (*i.e.*, 1–10), we defined five stages of sustainability, as follows: "bad" for levels lower or equal to 2; "poor" for levels between 2.01 and 4; "medium" in the case of scores ranging between 4.01 and 6; "fair" for levels covering the [6.01; 8] interval; and "good" for levels higher than 8.01. Each of the analyzed countries can be positioned in one or two of the stages, depending on the scores attained for the elements considered on the two axes. Moreover, we can establish a general stage of sustainability for a country by associating its position in the graphic representation with a specific colored section (Figure 6). "bad" for the gray section, "poor" for the blue one, "medium" for the green color, "fair" for the light green one, and "good" for the dark green section.

We structured our analysis into two parts. First, we compared the average levels of natural resources and climate and energy sub-dimensions of environmental wellbeing recorded along the 2006–2020 period with the human and economic wellbeing levels. Second, starting from the main results obtained in this comparative analysis, we identified the most stringent environmental problems and included the selected countries in the Barometer of Sustainability. In order to understand the influence of the human and economic components on the major weaknesses of the environmental dimension in this group of countries over the entire period, panel data-specific methods were applied. Figure 1 lists the notations of the indicators measuring human and economic wellbeing used in analyses. They represent the independent variables in the context of panel data models, while the indicators reflecting the weak points of environmental wellbeing represent the dependent variables. For increased clarity, Figure 7 shows the conceptual framework proposed in this article, following that used in different articles, such as Ulman et al. (2020); Ulman et al. (2021a); Ulman et al. (2021b), which aimed at establishing the nature of influence among, on the one hand, environmental and, on the other, economic and social components of wellbeing in different contexts, i.e., the European Union, the Central and Eastern European Countries, and the global level dividing countries in terms of stages of national development. However, these articles supported the observations of other studies that emphasized the impossibility of precisely detecting the consequences of different patterns of development. More specifically, in our study, as previous results showed, the economic and social dimensions of

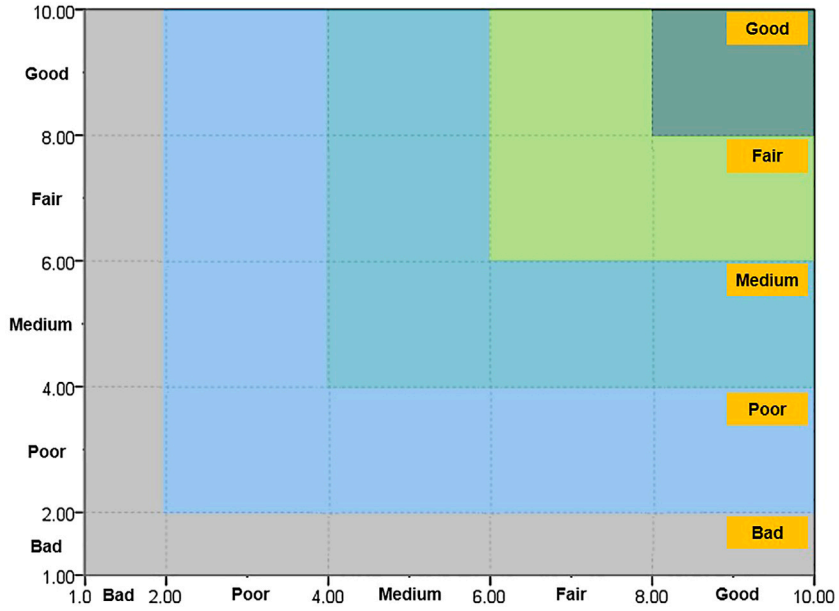

FIGURE 6
Barometer of Sustainability proposed by Prescott-Allen (2001), applied for the SSI.

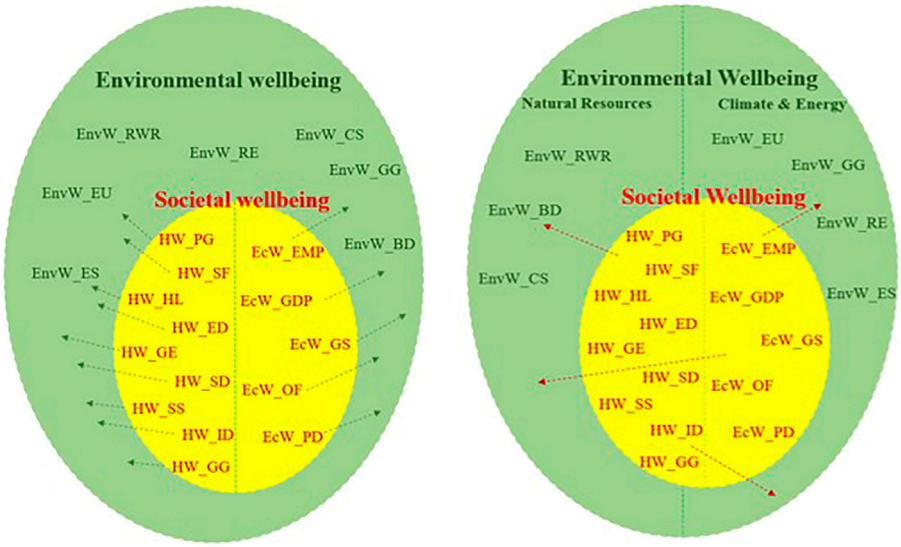

FIGURE 7
Conceptual framework of analysis starting from the perspective of Prescott-Allen (2001), using the Sustainable Society Index (SSI) framework (Van De Kerk and Manuel, 2012).

sustainability still generally imply damage to the environment. For the next step, our research focused on the main environmental vulnerabilities evidenced in post-communist countries.

For each weak point considered, panel data analysis consisted of four steps. First, we estimated the following three types of models: the pooled OLS (POLS) model, the fixed-effects (FEs) model, and the random-effects (REs) model. Second, to determine which of these models is most suitable for our data, we performed the following tests, which compared them in pairs and chose the best one: Chow test for the POLS–FE pair, Breusch–Pagan test for the POLS–RE pair, and Hausman test

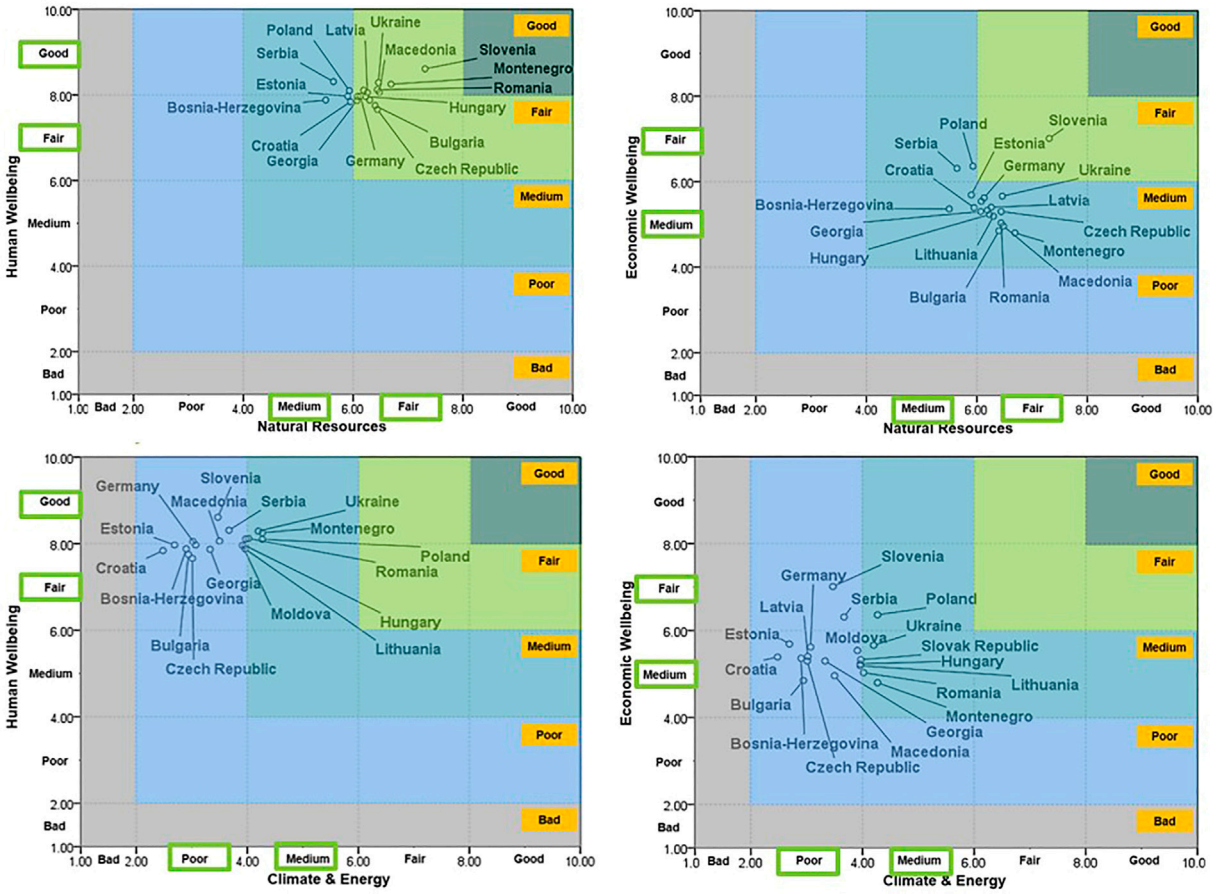

FIGURE 8
Graphic representations of the relationships between human and economic wellbeing and components of environmental wellbeing.

for the FE–RE pair (Greene, 2011; Frondel and Vance, 2010). Third, for the selected model, we applied tests to check the following four statistical hypotheses that should be accepted to validate it: independence, homoscedasticity, autocorrelation, and multicollinearity. As not all these hypotheses were attained, we estimated a corrected model in the last step. Taking into consideration that the number of years, nine (*i.e.*, 2006, 2008, 2010, 2012, 2014, 2016, 2018, 2019, and 2020), was lower than that of the number of countries (19), we applied the panel-corrected standard errors (PCSE) model (Reed and Ye, 2011), thus obtaining our final results.

Results

Human and economic wellbeing *vs.* components of environmental wellbeing

Following the SSI framework in terms of environmental wellbeing, two directions for measuring the quality of the environment can be established: Natural Resources and Climate and Energy. Figure 8 plots four graphical representations, in which the 19 post-communist countries are positioned according to their average levels of these two sub-dimensions of environmental wellbeing and human and economic wellbeing during the 2006–2020 period.

Among the dimensions of sustainable development, human wellbeing registered the highest scores in the considered countries. It was on average higher than six, thus positioning these countries at a "fair" or "good" stage of sustainability. Regarding economic wellbeing, the graphic representations emphasized scores between 4 and 8, therefore covering the stages of "medium" and "fair" sustainability. Moving on to the sub-dimensions of environmental wellbeing, i.e., Natural Resources and Climate and Energy, significant differences can be observed, while the 19 post-communist countries registered scores that correspond to the "medium" and "fair" stages regarding Natural Resources and Climate and Energy, the scores are lower, and the main stage identified was "poor" for most of them. One explanation could be a poor capacity to administer natural resources to obtain good

TABLE 3 Statistical description of the variables for all 19 post-communist economies.

Role	Variable	Mean	Median	Min	Max	Std. dev
Dependent	EnvW_EU	5.980	5.960	1.000	9.900	2.657
	EnvW_ES	4.635	4.500	1.000	10.000	2.285
	EnvW_GHG	4.593	4.728	1.000	9.068	2.223
	EnvW_RE	1.646	1.200	1.000	4.300	0.880
Independent	*Human wellbeing—basic needs*					
	HW_SF	9.921	10.00	8.990	10.00	0.207
	HW_SD	9.772	9.900	8.600	10.00	0.332
	HW_SS	9.136	9.590	4.130	9.920	1.111
	Human wellbeing—Personal Development & Health					
	HW_ED	8.622	8.800	6.900	10.00	0.891
	HW_HL	8.126	7.900	6.696	10.00	0.761
	HW_GE	7.085	7.014	6.598	8.100	0.296
	Human wellbeing—well-balanced society					
	HW_ID	6.699	6.971	2.500	9.792	1.998
	HW_PG	8.501	8.358	1.000	10.00	1.026
	HW_GG	5.773	5.900	3.401	8.167	1.133
	Economic wellbeing—transition					
	EcW_OF	5.280	5.480	1.012	10.00	3.153
	EcW_GS	7.815	8.275	2.471	9.276	1.367
	Economic wellbeing—economy					
	EcW_GDP	7.053	7.525	1.970	9.800	1.821
	EcW_EMP	3.829	3.900	1.000	8.000	1.832
	EcW_PD	6.903	8.054	1.000	9.830	2.736

conditions for Climate and Energy. Considering the relationship between each of the sub-dimensions of environmental wellbeing and human and economic wellbeing, most countries were positioned in the "fair" section for the human wellbeing–Natural Resources pair, the "medium" section for the economic wellbeing–Natural Resources example, and the "poor" section in the case of human wellbeing–Climate and Energy and economic wellbeing–Climate and Energy pairs (Figure 8).

These findings motivated us to focus on the Climate and Energy sub-dimension, analyzing in detail the four indicators characterizing it (*i.e.*, EU, ES, GHG, and RE), as well as how they are influenced by the indicators reflecting human and economic wellbeing.

Indicators of Climate and Energy in relation to human and economic wellbeing

Table 3 provides the statistical description of the dependent variables reflecting Climate and Energy and of the independent variables used for quantifying human and economic wellbeing.

Among the variables measuring Climate and Energy, EU, ES, and GHG have similar behavior, with a large range of scores, varying from 1 to at least 9. In the analyzed period, among the countries that registered, on average, the highest scores for EU were Georgia (8.8 points), Moldova (8.6 points), and Macedonia (8.1 points), while the countries with the lowest average scores were Ukraine (3.8 points), Czech Republic (3.2 points), and Germany (1.6 points). In contrast, regarding ES, Georgia, Moldova, and Macedonia register among the lowest average scores (2.1 points, 5.3 points, and 4.8 points, respectively), alongside Bulgaria (4.2 points) and Poland (3.9 points). In this respect, the countries with high average scores were Ukraine (7.1 points), Slovak Republic (5.6 points), and Germany (5.4 points). GHG (mainly CO_2 per capita) average scores indicated weak sustainability in the Czech Republic (1.0 points), Estonia (1.0 points), and Germany (1.1 points) and an approximately high sustainability in Georgia (8.4 points), Moldova (7.9 points), and Latvia (6.5 points). For example, the situation could be explained by the level of industrial activities in these countries, by low energy from agriculture (Moldova), or by some services (Latvia) that are specific for these countries. Unlike the other indicators, RE generally registered low scores, within the [1, 4.3] interval,

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TABLE 4 Relation between the components of Climate and Energy from environmental wellbeing and components of economic and human wellbeing.

Independent variable	Dependent variable							
	EnvW_EU		EnvW_ES		EnvW_GHG		EnvW_RE	
	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
Human wellbeing—basic needs								
HW_SF	-1.149	0.854	-1.433	1.482	-4.329***	0.778	-2.502***	0.413
HW_SD	-2.163**	0.783	-1.668**	0.834	-3.087***	0.786	-0.124	0.184
HW_SS	-0.183***	0.053	0.346**	0.167	-0.276***	0.058	-0.047	0.050
Human wellbeing—Personal Development & Health								
HW_ED	-0.103	0.144	-0.097	0.200	-0.415***	0.183	0.203***	0.071
HW_HL	2.114***	0.224	-1.162*	0.697	-0.234	0.262	0.172	0.124
HW_GE	-0.487	0.379	1.044	0.672	-0.091	0.420	0.621***	0.176
Human wellbeing—well-balanced society								
HW_ID	-0.184***	0.071	0.008	0.111	-0.186***	0.084	0.049	0.032
HW_PG	0.533***	0.130	-0.385	0.314	0.548***	0.172	0.120	0.082
HW_GG	-0.645**	0.243	-1.980***	0.548	-1.354***	0.289	-0.216	0.146
Economic wellbeing—transition								
EcW_OF	-0.023	0.047	0.255***	0.084	0.177***	0.072	0.085***	0.041
EcW_GS	-0.053	0.084	0.067	0.128	-0.004	0.075	-0.091***	0.032
Economic wellbeing—economy								
EcW_GDP	-0.183	0.250	1.147***	0.427	0.519***	0.217	0.010	0.083
EcW_EMP	-0.183***	0.066	-0.102	0.160	-0.184***	0.080	-0.207***	0.033
EcW_PD	-0.044	0.052	-0.411***	0.071	-0.217***	0.062	0.018	0.016
Constant	30.693***	13.027	42.785***	19.073	88.584***	13.923	21.341***	6.039
R^2	0.703	0.440	0.686	0.522				

***, **, and * denote the statistical significance at 1, 5, and 10% level, respectively. Source: SSI, database, computed in STATA v.13.

namely, sustainability for all 19 post-communist countries, besides other factors, are argued by a low capacity of governments to sustain the introduction of the new energy production technologies.

In relation to human wellbeing, most of the indicators have average scores higher than 8, indicating a good level of sustainability, except for gender equality, income distribution, and good governance, where there is still more room for improvement in the countries analyzed. As to economic wellbeing, generally, the average scores of the indicators are below 8, revealing "medium"–"fair" levels of sustainability in economic activities.

Moving on and focusing on the aim of the study, Table 4 lists the empirical results obtained regarding the influence of the indicators, reflecting human and economic wellbeing for the four indicators used for measuring the Climate and Energy category within environmental wellbeing.

In the model in which the EU is the dependent variable, most of the human wellbeing indicators have a significant influence, except for sufficient food, education, and gender equality. Among the significant determinants, the ones referring to basic needs (*i.e.*, sufficient to drink and safe sanitation) have negative influences (Coef. = -2.163; Prob. = 0.05; and Coef. = -0.183; Prob. = 0.01). Also, two of the measures of a well-balanced society, i.e., income distribution and good governance, exert the same type of influence (Coef. = -0.184; Prob. = 0.01; and Coef. = -0.645; Prob. = 0.05). Unlike these determinants, healthy life from the personal development & health category and population growth from the well-balanced society category have positive influences on the EU of the countries considered

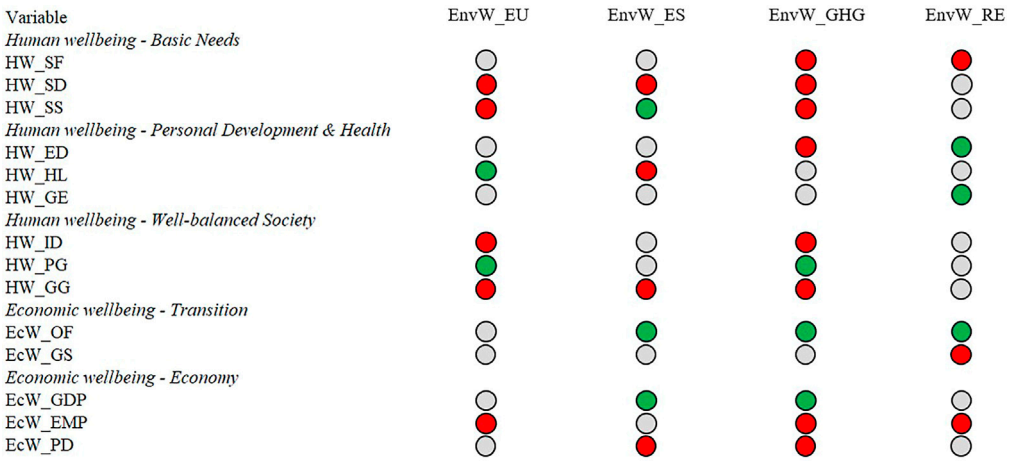

FIGURE 9
Snapshot of panel analysis results.

in the study (Coef. = 2.114; Prob. = 0.01; and Coef. = 0.533; Prob. = 0.01). In addition, economic wellbeing exerts a significant influence only through employment (Coef. = -0.183; Prob. = 0.01). The simultaneous variations of the determinants considered explaining the EU in a ratio of 70.3%.

The ES parameter is significantly influenced by part of the human wellbeing indicators: negatively by sufficient to drink (Coef. = -1.668; Prob. = 0.05), healthy life (Coef. = -1.162; Prob. = 0.10), and good governance (Coef. = -1.980; Prob. = 0.01); and positively by safe sanitation (Coef. = 0.346; Prob. = 0.05). Concerning the economic wellbeing indicators, organic farming (Coef. = 0.255; Prob. = 0.01) and GDP (Coef. = 1.147; Prob. = 0.01), they have a positive influence on ES variation, while public debt (Coef. = -0.411; Prob. = 0.01), a negative one. These variables explain only 44% of the total variation of ES.

In the case of GHGs, most of the indicators regarding human and economic wellbeing have negative influences. For instance, indicators referring to basic needs and well-balanced society exert their influences for a 1% significance level (Coef. = -4.329 for sufficient food; Coef. = -3.087 for sufficient to drink; Coef. = -0.276 for safe sanitation; Coef. = -0.186 for income distribution; and Coef. = -1.354 for good governance). In addition, both employment and public debt have the same direction of influence (Coef. = -0.184; Prob. = 0.01 and Coef. = -0.217; Prob. = 0.01). GHGs are explained in a ratio of 68.6% by the variation of these factors.

In the last model, RE is significantly and positively influenced by human wellbeing measured through education (Coef. = 0.203; Prob. = 0.01) and gender equality (Coef. = 0.621; Prob. = 0.01), and also by economic wellbeing measured through organic farming (Coef. = 0.085; Prob. = 0.01). The negative influences are given by sufficient food (Coef. = -2.502; Prob. = 0.01), genuine savings (Coef. = -0.091; Prob. = 0.01), and employment (Coef. = -0.207; Prob. = 0.01) parameters. However, the simultaneous variations of the determinants considered explains RE having a ratio of only 52.2%.

The results of the econometric analysis are given in Figure 9, where three types of circles are included: the green circle represents a positive and significant relationship between an indicator of Climate and Energy and one of the human or economic wellbeing indicators; the red circle represents a negative and significant relationship between variables, and the gray circle represents insignificant relationships.

In general, it can be observed that human wellbeing indicators regarding basic needs and a well-balanced society have negative and significant influences on the Climate and Energy indicators, while those measuring personal development and health have either a positive and significant influence or an insignificant one. Regarding economic wellbeing, indicators of transition have a positive relationship with some of those reflecting Climate and Energy, while the economy is mostly negatively related in this sense.

As a general perspective, our results show 25 insignificant, 20 negative, and 11 positive effects registered on the main vulnerable environmental indicators. Accordingly, a tendency of neutralizing the negative influence of human and economic components upon them could be observed. However, this distribution is not uniform across all indicators discussed in this regard. Figure 10 shows whether the hypotheses established in the first part of our article are validated or not.

Our starting hypothesis (H1) regarding the position of the post-communist countries on the bands of the Barometer of

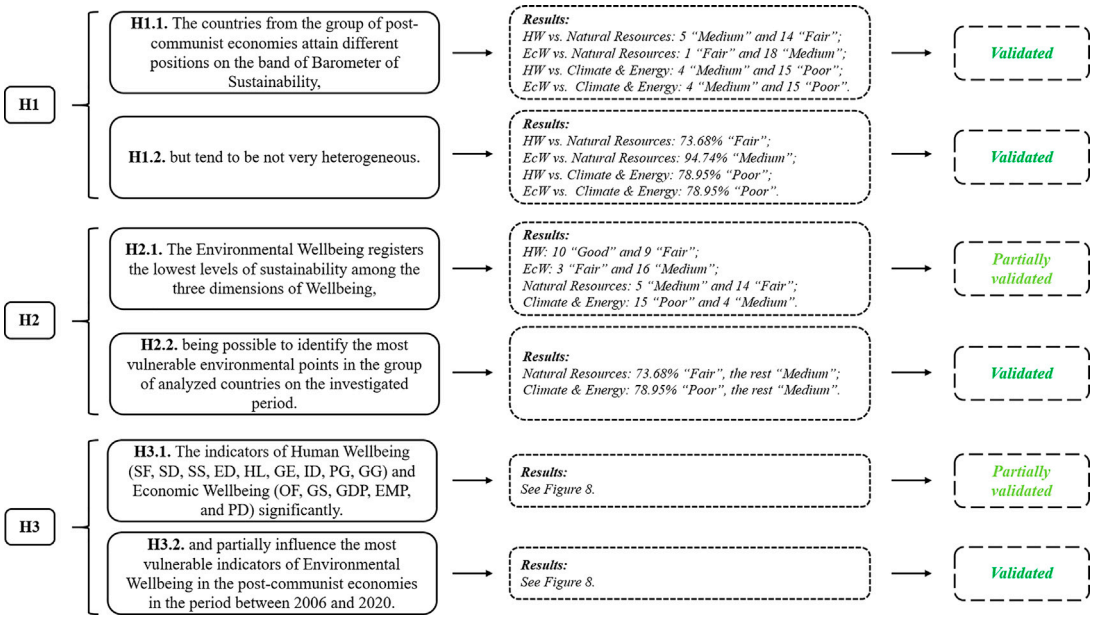

FIGURE 10
Overview in regard to the validation of the main hypothesis of the study.

Sustainability was validated. These countries do have different positions, such as "poor," "medium," and "fair" levels of sustainability across the investigated relationships (HW *vs.* Natural Resources; EcW *vs.* Natural Resources; HW *vs.* Climate and Energy; and EcW *vs.* Climate and Energy), while the extremities of "good" and "bad" sustainability are not attained by any of the analyzed countries. Next, the second hypothesis (H2), related to the status of environmental wellbeing compared to the ones of the other two dimensions of sustainability, is partially validated, with the observation that, when comparing the levels of wellbeing in terms of natural resources with the ones of economic wellbeing, the last one appears to register the lowest levels, as significantly more countries are included into a better category of sustainability when referring to this environmental sub-dimension. However, the Climate and Energy status seems to perform less, as 78.95% of the countries belong to the "poor" category of sustainability, while the remaining belong to the "medium" category. Accordingly, this was identified as the main environmental vulnerability, being analyzed in the final part of the article. Last, our third hypothesis (H3) is partially validated, as different types of influences exercised by human and economic indicators on the environmental ones were evidenced, i.e., positive, insignificant, or negative. However, it was shown that although the different components of the human and economic dimensions of sustainability seemed to still exercise a negative influence on the most vulnerable sectors of environmental wellbeing, greenhouse gases appeared to be the most affected, with harmful determinants like sufficiency in food and drinkable water, safe sanitation, education, good governance, employment, and public debt.

Discussion

As pointed out in the Introduction, Dasgupta (2021, p. 119) emphasizes the implicit assumption underlying the Sustainable Development Goals (SDGs), i.e., the desirability of continual global economic growth as the only viable route for ensuring that development is sustainable. This assumes that sustainable development has the difficult task of converting the negative influences of economic and human dimensions upon the environment into positive ones, the high levels of the first ones translating into high levels of the last ones. In other words, economic development is considered to represent a pillar of environmental wellbeing, a premise for it under the condition in which the environment is already very affected, registering a low level of wellbeing and representing the most problematic dimension, as shown both in this article and also in others, including those of Ulman et al., 2020; Ulman et al., 2021a; Ulman et al., 2021b; or Ulman and Cautisanu (2022). We intended to test this conventional assumption for a period higher than 10 years in a different specific context formed by approximately homogeneous countries, with a similar communist past. Following this rationale and according to the previously presented results, our findings do not portray an image full of green effects on the environment, as they should be following the conventional sustainable development

theory. However, this is not wholly red. Consequently, our results show that the practical representation in this analyzed set of countries does not reveal a complete position on the path of sustainable development. It supports the conventional theory that economic growth is the main driver of positive change, but strengthens sustainable wellbeing in which care is oriented to the whole system, not prioritizing one to the detriment of another. This means that the path of development followed by post-communist countries between 2006 and 2020 is not as "sustainable" as it should be. It is consequently recommended that different directions are found and suggested that are capable of overpassing the general theory of sustainable development. A higher and higher level of sustainable wellbeing, which supposes a good status in all its three dimensions, should be first considered. Randers et al. (2019) insist on the difference between adequate growth, potentially including a welcome economic decline, and inadequate growth, if considering the significant generation of greenhouse gases behind it. In such a context, our study showed that the focus has to be shifted from the economic and human dimensions that succeeded in attaining an approximately good status to the component of environmental wellbeing referring to climate and energy concerns that, in turn, offer a huge amount of benefits to humans and their wellbeing. This conclusion supports the concept of "economies-in-society-in-nature" as a pragmatic necessity (Sangha et al., 2022, p. 2), reiterating the idea that the economic dimension has to be positioned at the basis of the entire system: it should be perceived as a means, and not as the final goal of wellbeing. For a general understanding of this idea, increasingly educated environmental concerns should be an important target of environmental policies. This is especially the case because good governance is a decisive factor in environmental wellbeing and also that, in general, it still does not exercise the type of expected influence across societies. As a result, individual, corporate, and social behavior changes need to be implemented through a fast-moving learning curve, as defined by Randers et al. (2019).

When comparing the most vulnerable environmental indicators with the results of the analysis focused on general environmental wellbeing (see Figure 3), it appears that the human and economic indicators affect the environment in a more evident manner. In this way, the contribution given by our study is that it extends the general discussion of environmental wellbeing, concentrating on its most critical indicators. Accordingly, the harmful effects of increasing the levels of economic and human performance are better emphasized and, thus, the conventional theory of sustainable development focused on growth, is better critically analyzed.

Our study differs from the findings of others (Ulman et al., 2020; Ulman et al., 2021a; Ulman et al., 2021b) (see Figure 3) and especially in terms of greenhouse gases and energy use, as it emphasizes the need to better address basic needs in the group of countries that registered negative influences on the environment. Therefore, food, water, and sanitation policies should give special attention to their approaches, directives, and goals in the short and long run and try to neutralize their impact on the environment. Although other results indicated a possible relaxation with regard to the environmental impact of offering basic needs, the analysis performed on the 19 post-communist economies argues against it, as the negative effects on the environment are still present, especially concerning the unsustainable emission of greenhouse gases, encouraging prudence in this regard. Moreover, contrary to other findings is the fact that income distribution affects energy use and greenhouse gases in the situation in which its impact was generally shown to be insignificant or positive (Ulman et al., 2020; Ulman et al., 2021a; Ulman et al., 2021b; Ulman and Cautisanu, 2022; McMichael, 2015; Collin and Collin, 2015; Baloch et al., 2018). These different findings likely arise from the specificities of the selected sample of countries, the still negative effects indicating a lack of equality, efficiency, and eco-friendly solutions adopted in the post-communist countries. Accordingly, an important recommendation in this regard is to embrace actions and directives focused on energy use and savings, on fewer pollutant technologies, and on adopting renewable energy and more environmental-friendly systems in general, thus assuring basic needs such as food, water, and safe sanitation under proper environmental conditions. The same indication is valid in the case of income distribution, which also seems to be harmful to the environment. Although the economic activities of many countries are still predominantly based on fossil fuel energy consumption (*i.e.*, coal, oil, natural gas), and post-communist economies are not an exception, the search for alternative energy sources is present everywhere. In this context, it is recommended that renewable energy, as a potential means to decarbonize economies, is implemented and attentively studied. As Bourcet (2020, p. 1) mentions, it is essential that we understand the empirical determinants of renewable energy deployment for public policy guidance and to foster future research. Accordingly, our results indicate a need to prioritize the food sector, genuine savings, and employment as negative factors for this type of energy. This is the best context for determining changes in approach to environmental protection, as society and the general public seem to show an interest in climate change mitigation. Bogdanov et al. (2021) emphasized the fact that companies, cities, regions, and countries increasingly establish their actions caring more for the environment, with goals like limiting further growth in GHG emissions or completely transforming specific energy sectors into renewable energy supply in the coming decades. However, more coherent efforts have to be integrated within all socio-economic activities across societies, as they are strengthened even by the scientific evidence related to the technical feasibility (Brown et al., 2018) and economic viability (Hansen et al., 2019) of this huge societal project.

Another different result, this time positive, is related to population growth, which seems to become insignificant or positive in ways that are different from previous results, which indicate that its influence is particularly negative (Ulman et al., 2020; Ulman et al., 2021b; Ulman and Cautisanu, 2022; Zhao et al., 2020) (see EU countries, stage 1 of development, Romania).

Finally, similarities with other findings were related to the effects of good governance, gender equality, public debt, employment, and GDP. First, similar to previous studies (McMichael, 2015; Omri and Hadj, 2020; Ulman et al., 2020), governance does not sufficiently concentrate on the environment and is more oriented toward economic results than environmental protection, thus affecting the emissions of greenhouse gases and energy use and savings. Second, as also observed in other studies, gender equality seems to play an important role in the environment and the state of wellbeing, although its influence might not be unitarily understood (Ulman and Dobay, 2016; Vicente-Molina et al., 2018; Ulman and Dobay, 2020). Third, it has been shown that a high public debt constitutes a constraint on environmental wellbeing, with this negative influence confirmed in other studies (Clootens, 2017; Ulman et al., 2021a; Ulman et al., 2021b; Ulman and Cautisanu, 2022). Fourth, employment was found to be harmful to environmental wellbeing both at the general level (see Figure 3) (Ulman et al., 2021a; Ulman et al., 2021b; Ulman and Cautisanu, 2022) and also, as in our study, in terms of energy use, renewable energy, and greenhouse gases. These results follow the major concern mentioned in the study by Lawn (2009), referring to the potential conflict between environmental goals and employment. However, they contradict the ones of other studies (Yip, 2018; Curtis, 2015), considering unemployment as related to environmental taxes, with the effect of reducing financial support for environmental protection and, consequently, less environmental wellbeing. Next, GDP was found to be positive or insignificant in relation to the selected indicators of environmental wellbeing, which is consistent with the results of other studies (Ergun and Rivas, 2020; Hatmanu et al., 2022; Ulman et al., 2021a; Ulman et al., 2021b; Ulman and Cautisanu, 2022).

Accordingly, there are other factors that need increased attention because of their harmful effects on environmental indicators in post-communist economies, including good governance, employment, and public debt. These findings support the conclusion that the way of governing within this group of countries is still predominantly traditional and much more oriented toward socio-economic results than toward environmental protection (Ulman et al., 2020). Consequently, the development policies related to energy use, energy savings, and greenhouse gases have to be more attentively oriented toward them. As also concluded in another study (Ulman et al., 2020), a higher level of environmental concern is required even within or, especially, in the case of public servants who have the moral obligation of avoiding the non-optimal waste of energy, supervising, and even limiting the growth in GHG emissions and encouraging the energy sectors to convert to renewable energy. In addition, while public debt seems to be the other determinant factor, especially with regard to greenhouse gases and energy savings, the tendency of assuring lower and lower levels of this indicator would be equally beneficial for the sake of the environment, besides other important social and economic benefits, with high reverberation upon development in general. With regard to employment, we intend to be cautious with recommendations, considering that, in the case of the proper development of eco-friendly systems, a higher level of employment would be beneficial for all three dimensions of wellbeing.

Our research results should, however, take into consideration some limitations. Consequently, as derived from the lack of data availability, one first limiting factor of the study is given by the impossibility of developing the analysis over a larger period of time and of utilizing time series-specific methods, capable of offering a more accurate image of the analyzed phenomenon. Another limitation, but still specific to all the models proposed in the social sciences, is that the study involves the construction of an oversimplified model of reality, considering only a limited number of variables and relations. Responding to these concerns, as potential future research, while also checking and comparing the obtained results within this study, the employment of a similar approach, but using different indices that evaluate the same issues, could be beneficial. Furthermore, starting from our results, regarding, especially, the specific human and economic vulnerabilities identified in this study, future research may conduct more thorough analyses, mainly at the regional and national levels, with a focus on their specific environmental policies, in order to improve their full understanding and to observe the different ways, in which their effects on the environmental vulnerabilities could be improved. In addition, based on evolution in time and current figures, different projections with regard to the implementation of a sustainable future, following different prediction models (Shang et al., 2021 or Zhang et al., 2021), could also be an option for a future research endeavor.

Conclusion

Sustainability calls for increased levels of economic, social, and environmental wellbeing. Considering different national contexts, there are certainly differences in their capacity to attain sustainable wellbeing both at the general level and in relation to its three main dimensions. The increased awareness of climate change mitigation and resolving the other environmental concerns affecting everyday life appears to support this endeavor. This seems to be true in the situation of the pandemic, which generated energy crises and called for transformative changes across societies globally, regionally, and locally, improving the environmental issues.

Starting from this general background, which encourages research to focus on environmental issues, our study investigated how the conventional sustainable development approach applies in practice at the macro level in post-communist countries, focusing on the most vulnerable environmental components and their main socio-economic factors. It offered an answer to the question regarding the path of development, questioning whether it is as "sustainable" as it should be in this particular context, while also finding and suggesting different directions that do not focus on economic interest but are more focused on wellbeing. The first aim of this study was to compare the national levels of Natural Resources and Climate and Energy, and their components, between 2006 and 2020, in the post-communist economies. Second, putting Climate and Energy, with their major components, i.e., energy use, energy savings, greenhouse gases, and renewable energy, at the center of the analysis, as the major weaknesses of environmental wellbeing within the analyzed group of countries, we observed the nature of the influence of human and economic wellbeing upon each of them. In summary, the results obtained showed that 1) the components of environmental wellbeing registered a different evolution among post-communist economies across the 2006–2020 period; 2) there is still sufficient room for improvement in terms of environmental sustainability in this group of countries, especially in the case of Climate and Energy components; 3) these environmental components were closely linked to both economic and social dimensions; and 4) the determinants of energy use, energy saving, greenhouse gases, and renewable energy were found to be different in post-communist economies.

This study draws attention to the fact that the patterns of development applied in this selected group of countries seem to strengthen the sustainable goals, but not sufficiently enough for exceeding the traditional growth-oriented model. Moreover, it supports newer perspectives on wellbeing, which are based on the theoretical background of sustainability and ecological economics. This encourages the strengthening of the entire system, while not putting the economic issues at the center of interest. Accordingly, focusing on the environment and its main weaknesses, this study showed that the Climate and Energy sub-dimension and its components still registered low levels compared to those of the Natural Resources among post-communist economies and that economic and social components still negatively influence environmental wellbeing in the analyzed context. Considering these general conclusions and also the similitudes and differences of findings from other studies that come from the specificities of the selected samples of countries, the negative effects still indicate a lack of equality, efficiency, and eco-friendly solutions being adopted in post-communist economies.

These findings indicate that the development followed by these countries between 2006 and 2020 was not as "sustainable" as it should be, and we recommend a higher level of sustainable wellbeing that supposes a good status in all its three dimensions. As a response to this requirement, our study provides some recommendations. First, it was observed that food, water, and sanitation policies should give special attention to their approaches, directives, and goals in the short and long run, trying to neutralize their impact on the environment. For this, improving the productive approach, especially from the technological point of view, for more sustainable production processes and outputs, should be a priority, aided by investments in digitalization for more efficient coordination across the entire system. Putting into practice the principles of the circular economy across societies and promoting the short food supply chains could be directions of action to better respond to the desire to achieve sustainability. Completing this perspective, embracing actions and directives that focus on energy use and savings, adopting renewable energy, and more environmentally friendly systems, in general, is required. Second, other factors needing more attention because of their harmful effects on environmental indicators in post-communist economies included good governance, employment, and public debt. Third, renewable energy as a potential means to decarbonize economies was observed to be related to the food sector, genuine savings, and employment as negative determinant factors, thus implying changes improving this type of energy are required. Last, as an overall recommendation, an important target of environmental policies should be a focus on education, which would increase environmental concern and prompt further changes.

The findings of this study are consistent with those of other studies, especially considering the post-pandemic context, which have also been characterized by an energy crisis. It is worth emphasizing the stringent need for an increased level of general environmental awareness and concrete implications across societies to more attentively understand and put more sustainable approaches into practice. As a pressing factor, this present global crisis appears to be a context in which we need to determine changes in approach to sustainable development, which are necessary for increasing focus on environmental issues.

Data availability statement

Publicly available datasets were analyzed in this study. These data can be found here: https://ssi.wi.th-koeln.de/latest_data.html.

Author contributions

Conceptualization, S-RU and CM; methodology, CC; software, CC; validation, S-RU, CM, and CC; formal

analysis, CC and S-RU.; investigation, S-RU, CM, CC, I-SB, OC, and GS; resources, I-SB, OC, and GS; data curation, CC; writing—original draft preparation, S-RU and CC; writing—review and editing, S-RU and CC; visualization, S-RU and CC; supervision, S-RU and CM; and project administration, S-RU All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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