Sustainability Assessment of Tourism Destinations from the Lens of Green Digital Transformations

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Abstract
The rapid expansion of tourist destinations has important environmental, climate change, and socioeconomic impacts on countries. The main objectives of the paper are: to analyze sustainable tourism concepts, indicators, and frameworks of sustainability assessment in tourism; to develop a framework for sustainable tourism assessment of tourist destinations; to apply a developed framework for sustainability assessment of tourism destinations in Visegrad countries (Czech Republic, Hungary, Poland, and Slovakia) from the lens of green, digital transformations and boosting social-economic resilience. These are crucial policy pillars due to experiences during the COVID-19 pandemic. The main methods and data applied: several MCDM tools were applied to rank Visegrad countries on the progress achieved in sustainable tourism development. The data on indicators of the EU Tourism Dashboard were applied. The results of the ranking indicated that the best-performing country in terms of sustainable tourism development was Poland, following Hungary, the Czech Republic, and Slovakia. The main reason for this was the best results in digitalization and social-economic resilience shown by Poland and Hungary. The main policy implications for these countries are linked to the enhancement of environmental impact mitigation policies in tourism. The main contribution of this paper is a sustainability assessment of tourism destinations in Visegrad countries based on policy priorities and the newest available data by applying advanced MCDM tools.

1. Introduction

In recent decades, the tourism sector has been developing very rapidly around the world due to increasing living standards and growth of income in developing countries such as China, India, Brazil, etc. Tourism is one of the most popular forms of leisure and entertainment for most people. The fast development of tourism industries is linked with the rapid expansion of tourist destinations, which has significant environmental, climate change, and social effects on countries. Therefore, sustainable tourism development is the main policy priority in this area as the importance of this sector is growing very fast (Wasowicz, 2021).

Though the sustainable tourism development concept is quite old there is a clear problem with sustainability assessment of tourism and creation of sustainable tourism indicators frameworks due to the complexity of the sector and lack of available data to compare world countries. Especially

important is to develop sustainable tourism indicators by taking into account current challenges like COVID-19 pandemics, the Russian-Ukrainian war, and climate change and new policy priorities linked to these challenges. For instance, the Coronavirus pandemic created many economic problems (Kolková & Ključnikov, 2021) such as business bankruptcy (Civelek et al., 2023) that negatively affected the sustainability of some business services. Transportation has a large input on the tourism sector carbon footprint. Fossil fuels burning in vehicles, marine vessels, and air transport are responsible for a sizable amount of GHG emissions. Therefore, the use of renewables in transportation and endorsement of sustainable transportation options (electric vehicles, cycling, walking, public transportation, carpooling, and ride-sharing) are crucial in reducing GHG emissions from the transport sector in tourism destinations. Fossil fuels need to be replaced by biofuels and hydrogen to ensure more sustainable travel options and GHG emission reduction. The energy-intensive operations of hotels also add to the increase of the tourism industry's carbon footprint.

However, taking into account the challenges of climate change, the priorities in sustainable tourism development should be readdressed. The adverse environmental effects of tourism on the increase of GHG emissions need to be reconsidered and taken as a priority in the development of tourism policies and strategies. In addition, the COVID-19 experience puts additional policy pressure on sustainable tourism development and new priorities like economic-social resilience, and green and digital transformation of the tourism sector are emerging (Kő et al., 2022).

European Union is a flagman in the development of sustainable development strategies for all sectors of the economy. The European Green Deal strategy was prepared to convert the EU into a modern-day, efficient, and competitive carbon-neutral economy by 2050, and to achieve decoupling of economic growth from resource consumption and pollution by taking into account social equality. European Commission implemented a new industrial strategy in 2020 aiming to support EU tourism and other industries in sustainable development by accelerating green and digital transformations (Civelek et al., 2023b) and enhancing competitiveness in the global world (European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, 2022).

Several studies analysed available sustainability assessment methods and indicators in the tourism sector (Choi, Sirakay, 2006; Schianetz et al., 2007; Zolfani et al., 2015; Agyeiwaah et al., 2017; Rasoolimanesh et al., 2020; Baloch et al., 2023) however these studies were not able to propose universal frameworks for sustainable tourism development in line with current policy priorities, like economic and social resilience to global pandemics, climate change mitigation etc. In addition, most of the studies dealing with sustainability assessment of tourism destinations and proposing indicators do not include empirical studies and comparative assessments of countries based on selected indicators (Gavurova et al. 2023).

This paper aims to overcome this gap and applies the sustainability assessment of tourism indicators framework for a comparative assessment of 4 Visegrad countries (the Czech Republic, Hungary, Poland, and Slovakia) as tourism destinations from the lens of green digital transformations by considering EU industrial policy priorities. The case study of sustainability assessment of Visegrad Group countries as tourist destinations allows us to compare similar countries sharing the same geographical location and geo-political situation as well as economic development experience in terms of sustainability of the tourism sector.

The paper is structured in the following way: Section 2 presents a literature review on sustainable tourism and sustainability assessment of the tourism sector; Section 3 introduces data and methods; Section 4 provides preliminaries and a description of a case study for comparative sustainability assessment of tourism destination for Visegrad countries and discusses results of the case study; section 5 concludes.

2. Literature review

Sustainable Tourism refers to the tourism industry and its sustainable practices. Sustainable tourism seeks to minimize negative effects while maximizing positive ones. Among the negative effects on destination tourism are economic leakage, negative environmental effects including climate change, negative impact on local communities and overcrowding. Among the positive effects on a destination are the creation of new jobs, the preservation and interpretation of cultural heritage, the conservation of flora and fauna, adaptation to climate change and the rehabilitation of the landscape.

The UN World Tourism Organisation (UNWTO) defines sustainable tourism as "that takes full account of its current and future economic, social, and environmental impacts, addressing the needs of visitors, the tourism industry, the environment, and host communities." In addition, sustainable tourism can be defined as tourism that "refers to the environmental, economic, and socio-cultural aspects of tourism development, and a suitable balance must be established between these three dimensions to guarantee its long-term sustainability" (UNWTO, 2004).

Various issues arising from the sustainable development/sustainability debate are inevitably linked to sustainable tourism (de Bruyn, Gallardo Vázquez, 2023; Meyer, 2022; Tothova et al., 2022; Shpak et al., 2022; Yi et al., 2022). The lack of a universal definition has led to different customized meanings and applications. There are different ways to approach sustainable tourism, ranging from a light of green approach, which prioritizes tourism development and visitor and operator satisfaction, to a darker green process, which emphasizes the precautionary principle and carrying capacity concept (Hunter, 1997). The adopted approach has significant implications for the implementation strategy and outcome. Fundamental characteristics of sustainable tourism are not definitive or exclusive, as they vary depending on the adopted approach.

The concept of sustainable tourism has evolved through decades, and concerns about environmental issues, such as biodiversity losses, global warming, ozone depletion, and the greenhouse effect, have been discussed. The United Nations Environment Programme (UNEP) and the World Tourism Organization (UNWTO) have explained that sustainable tourism considers the social, cultural, and economic needs of host communities while promoting tourism activities and seeks to encourage repeat visits. Therefore, the primary objective of sustainable tourism is to promote return visits while preserving the destination's social, cultural, and economic characteristics and protecting the environment.

Since the late 1980s, sustainable tourism development has rapidly expanded and received attention in tourism studies. "Sustainable tourism" term first appeared nearly a couple decades ago, and the fundamental frameworks of sustainable tourism, and environmental management were investigated and developed. Reconceptualization and critiques were published in the second decade. According to Bramwell & Lane (2011), sustainable tourism occurred as a reactive response to numerous important issues. Progressively, tourism development has been promoted by introducing sustainable tourism principles that provide for the mitigation of negative environmental impacts and the creation of economic and social benefits for the local population.

The term Ecotourism was also applied to define sustainable tourism (Rauf et al., 2015). Factors such as ecosystems, climate, seasonality, and political stability have impact on ecotourism in tourist destinations (Rauf et al., 2015).

Miller (2001) applied Delphi survey and stressed the importance of stakeholder involvement as negative perception of locals are important 'barrier to sustainability'. According to Miller (2001) locals must be convinced therefore of the benefits from tourism before any progress can be made toward a more sustainable position. 358). Retka et al. (2019) conducted an evaluation of the non-material benefits of human-ecosystem interactions, known as CES, in Brazil.

Many studies in the tourism sector assessed the climatic suitability of tourism destinations, incorporating climate change impact forecasts and the most popular approach applied for quantifying climatic resources of tourism destinations was the Tourism Climate Index (TCI) developed by

Mieczkowski (2005). The TCI was constructed with the aim to combine the main variables relevant to tourism destinations into a distinct index.

Batat and Prentovic (2014) applied a conceptual sustainability framework for tourism based on systematic thinking which is able to resolve multifaceted problems of tourism sector sustainability through intra- and intertextual analysis. This tourism advertisement data and applied technique could help various actors in tourism sector to comprehend differences in culture during promotion of sustainable tourism development in definite regions (Batat & Prentovic, 2014).

Dwyer et al (2009) recommended to apply Triple Bottom Line (TBL) method to sustainability assessment of tourism destinations to ensure that entities operating in tourism sector incorporate social, environmental and according to Zsigmond & Mura (2023) economic evidence into management and decision-making. Actors in tourism sector need to be obliged to achieve sustainability in their actions having tourist destination conformed with sustainability agenda (Zolfani et al., 2015; Simionescu et al. 2021).

Choi and Sirakay (2006) created framework of indicators to quantity community tourism development within a sustainability path. The study used a modified Delphi technique and invited a panel of 38 academic researchers working in tourism sector to discuss the main criteria and indicators of sustainability assessment of tourism. The 125 indicators were selected based on consensus of researches. The framework includes 32 political, 28 social, 25 ecological, 24 economic, 3 technological, and 13 cultural indicators dimensions. However, this set of indicators can be applied just as initial stage in developing sustainable tourism indicators at the country or region level.

Asmantaite et al (2021) performed a sustainability assessment of national parks in Lithuania by applying qualitative assessment based on economic, social, and environmental criteria and surveys of managers operating in selected national parks.

There is no single perfect set of sustainability indicators of tourism sector (Manning, 1999), there are key indicator themes commonly used across numerous studies dealing with sustainability assessment of tourism sector. However, all these indicators created by various authors in various countries are useful as starting point for development of indicators for sustainable tourism in specific country and aiming to address the priority issue for this country. The other indicators used in various studies can provide a basis for enterprises operating in tourism sector to create their specific measures to assess the current status, targets and evaluate progress achieved in approaching sustainable development goals (Agyeiwaah et al., 2017). The study by Agyeiwaah et al., 2017) analysed sustainability assessment frameworks in tourism sector and for each of the four main dimensions of sustainability, i. e. economic, environmental, social and cultural selected more than 40 themes for assessment.

Rasoolimanesh et al. (2020), analysed and evaluated 97 scientific papers dealing with sustainable tourism in terms of developed indicators importance for achieving SDGs, stakeholders involvement, good governance practices applied and the bias of the indicators. Business viability and job creation indicators were analysed as the main economic indicators of sustainable tourism development in majority of studies dealing with measures of sustainable tourism development (Butler, 1999, Swarbrooke, 1999).

Creation of new jobs by tourism sector is linked to many issues related to social sustainability and is very important indicator of sustainable tourism development (Liu &Wall, 2006; Roehl, 1999). It is necessary to assess new jobs created by tourism sector in terms of quantity and jobs quality (Agyeiwaah et al., 2017; Mura et al., 2023). Water resources and their quality as well as waste disposal were the main areas under the environmental sustainability criteria for sustainable tourism development (Gössling et al., 2012).

IT technologies and big data have significant impact on sustainable tourism development (Rahmadian et al., 2022). Using social media can improve sustainable tourism management by enabling individuals to contribute to decision-making and planning, despite slow adoption by institutions. As

they are accessible to the public, interactive, and traceable, social media also plays a role in sustainable tourism industry's development (Park, & Jang, 2013).

MURMURATION SAS (2023) has developed the Tourism Sustainable Development Index (TSDI-index) to involve tourist destinations to develop in more sustainable ways. TSDI-index allows to rank countries and provides advice for decision making to achieve sustainable tourism development. TSDI Index includes the Biodiversity Pressure(GREEN Index) and social and economic components (HUMAN Index). Together, they allow to perform a normative judgements about sustainable development of tourism destination countries and help countries to share their experience and enhance their sustainable tourism development strategies based on the best examples of other countries.

The Global Sustainable Tourism Council (GSTC) directs the GSTC Criteria, and global standards for sustainable travels and issues the international accreditation for Certification Bodies of sustainable tourism. They are divided into four categories: (A) Sustainable management; (B) Socioeconomic impacts; (C) Cultural impacts; (D) Environmental impacts. The development of the Criteria was intended to adhere to the ISEAL Alliance's standard-setting code. The ISEAL Alliance is an international organization that provides direction for implementing sustainability standards across all industries. This code is based on pertinent ISO standards. A tourism destination's contribution to the 2030 Agenda for Sustainable Development and the 17 Sustainable Development Goals will be facilitated by applying the GSTC criteria. Against each GSTC criteria, one or more of the 17 SDGs to which it furthermost closely linked are defined.

However, the compilation of indicators for sustainable tourism for all countries encounters many problems, and though the European Tourism Indicator System (ETIS) was created there is lack of data in national statistics and many indicators are assessed by using additional data from surveys and other sources (European Commission, 2013).

3. Methods and data

The main method applied in this study is comparative sustainability assessment of four Visegrad countries as tourist destinations. The two different MCDM tools were applied to rank Visegrad countries in terms of sustainability of tourism destinations to ensure sensitivity analysis. The data used for developing sustainability indicators for the Czech Republic, Hungary, Poland, and Slovakia was collected from EU Tourism Dashboard (European Commission 2023). The detailed information on methods for ranking Visegrad countries are provided bellow.

3.1 TOPSIS Method

This method is called TOPSIS (Technique for Order Preference by Similarity to Ideal Solution). The main algorithms are provided in Roszkowska (2011).

Suppose the values of each indicator are continually increasing or decreasing. It is then possible to determine the "ideal" solution that consists of the best indicator values and the "negatively ideal" solution that consists of the worst indicator values. To apply the proximity point approach, it is necessary to construct a decision matrix X.

Step 1. In order to perform a TOPSIS analysis and calculate the weights of the criteria. It is important to perform a methodology or analysis of the application of expert reviews and opinions on the given matrix's weights.

Step 2. Construct the decision matrix and determine the weight of the criteria.

$$X = (x_{IJ})$$
$$W = [w_1, w_2, \ldots, w_n]$$

where:

X – decision matrix;

W – weight vector, $x_{ij} \in \Re$, and $w_1 + w_2 + \ldots + w_n = 1$.

Criteria of the functions can be benefit functions (more is better) or cost functions (less is better).

Step 3. Calculate the normalized decision matrix. The study of normalization's influence consists of two steps: Analysis of the normalization rules I for a sequence of even pseudo-random numbers. Normalizations were performed for this sequence of numbers, and the scattering characteristics of the normalized sequences were monitored; II – By changing the normalization rules in the TOPSIS method, the results obtained are subjected to statistical analysis.

The second step is the calculation of the normalization of matrix transforms different criteria dimensions into non-dimensional. This allows creating a comparison across criteria. Various criteria are usually measured in various units, the scores in the evaluation matrix have to be transformed to a normalized scale. The normalization of values can be carried out by one of the several known standardized formulas. The normalized value nij is calculated as follows:

$$n_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$$

Step 4. Consists of the calculations. Calculations will be made in order to weigh the normalized decision matrix. The weighted normalized value vij is calculated as follows:

$$v_{ij} = w_j n_{ij} \ for \ i = 1, \ldots , m; j = 1, \ldots , n ,$$

where:

$w_j -$ the weight of the jth criteria

Step 5. Includes the analysis and calculations of a positive ideal labeled as (V^+) and a negative ideal that is labeled as (V^-) solutions. The ideal positive solution is the solution that maximizes the benefit criteria and minimizes the cost criteria, whereas the negative ideal solution maximizes the cost criteria and minimizes the benefit criteria.

$$V^+ = (v_1^+, v_2^+, \ldots, v_n^+) = \left(\left(v_{ij} | j \in I \right), \left(v_{ij} | j \in J \right) \right)$$
$$V^- = (v_1^-, v_1^-, \ldots, v_n^-) = \left(\left(v_{ij} | j \in I \right), \left(v_{ij} | j \in J \right) \right)$$

where:

I is associated with benefit criteria and J with the cost criteria, i = 1, … , m; j = 1, … , n.

Step 6. Calculate the Euclidean distance from the ideal best (V^+) solution and the anti-ideal best $(V-)$ solution. The separation measures of each alternative from the ideal best (V^+) solution and the anti-ideal (V^-) solution, respectively, are as follows:

$$D_j^+ = \sqrt{\sum_{j=1}^{n} (vij - vj^+)^2} , i = 1,2, \ldots , m$$

$$D_j^- = \sqrt{\sum_{j=1}^{n} (vij - vj^-)^2} , i = 1,2, \ldots , m$$

Step 7. Calculate the relative closeness to the positive ideal solution. The relative closeness is defined as follows:

$P_i = \frac{s_i^-}{s_i^- + s_i^+}$,

where:

$0 \leq P_i \leq 1$, i = 1,2, … , m.

Step 8. Rank the preference order.
To apply the TOPSIS method, all the steps described above should be performed and analyzed.

3.2 EDAS Method

EDAS method was firstly proposed by Keshavarz et al. (2015). In EDAS method, they used positive and negative distances from the AV for appraising alternatives and then applied the method to inventory classification. They also made a comparative analysis to indicate the validity of the proposed approach and, compared EDAS method with Simple Additive Weighting (SAW) TOPSIS, Complex Proportional Assesment (COPRAS), and VIKOR methods.

The steps of EDAS method can be summarised as Keshavarz et al. (2015):
Step 1. In the first step, criteria and alternatives of the decision problem are determined.
Step 2. Then, decision matrix X is constructed as given in Equation (1)

$$X = \left[x_{ij}\right]_{n*m} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ \vdots & \vdots & \vdots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix} \quad (1)$$

In this matrix, x_{ij} indicates the performance value of ith alternative based on j^{th} criterion.
Step 3. AV based on all criteria are determined using Equation (2)

$$AV = \left[AV_j\right]_{1*m} \quad j = 1, … , m. \quad (2)$$

Here,

$$AV_j = \frac{\sum_{i=1}^{n} x_{ij}}{n} 1; …; m. \quad (3)$$

Step 4. The PDA and the NDA matrices are calculated based on the type of the criteria.

$$PDA = \left[PDA_{ij}\right]_{n*m'} \quad (4)$$
$$NDA = \left[NDA_{ij}\right]_{n*m^*} \quad (5)$$

If criterion j is benefit criterion

$$PDA_j = \frac{max(0,(x_{ij}-AV_j))}{AV_j}; \quad (7)$$
$$NDA_j = \frac{max(0,(AV_j-x_{ij}))}{AV_j}; \quad (8)$$

If criterion j is cost criterion,

$$PDA_j = \frac{max(0,(AV_j-x_{ij}))}{AV_j}; \quad (9)$$
$$NDA_j = \frac{max(0,(x_{ij}-AV_j))}{AV_j}; \quad (10)$$

Here, PDA_{ij} and NDA_{ij} indicate the positive and negative distances of ith alternative from AV in terms of jth criterion, respectively.
Step 5. Weighted sum of PDA and NDA for all alternatives are determined by using Equations (11) and (12)

$SP_i = \sum_{i=1}^{m} w_j PDA_{ij}$ (11)

$SN_i = \sum_{i=1}^{m} w_j NDA_{ij}$ (12)

Here, *wj* indicates the weight of *j*th criterion.

Step 6. For all alternatives, SP and SN values are normalised by using Equations 13 and 14, respectively:

$NSP_i = \frac{SP_i}{max(SP_i)'}$ (13)

$NSN_i = 1 - \frac{SN_i}{max(SN_i)}$ (14)

Step 7. Appraisal score (AS) for all alternatives are calculated via Equation (15)

$As_i = \frac{1}{2}(NSP + NSN_i)$ (15)

Here, $0 \le AS_i \le 1$.

Step 8. According to the obtained ASs, alternatives are ranked in descending order. The alternative with the highest *AS* is the best one among the other alternatives.

4. Case Study

4.1 Framework for sustainability assessment of tourism destinations

In face of COVID-19 pandemics the EU developed new industrial strategy stressing the urgency to secure the green and digital transitions and surge the economic resilience of the EU industries. Seeking to address experience of COVID-19 pandemics European Commission developed the transition pathways together with the main stakeholders. The transition pathway for tourism (European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, 2022) was published in February 2022. It identifies 27 priority areas in tourism development for EU member states. This document addresses the main principles of sustainability in terms of economic, social and environmental pillars and promotes circular economy principles, carbon free environmentally friendly tourism services together enhancing digitalization and improving diversity and accessibility of tourism services. The EU Tourism Dashboard was developed by the Joint Research Centre and DG GROW and presented in 2021. The indicators framework to support the transition pathway for tourism by following-up environmental, digitalization and socio-economic resilience issues of tourism through harmonised data for European tourism destinations at the country level. Tracking the progress of tourism destinations (EU member states) over time in relation to the main policy pillars: environmental impacts, digitalisation, and socio-economic vulnerability. This framework help to assess policies and strategies in the sustainable tourism development by tracking progress achieved in indicators development in EU countries as well as to compare their indicators trends and achieved results. The indicators of the EU Tourism Dashboard (European Commission, 2023) are organised under three policy pillars: "environmental impacts", "digitalization", and 'socio-economic vulnerability" and address priority areas of sustainable tourism development in tourism destination country. The dashboard currently covers all the EU27 Member States. Indicators are provided in Table 1.

Table 1. **Sustainability indicators of tourism destination for EU member states**

Indicators	Measures	Description
Environmental impact indicators		
Air travel emission intensity	kg of CO2/passenger	It is calculated by dividing all CO_2 emissions linked to all passenger flights by the number of passengers within a year in selected country. This indicator takes into account residents

		departing to a tourist destination and tourists returning home.
Tourism GHG intensity	kg/million EUR	It is computed by dividing all GHG (CO2, and N2O, CH4, HFC, PFC, SF6, NF3) emissions in CO2 equivalent generated by the tourism related activities by of Gross Value Added of tourism sector in selected country.
Tourism energy intensity	GJ/Million EUR	It is evaluated by dividing the energy used in tourism-related economic activities by Gross Value Added of tourism sector in selected country.
Share of trips by train	%	It measures the relative importance of sustainable means of transportation in tourism destination by the share of trips taken by train in selected country
Excellent bathing waters	%	It measures the quality of bathing waters in tourist destination and is calculated as the share of sampled bathing water sites that are classified as "excellent" within a tourist destination.
Dependence on distance origins	%	It is calculated as the share of nights spent by foreign tourists arriving from distant origins. The countries of origin are considered distant if they are at a more than 2000 km distance for tourist destination.
Digitalisation indicators		
E-Commerce sales	%	It measures the share of tourism enterprises in tourist destination country having online sales.
Enterprises using social media	%	It is calculated as the percentage of tourism enterprises in tourist destination country using two or more social media means.
Personnel training on digital skills	%	It estimates the percentage of tourism enterprises in tourism destination country providing ICT training to their personnel.
Enterprises seeking ICT specialists	%	It measures the share of tourism enterprises in tourism destination country seeking ICT specialists.
Internet speed at tourism destination	Mb/s	It assesses the maximum available speed of internet connection at tourism destinations country
Accommodations listed online	%	It is calculated as the share of observed tourist accommodation rooms listed on a key online platform to the expected number of listed number of rooms in selected tourism destination country.
Socio-economic resilience indicators		
Tourism intensity	Nights spent/capita	It is evaluated by dividing the number of nights spent at tourist accommodations by the resident population of tourist destination country
Tourism seasonality	coefficient of variation	It measures the temporal concentration of tourism activity throughout the year and shows unbalanced pressure and economic activity, as well as vulnerability to demand shocks. It is calculated as the coefficient of variation (standard deviation divided by average) of nights spent at tourist accommodations per month in tourism destination country
Dependence on 3 top origin	%	It is calculated as the percentage of the nights spent from the top three countries of origin for each tourism destination

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		country in relation to the total nights spent in the tourism destination country. The top 3 origins are specific to each destination country.
Tourism diversity, index	index	It is estimated as the Shannon diversity index of the distribution of tourism accommodations across five geographical zones within a tourism destination country: cities, coastal areas, rural areas, natural or mountainous areas, and snowy mountains.
Contribution of tourism to employment	%	It is evaluated based on a statistical relationship between tourism demand and employment by applying regression analysis.
Average tourism expenditure	PPS/night spent	It measures the average economic benefit generated per night spent at the tourist destination country, showing the contribution of tourism to the economy of the destination country. The expenditures were adjusted by taking into account (Parity Purchasing Standards) PPS

Source: European Commission, 2023

The "environmental impacts" indicators cover air travel intensity, tourism GHG intensity, tourism energy intensity, share of trips by train, and excellent bathing water. The "digitalization" indicators cover e-commerce sales, Enterprise using social media, personnel training on digital skills, enterprises seeking ICT specialists, internet speed at tourism destinations and accommodations listed online. "Socio-economic vulnerability" indicators cover tourism intensity, tourism seasonality, dependence on top 3 origins, tourism diversity (index), contribution of tourism to employment and average tourism expenditure.

4.2 Results and Discussion

The results of ranking of Visegrad counties based on the sustainability of tourism destinations in 2020 and applying TOPSIS and EDAS multi-criteria decision-adding tools described in section 2 are given in Table 2.

Table 2. **Ranking Visegrad countries based on sustainability of tourist destination in 2020**

Countries	Desi-rable trend	Poland	Hun-gary	Czech Republic	Slo-vakia
Environmental impact indicators					
Air travel emission intensity, kg of CO2/passenger	Decrease	89.5	92.5	98.7	91.1
Tourism GHG intensity, kg/million EUR	Decrease	406.35	753.00	497.95	446.86
Tourism energy intensity, GJ/Million EUR	Decrease	4.12	13.4	8.55	6.11
Share of trips by train, %	Increase	6.3	6.2	6.5	10.6
Excellent bathing waters, %	Increase	70	76.8	86.7	69.0
Dependence on distance origins, %	Decrease	3.1	10.46	11.35	4.25
Ranking according environmental impact (TOPSIS)		**3**	**1**	**2**	**4**
Ranking according environmental impact (EdAS)		**1**	**4**	**3**	**2**

Digitalisation indicators					
E-commerce sales, %	Increase	40	31.9	44.6	30.8
Enterprises using social media, %	Increase	25.2	14.6	30.4	25.3
Personnel training on digital skills, %	Increase	14.5	7.6	10.9	7.5
Enterprises seeking ICT specialists, %	Increase	1.8	2.7	1.7	0.6
Internet speed at tourim destination, Mb/s	Increase	67.9	91.0	53.9	46.7
Accomodations listed online, %	Increase	43.15	37.9	3.3	-5.59
Ranking according to digitalization (TOPSIS)		**1**	**2**	**3**	**4**
Ranking according to digitalization (EdAS)		**1**	**2**	**3**	**4**
Socio-economic resilience indicators					
Tourism intensity, Nights spent/capita	Decrease	1.4	1.5	2.9	1.7
Tourism seasonality, coefficient of variation	Decrease	0.8	0.9	0.9	0.93
Dependence on 3 top origin, %	Decrease	10.1	12.4	15.6	17.57
Tourism diversity, index	Increase	0.92	0.64	0.79	0.85
Contribution of tourism to employment, %	Increase	5.05	6.87	9.68	5.58
Average tourism expenditure, PPS/night spent	Increase	65.65	93.6	63.95	59.18
Ranking according socio-economic resilience (TOPSIS)		**1**	**2**	**3**	**4**
Ranking according socio-economic resilience (EdAS)		**1**	**2**	**3**	**4**
Total ranking (TOPSIS)		**1**	**2**	**3**	**4**
Total ranking (EDAS)		**1**	**2**	**4**	**3**

Source: own results

Two different MCDM tools applied for sustainability assessment of tourism destinations provided for similar results in country franking. One can notice from information provided in Table 2, that Poland was ranked as the best performing country based on TOPSIS and EDAS tools, followed by Hungary. The best results on sustainability assessment of tourism destinations was obtained for Poland due to high ranking according to digitalization and social-economic resilience criteria. The lowest ranking for Slovakia was obtained due to low ranking obtained also for digitalization and social-economic resilience though country showed good performance on environmental impact criteria indicators.

Comparing obtained results with other sustainability assessments of tourism sector in Visegrad countries it is clear that due to different indicators and evaluation approaches applied to measure sustainability of tourism destination, the different results were obtained.

In Table 3 the summarized results of the rankings Visegrad countries based on sustainability assessment of tourist destinations in current study are provided.

Table 3**. Summarized ranking results of Visegrad countries based on sustainability of tourist destination in 2020**

	Poland		Hungary		Czech Republic		Slovakia	
	EDAS	TOPSIS	EDAS	TOPSIS	EDAS	TOPSIS	EDAS	TOPSIS
Environmental impact indicators	2	3	4	1	3	2	1	4

Digitalisation indicators	1	1	2	2	3	3	4	4
Socio-economic resilience indicators	1	1	2	2	3	3	4	4
ALL	1	1	2	2	4	3	3	4

Source: own results

Performed sustainability assessment of tourism destinations based on EDAS model showed that the best-performing country in 2020 was Poland, followed by Hungary and Slovakia. The Czech Republic has received the lowest ranking. By applying TOPSIS method, the same results were obtained for Poland and Hungary, which were ranked as the best-performing countries however, Slovakia and the Czech Republic exchanged their places in rankings.

Other studies showed that Slovakia was ranked as 4th best country, Hungary -16th, Poland -34th and Czech Republic - 40th, according to Tourism Sustainable Development Index (TSDI) in 2020. The higher TSDI shows the better performance of tourism destination country according sustainable tourism development. The Environmental dimension of sustainable tourism development is assessed by Environmental and Climate index (ECI), which is "the smaller the better". The social-economic dimensions are assessed by Health Tourism Economic index (HTEI), which "the greater the better". Therefore, Slovakia has the highest TSDI among Visegrad countries-3.64. The ECI for Slovakia was 1.06 and HTEI- 3.861. The second best country in sustainable tourism development among Visegrad countries is Hungary with TSDI of 2.38. ECI of Hungary was 2.62 and HTEI- 6.239. For Poland-TSDI -2.96, ECI -6.3 and HTEI - 6.67. For Czech Republic- TSDI -2.89, ECI - 6.83; HTEI -5.69.

The main reason for the highest ranking of sustainable tourism development of tourism destinations of Poland and Hungary Poland is due to the high position of these Visegrad 4 countries in digitalization and social-economic resilience. Other studies dealing with green tourism and digital transformations (Kyriakopoulos, 2023; Hu et al., 2023; Yekimov et al., 2022; Misso et al., 2018) also showed that digital transformations in the industry play a decisive role in the contexts of micro- and macro-economy, especially in the sectors of entrepreneurship and manufacturing including the hospitality sector. The studies (Hu et al., 2023; Yekimov et al., 2022) confirmed the idea of this paper that improving green digital technologies in the tourism industry has a positive impact on tourism growth and agile innovation maximization, providing for sustainable development of the tourism sector. Furthermore, our study shows that the delivery of digital practices of innovative -ICT systems can improve the promotion of sustainable tourism or green tourism development in selected regions and strengthen the EU position in world tourism.

5. Conclusion

Conducted literature review showed that though there are many indicators developed for sustainability assessment of tourism sector however there is big problem with data collection and harmonization of developed indicators frameworks between countries. Therefore, there are no internationally recognized system of indicators to assess sustainability of tourism sector.

The sustainability assessment of tourism needs to address the policy priorities by taking into account current challenges of sustainable tourism development like experience and consequences of COVID-19 pandemics, political instability due to Russian-Ukrainian war, climate change threats etc. Therefore for sustainability assessment of tourism the environmental impacts, digitalization and social economic resilience were defined as the main policy pillars for promoting sustainable tourism

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development in EU. Based on three main policy priorities (green, digital transformations and boosting social-economic resilience) which are crucial policy pillars due to COVID-19 pandemics experiences for sustainable tourism development in EU the comparative sustainability assessment of tourism destinations was conducted for Visegrad countries (Czech Republic, Hungary, Poland, and Slovakia).

Sustainability assessment of tourism destination countries by applying Sustainability indicators of tourism destination for EU member states showed that the best performing country is Poland, followed by Hungary based on two different MCDM applied. The main reason of this was the good results showed by Poland and Hungary in digitalization and social-economic resilience. The low performance of Slovakia on digitazliation and social-economic resilience was the main reason of the low ranking of country based on the sustainability of tourism destinations though country showed the best performance on environmental impacts among Visegrad countries. The different weights applied for different sustainability assessment criteria would provide different results. Policy makers should define their priorities in decision-making on sustainable tourism development in the country.

The conducted research has several limitations. A deep analysis of the tourism sector of Visegrad countries is necessary to define the reasons for differences among Visegrad countries. Another significant improvement area is the in-depth review of policies and measures in the tourism sector of Visegrad countries. In addition, equal weights were applied for ranking countries according to sustainability criteria for tourism destinations however, the importance of criteria and indicators used to address this criterion should be defined based on policy makers or stakeholders surveys conducted in Visegrad countries.

The audience interested in this research are academia and policymakers working in the field of tourism as well as scholars researching sustainability assessment tools and indicators frameworks.

Therefore, future research of sustainability assessment of tourism destinations in Visegrad countries will include the missing information and analysis which is necessary for a better interpretation of research results and findings of this study.

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