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Efficiency and sustainability of the tourism industry in Latin America

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ABSTRACT

The tourism industry is economically very important. According to the World Travel Tourism Council, in 2019, the tourism industry accounted for a quarter of all new jobs created worldwide, 10.3% of all jobs, and 9.6×10^{12} USD of the global gross domestic product. This study aimed to calculate the tourism efficiency index for different Latin American countries from 2010 to 2021 using data envelopment analysis, which analyzes the relationships between input variables (including the number of employees in the tourism industry and the number of hotel-type establishments) and output variables (including tourism expenditures in other countries and public social expenditures in recreation and culture per capita). Additionally, this study aimed to identify the countries with greater tourism development and the factors that may affect the development of the tourism industry through the stochastic frontier production function. The results of the tourism efficiency index for Central America (including Costa Rica, Dominica, El Salvador, Honduras, Mexico, and Panama) and South America (including Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, and Uruguay) exhibited different trends. However, after the global health crisis, the tourism industry recovered, showing new opportunities to promote sustainability. The results of the stochastic frontier production function demonstrated that countries with higher levels of inbound and outbound tourism, contribution of tourism to the economy, natural resources, and literacy rate exhibited more efficient tourism industry, whereas countries with higher pollution levels exhibited less efficient tourism industry. The findings of this study could allow us to formulate suitable public policies to promote tourism, maintain natural resources, and diversify these sectors with more inclusive programmes that can facilitate growth and benefit vulnerable communities.

1. Introduction

Considering the landscapes and biodiversity in Latin America, the tourism industry exhibits great potential for

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emerging economies. The economic sector supports the creation of jobs, strengthens the local economy, contributes to local infrastructure development, and can help protect the natural environment and cultural assets and traditions, reducing poverty and inequality (BMZ, 2022). The effective promotion of economy can be achieved, in particular, if local and rural people can benefit from the income opportunities resulting from tourism with strategies that promote tourism successful businesses (GIZ, 2021, 2022).

The tourism industry generates multiple benefits for countries through employment (a quarter of jobs created worldwide) and accounts for 10.3% of the global labor market (WTTC, 2023). In terms of support for the economy, according to the World Travel & Tourism Council (WTTC, 2023), the tourism industry generates 9.6×10^{12} USD of the global gross domestic product (GDP) and contributes 6.8% to the total exports. It is estimated that international tourist spending increased by 3.8%, whereas national tourist spending increased by 31.4%. With respect to sustainability, emissions in the tourism industry account for 8.0%–11.0% of the global greenhouse gas (GHG) emissions, and it is projected that the GHG emissions in the tourism industry will increase to 5.3% of the total global emissions by 2030 and the emissions per tourist trip will vary between 0.001 and 9.300 t of carbon dioxide equivalent (CO_2e) (WTTC, 2021a). These data demonstrate that the outlook of the tourism industry is optimistic, exhibiting resilience and the ability to recover. Despite the difficulties and complications experienced by the tourism industry, it is expected that this industry will be strengthened during this decade and will achieve sustainability through long-term strategies and targets.

Different studies have demonstrated that tourism could provide environmental protection and resource conservation and reduce regional inequality by increasing public appreciation of the environment, promoting awareness of environmental problems, and generating new business opportunities (Lv, 2019; Subramaniam et al., 2022; Baloch et al., 2023; Liu, 2023). If planned and managed efficiently, tourism could become an ally and supportive economic force for conservation (Fadafan et al., 2018; Ahmad et al., 2022; Schönherr et al., 2023).

This study aimed to: (1) calculate the tourism efficiency index for different Latin American countries using data envelopment analysis (DEA) by analyzing the relationships between input variables (including the number of employees in the tourism industry and the number of hotel-type establishments) and output variables (including tourism expenditures in other countries and public social expenditures in recreation and culture per capita); and (2) determine the factors influencing the tourism industry for establishing strategies that could serve policymakers in promoting sustainable tourism. The results of this study could help identify strategies to enhance the tourism industry in emerging economies.

The main questions of this study were as follows: (1) which Latin American countries have achieved greater development in the tourism industry? and (2) what are the factors influencing the performance of the tourism industry? The identification of these factors could facilitate the formulation of appropriate strategies for the sustainable development of the tourism industry in Latin American countries. Additionally, novel methods can be applied to determine the efficiency and factors influencing environmental sustainability, thereby providing methodological contributions to tourism studies and providing evidence regarding elements that can positively influence efficiency and sustainability in the tourism industry through index calculation. This study allows for quantitative analysis of the tourism industry, which can support the establishment of satisfactory instruments to promote sustainability in the tourism industry of emerging economies.

To answer the research questions of this study, we used a two-stage DEA to analyze the panel data (combining time series and cross-sectional data) of 14 countries in Latin America from 2010 to 2021 to determine the tourism efficiency index and factors influencing the performance of the tourism industry. At the first stage, DEA was used to determine efficiency performance through index calculation, and at the second stage, the stochastic frontier production function was adopted to estimate the factors that determine the efficiency of resource use in the tourism industry from different perspectives, allowing us to evaluate the tourism industry by considering efficiency and sustainability.

2. Literature review

The tourism industry is closely related to sustainability through the development of alternative tourism models (ecotourism, community-based tourism, pro-poor tourism, slow tourism, green tourism, heritage tourism, etc.) that aim to improve livelihoods, increase local economic growth, alleviate poverty, protect natural environments and resources and wildlife, and balance the social, economic, and environmental targets of the tourism industry.

Efficiency and sustainability are closely related because efficiency contributes to reducing environmental

impacts, which are elements that constitute the sustainability concept. Moreover, better allocation and management of natural resources could lead to sustainability by simultaneously achieving income generation, pollution reduction, and social development promotion, demonstrating the importance of analyzing efficiency and sustainability for determining new strategies to promote suitable policies (Damania et al., 2023).

2.1. Tourism efficiency

Tourism efficiency has been analyzed as an indicator to describe the form in which resources are used and possibilities for achieving sustainability, considering that efficiency improvement promotes transformation of the economy and sustainable development of the tourism industry (Qiao et al., 2023). Therefore, tourism efficiency can be defined as obtaining the maximum output of tourism-related resources with minimal input within a certain time frame to meet the needs of stakeholders and maximize the total surplus (Li et al., 2014).

Studies on tourism efficiency have demonstrated the importance of promoting efficiency in the tourism industry, considering that resource consumption is increasing commensurately with considerable environmental impacts (Xue et al., 2022; Zhang et al., 2022a; Zhang et al., 2023). Moreover, under a business-as-usual scenario, tourism could generate increases of 154.0% in energy consumption, 131.0% in GHG emissions, 152.0% in water consumption, and 251.0% in solid waste disposal by 2050 (UNEP, 2022). Previous researches on facilitating tourism efficiency involved eco-efficiency and technical efficiency (Castilho et al., 2021; Guo et al., 2022; Zhang et al., 2022a; Zhang et al., 2022b). Studies involving different empirical methods have indicated that countries with a larger amount of qualified labor, greater productivity of natural and cultural resources, better management processes, more sustainable tourism activities and green products, and greater adoption of technologies or innovations are more efficient and can achieve greater performance (Song and Li, 2019; Peng et al., 2021; Alinsato et al., 2022; Jabeen et al., 2023). Different quantitative techniques can be employed to support digital finance, entrepreneurial equity financing, green bonds, renewable energy, green finance, and technical innovation to improve the tourism resource allocation efficiency in the long term by increasing the demand for tourism consumption and optimizing the supply of tourism factors (Liu et al., 2021; Qin et al., 2022; Shang et al., 2023; Zeng et al., 2023). These studies demonstrated that it is important to continuously analyze and identify strategies to improve efficiency in the tourism industry because the efficiency is important to achieve sustainable development and reduce social disparities. In this study, the tourism efficiency index, which includes different variables of the tourism industry, was calculated and analyzed.

2.2. Sustainability in the tourism industry

Sustainability in tourism is defined as sustainable practices adopted and implemented by the tourism industry, with the objective of characterizing all the impacts of tourism, both positive and negative. This approach aims to minimize negative impacts and maximize positive impacts, which refer to the environmental, economic, and sociocultural aspects of tourism development, and a suitable balance must be established among these three dimensions to guarantee long-term sustainability (UNEP and UNWTO, 2005).

Hence, according to the Global Sustainable Tourism Council (2021), there are four main pillars in terms of sustainability in the tourism industry. Firstly, sustainable management refers to adopting an integrated policy-industry-community approach, namely, mainstream integral sustainable policies and practices are employed, thereby developing more sustainable tourism business models that promote competitiveness and continuous improvements and implementing more suitable measures to better manage indicators (Day, 2017; Edgell, 2020; OECD, 2021). Secondly, studies on the socioeconomic impacts of tourism have demonstrated that the tourism industry supports economic growth and notably influences society by improving the economic status of local community members. The tourism workforce is fundamental for promoting regional development and contributes to infrastructure advancement, and new employment opportunities and businesses for a substantial segment of people, and for decreasing poverty and inequality levels, especially in developing countries (Kamanga and Njoloma, 2019; Kozhokulov et al., 2019; Kronenberg and Fuchs, 2021; Jehan et al., 2022). Thirdly, cultural impacts require a sustainable approach that offers a new perspective, as it places cultural heritage and local communities at the center of decision-making processes. It is important to increase awareness of the value of cultural resources to develop synergies between tourism and culture, enhance the community capacity, encourage partnership among locals and ownership of tourism projects, and provide space for negotiating with different stakeholders (European Commission, 2019; Moayerian et al., 2022; Wu and Lin, 2022). Lastly, the environmental impacts of tourism indicate that the government should formulate effective measures to implement appropriate strategies for sustaining tourism and trade to address environmental problems, considering that the main negative impacts are water

pollution, impaired health of wild animals, biodiversity loss, waste generation, damage to ecosystems, etc. For these reasons, tourism initiatives require the development of impact assessments to evaluate, monitor, and prevent impacts for achieving sustainable tourism management (Matias et al., 2022; Zhu et al., 2022). The relationship between sustainability and competitiveness was analyzed by Wang et al. (2022), who determined that resources, market, environment, society, and economy represent competitive advantages and homogenization is fundamental for promoting sustainability and competitiveness within the tourism industry. Studies mentioned above have indicated the importance of addressing sustainability issues in the tourism industry to achieve development and environmental protection. Therefore, in this study, different variables were considered to analyze sustainability in the tourism industry of emerging economies.

2.3. Data envelopment analysis (DEA) in the tourism industry

DEA has been applied in the tourism industry from different perspectives. For example, Mohammed et al. (2015) analyzed the topics and methodologies generally applied in tourism research. Huang (2018) measured the integrated and divisional performance levels within the tourism supply chain in China, thereby developing a measure that can be used to assess the efficiencies of various divisions within the tourism supply chain simultaneously. Huang et al. (2022) measured the overall, production, and service efficiencies of forest parks in different provinces of China. Wu and Li (2022) constructed a model to assess the performance of cultural tourism for various tourist destinations in Asia through DEA, thus determining that the value of cultural resources is vital for developing synergies between tourism and culture. Medina et al. (2022) analyzed the relationships among efficiency, innovation, and seasonality in Spanish coastal areas and found that seasonality intensity influences efficiency and innovation can offset possible decreases in efficiency. Fernandes et al. (2022) explored the relationship between air transport and tourism in Brazil and reported that the tourism performance in Brazil has deteriorated relative to its efficiency because Brazil has not learned how to utilize its competitive advantages in tourism and has failed to materialize potential jobs and enterprises in the tourism industry. With the use of the super-efficiency slack-based measure model, Cheng et al. (2023) examined the evolution of the ecological efficiency of tourism in the Hanjiang River Basin of China and determined that the distribution of tourism ecological efficiency shows obvious spatial clustering and dependence characteristics, with significant low-level homogenization phenomena. These studies all demonstrate the importance of DEA in tourism research and its application in other regions (e.g., Latin America), as well as the potential for integrating efficiency and sustainability assessments to advance tourism development.

2.4. Stochastic frontier production function in tourism research

Regarding the application of the stochastic frontier production function in the tourism industry, Chen (2007) analyzed the cost efficiency of the international tourist hotel industry in Taiwan of China and found that operation type significantly affects the hotel efficiency. Zhang et al. (2020) examined the effects of tourism specialization and market competition on the efficiency of the hotel industry using the stochastic frontier production function and determined that tourism development, represented by a high level of tourism specialization at a given destination, does not guarantee the high efficiency level of the hotel industry. Liu and Tsai (2021) assessed the changes of productivity in the hotel industry of China using the stochastic frontier production function and identified the improvements of productivity. These studies have demonstrated that the stochastic frontier production function has been applied mainly in the hotel industry, whereas in this study, the stochastic frontier production function was used from the integral perspective of the tourism industry, which is a novel approach.

The efficiency and sustainability of the tourism industry must be simultaneously evaluated via different quantitative models and techniques. Considering the limitations of related studies, there is a gap in this area, especially for developing countries in Latin America, where the tourism industry exhibits high potential to reduce poverty and inequality and diversify the economy within the context of energy transition.

3. Methods and data sources

In this study, a two-stage DEA was used to calculate the tourism efficiency index. An empirical model was then defined on the basis of the stochastic frontier production function. Moreover, in this section, the variables and data sources used at the two stages are explained.

3.1. Tourism efficiency index based on DEA

To calculate the tourism efficiency index, we created clusters by income level and country according to the geographical location of each variable and the population per unit. The tourism efficiency index can be calculated via the nonparametric dynamic DEA technique (with a constant return-to-scale input orientation), accounting for the intertemporality of the series of each country according to the classification of the dendrograms for the group of countries and the input variables (i.e., the number of employees in the tourism industry (10^3 persons) and the number of hotel-type establishments) and output variables (i.e., tourism expenditures in other countries (10^6 USD) and public social expenditures in recreation and culture per capita (USD)). The structural form of DEA relies on a constant return-to-scale input orientation and conforms with the following conditions:

$$\text{Max}_z = \sum_{j=1}^{J} u_{jm} y_{jm'}, \tag{1}$$

$$\sum_{i=1}^{I} v_{im} x_{im} = 1, \tag{2}$$

$$\sum_{j=1}^{J} u_{jm} y_{jn} - \sum_{i=1}^{I} v_{im} x_{in} \le 0, \tag{3}$$

$$v_{jm} x_{im} \ge 0 \ (i = 1, 2, ..., I; j = 1, 2, ..., J), \tag{4}$$

where Max_z is the functional form that determines technical efficiency of each country; J is the total outputs considered; j is the output generated by the unit of analysis; u_{jm} is the weight assigned to output variable; $y_{jm'}$ is the output variable; I is the total inputs considered; i is the input required by the unit of analysis; v_{im} is the weight assigned to input variable; x_{im} is the input variable; y_{jn} is the result generation rate; x_{in} is the production factor utilization rate; and v_{jm} is the restriction imposed on output to allow for variable returns to scale

3.2. Empirical model

Following the works of Behr (2015), Akpaeti and Umoh (2015), and Pardo Martíez and Cotte Poveda (2022), we used the stochastic frontier production function to estimate the efficiency of resource use in the tourism industry of specific Latin American countries, and this function can be expressed as follows:

$$\ln Y_t = \beta_0 + \beta_j \ln X_{ij} + V_i + U_i \ (t = 1, 2, ..., T), \tag{5}$$

where Y_t is the tourism efficiency index generated by DEA; β_0 is a constant; β_j is the coefficient for each variable; X_{ij} is a vector of variables that explain the determinants of the tourism industry for Models 1–14; V_i is the idiosyncratic error; U_i is a panel-level effect that varies over time; t is the first year during the study period; and T is the last year during the study period. Notably, Equation 5 requires the functional form of a process that captures inefficiencies. On the basis of the economic theory of production functions, in this study, we used a Cobb–Douglas-type technique to capture inefficiencies.

3.3. Data sources

We obtained annual data from the statistical databases of World Tourism Organization (UNWTO, 2023) and the United Nations Economic Commission for Latin America and the Caribbean (ECLAC, 2023a) for 14 Latin American countries from 2010 to 2021, including Argentina, Brazil, Chile, Colombia, Costa Rica, Dominica, Ecuador, El Salvador, Honduras, Mexico, Panama, Paraguay, Peru, and Uruguay. The main criteria for selecting variables, countries, and study period for the analysis were the availability and quality of the data. Moreover, in order to calculate and apply the quantitative techniques considered in this study, we used the last version of STATA 18 (StataCorp LLC, Texas, the USA). Table 1 details the characteristics of the variables used in this study.

In order to analyze sustainability, we divided the variables into the following categories according to the availability of data for each country: (1) economic variables (including inbound tourism, outbound tourism, and contribution of tourism to the economy); (2) natural resources variables (including mangroves area, terrestrial biodiversity, marine biodiversity, freshwater biodiversity, forest area, land area covered by forests, and area of forest plantations); (3) pollution variables (including GHG emissions per capita and CO_2 emissions per capita); and (4) social variables (including literacy rate, public social expenditure in education, public social expenditure in health, and public social expenditure in environmental protection). Table 2 provides the variables of each model and theoretical support for selection.

Table 1
Variables used in this study and their sources.

Variable	Definition	Source
Employment in the tourism industry (10^3 persons)	Number of employees in the tourism industry	UNWTO
Establishments in the tourism industry	Number of hotel-type establishments	UNWTO
Tourism expenditure (10^6 USD)	Tourism expenditure in other countries	UNWTO
Public social expenditure (USD per capita)	Public social expenditure in recreation and culture per capita	ECLAC
Inbound tourism (10^3 persons)	Total arrivals	UNWTO
Outbound tourism (10^3 persons)	Total departures	UNWTO
Contribution of tourism to the economy (%)	Share of tourism in the GDP	UNWTO
Mangroves area (10^3 hm^2)		ECLAC
Terrestrial biodiversity (%)	Proportion of terrestrial biodiversity sites covered by protected areas	ECLAC
Marine biodiversity (%)	Proportion of marine biodiversity sites covered by protected areas	ECLAC
Freshwater biodiversity (%)	Proportion of freshwater biodiversity sites covered by protected areas	ECLAC
Forest area (10^3 hm^2)		ECLAC
Percentage of land area covered by forests (%)		ECLAC
Area of forest plantations (%)	Area of forest plantations expressed as a percentage	ECLAC
GHG emissions per capita (t CO_2e per capita)		ECLAC
CO_2 emissions per capita (t per capita)		ECLAC
Literacy rate (%)	Literacy rate of people ages 15 years old and over	ECLAC
Public social expenditure in education (USD per capita)		ECLAC
Public social expenditure in health (USD per capita)		ECLAC
Public social expenditure in environmental protection (USD per capita)		ECLAC

Note: UNWTO, World Tourism Organization; ECLAC, the United Nations Economic Commission for Latin America and the Caribbean; GPD, gross domestic product; GHG, greenhouse gas; CO_2e, carbon dioxide equivalent. Monetary variables were calculated in constant dollar units.

Table 2
Variable classification of the models.

Classification	Variable	Estimated relationship	Reference
Economic variables	Inbound tourism	+	OECD (2024)
	Outbound tourism	+	
	Contribution of tourism to the economy	+	
Natural resources variables	Mangroves area	+	WTO (2010); Tyrväinen et al. (2014, 2017); Juutinen (2017)
	Terrestrial biodiversity	+	
	Marine biodiversity	+	
	Freshwater biodiversity	+	
	Forest area	+	
	Land area covered by forests	+	
	Area of forest plantations	+	
Pollution variables	GHG emissions per capita	–	The One Planet Network (2022)
	CO_2 emissions per capita	–	
Social variables	Literacy rate	+	Schianetz and Kavanagh (2008); Badulescu et al. (2022); Pololikashvili (2022); Ar Rashid (2023)
	Public social expenditure in education	+	
	Public social expenditure in health	+	
	Public social expenditure in environmental protection	+	

Note: + and – denote positive and negative effects, respectively.

4. Results

4.1. Analysis of the tourism efficiency index

The results of the tourism efficiency index for Central America (including Costa Rica, Dominica, El Salvador, Honduras, Mexico, and Panama) and South America (including Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, and Uruguay) exhibited different trends (Figs. 1 and 2). The average values of the tourism efficiency index during the study period were 0.86 for Costa Rica, 0.97 for Dominica, 0.95 for El Salvador, 0.83 for Honduras, 0.95 for Mexico, and 0.96 for Panama (Fig. 1). Figure 1 also shows the effects of global health crisis, which occurred after 2020, on the tourism efficiency index in Central America.

For the countries considered in South America, the average value of the tourism efficiency index demonstrated high variability. The average values of the tourism efficiency index during the study period were 0.67 for Argentina, 0.97 for Brazil, 0.39 for Chile, 0.66 for Colombia, 0.63 for Ecuador, 0.09 for Paraguay, 0.63 for Peru, and 0.83 for Uruguay. These results indicated that the global health crisis affected the tourism efficiency index in South America. Similarly, recovery has been observed in 2021.

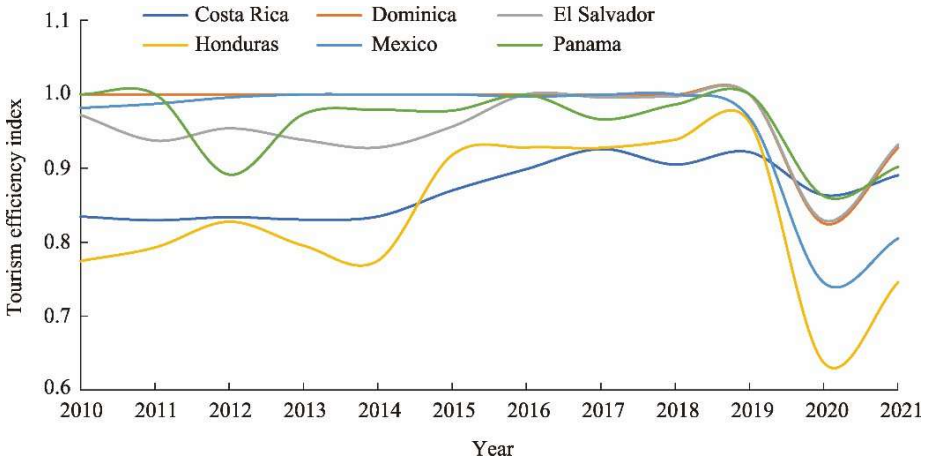

Fig. 1. Tourism efficiency index for Central America (including Costa Rica, Dominica, El Salvador, Honduras, Mexico, and Panama) during 2010–2021.

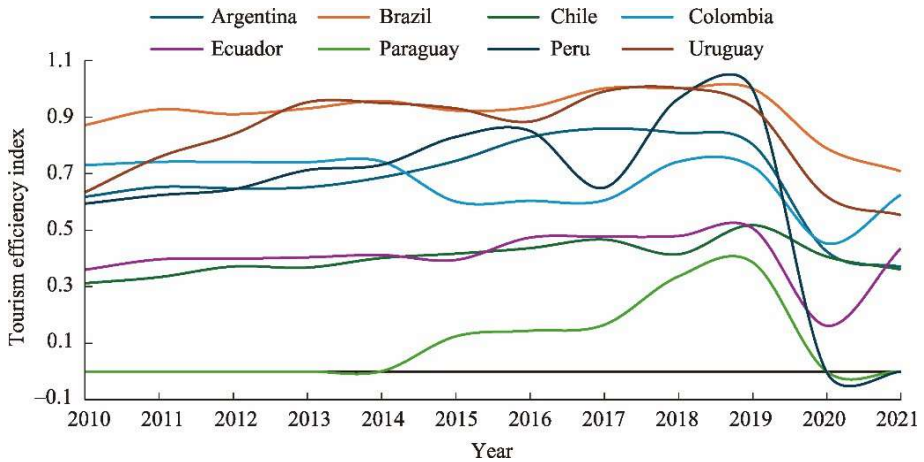

Fig. 2. Tourism efficiency index for South America (including Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, and Uruguay) during 2010–2021.

4.2. Results of the stochastic frontier production function

Table 3 provides the results of the 14 selected models, which demonstrates that in all the models, the stochastic frontier production function was positively and significantly related to sustainability, suggesting that countries with efficient use of economic, natural, and social resources are influenced by tourism efficiency.

Table 3
Results of regression models with the tourism efficiency index as the dependent variable.

Parameter	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Constant	–0.590** (0.276)	–1.093*** (0.277)	0.048 (0.228)	0.966*** (0.328)	–2.418*** (0.423)	–2.833*** (0.551)	–3.292*** (0.413)	–3.766*** (0.629)	–3.119*** (0.583)	–3.559*** (0.525)	–5.098*** (1.038)	–3.298*** (0.635)	–2.654** (1.079)	–5.002*** (1.265)
Inbound tourism	0.005 (0.012)	0.002*** (0.000)	0.012 (0.012)	0.117*** (0.552)	0.035*** (0.007)	0.034*** (0.007)	0.014* (0.008)	0.011 (0.008)	0.004 (0.008)	0.003 (0.008)	0.001 (0.007)	0.003 (0.008)	0.003 (0.008)	0.002 (0.010)
Outbound tourism	0.181*** (0.022)	0.406*** (0.041)	0.148*** (0.024)	0.243*** (0.029)	0.197*** (0.017)	0.142*** (0.027)	0.217*** (0.030)	0.215*** (0.029)	0.190*** (0.049)	0.173*** (0.052)	0.137*** (0.032)	0.169*** (0.033)	0.160*** (0.032)	0.139*** (0.034)
Contribution of tourism to the economy	0.074* (0.038)	0.292*** (0.051)	0.120** (0.039)	0.115*** (0.035)	0.115*** (0.030)	0.175*** (0.035)	0.124*** (0.037)	0.135*** (0.038)	0.075 (0.052)	0.064 (0.052)	0.066* (0.049)	0.081* (0.050)	0.090** (0.050)	0.064 (0.050)
Mangroves area		0.069*** (0.019)	0.000** (0.000)	0.052*** (0.014)	0.000*** (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000* (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Terrestrial biodiversity			0.006*** (0.001)	0.926*** (0.079)	0.016*** (0.001)	0.018*** (0.001)	0.015*** (0.001)	0.017*** (0.001)	0.016*** (0.002)	0.016*** (0.002)	0.017*** (0.002)	0.016*** (0.002)	0.016*** (0.003)	0.017*** (0.002)
Marine biodiversity				0.229*** (0.054)	0.321*** (0.039)	0.240*** (0.049)	0.191*** (0.048)	0.215*** (0.052)	0.296*** (0.056)	0.318*** (0.060)	0.243*** (0.059)	0.291*** (0.056)	0.307*** (0.061)	0.238*** (0.062)
Freshwater biodiversity					0.279*** (0.048)	0.472*** (0.099)	0.423*** (0.074)	0.497*** (0.102)	0.383*** (0.104)	0.464** (0.109)	0.603*** (0.134)	0.439*** (0.114)	0.352* (0.220)	0.577*** (0.194)
Forest area						0.078** (0.031)	0.029 (0.026)	0.049 (0.032)	0.050 (0.052)	0.068 (0.055)	0.105** (0.041)	0.075* (0.040)	0.065 (0.074)	0.093* (0.064)
Land area covered by forests							0.151*** (0.038)	0.160*** (0.037)	0.057 (0.071)	0.032 (0.075)				
Area of forest plantations								0.028 (0.028)	0.029 (0.034)	0.075* (0.047)	0.032 (0.029)	0.016 (0.038)	0.026 (0.091)	0.014 (0.083)
GHG emissions per capita									–0.158* (0.085)		–0.264*** (0.047)	–0.211*** (0.044)	–0.215*** (0.046)	–0.263*** (0.060)
CO_2 emissions per capita										–0.161** (0.076)				
Literacy rate											0.016** (0.007)			0.017** (0.007)
Public social expenditure in education												0.038 (0.036)		
Public social expenditure in health													0.013 (0.075)	0.000 (0.000)
Public social expenditure in environmental protection														0.001 (0.025)
σ_v	0.214	0.121	0.180	0.083	0.073	0.053	0.068	0.066	0.068	0.068	0.068	0.068	0.068	0.066
σ_u	0.002	0.001	0.059	0.001	0.108	0.132	0.090	0.093	0.001	0.000	0.001	0.001	0.000	0.000
σ^2	0.046	0.014	0.036	0.007	0.017	0.020	0.012	0.013	0.004	0.004	0.004	0.004	0.004	0.004
λ	0.011	0.015	0.331	0.018	1.476	2.473	1.318	1.409	0.016	0.100	0.014	0.014	0.012	0.013
Log likelihood	11.07	37.16	25.14	56.25	78.08	82.21	88.45	88.97	99.55	100.00	99.80	99.800	99.245	100.30

Note: σ_v is the estimate of the standard deviation of the idiosyncratic component; σ_u is the estimate of the standard deviation of technical inefficiency; σ^2 is the estimate of the total error variance; λ is the estimate of the ratio of the standard deviation of the ineffective component to the standard deviation of idiosyncratic component; Log likelihood is a test to determine the existence of a frontier; Model 1 is economic model; Model 2 is natural resources model including mangroves area; Model 3 is natural resources model including terrestrial biodiversity; Model 4 is natural resources model including marine biodiversity; Model 5 is natural resources model including freshwater biodiversity; Model 6 is natural resources model including forest area; Model 7 is natural resources model including land area covered by forests; Model 8 is natural resources model including area of forest plantations; Model 9 is pollution model including GHG emissions; Model 10 is pollution model including CO_2 emissions; Model 11 is social model including literacy rate; Model 12 is social model including the public social expenditure in education; Model 13 is social model including the public social expenditure in health; and Model 14 is social model including the public social expenditure in environmental protection. The values outside the parentheses are coefficients that determine the relationship between parameters, and the values in the parentheses are the standard errors. *** indicates significance at the $P<0.01$ level, ** indicates significance at the $P<0.05$ level, and * indicates significance at the $P<0.10$ level.

4.2.1. Economic model

The Model 1 revealed that inbound tourism, outbound tourism, and contribution of tourism to the economy were positively related with the tourism efficiency index, and there was a significant relationship between the tourism efficiency index and outbound tourism, as well as between the tourism efficiency index and contribution of tourism to the economy, indicating the importance of economic stability in promoting the tourism industry.

4.2.2. Natural resources model

Models 2–8 captured the relationships of natural resources variables with the tourism efficiency index, indicating

that countries with richer natural resources, such as mangroves, terrestrial, marine, and freshwater biodiversity, and forest resources, exhibited positive and relatively significant effects on the tourism efficiency index. This finding indicated that the tourism industry must maintain natural resources as a strategy to attract more tourists and protect natural resources as a fundamental element of the tourism industry.

4.2.3. Pollution model

Models 9–10 aimed to analyze the relationships between pollution considering emissions and the tourism efficiency index. Results indicated that higher pollution negatively influenced the tourism efficiency index, revealing the importance of reducing pollution as a strategy to promote the tourism industry.

4.2.4. Social model

Models 11–14 showed that social variables were positively related to the tourism efficiency index, highlighting the importance of education, as tourism service requires favorable customer service and education is the foundation.

The results of the 14 models indicated that achieving an adequate tourism efficiency index was necessary for realizing sustainability, demonstrating that the tourism industry was closely related to satisfactory economic and social results, the conservation of natural resources, and pollution reduction. Moreover, resource use efficiency was fundamental for achieving sustainable tourism through development, which promotes economic and social development and the conservation of natural resources.

The model results demonstrated that efficiency in the tourism industry is closely related to sustainability because the contribution of inbound tourism and outbound tourism to the GDP is key to the diversification of activities in the productivity sector. Considering that tourists seek natural landscapes and greater natural contact, natural resources are fundamental to promoting tourist destinations, whereas pollution serves as a deterrent in the tourism industry. Moreover, social variables are important for promoting high-quality tourism and guaranteeing the possibility of community inclusion.

5. Discussion

The tourism efficiency index results obtained through DEA indicated that all Latin American countries were affected by global health crisis, considering that some countries depend on international tourism for output, employment, and export revenues (IDB, 2020). The ECLAC (2020) reported that the GDP in Caribbean and Latin America could decrease by 8.0% and 1.0%, respectively, and the total employment could decrease by 7.0% in the Caribbean and 1.0% in Latin America, which conforms with the results of the tourism efficiency index in this study.

However, after global health crisis, new opportunities for Latin American tourism were generated, especially to promote sustainable and regenerative destinations due to the extraordinary richness of natural heritage in Latin American countries, thus preventing negative environmental impacts. To help mitigate and adapt to climate change, restoring and improving natural and cultural heritage and improving the well-being of citizens in rural communities, including indigenous peoples and citizens of African descent, are important, as this would support economic growth and diversification, generate high-quality jobs, enhance the business sector, and create social revenues, especially in local communities (CAF, 2023).

Another important result is that the 14 Latin American countries demonstrated improvements in the tourism efficiency index during the study period (except during the global health crisis period). It has been acknowledged that the tourism industry in Latin America provides a favorable strategy for diversifying economy, promoting development, and improving travel and tourism competitiveness. However, in order to promote the efficiency and competitiveness of the tourism industry, the following activities need to be carried out: alliances between the public and private sectors, promoting the inclusion and survival of business companies (especially small- and medium-sized enterprises), and encouraging community and rural activities within tourism activities (World Economic Forum, 2020).

These findings suggest that Latin American programmes must continue to promote adequate policies that allow sustainable growth of the tourism industry for optimizing the use of environmental resources, protect natural heritage and biodiversity, respect the sociocultural authenticity of host communities, and ensure viable, long-term economic operations that encourage employment and facilitate poverty alleviation (UNEP and UNWTO, 2005; OECD, 2017).

Moreover, the results of the tourism efficiency index revealed that countries with low values exhibit different challenges and alternatives for improving performance (Saner and Filadoro, 2019; Khan et al., 2020b; ECLAC,

2022). Strategies to promote sustainable tourism should not be free-standing efforts but should be incorporated into annual national development plans and should engage different stakeholders from all sectors, particularly for local communities at existing or potential tourism locations (ECLAC, 2023b).

According to the stochastic frontier production function, the relationship between the tourism efficiency index and economic variables indicated that promoting tourism flows contributes to improvements in economic growth, which agrees with the findings of Rasool et al. (2021) that the tourism industry could provide greater economic growth, generating development with multiple advantages. Importantly, the public sector and stakeholders must design and promote policies that increase inbound tourism and increase average spending per tourist as key elements to guarantee the contribution of the tourism industry to economy and close any development gaps in rural areas or communities with natural heritage, especially in emerging and transitional economies.

The positive relationship between the tourism efficiency index and the presence of natural resources, such as mangroves, biodiversity, and forest areas, demonstrated that strengthening and improving tourism are necessary to maintain and preserve natural heritage. This relationship has been demonstrated in different studies, indicating that natural resources contribute to tourism development (Khan et al., 2020a), and constitute an important element of tourism assets and determine the shape and level of tourist destination attractiveness (Marczak and Borzyszkowski, 2020).

In contrast, pollution, measured by GHG and CO_2 emissions, negatively affected the tourism efficiency index, indicating that countries must find ways to decrease emissions or pollution as a strategy to promote the tourism industry, considering that tourism is responsible for approximately 8.0% of the global carbon emissions (Lenzen et al., 2018). These findings revealed that the tourism industry should promote emission and pollution reduction efforts and sustain a low-carbon economy by adopting processes to promote the adoption of green and cleaner technology to achieve carbon neutrality (Ghosh, 2022; Yang et al., 2022).

In terms of social variables, this study revealed a positive relationship between social variables and the tourism efficiency index, indicating that tourism development is closely related to improved social conditions and enhanced social progress, agreeing with the findings of the WTTC (2021b), which determined that the main social outcomes of global tourism are as follows: the tourism industry is one of the most diverse sectors globally, supports and improves the livelihoods of hundreds of millions of people and their respective communities worldwide, and is one of the sectors that is the leading driver of job creation worldwide, helps support local businesses, and fosters entrepreneurship and new business ventures.

The findings of this study are important for promoting sustainability and efficiency in the tourism industry in Latin America, considering that this region exhibits more advantages through the cross-cutting nature of tourism for promoting local development (ECLAC, 2023c): diversifying activities, developing sustainable energy, using the Internet for production, protecting ecosystems, conducting territorial planning, achieving efficient mobility, optimizing agriculture by strengthening its participation in the touristic value chain, favoring responsible tourism with sustainability, facilitating social inclusion, reducing poverty, and diversifying economy, thereby creating new jobs and entrepreneur opportunities to achieve decarbonization of the tourism industry. Tourism in Latin America and the Caribbean offers opportunities to better understand that the tourist destinations are not only creators of wealth and welfare but also communicators of socio-economic and productive development, which have a positive impact on the environment and contribute to climate change mitigation and adaptation. In the coming decades, Latin America must leverage its notable natural potential to become a global benchmark for regenerative tourism, which could help drive economic growth, create high-quality jobs, strengthen the business fabric, and generate social revenues, especially in local communities (Fernández, 2023).

The main limitation of this study is the need to identify adequate variables and databases related to the research of the tourism industry, for which it is important to generate databases that could be employed to determine trends in the tourism industry, especially in emerging economies. Research on the impact of tourism sustainability, the relationship between efficiency and sustainable tourism, and the application of policies in various countries remains important.

6. Conclusions

In this study, efficiency and sustainability in the tourism industry were analyzed via DEA and the stochastic frontier production function. The results of DEA revealed that the tourism efficiency index values for Central America and South America exhibited different trends. However, after the global health crisis, the tourism industry recovered with new opportunities to promote sustainability. Focusing on the results of the stochastic frontier

production function, the variables used in this study were significantly related to sustainability, suggesting that countries where economic, natural, and social resources are utilized efficiently are influenced by tourism efficiency. The tourism efficiency index was positively related to the inbound tourism, outbound tourism, contribution of tourism to the economy, mangroves area, terrestrial biodiversity, marine biodiversity, freshwater biodiversity, forest area, land area covered by forests, and area of forest plantations. The tourism efficiency index was closely related to positive behavior in regard to the use of economic and natural resources, whereas higher pollution negatively influenced the tourism efficiency index. Literacy rate, public social expenditure in education, public social expenditure in health, and public social expenditure in environmental protection all positively affected the tourism efficiency index. The findings of this study demonstrated the importance of promoting efficiency and sustainability in the tourism industry of Latin America as a strategy for facilitating economic growth, protecting environmental resources, and improving social performance, which are fundamental for protecting natural heritage, generating new opportunities, and diversifying economy of the region.

Authorship contribution statement

Clara Inés PARDO MARTÍNEZ: conceptualization, formal analysis, writing - review & editing, and project administration; and Alexander COTTE POVEDA: formal analysis, investigation, writing - review & editing, and methodology. All authors approved the manuscript.

Declaration of conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

Ahmad, N., Youjin, L., Hdia, M., 2022. The role of innovation and tourism in sustainability: Why is environment-friendly tourism necessary for entrepreneurship? J. Clean Prod. 379(2), 134799, doi: 10.1016/j.jclepro.2022.134799.

Akpaeti, A.J., Umoh, G.S., 2015. Conflict, technical efficiency of resource poor farmers: A stochastic frontier analysis. Russian Agricultural Sciences. 41, 299–304.

Alinsato, A.S., Bassongui, N., Wondeu, F.N., 2022. Comparative countries' tourism technical efficiency assessment: A stochastic output distance function approach. Sci. Afr. 15, e01096, doi: 10.1016/j.sciaf.2022.e01096.

Ar Rashid, H., 2023. The Role of Education in the Tourism Sector. [2023-11-18]. https://limbd.org/the-role-of-education-in-the-tourism-sector/#:~:text=In%20conclusion%2C%20education%20is%20the,the%20ever%2Devolving%20industry%20landscape.

Badulescu, D., Simut, R., Simut, C., et al., 2022. Tourism at the crossroads between well-being, public health and the environment: Panel data evidence from the European Union. Int. J. Environ. Res. Public Health. 19(19), 12066, doi: 10.3390/ijerph191912066.

Baloch, Q.B., Shah, S.N., Iqbal, N., et al., 2023. Impact of tourism development upon environmental sustainability: A suggested framework for sustainable ecotourism. Environ. Sci. Pollut. Res. 30(3), 5917–5930.

Behr, A., 2015. Production and Efficiency Analysis with R (1st ed.). Berlin: Springer.

BMZ (Federal Ministry for Economic Cooperation and Development), 2022. An Opportunity for Sustainable Development. [2023-11-17]. https://www.bmz.de/en/issues/tourism#:~:text=It%20creates%20jobs%2C%20strengthens%20the,to%20reduce%20poverty%20and%20inequality.&anc=id_119280_119280.

CAF (Development Bank of Latin America and the Caribbean), 2023. Latin America's New Voice in Global Tourism. [2023-11-22]. https://www.caf.com/en/knowledge/views/2023/01/latin-americas-new-voice-in-global-tourism/.

Castilho, D., Fuinhas, J.A., Marques, A.C., 2021. The impacts of the tourism sector on the eco-efficiency of the Latin American and Caribbean countries. Socio-Econo. Plan. Sci. 78, 101089, doi: 10.1016/j.seps.2021.101089.

Chen, C.F., 2007. Applying the stochastic frontier approach to measure hotel managerial efficiency in Taiwan. Tourism Manage. 28(3), 696–702.

Cheng, Y.F., Zhu, K., Zhou, Q., et al., 2023. Tourism ecological efficiency and sustainable development in the Hanjiang River Basin: A super-efficiency slacks-based measure model study. Sustainability. 15(7), 6159, doi: 10.3390/su15076159.

Damania, R., Polasky, S., Ruckelshaus, M., et al., 2023. Nature's Frontiers: Achieving Sustainability, Efficiency, and Prosperity with Natural Capital. In: World Bank Group. Washington, the USA.

Day, J., 2017. An Integrated Systems Approach to Managing Tourism Growth: A Destination Marketing Organization Perspective. [2023-11-16]. https://www.purdue.edu/colombia/partnerships/orinoquia/docs/3241%20An%20Integrated%20Systems%20Approach%20to%20Managing%20Tourism%20Growth.pdf.

ECLAC (United Nations Economic Comission for Latin America and the Caribbean), 2020. The Impact of the COVID-19 Pandemic on the Tourism Sector in Latin America and the Caribbean, and Options for a Sustainable and Resilient Recovery. [2023-11-21]. https://www.cepal.org/en/publications/46502-impact-covid-19-pandemic-tourism-sector-latin-america-and-caribbean-and-options.

ECLAC, 2022. Towards Transformation of the Development Model in Latin America and the Caribbean: Production, Inclusion and Sustainability. [2023-11-20]. https://www.cepal.org/en/publications/48305-towards-transformation-development-model-latin-america-and-caribbean-production.

ECLAC, 2023a. Statistical Databases and Publications. [2023-11-13]. https://statistics.cepal.org/portal/cepalstat/index.html?lang=en.

ECLAC, 2023b. Halfway to 2030 in Latin America and the Caribbean: Progress and Recommendations for Acceleration. [2023-11-14]. https://www.cepal.org/en/publications/48826-halfway-2030-latin-america-and-caribbean-progress-and-recommendations.

ECLAC, 2023c. Sustainable Tourism. [2023-08-13]. https://biblioguias.cepal.org/c.php?g=1041479&p=7670186.

Edgell, D.L., 2020. Managing Sustainable Tourism. A Legacy for the Future (3rd ed.). London: Routledge.

European Commission, 2019. Sustainable Cultural Tourism. [2023-08-22]. https://culture.ec.europa.eu/cultural-heritage/cultural-heritage-in-eu-policies/sustainable-cultural-tourism.

Fadafan, F.K., Danehkar, A., Pourebrahim, S., 2018. Developing a non-compensatory approach to identify suitable zones for intensive tourism in an environmentally sensitive landscape. Ecol. Indic. 87, 152–166.

Fernandes, V.A., Rodrigues, R.R., Fernandes, E., 2022. A dynamic analysis of air transport and tourism in Brazil. J. Air Transp. Manag. 105, 102297, doi: 10.1016/j.jairtraman.2022.102297.

Fernández, E.R., 2023. Latin America's New Voice in Global Tourism. [2023-08-28]. https://www.caf.com/en/knowledge/views/2023/01/latin-americas-new-voice-in-global-tourism/.

Ghosh, S., 2022. Effects of tourism on carbon dioxide emissions, a panel causality analysis with new data sets. Environ. Dev. Sustain. 24(3), 3884–3906.

GIZ (German Society for International Cooperation), 2021. Inclusion and Tourism. Analysis and Practical Approaches for Development Cooperation Projects. [2023-11-15]. https://www.giz.de/de/downloads/giz2021-en-inclusion-tourism.pdf.

GIZ, 2022. Adaptation to Climate Change in the Tourism Sector. [2023-08-18]. https://www.giz.de/en/worldwide/66805.html.

Global Sustainable Tourism Council, 2021. GSTC Criteria Overview. [2023-10-28]. https://www.gstcouncil.org/gstc-criteria/.

Guo, L.J., Li, P.Z., Zhang, J.H., et al., 2022. Do socio-economic factors matter? A comprehensive evaluation of tourism eco-efficiency determinants in China based on the Geographical Detector Model. J. Environ. Manage. 320, 115812, doi: 10.1016/j.jenvman.2022.115812.

Huang, C.W., 2018. Assessing the performance of tourism supply chains by using the hybrid network data envelopment analysis model. Tourism Manage. 65, 303–316.

Huang, X.J., An, R., Yu, M.M., et al., 2022. Tourism efficiency decomposition and assessment of forest parks in China using dynamic network data envelopment analysis. J. Clean Prod. 363, 132405, doi: 10.1016/j.jclepro.2022.132405.

IDB (Intermaerican Development Bank), 2020. Extreme Outlier: The Pandemic's Unprecedented Shock to Tourism in Latin America and the Caribbean. [2023-10-19]. https://publications.iadb.org/en/extreme-outlier-pandemics-unprecedented-shock-tourism-latin-america-and-caribbean.

Jabeen, G., Wang, D., Işık, C., et al., 2023. Role of energy utilization intensity, technical development, economic openness, and foreign tourism in environmental sustainability. Gondwana Res. 127, 100–115.

Jehan, Y., Batool, M., Hayat, N., et al., 2022. Socio-economic and environmental impacts of tourism on local community in Gilgit Baltistan, Pakistan: A local community prospective. J. Knowl. Econ. 14(1), 180–199.

Juutinen, A., Kosenius, A.K., Ovaskainen, V., et al., 2017. Heterogeneous preferences for recreation-oriented management in commercial forests: The role of citizens' socioeconomic characteristics and recreational profiles. J. Environ. Plan. Manag. 60(3), 399–418.

Kamanga, G., Njoloma, E., 2019. Socioeconomic impacts of tourism on the local community. In: Gursoy, D., Nunkoo, R., (eds.). The Routledge Handbook of Tourism Impacts: Theoretical and Applied Perspectives. London: Routledge, 254–269.

Khan, A., Bibi, S., Lorenzo, A., et al., 2020a. Tourism and development in developing economies: A policy implication perspective. Sustainability. 12(4), 1618, doi: 10.3390/su12041618.

Khan, A., Yang, C.G., Hussain, J., et al., 2020b. Natural resources, tourism development, and energy-growth-CO_2 emission nexus: A simultaneity modeling analysis of BRI countries. Resour. Policy. 68, 101751, doi: 10.1016/j.resourpol.2020.101751.

Kozhokulov, S., Chen, X., Yang, D.G., et al., 2019. Assessment of tourism impact on the socio-economic spheres of the Issyk-Kul Region (Kyrgyzstan). Sustainability. 11(14), 3886, doi: 10.3390/su11143886.

Kronenberg, K., Fuchs, M., 2021. Aligning tourism's socio-economic impact with the United Nations' sustainable development goals. Tour. Manag. Perspect. 39, 100831, doi: 10.1016/j.tmp.2021.100831.

Lenzen, M., Sun, Y.Y., Faturay, F., et al., 2018. The carbon footprint of global tourism. Nat. Clim. Chang. 8(6), 522–528.

Li, R., Guo, Q., Wu, D.T., et al., 2014. Spatial characteristics of development efficiency for urban tourism in eastern China: A case study of six coastal urban agglomerations. J. Geogr. Sci. 24(6), 1175–1197.

Liu, B., Luo, C.L., Meng, F., et al., 2021. Modeling venture capital networks in hospitality and tourism entrepreneurial equity financing: An exponential random graph models approach. Int. J. Hosp. Manag. 95, 102936, doi: 10.1016/j.ijhm.2021.102936.

Liu, H.W., Tsai, H., 2021. A stochastic frontier approach to assessing total factor productivity change in China's star-rated hotel industry. J. Hosp. Tour. Res. 45(1), 109–132.

Liu, X., 2023. Tourism development, environmental regulations, and natural resource management: Evidence from G20 countries. Resour. Policy. 86(A), 104224, doi: 10.1016/j.resourpol.2023.104224.

Lv, Z.K., 2019. Deepening or lessening? The effects of tourism on regional inequality. Tourism Manage. 72, 23–26.

Marczak, M., Borzyszkowski, J., 2020. Are natural resources important elements in the national tourism policy? Examples of European countries. Journal of Environmental Management and Tourism. 11, 1200–1214.

Martinez, C.I.P., Poveda, A.C., 2022. The effects of environmental performance on competitiveness and innovation: A stochastic frontier approach for Colombia. Environment Systems and Decisions. 42(1), 51–62.

Matias, T.P., Leonel, J., Imperador, A.M., 2022. A systemic environmental impact assessment on tourism in island and coastal ecosystems. Environ. Dev. 44, 100765, doi: 10.1016/j.envdev.2022.100765.

Medina, R.M.P., Martín, J.M.M., Martínez, J.M.G., et al., 2022. Analysis of the role of innovation and efficiency in coastal destinations affected by tourism seasonality. J. Innov. Knowl. 7(1), 100163, doi: 10.1016/j.jik.2022.100163.

Moayerian, N., McGehee, N.G., Stephenson, M.O., 2022. Community cultural development: Exploring the connections between collective art making, capacity building and sustainable community-based tourism. Ann. Touris. Res. 93, 103355, doi: 10.1016/j.annals.2022.103355.

Mohammed, I., Guillet, B.D., Law, R., 2015. The contributions of economics to hospitality literature: A content analysis of hospitality and tourism journals. Int. J. Hosp. Manag. 44, 99–110.

OECD (Organisation for Economic Co-operation and Development), 2017. Policy Statement – Tourism Policies for Sustainable and Inclusive Growth. [2023-08-29]. https://www.oecd-ilibrary.org/docserver/tour-2018-2-en.pdf?expires=1728900624&id=id&accname=guest&checksum=AAFA950CE5A92954F153A342C537189F.

OECD, 2021. Managing Tourism Development for Sustainable and Inclusive Recovery. [2023-08-12]. https://www.oecd-ilibrary.org/docserver/b062f603-en.pdf?expires=1681082246&id=id&accname=guest&checksum=0EA2874BC1CD6929C55AF72AF08267CA.

OECD, 2024. Key Tourism Indicators. [2024-01-22]. https://www.oecd-ilibrary.org/economics/data/oecd-tourism-statistics/key-tourism-indicators_e5d0c450-en.

Peng, H.S., Zhang, J.H., Zhong, S., et al., 2021. Corporate governance, technical efficiency and financial performance: Evidence from Chinese listed tourism firms. J. Hosp. Tour. Manag. 48, 163–173.

Pololikashvili, Z., 2022. Promoting Sustainable Development through Tourism Education – The Role of the World Tourism Organization. [2023-08-21]. https://multilateralism.sipa.columbia.edu/news/promoting-sustainable-development-through-tourism-education-role-world-tourism- organization.

Qiao, G.T., Chen, F., Wang, N., et al., 2023. Spatio-temporal evolution analysis of the coupling situation of the economic–social–ecological system in Guangdong. Environ. Sci. Pollut. Res. 30(12), 32406–32426.

Qin, W., Li, Y., Yue, Z.G., 2022. Research on development of digital finance in improving efficiency of tourism resource allocation. Resour. Environ. Sustain. 8, 100054, doi: 10.1016/j.resenv.2022.100054.

Rasool, H., Maqbool, S., Tarique, M., 2021. The relationship between tourism and economic growth among BRICS countries: A panel cointegration analysis. Futur. Bus. J. 7(1), 1, doi: 10.1186/s43093-020-00048-3.

Saner, R., Yiu, L., Filadoro, M., 2019. Tourism development in least developed countries: Challenges and opportunities. In: Angelo, A.C., (ed.). Handbook of Research on Global Hospitality and Tourism Management. Hershey: IGI Global, 94–120.

Schianetz, K., Kavanagh, L., 2008. Sustainability indicators for tourism destinations: A complex adaptive systems approach using systemic indicator systems. J. Sustain. Tour. 16(6), 601–628.

Schönherr, S., Peters, M., Kuščer, K., 2023. Sustainable tourism policies: From crisis-related awareness to agendas towards measures. J. Destin. Mark. Manag. 27, 100762, doi: 10.1016/j.jdmm.2023.100762.

Shang, Y.F., Zhu, L.R., Qian, F.B., et al., 2023. Role of green finance in renewable energy development in the tourism sector. Renew. Energy. 206, 890–896.

Song, M.L., Li, H., 2019. Estimating the efficiency of a sustainable Chinese tourism industry using bootstrap technology rectification. Technol. Forecast. Soc. Chang. 143, 45–54.

Subramaniam, Y., Masron, T.A., Loganathan, N., 2022. Tourism and income inequality. Journal of Business and Socio-economic Development. 2(2), 181–194.

The One Planet Network, 2022. Tourism Climate Action. Climate Change & Tourism. [2023-08-17]. https://www.oneplanetnetwork.org/programmes/sustainable-tourism/glasgow-declaration/climatechange-tourism.

Tyrväinen, L., Mäntymaa, E., Ovaskainen, V., 2014. Demand for enhanced forest amenities in private lands: The case of Ruka-Kuusamo tourism area Finland. Forest Policy Econ. 47, 4–13.

Tyrväinen, L., Silvennoinen, H., Hallikainen, V., 2017. Effect of the season and forest management on the visual quality of the nature-based tourism environment: A case from Finnish Lapland. Scand. J. Forest Res. 32(4), 349–359.

UNEP (United Nations Environment Program), UNWTO (World Tourism Organization), 2005. Making Tourism More Sustainable – A Guide for Policy Makers. [2023-11-13]. https://www.e-unwto.org/doi/book/10.18111/9789284408214.

UNEP, 2022. Tourism. [2023-11-13]. https://www.unep.org/explore-topics/resource-efficiency/what-we-do/responsible-industry/tourism.

UNWTO, 2023. Tourism Statistics Database. [2023-11-13]. https://www.unwto.org/tourism-statistics/tourism-statistics-database.

Wang, W., Wang, S.Q., Li, Y.S., et al., 2022. Assessing the sustainability and competitiveness of tourism economies in China's Chengdu-Chongqing metropolitan area. Environ. Sci. Pollut. Res. 29(44), 66960–66978.

World Economic Forum, 2020. Latin America's Tourism Industry Must Address Long-Standing Shortfalls to Bounce Back after COVID-19. [2023-09-21]. https://www.weforum.org/press/2020/07/latin-america-s-tourism-industry-must-address-long-standing-shortfalls-to-bounce-back-after-covid-19/.

WTO (World Trade Organization), 2010. Tourism and Biodiversity – Achieving Common Goals Towards Sustainability. [2023-08-26]. https://www.e-unwto.org/doi/book/10.18111/9789284413713.

WTTC (World Travel & Tourism Council), 2021a. A Net Zero Roadmap for Travel & Tourism Proposing a New Target Framework for the Travel & Tourism Sector. [2023-11-13]. https://www.unep.org/events/publication-launch/net-zero-roadmap-travel-and-tourism-proposing-new-target-framework-travel.

WTTC, 2021b. Travel & Tourism. As a Catalyst for Social Impact. [2024-03-23]. https://researchhub.wttc.org/product/travel-and-tourism-as-a-catalyst-for-social-impact.

WTTC, 2023. Travel & Tourism. Economic Impact 2023 Report. [2023-11-11]. https://uploads-ssl.webflow.com/6329bc97af73223b575983ac/64e6244d08528e654e406de6_EIR2023-Global-Trends-compressed%20(1).pdf.

Wu, Y.C., Lin, S.W., 2022. Efficiency evaluation of Asia's cultural tourism using a dynamic DEA approach. Socio-Econ. Plan. Sci. 84, 101426, doi: 10.1016/j.seps.2022.101426.

Xue, D., Li, X.Z., Ahmad, F., et al., 2022. Exploring tourism efficiency and its drivers to understand the backwardness of the tourism industry in Gansu, China. Int. J. Environ. Res. Public Health. 19(18), 11574, doi: 10.3390/ijerph191811574.

Yang, S.Y., Hao, Q., Wang, Y.C., et al., 2022. Impact of the participation of the tourism sector on carbon emission reduction in the tourism industry. Sustainability. 14(23), 15570, doi: 10.3390/su142315570.

Zeng, H.L., Chau, K.Y., Waqas, M., 2023. Does green finance and renewable energy promote tourism for sustainable development: Empirical evidence from China. Renew. Energy. 207, 660–671.

Zhang, D.P., Tu, J.H., Zhou, L.X., et al., 2020. Higher tourism specialization, better hotel industry efficiency? Int. J. Hosp. Manag. 87, 102509, doi: 10.1016/j.ijhm.2020.102509.

Zhang, H., Duan, Y., Wang, H., et al., 2022a. An empirical analysis of tourism eco-efficiency in ecological protection priority areas based on the DPSIR-SBM model: A case study of the Yellow River Basin, China. Ecol. Inform. 70, 101720, doi: 10.1016/j.ecoinf.2022.101720.

Zhang, L.J., Marzuki, A., Liao, Z.J., 2023. The coordination pattern of tourism efficiency and development level in Guangdong Province under high-quality development. Hum. Soc. Sci. Commun. 10(1), 796, doi: 10.1057/s41599-023-02314-5.

Zhang, W., Zhan, Y., Yin, R.Y., et al., 2022b. The tourism eco-efficiency measurement and its influencing factors in the Yellow River Basin. Sustainability. 14(23), 15654, doi: 10.3390/ su142315654.

Zhu, S.D., Luo, Y.T., Aziz, N., et al., 2022. Environmental impact of the tourism industry in China: Analyses based on multiple environmental factors using novel Quantile Autoregressive Distributed Lag model. Ekon. Istraz. 35(1), 3663–3689.