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Comparative Assessment of Climate-responsible Tourism Destinations in Visegrad Countries

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ABSTRACT

The paper analyses indicators of climate-responsible tourism destinations and develops an indicators framework for the comparative assessment of climate-responsible tourism destinations and applies a developed framework for ranking 3 Visegrad countries (Poland, Hungary, and Czech Republic). The paper applies a comparative assessment approach and compares the Baltic States in terms of decarbonization of the tourism sector. Multi-criteria decision-adding tool was applied to ranking selected countries based on their achievements towards developing the climate-responsible tourism sector. Performed comparative assessment revealed that the best-performing country in terms of climate-responsible tourism in 2020 was Poland following Czech Republic.

INTRODUCTION

Tourism is a highly climate-sensitive sector. The environmental and socioeconomic consequences of climate change influence this sector. In addition, tourism is an essential source of greenhouse gas (GHG) emissions. Tourism's global carbon footprint has enlarged from 4.0 to almost 5 $GtCO_2e$ since 2009, contributing to more than 8% of global GHG emissions (Lenzen at al, 2018). Transport and hospitality sectors are important contributors to climate change. The main drivers of global tourism carbon footprint growth are high-income countries (Scot et al., 2012; Gössling et al., 2015). The fast growth in tourism demand is surpassing the decarbonization path of this sector due to the implementation of new technologies and energy and water-saving measures.

Scholars were analyzing the sustainability of tourism and sustainable tourism development challenges by addressing the role of climate change in achieving a sustainable development path (Weaver, 2012;

Peeters, 2012). The growing role of aviation as a contributor to climate change was recognized by many scholars (Becken, 2013).

Though the central studies about tourism and climate change are mainly related to the investigation of climate change impacts on the abilities of tourism destinations to adapt to climate change, there is a growing number of studies analyzing the impact of tourism sector on climate change and climate change mitigation measures. Scholars explore carbon footprint of tourism and polices and measures of decarbonization of tourism sector (Becken, 2013). Though the number of publications on tourism and climate change was steadily growing since publication of the first paper in 1986, there are still many gaps in this research area. There needs to be more internationally recognized indicators to measure the impact of tourism on climate change. The climate-responsible tourism assessment is another important gap due to the limited number of case studies in this field related to the need for international compatible data on climate-responsible tourism assessment.

The paper aims to overcome this gap by analysing studies dealing with tourism and climate change mitigation and assessments of tourism's impact on climate change and developing an indicators framework to examine the achievement of countries in terms of climate-responsible tourism development. The developed framework of climate-responsible tourism development was tested and applied for a case study in Visegrad countries except for Slovakia due to unavailable data on energy, water, and climate footprint data for hotels in tourism destination countries. Multi-criteria decision-aiding methods (MCDM) were applied to rank Visegard countries based on their achievements in the decarbonization of the tourism sector and achieved climate responsibility level by country. Policy recommendations were developed based on the study conducted.

The rest of the paper is structured in the following way: section 1 presents a literature review, section 2 introduces methods and data; section 3 provides case study results; and section 4 concludes and provides policy implications.

1. LITERATURE REVIEW

Publications related to tourism and climate change usually discuss the impacts of climate change on tourism sector development and analyses opportunities of tourism sector to adapt to climate change. Due to urgency to address climate change and implement GHG emission reduction measures in tourism sector more and more GHG emission measurement studies in tourism destinations were developed. Such approaches as energy audits, ecological and carbon footprints, life-cycle analysis were dominating (Filimonau et al., 2011; Gössling et al., 2002). However, there is lack of one widely accepted and consistent approach in carbon measurement exercises in tourism sector (Rossello-Batle et al., 2010). GHG inventories are usually addressing tourism destinations on country level (Dwyer et al., 2010; Lin, 2010; Walz et al., 2008). There has been growing interest among researchers in the tourism industry's efforts to reduce its impact on the environment and decarbonize this sector (Bows et al., 2009; Sgouridis et al., 2010). Research has also been conducted on the role of tourism transport in global mitigation (Peeters & Dubois, 2010), as well as on travels and itineraries (Becken, 2013; Becken, Schiff, 2011). Other studies have focused on specific subsectors such as cruise ships (Howitt et al., 2010) and "slow travel" modes (Dickinson, Lumsdon, 2010).

The tourism industry has the potential to contribute to global energy consumption and greenhouse gas emissions significantly. However, there needs to be more research on this issue, with most studies focusing on energy use in accommodations rather than in transport and other sub-sectors of tourism destinations. Some studies have highlighted the potential for renewable energy sources to be used in this sector (Baloch et al., 2023). The impact of tourism on the environment and climate change has been studied extensively in primary literature sources (Weaver, 2012; Peeters, 2012; Becken, 2013). One crucial question is whether tourists modify their travel behavior to reduce their impact on climate change. Some studies indicated that environmentally aware and educated tourists are more likely to travel frequently. However, research also suggests that people tend to engage less in climate mitigation activities while on vacation compared to their everyday life. Nevertheless, some studies have shown that there are specific groups of tourists that are more likely to engage in climate change mitigation, but such segmentation analyses are only partially reliable due to the small number of people who actually offset carbon emissions. The role of carbon offsetting to reduce tourism-related emissions has received both attention and criticism in academic literature. Although tourism stakeholders are increasingly involved in planning and responding to climate change, there is still a need for more extensive academic research on the subject. Most policy-related publications focus on the impact of policies and measures such as carbon taxes on GHG emission reduction from aviation (Hihara, 2010, Mayor, Tol, 2007; Gössling et al., 2015). Additionally, there are concerns that the growing world population's increasing travel demands may not be compatible with international climate change mitigation commitments (Gössling et al., 2010).

A study conducted with 70 European tourism experts through Delphi method found that companies and state authorities were the most responsible actors in climate change mitigation. The main actions to reduce GHG emissions in tourism industry were linked to increased usage of renewables and increase of energy use efficiency. On the other hand, public authorities were responsible for promoting environmental awareness of travelers (Valls, Sardá, 2009). However, there are considerable gaps in the existing policies (Yaw, 2005). It has also been found that some tourism stakeholders do not consider climate change a significant problem (Dodds, Kelman, 2008). Countries having strict climate change policies have also developed more policies in the tourism sector to address climate change challenges (Becken, Hay, 2012).

Though there is a growing number of literature on climate change mitigation in the tourism sector, there is still a lack of indicators to measure the tourism sector's impact on the increase of GHG emissions and to monitor the achievements of tourism sector decarbonization by tourism destinations (Agyeiwaah et al., 2017; Asmantaite et al., 2021; Rasoolimanesh et al., 2020; Miller, 2001; Wasowicz, 2021). Though scholars have developed some indicator systems, the application of these indicators to measure climate-responsible tourism development achievements is minimal due to the need for consistent data.

2. METHODS AND DATA

2.1 EDAS method

Multi-criteria decision-aiding method (MDM) EDAS method was first proposed by (Ghorabaee 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 (Ghorabaee 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)

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

In this matrix, x_{ij} indicates the performance value of i^{th} alternative based on j^{th} criterion.

Step 3. AV based on all criteria are determined using Equation (2)

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

Here,

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

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

$$PDA = [PDA_{ij}]_{n*m}, \quad (4)$$

$$NDA = [NDA_{ij}]_{n*m^*} \quad (5)$$

If criterion *j* is benefit criterion

$$PDA_j = \frac{\max(0,(x_{ij} - AV_j))}{AV_j}; \quad (6)$$

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

If criterion *j* is cost criterion,

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

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

Here, PDA_{ij} and NDA_{ij} indicate the positive and negative distances of *i*th alternative from AV in terms of *j*th criterion respectively.

Step 5. Weighted sum of PDA and NDA for all alternatives are determined by using Equations (10) and (11)

$$SP_i = \sum_{i=1}^{m} w_j PDA_{ij} \quad (10)$$

$$SN_i = \sum_{i=1}^{m} w_j NDA_{ij} \quad (11)$$

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

Step 6. For all alternatives, SP and SN values are normalised by using Equations 12 and 13, respectively:

$$NSP_i = \frac{SP_i}{max(SP_i)}, \quad (12)$$

$$NSN_i = 1 - \frac{SN_i}{max(SN_i)} \quad (13)$$

Step 7. Appraisal score (AS) for all alternatives are calculated via Equation (14)

$$As_i = \frac{1}{2}(NSP_i + NSN_i) \quad (14)$$

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

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

2.2 COPRAS method

The preference ranking method of complex proportional assessment (COPRAS) method was developed by Zavadskas et al. (2015). In this method, the influence of maximizing and minimizing criteria on the evaluation result is considered separately. The selection of the best alternative is based considering both the ideal and the anti-ideal solutions. The main procedure of COPRAS method includes several steps (Chatterjee et al., 2011): Step 1: Set the initial decision matrix, X.

$$X = [x_{ij}]_{m*n} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad (15)$$

where x_{ij} is the assessment value of i-th alternative in respect to j-th criterion, *m* is the number of alternatives and *n* is the number of criteria.

Step 2: Normalization of the decision matrix by using the following equation:

$$R = \left[r_{ij}\right]_{m*n} = x_{ij} \Big/ \sum_{i=1}^{m} x_{ij} \tag{16}$$

Step 3: Determination of the weighted normalized decision matrix, D, by using the following equation:

$$D = \left[y_{ij}\right]_{m*n} = r_{ij}.W_j, i = 1, \dots, m, j = 1, \dots, n \tag{17}$$

where r_{ij} is the normalized performance value of i-th alternative on j-th criterion and w_j is the weight of j-th criterion. The sum of weighted normalized values of each criterion is always equal to the weight for that criterion:

$$\sum_{i=1}^{m} x_{ij} = w_{ij} \tag{18}$$

Step 4: In this step the sums of weighted normalized values are calculated for both the beneficial and non-beneficial criteria by using the following equations:

$$S_{+i} = \sum_{j=1}^{n} y_{+ij}, S_{-i} = \sum_{j=1}^{n} y_{-ij} \tag{19}$$

where y_{+ij} and y_{-ij} are the weighted normalized values for the beneficial and non-beneficial criteria, respectively.

Step 5: Determination the relative significances of the alternatives, Q_i, by using the following equation:

$$Q_i = S_{+i} + \frac{S_{-min} \cdot \sum_{i=1}^{n} S_{-i}}{S_{-i} \cdot \sum_{i=1}^{m} \left(S_{-min}/S_{-i}\right)}, i = 1, \dots, m \tag{20}$$

where S_{-min} is the minimum value of S_{-i}.

Step 6: Calculation of the quantitative utility, U_i, for i-th alternative by using the following equation:

$$U_i = \frac{Qi}{Q_{max}}.100\% \tag{21}$$

where Q_{max} is the maximum relative significance value.

As a consequence of Eq. 6, utility values of the candidate alternatives range from 0% to 100%.

The greater the value of U_i, the higher is the priority of the alternative. Based on alternative's utility values a complete ranking of the competitive alternatives can be obtained.

2.3 Indicators and data

The various indicators of sustainable tourism development were analyzed, including decarbonization or climate-responsible tourism indicators. The main indicators for assessing climate-responsible tourism were selected based on available data. The main carbon, energy, and water footprint indicators for hotels were selected from the Cornell Hotel Sustainability Benchmarking Index (CHSB) database (Cornell University, 2022). The missing data on transport, which plays a significant role in GHG emissions from the transport sector, like air travel carbon intensity, energy and carbon intensity of tourism per value-added and share of trips by train, were selected from EU Tourism Dashboard indicators of the environmental impact of tourism destinations (European Commission, 2023).

The indicators framework for the assessment of climate-responsible tourism development in the destination country are provided in Table 1.

Table 1. Indicators for assessing climate-responsible tourism destinations

Indicators	*Measures*	*Description*	*Source*
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.	European Commission, 2023
Tourism GHG intensity	kg/million EUR	It is calculated 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.	European Commission, 2023
Tourism energy intensity	GJ/Million EUR	It is calculated by dividing the energy used in tourism-related economic activities by Gross Value Added of tourism sector in selected country.	European Commission, 2023
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	European Commission, 2023
Average hotel carbon footprint per occupied room	kgCO2e	The total carbon footprint of a property for the calendar year, divided by its number of OCCUPIED rooms within the same calendar year period. The average is calculated for the properties within the country, divided by the number of corresponding properties.	Cornell University, 2022
Average hotel energy usage per occupied room	kWh	Total energy usage of a property for the calendar year, divided by its number of OCCUPIED rooms within the same calendar year period. The average is calculated for the properties within the country, divided by the number of corresponding properties.	Cornell University, 2022
Average hotel water usage per occupied room	liiters	Total water usage of a property for the calendar year, divided by its total number of OCCUPIED ROOMS within the same calendar year period. The average is calculated for the properties within the country, divided by the number of corresponding properties.	Cornell University, 2022

Source: European Commission, 2023; Cornell University, 2022.

Therefore, the data on the indicator can be obtained for all EU member states in the EU Tourism Dashboard (European Commission, 2023) and in The Cornell Hotel Sustainability Benchmarking Index (CHSB) database (Cornell University, 2022). CHSB is an industry-led global data initiative started in 2013 to enable any hotel to calculate its carbon footprint and benchmark its energy, water, and carbon emissions at low cost, drawing from a dataset of over 25,000 hotels worldwide. Participants in the CHSB index include major hotel brands and operators representing 64 countries. The CHSB data for 2021 includes just 3 Visegrad countries (Czech Republic, Hungary, and Poland). The data for Slovakia needs to be included in the CHSB index. The study applies MCDM tools for ranking of Visegrad countries based on climate-responsible tourism development achievements in the country of destination.

3. CASE STUDY RESULTS

The following section of the paper analyses discusses and analyses the results of a case study on a comparative assessment of 3 Visegrad countries (Czech Republic, Hungary, and Poland) based on climate-responsible tourism development of destination country. The Visegrad countries were selected for the comparative assessment case study as these countries share similar geographical and geopolitical locations and passed the same economic and social transformation process from command to market economy after the collapse of the Soviet Union. These countries are attractive tourism destinations countries having good infrastructure and large flows of foreign tourists (Table 2).

Table 2. Basic data on tourism for 3 Visegrad countries 2021.

Countries	*Czech Republic*	*Hungary*	*Poland*
Number of arrivals, millions	11.38	6.57	22.2
Occupancy rate, %	27	23.4	25.5
Average duration of stay, no days	2.9	2.59	2.87
Share of foreign tourists, %	23.54	25.85	12.89
Presence of Blue flag awarded sites, number	0	0	35
UNESCO sites, number	14	7	15

Source: (European Commission, 2023)

As one can notice from information given in Table 2, Poland as the biggest country has the highest number of arrivals and highest number of blue flag award and UNESCO sites. Czech Republic distinguishes with the highest average duration of stay and highest occupancy rate among analyzed Visegrad countries. Hungary has the highest share of foreign tourists. The data for the climate-responsible tourism destination comparative assessment study for Visegrad countries is given in Table 3.

Table 3. Indicators of climate-responsibility of tourism destination in 3 Visegrad countries in 2021.

Countries	*Desirable trend*	*Czech Republic*	*Hungary*	*Poland*
Air travel emission intensity, kg of CO2/passenger	Decrease	98.7	92.5	89.5
Tourism GHG intensity, kg/million EUR	Decrease	497.95	753.00	406.35
Tourism energy intensity, GJ/Million EUR	Decrease	8.55	13.4	4.12
Share of trips by train, %	Increase	6.5	6.2	6.3
Mean hotel carbon footprint per occupied room, kgCO2e	Decrease	31.8	22.0	35.8
Mean hotel energy usage per occupied room, kWh	Decrease	89.9	97.0	73.0
Mean hotel water usage per occupied room, liters	Decrease	420.1	559.1	343.5

Source: (European Commission, 2023; Cornell University, 2022)

In Table 4 the initial matrix for EDAS is presented based on the first data.

Table 4. Initial ranking matrix for EDAS

weights of criteria	0.142857	0.142857	0.142857	0.142857	0.142857	0.142857	0.142857
kind of criteria	-1	-1	-1	1	-1	-1	-1
	C1	C2	C3	C4	C5	C6	C7
A1 (Poland)	89.5	406.35	4.12	6.3	35.8	73	343.5
A2 (Hungary)	92.5	753	13.4	6.2	22	97	559.1
A3 (Czech Republic)	98.7	497.95	8.55	6.5	31.8	89.9	420.1
Average Solution	93.5667	552.4333	8.6900	6.3333	29.8667	86.6333	440.9000

Source: own calculations

In Table 5 the final ranking of countries by EDAS is given.

Table 5. Final ranking of countries by EDAS

Countries	*Si*	*RANKING*
A1 (Poland)	0.922	1
A2 (Hungary)	0.113	3
A3 (Czech Republic)	0.518	2

Source: own calculations

In Table 6 the initial matrix for COPRAS is presented based on formula (15)

Table 6. Initial ranking matrix for COPRAS

weights of criteria	0.142857	0.142857	0.142857	0.142857	0.142857	0.142857	0.142857
kind of criteria	-1	-1	-1	1	-1	-1	-1
	C1	C2	C3	C4	C5	C6	C7
A1 (Poland)	89.5	406.35	4.12	6.3	35.8	73	343.5
A2 (Hungary)	92.5	753	13.4	6.2	22	97	559.1
A3 (Czech Republic)	98.7	497.95	8.55	6.5	31.8	89.9	420.1
SUM	280.7	1657.3	26.07	19	89.6	259.9	1322.7

Source: own calculations

In Table 7 the normalized matrix for COPRAS is presented based on formula (16)

Table 7. Normalized ranking matrix for COPRAS

weights of criteria	0.142857	0.142857	0.142857	0.142857	0.142857	0.142857	0.142857
kind of criteria	-1	-1	-1	1	-1	-1	-1
	C1	C2	C3	C4	C5	C6	C7
A1 (Poland)	0.3188	0.2452	0.1580	0.3316	0.3996	0.2809	0.2597
A2 (Hungary)	0.3295	0.4544	0.5140	0.3263	0.2455	0.3732	0.4227
A3 (Czech Republic)	0.3516	0.3005	0.3280	0.3421	0.3549	0.3459	0.3176

Source: own calculations

In Table 8 the weighted normalized ranking matrix for COPRAS using formula (17) is given.

Table 8. Weighted normalized ranking matrix for COPRAS

Kind of criteria	-1	-1	-1	1	-1	-1	-1
	C1	C2	C3	C4	C5	C6	C7
A1 (Poland)	0.0455	0.0350	0.0226	0.0474	0.0571	0.0401	0.0371
A2 (Hungary)	0.0471	0.0649	0.0734	0.0466	0.0351	0.0533	0.0604
A3 (Czech Republic)	0.0502	0.0429	0.0469	0.0489	0.0507	0.0494	0.0454

Source: own calculations

In Table 9. the final ranking of countries with using formulas 18, 19 and 20 is provided

Table 9. Final ranking of countries

Alternatives	*S+*	*S-*	*1/S-*	*Q*	*U*		*Ranking*
A1 (Poland)	0.0474	0.2375	4.2113	0.3845	100	100	1
A2 (Hungary)	0.0466	0.3342	2.9923	0.2862	74.42	74.42	3
A3 (Czech Republic)	0.0489	0.2855	3.5027	0.3293	85.64	85.64	2

Source: own calculations

As one can notice from the information presented in the tables above, the final ranking of Visegrad countries according to climate-responsible tourism destination indicators in 2021 by two different MCDM tools- EDAS and COPRAS, indicated the same results. It was found that Poland is the best-performing country, following the Czech Republic among examined Visegrad countries. Hungary has obtained the lowest ranking according to achieved results in climate-responsible tourism development in 2021.

CONCLUSIONS

Travel and tourism is strongly affected by its impacts, but as many other sectors, is also an important emitter of greenhouse gas (GHG) emissions, thereby actively contributing to climate change. It is, therefore of utmost importance to decarbonize the sector as quickly as possible and reach net zero by 2050

Continuous monitoring of climate commitments and actions is necessary to improve understanding and evidence about the status quo, progress made, and the catalytic potential actions have to transform the sector towards a climate-responsible one. For this purpose, it is necessary to develop indicators of decarbonization of the tourism sector or climate-responsible tourism development in destination countries, to monitor progress achieved and compare countries based on their achievements, to share experiences, and to learn from the best-performing countries.

The MCDM applied for ranking 3 Visegrad countries based on decarbonization indicators of the tourism sector like carbon intensity of air travel, carbon, and energy intensity per value added of the tourism sector, and carbon, energy, and water footprints of hotels etc. The results of the performed comparative case study showed that despite the progress already made, there still needs to be more room for scaling up climate action.

Based on the results of the ranking of Visegrad countries according to climate-responsible tourism destination indicators in 2021 by two different MCDM tools- EDAS and COPRAS., Poland is the best-performing country among examined Visegrad countries. The Czech Republic was found to be the second best-performing country. Hungary received the lowest ranking. The same results were obtained by applying both methods.

A good position in Poland, according to the decarbonization of tourism destinations, was achieved due to the lowest tourism GHG and air travel emission intensity and tourism energy intensity, including the lowest energy and water usage per occupied room in the country. Though Poland is distinguished with a high carbon intensity of primary energy supply due to extensive usage of local coal resources, the policies to increase energy use efficiency in all sectors of the economy positively influenced the decarbonization of the tourism sector as well. The Czech Republic was the second best-performing country due to the same indicators having lower values in comparison with the lowest-ranked country – Hungary. Hungary has high tourism GHG and energy intensity and the highest mean hotel energy and water usage per occupied room. Therefore, policies to increase energy and other resource use efficiency in the tourism sector should be the priority for Hungary.

The study has several limitations. Future research is necessary for a detailed analysis of climate change mitigation policies and measures implemented in the tourism sector in Visegrad countries to develop policy recommendations for the lagging countries in terms of decarbonization of the tourism sector.

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