Heliyon 10 (2024) e33362

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Comparative analysis of environmental sustainability indicators: Insights from Japan, Bangladesh, and Thailand

Md Sujahangir Kabir Sarkar [a,b], Md Nazirul Islam Sarker [c,*], Sumaiya Sadeka [d], Isahaque Ali [e], Abul Quasem Al-Amin [d,f]

[a] Department of Economics and Sociology, Patuakhali Science and Technology University, Dumki, 8602, Patuakhali, Bangladesh
[b] Institute for the Advanced Study of Sustainability, United Nations University, 5–53–70 Jingumae, Shibuya-ku, Tokyo, 150-8925, Japan
[c] Miyan Research Institute, International University of Business Agriculture and Technology, Dhaka, 1230, Bangladesh
[d] Centre of Asian Climate and Environmental Policy Studies, 1525 University Avenue West, Windsor, ON N9B 1C1, Canada
[e] School of Social Sciences, Universiti Sains Malaysia, Pulau Pinang, 11800, Malaysia
[f] Department of Geography and Environmental Management, University of Waterloo, Waterloo, ON, N2L 3G1, Canada

ARTICLE INFO

Keywords:
Renewable energy
Vulnerability
Resilience
Air quality index
Environmental governance
Energy policy

ABSTRACT

This study analyses environmental sustainability indicators (ESIs) and explores their governance challenges in developing countries (Bangladesh and Thailand) and advances possible remedies in light of the practices of a developed country (Japan). A comparative analysis of countries' performance based on the ESIs could help identify useful practices from countries with high ESI to improve the poor ESI countries. While it is broadly understood that renewable energy and effective governance support environmental sustainability, our findings extend this knowledge by detailing how these factors interact specifically within the contexts of developed and developing nations. The analysis delineates the complex relationship between GDP growth, fossil fuel reliance, and sustainability efforts, offering a detailed examination of the variance in ESI performance across these countries. Beyond established notions, this study empirically validates the relationships between environmental sustainability (ES) and its influencing factors, providing a country-specific analysis that emphasizes the differential impact of renewable energy adoption, governance quality, and economic policies on environmental sustainability in Japan, Bangladesh, and Thailand. The results also revealed that Bangladesh's performance in terms of majority ESIs ranges from bad to worse, while Japan exhibits good performance in all its ESI indicators except for emissions. Thailand's ESI performance indicates its vulnerability to climate disasters and slow growth of renewable energy. The ESI measures of Thailand have shown its susceptibility to climate-related calamities and a slowdown in the rate of renewable energy implementation. A noticeable discrepancy in the execution of regulatory frameworks was noted between developing countries, such as Bangladesh, and industrialized ones, such as Japan. The outstanding results of Japan's ESI may be credited to the successful practices of its citizens and their strong devotion to the rule of law.

* Corresponding author.
E-mail addresses: skabir@pstu.ac.bd (M.S.K. Sarkar), sarker.usm@yahoo.com (M.N.I. Sarker), sumaiyasarkar_ru@yahoo.com (S. Sadeka), ialisw@yahoo.com (I. Ali), qalamin@uwaterloo.ca (A.Q. Al-Amin).

https://doi.org/10.1016/j.heliyon.2024.e33362
Received 3 January 2024; Received in revised form 15 June 2024; Accepted 19 June 2024
Available online 20 June 2024

Acronyms

AQI	Air Quality Index
CRS	Country Risk Score (CRS)
CO_2	Carbon Dioxide
EG	Environmental Governance
EPI	Environmental Performance Index
ESIs	Environmental Sustainability Indicators
ES	Environment Sustainability
EKC	Environmental Kuznets Curve (EKC)
GDP	Gross Domestic Product
LNG	Liquefied Natural Gas
OECD	Organisation for Economic Co-operation and Development
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SDGs	Sustainable Development Goals SSIs: Social Sustainability Indicators
WHO	World Health Organization

1. Introduction

Environment Sustainability (ES) is one of the crucial elements for human well-being, and is related to the concepts of balance, resilience and interconnection, which emphasize the ability of people to meet their requirements without depletion the capacity of the ecosystems [1,2]. Despite the importance of ES to the survival of humans and animals on the planet, many countries are not doing much to protect their environment. Some of the environmental challenges facing developing and least-developed countries include pollution, over-exploitation of natural resources, deforestation, waste generation and biodiversity loss, global warming and climate change [3,4]. Environmental degradation and pollution (poor air and water quality) due to toxic chemicals, waste and pollutants emissions are now considered a major cause of death, diseases and disabilities worldwide, particularly in developing countries.

Due to the recent increase in global awareness of environmental and social deterioration, members of the United Nations have been compelled to embrace a set of objectives to secure a sustainable planet. Governments play a crucial role in the effective formulation and execution of any project connected to the Sustainable Development Goals (SDGs), and have pledged to support these goals through national plans and roadmaps [5]. In fact, it has been stated that the government's failure to create long-term sustainable development strategies, financial underinvestment in sustainability, insufficient systems for transferring technology, or trade restrictions are responsible for nations' failure to achieve the SDGs. However, several studies have highlighted the crucial role of government in the development of rules and regulations to improve sustainability, environmental protection, and the creation of sustainable business models [6–8]. These acts require interaction between several actors, including organizations, businesses, stakeholders and interrelated aims. For instance, governments can encourage eco-innovation, environmental certification, or the shift from linear to circular models to foster environmental protection [2]. However, all these initiatives call for the involvement of suppliers, businesses, and other stakeholders to advance climate action and ethical production [9].

Governments also require indicators to track the accomplishment of these goals. Numerous research studies have suggested metrics and approaches that account for sustainability's three facets: environmental, economic, and social [10–12]. The Country Risk Score (CRS) was created in economics to assist traders and investors in making wiser choices regarding their global transactions [2]. Country risk assesses the risk and uncertainty associated with investing in a certain nation based on elements beyond a company's control. Among the political, economic and structural variables discussed are political uncertainty, the effectiveness of institutions and the government, economic structure, development prospects, external finance and monetary system flexibility. The path of the economy and social output, which is heavily reliant on national governments' political and economic management, is therefore used by country risk to identify dangers [13]. The inability of governments to provide the necessary circumstances for economic development, i.e., to encourage trade, collaboration, innovation and technology transfer, results in uncertainty, poses impediments to business growth, and ultimately limits a nation's capacity to pay back its debts. Researchers cannot ignore the interrelationships between economic growth and other sustainable development efforts, such as environmental impact and climate change [14]. Economic growth is a factor that contributes to sustainable development but needs to be integrated with other efforts. Government interventions may be ineffectual because politicians and bureaucrats frequently prioritize observable and manageable factors, like resources and activities, rather than the outcomes of these factors, which are more elusive and difficult to quantify [15]. To address this, measures of good governance should closely monitor the processes that link inputs and results, as opposed to only focusing on the acts themselves [16].

Bangladesh confronts several environmental issues, like desertification, soil depletion and erosion, air pollution, water scarcity, pollution and biodiversity loss [17]. The country's air and water quality, especially in the capital city (Dhaka), has already reached a dangerous level, as confirmed by the United Nations and WHO, among others [18]. On the other hand, developed countries are trying to maintain their environment and ensure its sustainability through various measures and actions, such as proper waste management, control of pollution, industrial waste treatment plants and sewerage management [19]. Japan, as a developed country, has taken the

initiative to become a cleaner and more ecologically responsible country [20]. Moreover, the country has promoted its citizens' consciousness of the environment and implemented strict rules and regulations to maintain environmental sustainability [21]. However, the country's commercial, agricultural, and industrial processes contribute to a broader range of ecological concerns, including the handling of massive amounts of trash. Therefore, the country has adopted an aggressive recycling policy where most waste is recycled [22]. Thailand, a representative of higher middle-income countries, is advancing its efforts toward environmental sustainability [23]. However, challenges, especially in the governance system, remain in most developing countries to ensure ES, which is critical for sustainable development [24].

The remarkable increase in sustainability issues has led to the adoption of SDGs by the United Nations in 2015. Many SDGs, particularly SDG3, 6, 7, 9 11, 12, 13, 14 and 15 have been designed to address ES by 2030 [5]. In addressing ES challenges, particularly in developing countries, it is important to study the initiatives undertaken by other countries in tackling environmental challenges. A comparative study of ESIs among countries could help identify effective practices for advancing ES in developing countries. Therefore, this study explores the performance of ESIs among three countries and provides some policy recommendations for developing countries.

Many previous studies have focused on sustainability assessment [11,23,25–27], governance indicator [28–30], sustainability indicator [31,32,32–34], environmental governance [35–38], and environmental sustainability [39–42], with many exploring these topics in the contexts of regions, like Southeast Asia [43,44], South Asia [21,45–48], America [31,32] and Europe [49], as well as from the perspective of specific countries, such as China [50–52], Japan [53,54], Thailand [55,56] and Bangladesh [46,57–60]. However, almost no studies have solely focused on ES indicators, particularly in the cross-country context. Therefore, this study intends to fill this gap by addressing two research questions: (a) what is the status of the ESI in developing countries like Bangladesh and Thailand and developed countries like Japan? (b) Is there any difference between the practices of ES in these three countries? This study attempts to spotlight existing environmental problems faced by developing countries and advance useful recommendations by comparing performance, ESIs and governances, including policies and measures to control environmental problems, between developing and developed countries.

Japan, Thailand, and Bangladesh were chosen for our research due to their distinct economic development patterns and environmental sustainability challenges. Japan stands out as a mature economy with excellent environmental policies, and an overall strong commitment towards sustainability. Environmentalism provides insight into the effectiveness of environmental governance. Thailand stands as an upper middle-income nation that successfully balances rapid industrialization with sustainable environmental practices, providing insight into the challenges associated with transitioning economies. Bangladesh faces serious environmental challenges as an economically poor nation and serves as an illustration of why sustainable development strategies should be integrated into development plans. This broad array of choices allows for deep comparison analysis, providing greater insight into the complicated relationship between economic standing, environmental policy, and sustainability performance in relation to nations with similar development levels. These wider implications apply also to nations which possess similar development levels.

Within the field of environmental research, a multitude of studies have extensively examined the distinct performances of nations in relation to their ESIs. Nevertheless, there has been little scholarly exploration into conducting a comparative examination that contrasts the ESI achievements of industrialized and developing countries, emphasizing the discrepancies and extracting insights from their diverse strategies. This study offers a distinctive viewpoint by examining the ESI trajectories of Japan, a developed country, in comparison to Thailand and Bangladesh, which reflect varying phases of development. This comparative analysis highlights the unique obstacles and achievements encountered by each nation, while also shedding light on the crucial influence of government, citizen behaviours, and economic objectives in creating environmental results. This study, therefore, also contributes to the discipline in several ways. First, this study assesses the ESIs of Bangladesh, Thailand and Japan. Second, it compares the ES practices and performance between developed and developing countries (Japan, Bangladesh and Thailand). Third, it evaluates the governance challenges for ensuring ES in developing countries. Fourth, it shows Japan's current ES practices, which may be adopted in developing countries. Finally, it adds several key indicators to the ESI measurements that can help measure ES in developing countries.

2. .Literature review

There are numerous studies on environmental performance indicators, particularly in the context of various companies and industries [61–64]. Resource efficiency, ecologically responsible behavior, and sustainable business practices have all been observed to directly and favorably affect a company's worth [65]. Therefore, companies should think about incorporating sustainable practices into their long-term plan as well as their short-term strategy [66].

Government development and implementation of proper regulatory framework remain a vital agenda for developing sustainable business [67]. Some of the ongoing initiatives undertaken by the government, particularly in developing countries, so far include the sensitization of the public to prioritize environmentally friendly approaches in their personal and business activities. Governments have also created various regulations to protect natural resources, reduce greenhouse gas emissions, lessen air pollution and promote an eco-friendly way of life for both individuals and educational institutions [14].

The examination of environmental sustainability indicators (ESIs) in different countries has been crucial in identifying effective strategies and areas for enhancement in environmental governance [38]. These studies provide valuable insights into the efficacy of national policies and their influence on environmental outcomes. The Environmental Kuznets Curve (EKC) hypothesis, which examines the correlation between economic growth and environmental degradation, has been the subject of much research [68]. While certain studies support the U-shaped trajectory of the Environmental Kuznets Curve (EKC), which posits that economic growth initially worsens but eventually improves environmental degradation, alternative perspectives advocate for a more nuanced comprehension.

The aforementioned viewpoints emphasize the importance of institutional quality and policy interventions in influencing the correlation between economic growth and environmental deterioration [69]. Moreover, there has been a notable focus within academia on examining the influence of governance systems on environmental performance [70]. The literature indicates that robust governance systems have the potential to significantly enhance environmental outcomes, particularly in the setting of accelerated economic development [30,31,71]. The present study offers a significant contribution to the extant body of literature by presenting a fresh perspective on the ESIs pertaining to certain countries. The aim of this study is to augment our comprehension of the intricate interconnection.

The scholarly literature has widely demonstrated the significance of Environmental Sustainability Indicators (ESIs) in shaping environmental management practices and policy formulation [46,72,73]. In recent times, there has been a notable surge in scholarly focus on the subject of sustainable development. The increase in interest may be ascribed to multiple variables, encompassing socioeconomic shifts, degradation of the environment, and an expanding public apprehension [74]. The importance of sustainability is underscored in a comprehensive analysis, which underscores the imperative of taking into account not just environmental indicators but also economic, social, and institutional indicators [75]. Furthermore, extensive scholarly investigation has been carried out regarding the integration of the circular economy inside supply chains, placing specific emphasis on the imperative need for suitable indicators [59]. The discourse surrounding economic and environmental objectives has been the subject of substantial examination. However, the consideration of social sustainability indicators (SSIs) in relation to ecosystem services (ES) has only recently emerged as a topic of interest within scholarly literature [2].

Many scholars have examined the connection between environmental management and stakeholder demands in corporations and organizations [61,76–78], and renewable energy, non-renewable energy, and environmental quality [79–81]. Prior literature focused on environmental and sustainability challenges that influence stakeholders' interests [82,83]. Environmentally proactive nations are known to have lower levels of uncertainty and risk, resulting in their demonstration of strong economic and financial success and social development [61]. Thus, a global push toward more effective environmental management can significantly impact a country's policies and, consequently, its international reputation as an investment destination [9]. The primary objective of this study is to address the current gap in the existing body of literature by conducting a comprehensive comparative examination of ESIs in a specific set of nations. This analysis will emphasize the originality and importance of the study.

Fig. 1 presents the conceptual framework, which shows the link between the environment, stakeholders and governance, toward ensuring ES [14]. This study is focused on environmental governance, such as appropriate policies and measures, finance and investment, rules/regulations and strong institutions as the essential components to mitigate environmental problems and ensure environmental protection and sustainability.

3. .Methodology

This research employed secondary data analysis, trend expansion and regression methods to compare ESIs across Japan, Thailand and Bangladesh. Utilizing secondary data sourced from reliable sources like World Development Indicators and OECD statistics ensures both accuracy and reproducibility in the findings. These methods allow to draw from existing datasets, providing an empirically sound basis for comparing each country on sustainability of the environment. Trend and growth analysis allow for the investigation of

Fig. 1. Link between environment, stakeholders and governance toward achieving environmental sustainability.

changes over time in ESIs. Regression analysis helps establish fundamental relationships between ESIs and economic and energy variables, thus revealing which ones drive environmental sustainability.

The comparative analysis framework was chosen due to its effectiveness in illuminating differences in ESI efficiency and governance issues across countries at various stages of economic growth. The approach allows us to draw nuanced and accurate conclusions regarding the effects of renewable energy use, governance quality and economic policies on sustainable outcomes. By comparing experiences in Japan, Thailand, and Bangladesh. This research not only highlights effective techniques and potential areas for improvement, but it also offers tailored policy suggestions tailored specifically for developed and developing nations alike, providing direct support towards increasing environmental sustainability worldwide.

3.1. Indicators selection

Environmental sustainability indicators (ESIs) are crucial for assessing the ES of a country. They also guide national policymakers and researchers in their decision-making, monitoring and evaluation of environmental policies. Japan, Thailand, and Bangladesh were selected based on their unique developmental stages, which provide a complete perspective on environmental concerns within diverse economic situations. Japan is representative of established nations, Thailand serves as an exemplar for quickly industrializing countries, and Bangladesh exemplifies developing economies. The varied geographical and environmental obstacles, along with divergent policy strategies, offer enough opportunities for a comprehensive comparative examination.

As part of our research, when selecting environmental sustainability indicators (ESIs), we tried to cover an array of environmental sustainability-related factors which include pollution levels and patterns of energy consumption as well as forest cover and waste management practices. These indicators were selected due to their established influence on environmental outcomes and alignment with the SDGs, providing for an in-depth assessment of each nation's sustainability performance. Based on internationally acknowledged models such as The World Development Indicators or OECD statistics, our indicators ensure consistency and accuracy across contexts within each country. The inclusion of accurate and dependable data from these nations significantly enhanced the strength and validity of our research. This study explores the existing performance of ESIs in Bangladesh, Thailand and Japan. These countries have been considered in this study based on some logical arguments. First, Bangladesh is a lower-middle-income country—now transitioning to a developing country—that is plagued with substantial environmental problems, as indicated in its ranking (177 positions out 180 countries) of the 2022 Environmental Performance Index (EPI). Thailand is an upper middle-income country (developing country) with a moderate environmental problem, ranking 80 out of 180 countries in EPI 2022, while Japan is a high-income country (developed country) characterized by lower environmental problems, as evidenced in its rank (25 out of 180 countries) in the 2022 EPI. This study does not only compare the existing scenario of ESIs between developed and developing countries but also identifies beneficial policies and initiatives of a country (Japan) with higher ESIs that can be adopted by a country (Bangladesh) with poorer ESIs to improve its ES. Moreover, the selected countries also serve as a good case study of ESI comparison between developed and developing countries. Using data from WDI and OECD environmental indicators, various appropriate indicators of the environmental situation were selected (see in Table 1). Moreover, the selected ESIs, which fall under different ES dimensions (pollution, emission, energy and renewables, forest coverage, waste, sanitation and clean fuel), were linked with the relevant SDGs. Other indexes used to analyse a country's environmental performance include liveability index, pollution index and sustainability

Table 1
Selected environmental sustainability (ES) indicators for the study.

ES issues/dimensions	Selected indicators	Connection with SDGs	Data sources
GHG emission CO_2 emission Carbon footprint	• Total and per capita CO_2 emission • Sectoral emission • Per capita carbon footprint	SDG 13	WDI, World Bank, 2022 GFN, 2022
Pollution Air Water	• Air pollution • Water pollution	SDG 3, 6, 11, 14, 15	Air quality report, 2021, AQI, 2022 Water pollution Stat.
Waste generation and management	• Total waste production • Waste collection • Reuse and recycle	SDG 3,9,11, 14,15	OECD stat
Energy Conventional energy Renewable energy (RE)	• Energy production by sources • Share of renewable energy	SDG 7, 9, 11, 13	World Development Indicators, World Bank, 2022
Forest coverage and resources depletion and biodiversity	• Forest area (% of total land) • Deforestation	SDG 15	World Development Indicators, World Bank, 2022
Environment-related innovation and expenditure	• Technology innovation • Environment-related expenditure	SDG 17	
Environmental governance	• Environmental policy/plan • Institutions, laws/acts and strategies	SDG 16, 17	Relevant country's sources

Source: Adapted by authors

index.

The selection of indicators was determined by considering their international recognition, alignment with the aims of the research, and the availability of consistent data across the nations included in the analysis. The indicators included in this study have been derived from reputable sources such as World Development Indicators, OECD statistics, Air Quality Reports, and other secondary data sources. These indicators are generally acknowledged in the academic literature as crucial factors influencing environmental sustainability. The conscious choice was made to exclude the food supply chain as an indication. The assessment of a country's environmental footprint, particularly in relation to water use, land degradation, and greenhouse gas emissions, heavily relies on the food supply chain. However, it is important to note that the intricacy of this supply chain varies considerably across different nations. Incorporating this information necessitates a distinct, comprehensive examination to accommodate the subtleties and complexities inherent in the farming practices, food processing, distribution, consumption, and waste management systems of each respective country. Considering the extent of this research, we have made the decision to concentrate on variables that can be comparably analyzed throughout Japan, Thailand, and Bangladesh in a more consistent manner.

3.2. Data sources

It is assumed that a comparative analysis of countries' performance based on their ESIs could be useful in determining policies and practices of countries with higher ESI score that could be adopted by poorer countries in terms of ESI scores to improve their ES. This study has selected three countries (Japan, Thailand and Bangladesh) to compare their ESI performance using data from secondary sources, such as World Development Indicators, OECD statistics, Air Quality Report, etc.

3.3. Analytical approaches

The ESIs were analyzed using time series and cross-sectional data and subsequently presented using a descriptive technique, trend and percentage changes over the year. In addition, growth or changes of particular indicators between years were calculated based on the following equation (Equation (1)):

$$Changes\ of\ indicators = \frac{Current\ year\ data - Previous\ year\ data}{Previous\ year\ data} x100 \tag{1}$$

Several analytical techniques were used in this study. The following equation measures the correlation coefficient between different indicators (Equation (2)).

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{\left[n\sum x^2 - (\sum x)^2\right]\left[n\sum y^2 - (\sum y)^2\right]}} \tag{2}$$

The time series data was tested by unit root, and was found to be stationary at level. To examine the factors affecting CO_2 emission, this study applied a panel regression model based on Ordinary Least Square (OLS) as follows (Equation (3)):

$$CO_{2t} = f\ (GDP_t;\ RE_t;\ Elec - coal_t;\ Fossil - Fuel_t) \tag{3}$$

Where GDP_t is the gross domestic product over time *t*, *REt* is the renewable energy use at time *t*, $Elec\text{-}coal_t$ is the electricity production by coal at time *t*, and $Fossil\text{-}Fuel_t$ is the fossil fuel consumption at time *t*. Although some other variables, including technological innovation, urbanization and forest area, also influence CO_2 emission, we did not consider the data due to their nature and inappropriateness for this model.

Equation (4) was customized into an econometric model as follows:

$$CO\_(2)\ t = \beta\_(0) + \beta\_(1)\ GDPt + \beta\_(2)\ \tau 2RE\_(t) + \beta\_(3)\ Elec - coal\_(t) + \beta\_(4)\ Fossil - Fuel\_(t)\ ) + \varepsilon t \tag{4}$$

Where β_0 and εt refer to intercept and error terms, respectively. In addition, β_1, β_2, β_3 and β_4 denote the coefficients.

Equation (5) demonstrates the logarithmic arrangement of Equation (4):

$$LCO_2t = \beta_0 + \beta_1 LGDPt + \beta_2 LRE_t + \beta_3 LElec - coal_t + \beta_4 LFossil - Fuel_t + \varepsilon t \tag{5}$$

The notation used in this study includes LCO_2t to represent the logarithmic form of carbon dioxide (CO2) emissions at time *t*, *LGDPt* to denote the logarithmic form of gross domestic product (GDP) at time *t*, *LREt* to indicate the logarithmic form of renewable energy use at time *t*, *LElec-coalt* to represent the logarithmic form of electricity production from coal, and $LFossil\text{-}Fuel_t$ to signify the logarithmic form of fossil fuel consumption at time t.

4. Results and discussion

4.1. Climate change and GHG emission

Climate change is considered a major threat to human health, the economy and the environment. Most countries are affected by

climate change but with varying degrees of consequences. Japan was ranked fourth in the global climate risk index published in 2019 [84]. On the other hand, Bangladesh and Thailand were ranked seventh and ninth (9), respectively [84]. Climate change has triggered 185 life-threatening weather events from 2000 to 2019, resulting in more than eleven thousand (11,450) death and economic losses worth $3.72 billion. Meanwhile, the major cause of widespread climate change or global warming is the increase in GHG emissions, particularly in high-income and industrialized countries, over the past years.

Japan is one of the leading emitters of carbon in Asia, followed by China and India [47]. Fig. 2 shows that Thailand and Bangladesh have experienced an increasing trend of total CO_2 emission and per capita emission over time, while a fluctuating trend was observed in the case of Japan. Specifically, Japan's total and per capita CO_2 emissions were 1.1 million (Kt) and 8.74, respectively, in 2018. Japan is committed to lessening GHG emissions by 26 % in 2030 and has set a bold and ambitious target to attain carbon neutrality by 2050 [29]. To reach the target, Japan has taken various policies and initiatives, such as the Green Growth Strategy and Environment Innovation Strategy, Climate Innovation Finance Strategy, Ministry of Environment RE100 initiative, green bond initiatives, zero-carbon cities, and Act on Promotion of Global Warming Countermeasures. Thus, due to Japan's effort and commitment, Japan has already reduced its CO_2 emission by 12.27 % from 2013 to 2018, as shown in Table 2. Moreover, the country also achieved a 2.7 % reduction in GHG emissions in FY 2019, a record reduction since emissions tracking began three decades ago.

Thailand also pledged to UNFCCC under the Paris Agreement and COP26 (Conference of the Parties 2021) to lessen GHG emissions by 20 %–25 % by 2030 and to reach net zero (0) carbon emissions by 2065 [85]. Thailand's government has multiple policies and initiatives, including NDC (Nationally determined contribution), National energy policy, National Climate Change Master Plan (2015-50), green bonds and loans, and green projects. Similarly, Bangladesh has prepared a National Adaptation Plan to deal with climatic events but still lacks green and Renewable Energy (RE) initiatives to promote a green economy.

4.2. Pollution scenario among the countries

4.2.1. Air pollution

Pollution is a major problem, particularly in developing countries, resulting from a lack of management practices and protection measures. Statistics (see Table 3) show that developing or least developed countries constitute the top five most polluted countries [86], with Bangladesh being ranked number one. Despite Bangladesh's introduction of National Ambient Air Quality Monitoring Programme, no improvement has been recorded in its air quality over the past few years. In 2021, Dhaka was considered the 2nd worst city in the world and the most polluted city in the world. Dhaka scored 370 on the US Air Quality Index (AQI), which is classified as "very unhealthy" [86]. On the other hand, Japan is ranked 92 of 118 countries in the global air quality index 2021, suggesting that the country enjoys relatively good air quality. This may be attributed to the country's strong Air Pollution Control Law/Act (1968, 1996), which is strictly monitored by the Ministry of Environment.

According to the World Health Organisation (WHO), Japan's average PM2.5 was 11.7 $\mu g/m^3$, again placing it in good standing in terms of air pollution level. In the case of Thailand, the country ranked 67 on the global air quality index, thus experiencing moderate air quality [86]. The result indicates that Bangladesh faces unhealthy air compared to Thailand and Japan. Therefore, the country should emulate the practices and policies of Japan to improve its air quality in the future.

4.2.2. Water pollution

Bangladesh is a riverine nation with over 230 major and minor rivers. However, these rivers are now clogged with pollution primarily caused by human activity [87]. About 8.5 % of deaths in Bangladesh are attributable to water, sanitation and hygiene concerns [88]. Surface water bodies are extensively used to dispose of untreated industrial wastes, which are one of the primary sources of pollution. Major causes of water pollution are industrial waste, urban waste, agrochemicals, and sewerage waste, according to Islam et al. [89], and about 7.7 million tons of liquid waste and 88 million tons of solid waste from tanneries are added to Dhaka

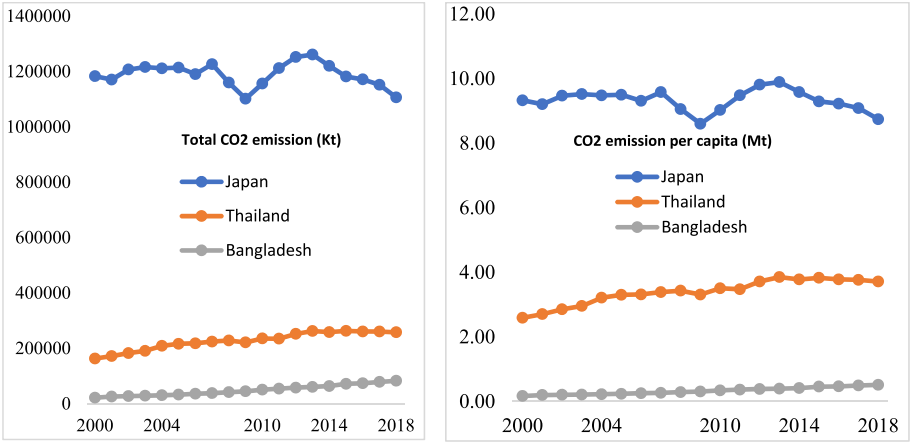

Fig. 2. Total and per capita CO_2 emissions among the countries.

Table 2
Changes in total and per capita CO_2 emissions.

Countries	CO_2 emission		CO_2 emission per capita		Changes (%) of Total CO_2 emission	Changes (%) of per capita CO_2 emission
	2013	2018	2013	2018		
Japan	1260900	1106150	9.89	8.74	−12.27	−11.64
Thailand	262460	257860	3.78	3.71	−1.75	−3.57
Bangladesh	60580	82760	0.40	0.51	+36.61	+29.32

Source: Changes are calculated from the data of the World Bank [][90].

Table 3
Top five polluted countries and capitals in the world.

Top five most polluted countries in the world			Top five most polluted capitals in the world		
Countries	Score	Rank	Capitals	Score	Rank
Bangladesh	**76.9**	**1**	New Delhi, India	85	1
Chad	75.9	2	Dhaka, Bangladesh	78.1	2
Pakistan	66.8	3	N'Djamena, Chad	77.6	3
Tajikistan	59.4	4	Dushanbe, Tajikistan	59.5	4
India	58.1	5	Muscat, Oman	53.1	5
Thailand	**20.2**	**45**	Bangkok, Thailand	20	42
Japan	**9.1**	**92**	Tokyo, Japan	9.1	87

Source: World Air Quality Report, 2021

city's surrounding rivers annually.

Japan has made remarkable improvements in its water quality in recent years and successfully reduced heavy metal pollution of water via the implementation of industrial wastewater regulation. While Japan is yet to achieve environmental quality standards for organic pollution in about 30 % of its total water area, 98 % of the country's population have access to safe water [90]. Japan also promotes sustainable use of water, as indicated in a survey, which demonstrates that 72 % of Japanese practice water conservation.

Thailand is also well ahead of Bangladesh in terms of water. According to the WHO, 99 % and 98 % of people in Thailand have access to drinkable water and basic sanitation, respectively, as opposed to 60 % and 54 % among Bangladeshis [90]. Although most (97 %) Bangladeshis have access to water, only few have access to safe drinking water. These findings indicate that Bangladesh has a long way to go in ensuring water access and quality.

4.3. Waste: generation and management

Waste is another element that creates substantial environmental problems, especially in developing countries. Bangladesh's environmental pollution is likely to worsen due to its lack of proper waste management. South Korea has been included as a case study for waste collection and recycling, as it ranked number one (1) in the world in terms of waste recycling and prides itself as a country with no open dump waste.

Japan has also been considered for comparison, as it is one of the countries with an improved waste management system. The country has experienced huge waste growth due to its economic growth and industrialization during the 20th century. It is projected that Japan's garbage has risen by 35 million tons over the past two decades, with 70 % of waste coming from families and 30 % from businesses [91]. As a result of the adoption of recycling regulations in the late 20th century, the average daily quantity of waste created per capita and the total amount of rubbish produced have decreased significantly since 2005. However, Japan consumes a great deal of plastic garbage due to its reliance on plastic packaging. The country generates the second-most plastic packaging trash per capita, after the United States. Over 60 percent of all plastic trash created in Japan is comprised of plastic packaging. As such, Japan made its first policy "Waste Cleaning Act" in 1900 and promoted a sound material-cycle society to improve public health, pollution control and environmental protection by reducing consumption and recycling waste, in line with the 3R (Reduce, Reuse and Recycle) concept [91]. For instance, Kamikatsu in Japan is transforming into a zero-waste town based on a systematic method of recycling where the current recycling rate is over 80 % [92]. Their target is to achieve 100 % recycling of waste through the involvement of local government, local people, zero waste centers and academics (Table 4).

Table 4
Waste generation and recycling among the selected countries.

Country	Waste Generated	Recycling	Incineration	Landfill	Open Dump	Recycled/generated	Rank in the world
South Korea	400 kg	243 kg	88 kg	46 kg	0 kg	60.8 %	1
Japan	336 kg	66 kg	268 kg	3 kg	0 kg	19.6 %	7
[1]Thailand	410.4 kg	–	–	–	–	–	–
[2]Bangladesh	170 kg	25.5 kg	–	–	–	15 %	–

Source: Adapted from Sensoneo [93], 1World Bank [90], 2Islam et al. [89].

In the case of plastic waste, Japan has set up the Plastic Waste Management Institute, where the country's 83 % of plastic wastes are recycled or incinerated (Table 5). Thus, Japan is working towards reducing waste and recycling throughout the country based on policy, laws, strong institutions and citizen motivation.

4.4. Energy and renewables

Bangladesh's energy is produced mainly by natural gases (62.39 %), followed by furnace oil (20.49 %) and diesel (7.79 %) [95]. Only 2 % of its energy comes from renewables, making the country more fossil fuel-dependent and less environmentally friendly (Fig. 3). Thailand also produced the majority (75 %) of its energy from fossil fuels, including coal (19.5 %), while RE also contributed a significant amount (16.5 %) of energy [90]. In the case of Japan, RE contributed 17 % of electricity generation, while coal and LNG were used to produce 26.5 % and 31.7 % of electricity, respectively [96]. The statistics revealed that fossil fuels dominate selected countries' sources of energy production. However, Japan recently enacted its Sixth Strategic Energy Plan in 2021, in which the government set the target to produce 36–38 % electricity by renewables and 19 % coal, and ensure 46 % carbon emission reduction by 2030. The country emphasizes S+3E (i.e., safety with energy security, efficiency and environmental protection) in its energy policy [96]. On the contrary, Bangladesh develops Power System Master Plans in 2005, 2010, and 2016, and the National Energy Policy 2008, whose goal was to ensure the country generates 10 % of its energy from RE by 2020. Unfortunately, these initiatives are yet to yield significant success [97].

While Japan seems to make progress in its adoption of renewables over time, Thailand's trend in the use of RE is fluctuating. Thus, to maintain the policy target and ensure consistent achievement in the energy sector, both Thailand and Bangladesh could take lessons from Japan (Table 6).

The correlation coefficient result indicated that CO_2 emission is negatively correlated with the share of renewable energy and positively related with the electricity production by coal, fossil fuel consumption and GDP of the countries. Moreover, the result obtained from panel regression generates similar findings, as shown in Table 7. The coefficient of RE was −0.439, which is negative and significant. It denotes that if the share of renewable energy increases by 1 %, CO_2 emission will be decreased by 0.43 %. Again, the coefficients of GDP and electricity production by coal were observed to be 0.295 and 0.283, respectively, both of which were positive and significant. This suggests that if GDP and electricity production by coal increase by 1 %, CO_2 emission will be increased by 0.29 % and 0.28 %, respectively. The findings are quite similar to those of Rahman and Alam [60], which also found positive and negative relationships between the variables.

4.5. Forest coverage

Forest is one of the key indicators of ES, which significantly contributes to biodiversity conservation, ecological protection, and mitigation and adaptation of climate change (Ding et al., 2019; Cheng et al., 2020; Ángel et al., 2022). Forest conservation and afforestation/reforestation are recognized as useful mechanisms for climate change mitigation through emission reduction, which is popularly known as REDD + [99].

Bangladesh has one of the lowest levels of forest cover per capita in the world. According to estimations by the World Bank, Bangladesh's total forest lands fell by over 700 km^2 between 1990 and 2016, equating to a loss of more than 4.5 % of the country's total forest areas in the previous 25 years [90]. In recent years, deforestation has reached a critical rate. The country's Sundarbans mangrove forests, the biggest single-tract mangrove formation in the world, are also suffering increased destruction, which is impeding vital ecosystem functions and protective capacity against coastal erosion, cyclone and so on. The Sundarbans are home to several natural plant and animal species, including the critically endangered Bengal Tiger. Bangladesh is one of the world's most flood-prone nations due to its proximity to the Ganges Delta, which flows into the Bay of Bengal. Approximately 80 % of the country's landmass consists of floodplains, and 70 % of its land is even less than 10 m above sea level. The deforestation and deterioration of Bangladesh's downstream ecosystems have led to frequent and intense floods and fast siltation. Bangladesh has made a Forest Policy (1994), Forest Act (2000), and Social Forestry Rules (2004), but no progress has been achieved so far in terms of forest protection and conservation. This study estimates that Bangladesh suffered a decrease in forest coverage by 1.92 % between 2000 and 2020, while Japan and Thailand experienced an expansion of forests by 0.23 % and 4.6 %, respectively (Fig. 4).

It was mentioned that both Japan and Thailand have taken several policies and initiatives to manage their forest conservation, afforestation and management. Specifically, Japan establishes strong and sound regulations and plans, such as the Forest Act (1951), Forestry Basic Act (1964), and Basic Plan on Forest Resources (1966), among others, for forest development, sustainable forest management and conservation [100]. The Ministry of Agriculture, Forestry and Fisheries, Forestry Agency, Development Corporation, and Prefectural Forestry Corporations are actively engaged and working in Japan for sustainable forest management. On the other

Table 5
Plastic waste generation and recycling among the selected countries.

Country	Collected	Disposed to sanitary facilities	Disposed to unsanitary facilities	Uncollected	Recycled
Japan	100 %	17 %	0	0	83 %
[1]Thailand	89 %	52.6 %	15 %	11 %	21.4 %
[2]Bangladesh	37%–77 %	0	62.8 %	55 %	37.2 %

Source: Adapted from Sensoneo [93], 1World Bank [94], 2Islam et al. [89].

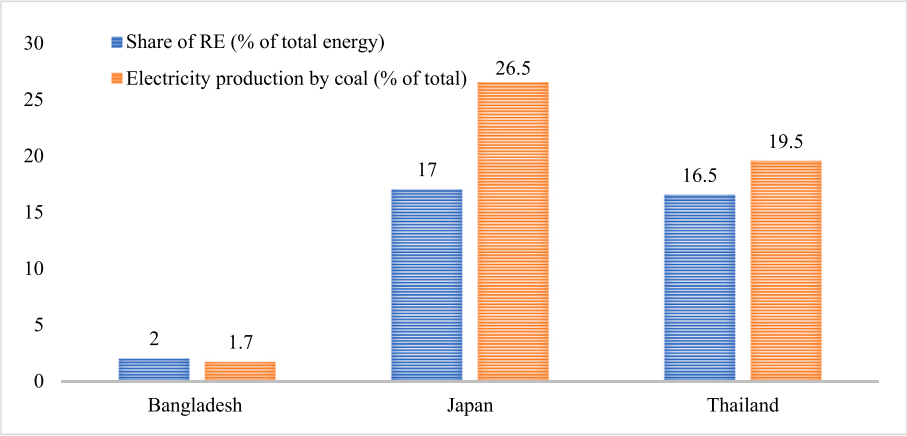

Fig. 3. Share of RE and electricity production by coal among the countries.

Table 6
Correlation between variables among the countries.

Country	Correlation between variables			
	Correlation between CO_2 emission and RE	Correlation between CO_2 emission and fossil fuel consumption	Correlation between CO_2 emission and electricity production by coal	Correlation between CO_2 emission and GDP
Japan	−0.347	0.583	0.353	0.022
Bangladesh	−0.986	0.987	0.665	0.940
Thailand	0.774	0.371	0.543	0.984

Table 7
Results of panel least square among the selected variables of the three countries.

Dependent Variable: L_CO_2				
Method: Panel Least Squares				
Date: 08/13/2022 Time: 18:08				
Sample: 2000 2020				
Periods included: 21				
Cross-sections included: 3				
Total panel (balanced) observations: 63				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
L_ECOAL	0.283042	0.018753	15.09284	0.0000
L_RE	−0.439251	0.046688	−9.408229	0.0000
L_FOSSIL	1.143014	0.202629	5.640928	0.0000
L_GDP	0.295624	0.027123	10.89943	0.0000
Root MSE	0.088780	R-squared		0.995558
Mean dependent var	12.36594	Adjusted R-squared		0.995332
S.D. dependent var	1.342792	S.E. of regression		0.091740
Akaike info criterion	−1.878333	Sum squared resid		0.496556
Schwarz criterion	−1.742261	Log likelihood		63.16749
Hannan-Quinn criteria	−1.824815	Durbin-Watson stat		0.452894

Sources: Compiled by authors

hand, Thailand has also achieved some level of success in forest protection, management and development through the implementation of its Forest Law (1941), National Reserved Forest Law (1964), National Forest Policy (1985, 2020), Wildlife Conservation Law (2019), Forest Plantation Law (1992) and Community Forestry Law (2019).

4.6. The countries in the global indexes

Bangladesh is ranked 177 out of 180 countries in the 2022 EPI, with just 23.10 EPI points, and also secured the 4th position in the world as the worst in minimizing pollution. Notably, the country has faced a negative change (−1.90) in its environmental performance score and ecosystem vitality over the last 10 years [101], ranking 129th out of 191 countries on the Human Development Index, 116th out of 132 on the Global Innovation Index, 104 out of 163 countries on the Global Sustainability Index and 159 out of 180 countries in ecosystem vitality.

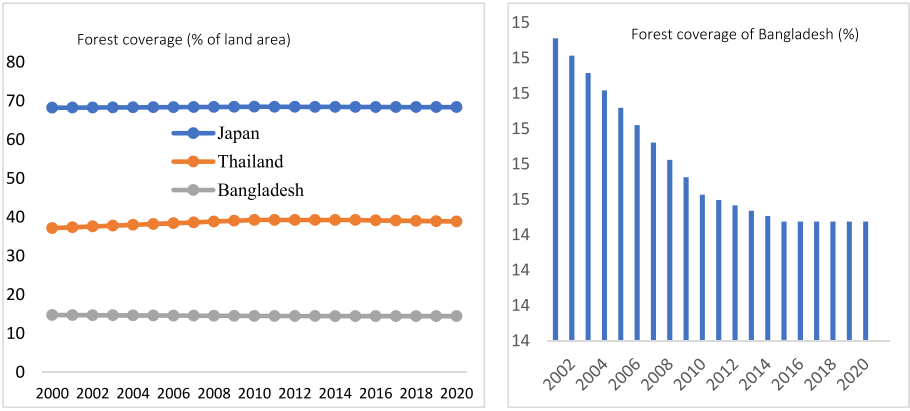

Fig. 4. Forest coverage (% of total land) among the countries.

Thailand's positions are better than Bangladesh's in all selected indexes. On the other hand, Japan has secured its position among the top 20 countries in all the indexes except EPI, where the country ranked 25 out of 180 countries (see Table 8). However, the study found that Denmark, Switzerland, and Finland are always found in the best position in almost all the global indexes. The findings indicate that most developing countries are lagging in ES. Japan is continuously trying to improve its ES through better environmental governance, especially in terms of institutions, policy, and implementation. Thus, Japan still has an opportunity to strengthen its position in the global indexes, whereas Bangladesh and Thailand still have to go a long way to promote ES.

4.7. Environmental governance and challenges

Environmental governance (EG) is one of the crucial components of ES management [103]. Generally, poor EG is found in developing and least-developed countries, while developed countries ensure better EG to limit their environmental impacts and promote sustainability [98,104]. However, EG has various dimensions, including environmental policy, institutional arrangement and capacity and political structure and commitment [103]. Moreover, some critical aspects like low carbon technology, renewable energy initiatives and green finance are also considered important tools of environmental/green governance [105]. This study explores Japan's commitment to carbon neutrality and its specific milestones and targets and possible outcomes under the dynamic leadership of the Ministry of Environment (MOE). In October 2020, Japan declared its vision to attain net-zero by 2050 [106,107]. To achieve this vision, Japan is committed to lessening greenhouse gas (GHG) emissions by 26 % from 2013 levels by 2030 (Table 9), and by promoting green finance and developing new and innovative technologies, Japan aims to achieve net zero GHG emissions by 2050 [106, 107]. The country has already achieved a 2.7 % reduction of GHG emissions in FY 2019. In terms of policy initiatives, various public agencies have already declared the "Green Growth Strategy through Achieving Carbon Neutrality in 2050." This effort signifies Japan's strong environmental governance performance toward achieving ES.

Bangladesh has also committed to reducing its emission and increasing its share of renewable energy by 2030. However, recent data shows no increase in RE share and decrease in emissions between 2015 and 2020 [90]. Bangladesh has enacted several laws and rules in favor of environmental conservation; yet, its environmental performance and air and water pollution are not encouraging [86]. Thus, it is recognized that there is a big gap between environmental governance and its implications for the environment in Bangladesh.

Thailand is trying to improve its environmental performance through various policies and initiatives, such as the national energy policy, greenhouse gas management, green bond, and project. One of the biggest weaknesses of Thailand's efforts is its fluctuating trend of RE amid the continuous increase in emissions. This finding is almost similar to many other developing countries where no significant progress was made in ES and governance. Thus, developing countries should strengthen their environmental governance

Table 8
Performance of the countries on some vital global indexes.

Country	Environmental performance index	Human development index	Global innovation index	Global sustainability index	Ecosystem vitality
Bangladesh	23.10	0.661		64.22	
Rank	177/180	129/191	116/132	104/163	159/180
Thailand	38.10	0.800		74.13	
Rank	108/180	66/191	43/132	44/163	101/180
Japan	57.20	0.925		79.58	
Rank	25/180	19/191	13/132	19/163	16/180
Best country	Denmark (77.90)	Switzerland (0.962)	Switzerland	Finland (86.51)	Denmark

Source: Adapted from EPI [101], Sachs et al. [102].

Table 9
Country's commitment, policies, and regulations relating to environment and climate.

Countries	Commitments and targets in environment and climate change	Policies and initiatives	Laws/regulations
Bangladesh	• 22 % emission reduction by 2030 • 40 % of energy from renewable sources by 2041	• NDC, Bangladesh • Environment Policy (1992) • Forest Policy (1994) • Water Policy (1998), • National Agriculture Policy (1999) • Energy Policy (1995) • National Environment Management Action Plan, 1995	• Environmental Conservation Act (ECA) of 1995 • Environment Conservation Rule of 1997 • Environment Court Act. 2000 • Environmental Pollution Control Ordinance 1997 • Wildlife (Preservation) Act 1973 • Water Hyacinth Act 1939 • Factories Act 1965
Thailand	• Carbon neutrality by 2065 • 20–25 % emission reduction by 2030 • 30 % energy from renewable sources by 2037	• NDC, Thailand • National energy policy • National Climate Change Master Plan (2015-50) • Thailand Greenhouse Gas Management Organization (TGO) • Green investment	• the Enhancement and Conservation of National Environmental Quality Act, 1992 • the Hazardous Substances Act, 1992 • the Public Health Act, 1992 • the Factories Act, 1992 and • the Navigation in Thai Territorial Waters Act, 1997
Japan	• Carbon neutrality by 2050 • 26 % emission reduction by 2030 • 36–38 % energy from renewables by 2030	• Green Growth Strategy • Environment innovation strategy • Climate Innovation Finance Strategy 2020 • Ministry of Environment RE100 initiative • Zero carbon cities • NDC of Japan • Green innovation fund • Green bond	• The Basic Environment Law, 1993 • Environment impact assessment act 1997 • GHG emission measurement Act • Air Pollution Control Act • Water Pollution Control Law • Act on Promotion of Global Warming Countermeasures • Waste management and cleaning Act • Chemical substance control act

Source: Compiled by authors

through the promotion of good governance and citizen consciousness to achieve/promote ES in the long run.

5. Conclusion and policy recommendations

Environmental protection and sustainability are vital for human development and well-being. However, achieving ES is considered a big challenge for governments worldwide due to many developments and economic activities that ignore or neglect environmental concerns. A comparative analysis of the performance of countries based on their ESIs could help identify practices from countries with high ESIs that could be applied to countries with low ESIs in order to enhance them. This study compares the ESI performance of Japan, Thailand, and Bangladesh using secondary data sources, including World Development Indicators, OECD statistics, Air Quality Reports, etc. ESI performance and the relationship between the indicators were evaluated utilizing trend, growth, and regression analysis. This study found positive relationships exist between ES and the increased share of renewable energy and sound governance, while negative relationships exist between ES and the increased consumption of fossil fuels and coal, as well as economic growth. The results also revealed that Bangladesh's performance with regard to the majority of ESIs ranges from poor to poorer, whereas Japan exhibits excellent performance with regard to all of its ESI indicators, with the exception of emissions. In contrast, Thailand's ESI performance indicates its susceptibility to climate disasters and slowed renewable energy growth. Although firm policies and regulations were identified in all countries, there is a significant implementation disparity between developing (Bangladesh) and developed (Japan) countries. Specifically, Japan's good citizen practices and adherence to the rule of law have contributed to its remarkable success in implementing regulations.

Many countries, especially developing and least-developed countries, neglect ES in their policies and priorities. For instance, the recent trend shows that Bangladesh's environmental performance has declined gradually. These countries are focusing on GDP growth, which encourages better welfare but also generates environmental consequences. Although many developing countries have achieved higher GDP in their economy, they lag behind in ES indicators. Bangladesh's progress in the management of its air and water pollution and waste has been discouraging, which may result in an adverse effect on human health and environmental quality. As a higher middle-income country, Thailand is in a better position than Bangladesh in terms of ESIs. On the other hand, Japan, being a developed country, fared well in its environmental performance and has continuously improved its EPI score over the year, indicating that Japan has not only enhanced its environmental policy but also successfully implemented it through a better EG process to achieve ES.

EG remains a major key to promoting ESIs, especially in developing countries. This could be ensured by different ES practices, including the development and adoption of renewable resources, green financing, sustainable farming, tree plantation/reforestation and carbon tax/pricing, reduction of fossil fuel consumption, and regulatory control of pollution. Moreover, a good governance mechanism could also help stimulate other stakeholders, including business organizations/industry, GOs/NGOs and communities/local people, to play an important role in ensuring ES.

The ES could help maintain a balance between ecological system protection, economic development and social well-being. However, this requires a sound environmental governance system. This study, therefore, outlines the following recommendations

to ensure environmental governance and sustainability, especially for developing countries. Governments of developing countries lack the strong political will to ensure environmental protection and conservation. There is also a lack of the rule of law or proper implementation of rules and regulations. Thus, global organizations and funding agencies should consider the political commitment of governments and their dedication to upholding the rule of law as conditions to access financial support. People in developing countries are less conscious and exhibit poor attitudes and motivation toward the environment. Thus, the government should take some initiatives to raise their consciousness and encourage their pro-environmental attitude. In addition, developing countries suffer from a lack of technology innovation and finance for environmental protection and conservation. This can be abated by promoting technology transfer through the investment of developed countries in developing countries to enhance sustainable practices. Further, industries in developing nations should be brought under strict environmental rules and regulations to ensure environmental safety and security. The government should discourage the use of old and faulty transport while promoting the concept of green transport. Developing countries should take comprehensive policies and initiatives to increase the share of renewable energy, reduce fossil fuel consumption, promote the recycling of waste and encourage tree plantation/reforestation. Finally, the developing country can accelerate ES by promoting an environment-first policy at all levels.

6. Limitations and future research directions

This study provides an analysis of the environmental sustainability indicators (ESIs) pertaining to Japan, Thailand, and Bangladesh. However, it is important to acknowledge the inherent limitations associated with this study. The choice of these three countries, albeit predicated on their distinct stages of development, may not fully encompass the wider range of environmental concerns encountered by other nations. Though supply chains for food are an integral component of environmental sustainability, impacting land water resources, land use patterns and greenhouse gas emissions, their complexity and diversity create formidable obstacles to comparison analysis between countries. Factors such as agricultural practices, dietary preferences, and supply chain logistics vary widely, requiring a detailed, context-specific examination beyond the scope of our current study. Furthermore, the selected Environmental Sustainability Indicators (ESIs), although pertinent, did not encompass key facets such as the food supply chain, which may have constrained the breadth of our analysis. The use of secondary data sources may fail to encompass the latest advancements in these nations.

Subsequent investigations may yield valuable insights by incorporating a broader range of nations, thereby offering a comprehensive global outlook on ESIs. The inclusion of a wider array of indicators, encompassing aspects such as biodiversity and the food supply chain, would provide a more comprehensive perspective. In order to obtain more detailed information, it is possible to utilize primary data-gathering methods, such as conducting stakeholder interviews. By directing attention towards particular domains, such as renewable energy or waste management, it is possible to attain a more profound understanding of optimal strategies and obstacles pertaining to environmental sustainability.

Data availability statement

Data will be made available on request.

Funding

This study did not receive any external funding.

CRediT authorship contribution statement

Md Sujahangir Kabir Sarkar: Writing – review & editing, Writing – original draft, Visualization, Software, Resources, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Md Nazirul Islam Sarker:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation. **Sumaiya Sadeka:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Investigation, Formal analysis, Data curation. **Isahaque Ali:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Formal analysis. **Abul Quasem Al-Amin:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Investigation.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:The corresponding author, Dr. Md Nazirul Islam Sarker, is an academic editor of Heliyon journal (Society & Politics section). There are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] J. Morelli, Environmental sustainability: a definition for environmental professionals, J. Environ. Sustain. 1 (2011) 1–10, https://doi.org/10.14448/jes.01.0002.

[2] P.S. Ángel, C.R. Roberto, S.O. Marival, Can a country's environmental sustainability exert influence on its economic and financial situation? The relationship between environmental performance indicators and country risk, J. Clean. Prod. 375 (2022), https://doi.org/10.1016/j.jclepro.2022.134121.

[3] M.A. Villanthenkodath, M.K. Mahalik, Does economic growth respond to electricity consumption asymmetrically in Bangladesh? The implication for environmental sustainability, Energy 233 (2021) 121142, https://doi.org/10.1016/j.energy.2021.121142.

[4] A.K. Feroz, H. Zo, A. Chiravuri, Digital transformation and environmental sustainability: a review and research agenda, Sustainability 13 (2021) 1530, https://doi.org/10.3390/su13031530.

[5] M. Elder, G. Ellis, ASEAN countries' environmental policies for the Sustainable Development Goals (SDGs), Environ. Dev. Sustain. (2022), https://doi.org/10.1007/s10668-022-02514-0.

[6] S. Lamichhane, G. Eğilmez, R. Gedik, M.K.S. Bhutta, B. Erenay, Benchmarking OECD countries' sustainable development performance: a goal-specific principal component analysis approach, J. Clean. Prod. 287 (2021), https://doi.org/10.1016/j.jclepro.2020.125040.

[7] V. Sebestyén, J. Abonyi, Data-driven comparative analysis of national adaptation pathways for Sustainable Development Goals, J. Clean. Prod. 319 (2021) 128657, https://doi.org/10.1016/j.jclepro.2021.128657.

[8] R. Arbolino, R. Boffardi, G. Ioppolo, T.L. Lantz, P. Rosa, Evaluating industrial sustainability in OECD countries: a cross-country comparison, J. Clean. Prod. 331 (2022) 129773, https://doi.org/10.1016/j.jclepro.2021.129773.

[9] K. Nwanekezie, B. Noble, G. Poelzer, Transitions-based strategic environmental assessment, Environ. Impact Assess. Rev. 91 (2021) 106643, https://doi.org/10.1016/j.eiar.2021.106643.

[10] R. Roy, N.W. Chan, R. Rainis, Development of indicators for sustainable rice farming in Bangladesh: a case study with participative multi-stakeholder involvement, World Appl. Sci. J. 22 (2013) 672–682, https://doi.org/10.5829/idosi.wasj.2013.22.05.2890.

[11] N. Pollesch, V.H. Dale, Applications of aggregation theory to sustainability assessment, Ecol. Econ. 114 (2015) 117–127, https://doi.org/10.1016/j.ecolecon.2015.03.011.

[12] T. Dietz, L. Biber-Freudenberger, L. Deal, J. Börner, Is private sustainability governance a myth? Evaluating major sustainability certifications in primary production: a mixed methods meta-study, Ecol. Econ. 201 (2022), https://doi.org/10.1016/j.ecolecon.2022.107546.

[13] C. Gallucci, R. Santulli, V. Lagasio, The conceptualization of environmental, social and governance risks in portfolio studies A systematic literature review, Socioecon. Plann. Sci. (2022) 101382, https://doi.org/10.1016/j.seps.2022.101382.

[14] V.M. Taghvaee, M. Nodehi, R.M. Saber, M. Mohebi, Sustainable development goals and transportation modes: analyzing sustainability pillars of environment, health, and economy, World Dev. Sustain. 1 (2022) 100018, https://doi.org/10.1016/j.wds.2022.100018.

[15] F. Krampe, F. Hegazi, S.D. VanDeveer, Sustaining peace through better resource governance: three potential mechanisms for environmental peacebuilding, World Dev. 144 (2021) 105508, https://doi.org/10.1016/j.worlddev.2021.105508.

[16] A. Omri, N. Ben Mabrouk, Good governance for sustainable development goals: getting ahead of the pack or falling behind? Environ. Impact Assess. Rev. 83 (2020) 106388 https://doi.org/10.1016/j.eiar.2020.106388.

[17] M.S. Islam, M.K. Uddin, S.M. Tareq, M. Shammi, A.K.I. Kamal, T. Sugano, M. Kurasaki, T. Saito, S. Tanaka, H. Kuramitz, Alteration of water pollution level with the seasonal changes in mean daily discharge in three main rivers around Dhaka City, Bangladesh, Environments 2 (2015) 280–294, https://doi.org/10.3390/environments2030280.

[18] M.N. Hossain, A. Rahaman, M.J. Hasan, M.M. Uddin, N. Khatun, S.M. Shamsuddin, Comparative seasonal assessment of pollution and health risks associated with heavy metals in water, sediment and Fish of Buriganga and Turag River in Dhaka City, Bangladesh, SN Appl. Sci. 3 (2021) 1–16, https://doi.org/10.1007/s42452-021-04464-0.

[19] D. Jain, S. Bhatnagar, K. Sachdeva, Impact of degrading air quality on mode choice and emissions – study of ten global cities, World Dev. Sustain. 1 (2022) 100002, https://doi.org/10.1016/j.wds.2022.100002.

[20] Ministry of the Environment of Japan, History and Current State of Waste Management in Japan, 2014, pp. 1–32. https://www.env.go.jp/en/recycle/smcs/attach/hcswm.pdf.

[21] R. Luo, S. Ullah, K. Ali, Pathway towards sustainability in selected asian countries: influence of green investment, technology innovations, and economic growth on CO2 emission, Sustainability 13 (2021) 12873, https://doi.org/10.3390/su132212873.

[22] M. Herrador, W. de Jong, K. Nasu, L. Granrath, Circular economy and zero-carbon strategies between Japan and South Korea: a comparative study, Sci. Total Environ. 820 (2022) 153274, https://doi.org/10.1016/j.scitotenv.2022.153274.

[23] T. Silalertruksa, S.H. Gheewala, Environmental sustainability assessment of bio-ethanol production in Thailand, Energy 34 (2009) 1933–1946, https://doi.org/10.1016/j.energy.2009.08.002.

[24] J. Prasara-A, S.H. Gheewala, T. Silalertruksa, P. Pongpat, W. Sawaengsak, Environmental and social life cycle assessment to enhance sustainability of sugarcane-based products in Thailand, Clean Technol. Environ. Policy 21 (2019) 1447–1458, https://doi.org/10.1007/s10098-019-01715-y.

[25] S.N.M. Menikpura, S.H. Gheewala, S. Bonnet, Framework for life cycle sustainability assessment of municipal solid waste management systems with an application to a case study in Thailand, Waste Manag. Res. 30 (2012) 708–719, https://doi.org/10.1177/0734242X12444896.

[26] X. Liu, H. Liu, J. Chen, T. Liu, Z. Deng, Evaluating the sustainability of marine industrial parks based on the DPSIR framework, J. Clean. Prod. 188 (2018) 158–170, https://doi.org/10.1016/j.jclepro.2018.03.271.

[27] P. Halla, A. Merino-Saum, C.R. Binder, How to link sustainability assessments with local governance? – Connecting indicators to institutions and controversies, Environ. Impact Assess. Rev. 93 (2022) 106741, https://doi.org/10.1016/j.eiar.2022.106741.

[28] Y.P. Pillay, F.T. Buschke, Misaligned environmental governance indicators and the mismatch between government actions and positive environmental outcomes, Environ. Sci. Pol. 112 (2020) 374–380, https://doi.org/10.1016/j.envsci.2020.07.010.

[29] M. Alsaleh, A.S. Abdul-Rahim, M.M. Abdulwakil, The importance of worldwide governance indicators for transitions toward sustainable bioenergy industry, J. Environ. Manag. 294 (2021) 112960, https://doi.org/10.1016/j.jenvman.2021.112960.

[30] M. Billi, A. Mascareño, J. Edwards, Governing sustainability or sustainable governance? Semantic constellations on the sustainability-governance intersection in academic literature, J. Clean. Prod. 279 (2021) 123523, https://doi.org/10.1016/j.jclepro.2020.123523.

[31] H. Nancy, Incorporating local sustainability indicators into structures of local governance : a review of the literature, Local Environ. 14 (2009) 365–375.

[32] L.Y. Shen, J. Jorge Ochoa, M.N. Shah, X. Zhang, The application of urban sustainability indicators - a comparison between various practices, Habitat Int. 35 (2011) 17–29, https://doi.org/10.1016/j.habitatint.2010.03.006.

[33] Y.T. Chong, K.M. Teo, L.C. Tang, A lifecycle-based sustainability indicator framework for waste-to-energy systems and a proposed metric of sustainability, Renew. Sustain. Energy Rev. 56 (2016) 797–809, https://doi.org/10.1016/j.rser.2015.11.036.

[34] S. Hendiani, H. Liao, C.J.C. Jabbour, A new sustainability indicator for supply chains: theoretical and practical contribution towards sustainable operations, Int. J. Logist. Res. Appl. 25 (2022) 384–409, https://doi.org/10.1080/13675567.2020.1761308.

[35] D. Armitage, R. De Loë, R. Plummer, Environmental governance and its implications for conservation practice, Conserv. Lett. 5 (2012) 245–255, https://doi.org/10.1111/j.1755-263X.2012.00238.x.

[36] F.F. Ye, L.H. Yang, Y.M. Wang, A new environmental governance cost prediction method based on indicator synthesis and different risk coefficients, J. Clean. Prod. 212 (2019) 548–566, https://doi.org/10.1016/j.jclepro.2018.12.029.

[37] S.R.L. Kruk, S. Kloppenburg, H.M. Toonen, S.R. Bush, Digitalizing environmental governance for smallholder participation in food systems, Earth Syst. Gov. 10 (2021) 100125, https://doi.org/10.1016/j.esg.2021.100125.

[38] G. Borongan, A. NaRanong, Factors in enhancing environmental governance for marine plastic litter abatement in Manila, the Philippines: a combined structural equation modeling and DPSIR framework, Mar. Pollut. Bull. 181 (2022) 113920, https://doi.org/10.1016/j.marpolbul.2022.113920.

[39] T.M. Baynes, T. Wiedmann, General approaches for assessing urban environmental sustainability, Curr. Opin. Environ. Sustain. 4 (2012) 458–464, https://doi.org/10.1016/j.cosust.2012.09.003.

[40] B. Moldan, S. Janoušková, T. Hák, How to understand and measure environmental sustainability: indicators and targets, Ecol. Indicat. 17 (2012) 4–13, https://doi.org/10.1016/j.ecolind.2011.04.033.

[41] R. Cheng, W. Li, Z. Lu, S. Zhou, C. Meng, Integrating the three-line environmental governance and environmental sustainability evaluation of urban industry in China, J. Clean. Prod. 264 (2020) 121554, https://doi.org/10.1016/j.jclepro.2020.121554.

[42] J. Gómez-Limón, M. Arriaza, M. Guerrero-Baena, Building a composite indicator to measure environmental sustainability using alternative weighting methods, Sustainability 12 (2020) 4398, https://doi.org/10.3390/su12114398.

[43] E. United Nations, Achieving Sustainable Development Goals in East and North-East Asia, United Nations, 2017, https://doi.org/10.18356/e90a48bb-en. Retrieved from, https://www.un-ilibrary.org/content/books/9789210603669. (Accessed 1 December 2022).

[44] S.S. Mohamad, M.S. Sarkar, Comparative analysis of sustainable development indicators in southeast Asian countries: current status and policy implications, Int. J. Dev. Sustain. 7 (2018) 2445–2462. www.isdsnet.com/ijds.

[45] S. Krank, H. Wallbaum, Lessons from seven sustainability indicator programs in developing countries of Asia, Ecol. Indicat. 11 (2011) 1385–1395, https://doi.org/10.1016/j.ecolind.2011.02.017.

[46] A. Hoque, A. Clarke, T. Sultana, Environmental sustainability practices in South Asian university campuses: an exploratory study on Bangladeshi universities, Environ. Dev. Sustain. 19 (2017) 2163–2180, https://doi.org/10.1007/s10668-016-9845-0.

[47] M.S.K. Sarkar, R.A. Begum, S. Sadeka, J.J. Pereira, Current trends and policies of energy consumption and CO2 emission from the largest Asian economies, Int. J. Glob. Warming 14 (2018) 417–439, https://doi.org/10.1504/IJGW.2018.091530.

[48] M. Nosheen, J. Iqbal, H.U. Khan, Analyzing the linkage among CO2 emissions, economic growth, tourism, and energy consumption in the Asian economies, Environ. Sci. Pollut. Res. 28 (2021) 16707–16719, https://doi.org/10.1007/s11356-020-11759-z.

[49] Y. Kajikawa, T. Inoue, T.N. Goh, Analysis of building environment assessment frameworks and their implications for sustainability indicators, Sustain. Sci. 6 (2011) 233–246, https://doi.org/10.1007/s11625-011-0131-7.

[50] R. Cheng, W. Li, Evaluating environmental sustainability of an urban industrial plan under the three-line environmental governance policy in China, J. Environ. Manag. 251 (2019) 109545, https://doi.org/10.1016/j.jenvman.2019.109545.

[51] L. Zhou, R. Zhang, A. Li, New concepts for bootstrap-based cross-efficiency and relative weight analysis and an application to China's governance-finance-innovation-sustainability system, J. Clean. Prod. 379 (2022) 134549, https://doi.org/10.1016/j.jclepro.2022.134549.

[52] W. Fan, L. Yan, B. Chen, W. Ding, P. Wang, Environmental governance effects of local environmental protection expenditure in China, Resour. Pol. 77 (2022) 102760, https://doi.org/10.1016/j.resourpol.2022.102760.

[53] R.L. Burritt, C. Saka, Environmental management accounting applications and eco-efficiency: case studies from Japan, J. Clean. Prod. 14 (2006) 1262–1275, https://doi.org/10.1016/j.jclepro.2005.08.012.

[54] T.S. Adebayo, D. Kirikkaleli, Impact of renewable energy consumption, globalization, and technological innovation on environmental degradation in Japan: application of wavelet tools, Environ. Dev. Sustain. 23 (2021) 16057–16082, https://doi.org/10.1007/s10668-021-01322-2.

[55] S.N.M. Menikpura, S.H. Gheewala, S. Bonnet, C. Chiemchaisri, Evaluation of the effect of recycling on sustainability of municipal solid waste management in Thailand, Waste and Biomass Valorization 4 (2013) 237–257, https://doi.org/10.1007/s12649-012-9119-5.

[56] S. Pilouk, T. Koottatep, Environmental performance indicators as the key for eco-industrial parks in Thailand, J. Clean. Prod. 156 (2017) 614–623, https://doi.org/10.1016/j.jclepro.2017.04.076.

[57] R.J. Nicholls, C.W. Hutton, A.N. Lázár, A. Allan, W.N. Adger, H. Adams, J. Wolf, M. Rahman, M. Salehin, Integrated assessment of social and environmental sustainability dynamics in the Ganges-Brahmaputra-Meghna delta, Bangladesh. https://doi.org/10.1016/j.ecss.2016.08.017, 2016.

[58] S. Akhter, P.K. Dey, Sustainability reporting practices: evidence from Bangladesh, Int. J. Account. Financ. Report. 7 (2017) 61, https://doi.org/10.5296/ijafr.v7i2.11659.

[59] T. Chowdhury, H. Chowdhury, A. Ahmed, Y.-K. Park, P. Chowdhury, N. Hossain, S.M. Sait, Energy, exergy, and sustainability analyses of the agricultural sector in Bangladesh, Sustainability 12 (2020) 4447, https://doi.org/10.3390/su12114447.

[60] M.M. Rahman, K. Alam, Clean energy, population density, urbanization and environmental pollution nexus: evidence from Bangladesh, Renew. Energy 172 (2021) 1063–1072, https://doi.org/10.1016/j.renene.2021.03.103.

[61] L. Johannsdottir, Drives of proactive environmental actions of small, medium and large Nordic non-life insurance companies - and insurers as a driving force of actions, J. Clean. Prod. 108 (2015) 685–698, https://doi.org/10.1016/j.jclepro.2015.06.055.

[62] A. Brambila, P. Flombaum, Comparison of environmental indicator sets using a unified indicator classification framework, Ecol. Indicat. 83 (2017) 96–102, https://doi.org/10.1016/j.ecolind.2017.07.023.

[63] M.Z. Rafique, A.M. Nadeem, W. Xia, M. Ikram, H.M. Shoaib, U. Shahzad, Does economic complexity matter for environmental sustainability? Using ecological footprint as an indicator, Environ. Dev. Sustain. 24 (2022) 4623–4640, https://doi.org/10.1007/s10668-021-01625-4.

[64] X. Shui, M. Zhang, P. Smart, F. Ye, Sustainable corporate governance for environmental innovation: a configurational analysis on board capital, CEO power and ownership structure, J. Bus. Res. 149 (2022) 786–794, https://doi.org/10.1016/j.jbusres.2022.05.037.

[65] I. Gallego-Álvarez, M.P. Galindo-Villardón, M. Rodríguez-Rosa, Evolution of sustainability indicator worldwide: a study from the economic perspective based on the X-STATICO method, Ecol. Indicat. 58 (2015) 139–151, https://doi.org/10.1016/j.ecolind.2015.05.025.

[66] V. Nakthong, K. Kubaha, Development of a sustainability index for an energy management system in Thailand, Sustainability 11 (2019) 4587, https://doi.org/10.3390/su11174587.

[67] K. Kluza, M. Ziolo, A. Spoz, Innovation and environmental, social, and governance factors influencing sustainable business models - meta-analysis, J. Clean. Prod. 303 (2021) 127015, https://doi.org/10.1016/j.jclepro.2021.127015.

[68] S. Dinda, Environmental Kuznets curve hypothesis: a survey, Ecol. Econ. 49 (2004) 431–455, https://doi.org/10.1016/j.ecolecon.2004.02.011.

[69] D.I. Stern, The rise and fall of the environmental Kuznets curve, World Dev. 32 (2004) 1419–1439, https://doi.org/10.1016/j.worlddev.2004.03.004.

[70] A. Valencia, J. Qiu, N. Bin Chang, Integrating sustainability indicators and governance structures via clustering analysis and multicriteria decision making for an urban agriculture network, Ecol. Indicat. 142 (2022) 109237, https://doi.org/10.1016/j.ecolind.2022.109237.

[71] B.Y. An, S.Y. Tang, W.D. Leach, Managing environmental change through inter-agency collaboration: protective governance in mandated sustainability planning, Environ. Sci. Pol. 125 (2021) 146–156, https://doi.org/10.1016/j.envsci.2021.08.024.

[72] L.T. Hai, P.H. Hai, T. Van Y, L. Hens, Health and environmental sustainability indicators in quang tri province, vietnam, Int. J. Sustain. Dev. World Ecol. 16 (2009) 77–86, https://doi.org/10.1080/13504500902793481.

[73] D. Cook, N.M. Saviolidis, B. Davíðsdóttir, L. Jóhannsdóttir, S. Ólafsson, Measuring countries' environmental sustainability performance—the development of a nation-specific indicator set, Ecol. Indicat. 74 (2017) 463–478, https://doi.org/10.1016/j.ecolind.2016.12.009.

[74] X. Liu, X. Ji, D. Zhang, J. Yang, Y. Wang, How public environmental concern affects the sustainable development of Chinese cities: an empirical study using extended DEA models, J. Environ. Manag. 251 (2019) 109619, https://doi.org/10.1016/j.jenvman.2019.109619.

[75] F. Rosa, A. Kern, L. Bragança, Comparative analysis of sustainable development environmental indicators between worldwide, Portugal and Brazil and between two universities within these countries, IOP Conf. Ser. Earth Environ. Sci. 503 (2020) 012039, https://doi.org/10.1088/1755-1315/503/1/012039.

[76] W. Yuan, M. Liang, G. Jing, T. Fengfei, S. Lianxi, The study on the indicator system for strategic environmental assessment, Adv. Mater. Res. 664 (2013) 348–352, https://doi.org/10.4028/www.scientific.net/AMR.664.348.

[77] N. Abid, M. Ikram, J. Wu, M. Ferasso, Towards environmental sustainability: exploring the nexus among ISO 14001, governance indicators and green economy in Pakistan, Sustain. Prod. Consum. 27 (2021) 653–666, https://doi.org/10.1016/j.spc.2021.01.024.

[78] H.A. Fakher, M. Panahi, K. Emami, K. Peykarjou, S.Y. Zeraatkish, Investigating marginal effect of economic growth on environmental quality based on six environmental indicators: does financial development have a determinative role in strengthening or weakening this effect? Environ. Sci. Pollut. Res. 28 (2021) 53679–53699, https://doi.org/10.1007/s11356-021-14470-9.

[79] H.A. Fakher, Z. Ahmed, A.O. Acheampong, S.P. Nathaniel, Renewable energy, nonrenewable energy, and environmental quality nexus: an investigation of the N-shaped Environmental Kuznets Curve based on six environmental indicators, Energy 263 (2023) 125660, https://doi.org/10.1016/j.energy.2022.125660.
[80] H.A. Fakher, Z. Ahmed, R. Alvarado, M. Murshed, Exploring renewable energy, financial development, environmental quality, and economic growth nexus: new evidence from composite indices for environmental quality and financial development, Environ. Sci. Pollut. Res. 29 (2022) 70305–70322, https://doi.org/10.1007/s11356-022-20709-w.
[81] H.A. Fakher, R. Inglesi-Lotz, Revisiting environmental Kuznets curve: an investigation of renewable and non-renewable energy consumption role, Environ. Sci. Pollut. Res. 29 (2022) 87583–87601, https://doi.org/10.1007/s11356-022-21776-9.
[82] A.A. Hezri, S.R. Dovers, Sustainability indicators, policy and governance: issues for ecological economics, Ecol. Econ. 60 (2006) 86–99, https://doi.org/10.1016/j.ecolecon.2005.11.019.
[83] H.A. Fakher, M. Murshed, Does financial and economic expansion allow for environmental sustainability? Fresh insights from a new composite index and PSTR analysis, J. Environ. Plann. Manag. (2023) 6–11, https://doi.org/10.1080/09640568.2023.2205997.
[84] Global Climate Risk Index, Global Climate Risk Index - 2021, 2021. Retrieved from, https://www.germanwatch.org/sites/default/files/Global. %20Climate%20Risk%20Index%202021_2.pdfonNovember1,2022.
[85] Bangkok Post, Carbon neutrality by 2065 (2021) 1–5.
[86] World Air Quality Report, World air quality Report - 2021, Retrieved from, https://www.iqair.com/world-most-polluted-countries, 2021. (Accessed 12 October 2022).
[87] M.K. Hasan, A. Shahriar, K.U. Jim, Water pollution in Bangladesh and its impact on public health, Heliyon 5 (2019) e02145, https://doi.org/10.1016/j.heliyon.2019.e02145.
[88] M.J. Uddin, Y.K. Jeong, Urban river pollution in Bangladesh during last 40 years: potential public health and ecological risk, present policy, and future prospects toward smart water management, Heliyon 7 (2021) e06107, https://doi.org/10.1016/j.heliyon.2021.e06107.
[89] M.S. Islam, A.Q. Al-Amin, M.S.K. Sarkar, Energy crisis in Bangladesh: challenges, progress, and prospects for alternative energy resources, Util. Pol. 71 (2021) 101221, https://doi.org/10.1016/j.jup.2021.101221.
[90] World Bank, World development indicators, Retrieved from, https://databank.worldbank.org/source/world-development-indicators, 2021.
[91] K. Luk, How strict waste management in Japan alleviated its environmental impact, Earth.Org (2021) 1–6. https://earth.org/japan-waste-management/.
[92] T. Greuner, Kamikatsu in Japan is transforming into a zero-waste town, TimeOut, 03 March 2022 (2022) 1–2.
[93] Sensoneo, Global Waste Index 2022, Bratislava, Slovakia, 2022. Retrieved from, https://sensoneo.com/global-waste-index/. (Accessed 10 January 2023).
[94] World Bank, Plastic Waste: Material Flow Analysisfor Thailand, Summary Report of the east Asia and Pacific region: marine plastic series, Retrieved from, https://documents1.worldbank.org/curated/en/099515103152238081/pdf/P17099409744b50fc09e7208a58cb52ae8a.pdfon, 2022. (Accessed 12 December 2022).
[95] M.A.H. Baky, M.M. Rahman, A.K.M.S. Islam, Development of renewable energy sector in Bangladesh: current status and future potentials, Renew. Sustain. Energy Rev. 73 (2017) 1184–1197, https://doi.org/10.1016/j.rser.2017.02.047.
[96] METI, Transition roadmap for power sector, Retrieved from, https://www.meti.go.jp/policy/energy_environment/global_warming/transition/transition_finance_technology_roadmap_power_eng.pdf, 2022. (Accessed 1 September 2022).
[97] S. Bin Amin, Y. Chang, F. Khan, F. Taghizadeh-Hesary, Energy security and sustainable energy policy in Bangladesh: from the lens of 4As framework, Energy Pol. 161 (2022) 112719, https://doi.org/10.1016/j.enpol.2021.112719.
[98] X. Ding, C. Zhou, W. Zhong, P. Tang, Addressing uncertainty of environmental governance in environmentally sensitive areas in developing countries: a precise-strike and spatial-targeting adaptive governance framework, Sustainability 11 (2019) 4510, https://doi.org/10.3390/su11164510.
[99] A. Raihan, D.A. Muhtasim, S. Farhana, M.I. Pavel, O. Faruk, M. Rahman, A. Mahmood, Nexus between carbon emissions, economic growth, renewable energy use, urbanization, industrialization, technological innovation, and forest area towards achieving environmental sustainability in Bangladesh, Energy Clim. Chang. 3 (2022) 100080, https://doi.org/10.1016/j.egycc.2022.100080.
[100] K. Matsushita, Japanese forestation policies during the 20 Years following world war II, in: Precious for. - Precious Earth, InTech, 2015, pp. 1–54, https://doi.org/10.5772/61268.
[101] EPI, Environmental performance index, Retrieved from, https://epi.envirocenter.yale.edu/about-epi, 2022.
[102] J. Sachs, C. Kroll, G. Lafortune, G. Fuller, F. Woelm, Sustainable development Report 2022, Sustain. Dev. Rep. 2022 (2022) 1–9, https://doi.org/10.1017/9781009210058.
[103] A. Vatn, Environmental governance – from public to private? Ecol. Econ. 148 (2018) 170–177, https://doi.org/10.1016/j.ecolecon.2018.01.010.
[104] N.J. Bennett, T. Satterfield, Environmental governance: a practical framework to guide design, evaluation, and analysis, Conserv. Lett. 11 (2018), https://doi.org/10.1111/conl.12600.
[105] S. Xu, H. Zhu, Does green governance efficiency and green finance polices matters in sustainable environment: implications for public health, Front. Public Health 10 (2022) 1–13, https://doi.org/10.3389/fpubh.2022.861349.
[106] H. Ohta, Japan's policy on net carbon neutrality by 2050, East Asian Policy 13 (2021) 19–32, https://doi.org/10.1142/s1793930521000027.
[107] M.M. Sokołowski, S. Kurokawa, Energy justice in Japan's energy transition: pillars of just 2050 carbon neutrality, J. World Energy Law Bus. 15 (2022) 183–192, https://doi.org/10.1093/jwelb/jwac011.