Application of Cluster Analysis on the Tourism Regions in Slovakia: Assessing the Level of Their Tourism Development

Martin Schmidt[1] – Lucia Uderianová[2]
ORCID iD: 0009-0003-9326-2500[1], 0009-0006-0192-3618[2]
martin.schmidt@euba.sk, lucia.uderianova@euba.sk
[1,2]Bratislava University of Economics and Business, Faculty of Commerce,
Department of Tourism
Bratislava, Slovakia

https://doi.org/10.53465/CEECBE.2025.9788022552257.315-327

Abstract: The paper explores various levels of development across Slovak tourism regions. The main objective is to identify the six most developed tourism regions in Slovakia. Hierarchical cluster analysis was used as the primary tool for assessing the level of tourism development. Several indicators reflecting the level of tourism development in Slovak regions were applied in the analysis. The findings reveal six clusters, with the six most developed tourism regions in Slovakia. These regions are the Region of Bratislava, Turiec, Horehronie, Pohronie, Tatras, and Liptov. For future research, we recommend assessing the level of tourism development in the tourism regions of neighboring countries, which could highlight potential partners for Slovakia's well-developed regions. This could contribute to more effective cooperation among the most developed tourism regions in Central Europe.

Keywords: Tourism Development, Cluster Analysis, Tourism Regions

JEL Classification codes: Z32

INTRODUCTION

Tourism plays a crucial role in the economic and social development of regions, offering opportunities for economic diversification, employment, and infrastructure improvements. In Slovakia, a country with diverse natural landscapes, rich cultural heritage, and a growing tourism industry, assessing the level of development of its tourism regions is essential for strategic planning and policy-making. Understanding the disparities and strengths of different regions can help stakeholders optimize resources, enhance competitiveness, and foster sustainable tourism development.

This study aims to evaluate the level of tourism development across Slovakia's regions using cluster analysis. Cluster analysis is a statistical method that groups regions with similar characteristics, enabling a data-driven classification of tourism performance.

The research is structured to analyze key indicators of tourism development, including tourist arrivals, overnight stays, number of accommodation facilities, beds, etc. The findings from this study can contribute to better regional policy formulation, targeted investment strategies, and enhanced marketing efforts tailored to the unique attributes of each tourism cluster.

In the following sections, we present the theoretical background and methodological framework of the study, followed by an analysis of the results and their implications for regional tourism development in Slovakia.

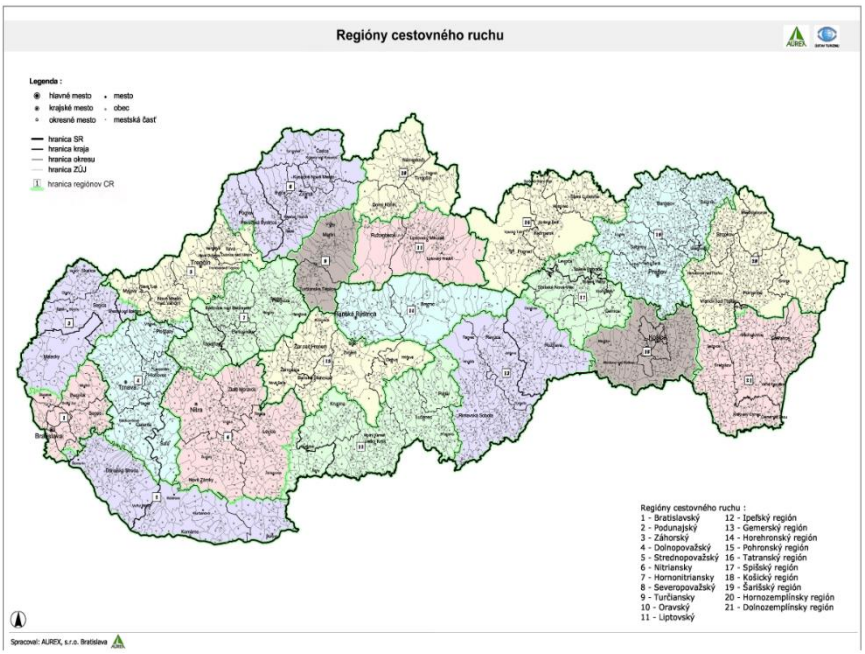
1 LITERATURE REVIEW

"*Tourism has been always considered to be one of the sectors, which could contribute to the economic growth of the country*" (Gajdošíková et al., 2016, p. 411).

According to Khan et al. (2020), many factors can affect tourism worldwide. Some of these factors are high prices of services, terrorist attacks, and global pandemics. Among these, the COVID-19 pandemic had a particularly severe impact on the tourism industry. During this period, a rapid decline in demand for travelling and a slight increase in unemployment was observed (Vašaničová et al., 2023). According to Grešš (2021), the solution for global pandemics should be to set understandable and unchanging rules to create safe conditions for traveling even in tough times. If we follow the rules, we can minimize the negative impacts on tourism. Regarding the research conducted by Michálková and Gáll (2021), the most vulnerable regions in Slovakia are Tatras, Liptov, Spiš and Orava. Due to the COVID-19 pandemic, the whole tourism sector struggled. The decrease between the first and second quarters of 2020 was more than 12% in the employment in tourism. 75.38% decrease in number of overnight stays and almost 80% decrease of visitors in Slovakia. During this period, it was crucial to maintain as many jobs as possible and to prevent further decline. Moreover, the COVID-19 pandemic could help resolve the problem of fragmented destination management in the most vulnerable tourism regions.

The criteria for defining tourism regions listed in the Regionalization of tourism in Slovakia include natural and anthropogenic conditions and a common demand for tourism. Regionalization also considers the cadastral boundaries of municipalities and higher territorial units. Before the current valid regionalization of tourism, regionalization was also created in 1962, when 20 regions were identified, and in 1981, when 24 tourism regions were identified (Országová, 2020). At present, the territory of Slovakia is split into 21 tourism regions based on various factors such as interconnections within the region, consistency of conditions, geographical proximity, historical factors and natural centers already existing in the areas (Ústav turizmu, 2005).

Fig. 1 Tourism regions in Slovakia



Source: Ministry of Transport of the Slovak Republic, 2005

Tourism regions belong to the group of purpose-built regions. In Slovakia, regions such as Liptov and the Tatras serve as notable examples. They can be defined as a territory characterized by relatively homogeneous cultural as well as natural resources, which can then be transformed for the further development of these regions. Tourism regions can be classified in terms of their character of the landscape, life cycle, and degree of attractiveness. The landscape's character depends mainly on the altitude of the region, its infrastructural facilities, and the level of provided services. Tourist regions can also be classified according to their phase during the life cycle. Regions can be in the phase of discovery, involvement, development, consolidation, stagnation, decline, or revival. The degree of attractiveness depends mainly on natural and cultural-historical resources, infrastructure facilities, and communication of the destination. Thanks to these aspects, we can easily identify regions with local, regional, national, and international importance (Gúčik, 2021).

A large number of authors, such as Mydlár (2015), Vašaničová (2016), and Vongrej (2014), agree that tourism in Slovakia has great potential. However, this potential is still untapped, and it's far from an efficient use of the resources which Slovakia has at its disposal. To ensure positive development of this industry, it is necessary to stay competitive among the neighboring countries. After 1990, tourism in Slovakia recorded growth rates resulting from the economic boom in the whole of Europe. However, if Slovakia wants to stay competitive in the tourist market, it must set up and implement short-term and long-term goals. In terms of already established source markets, Slovakia has to adjust its product portfolio. Moreover, Slovakia should penetrate other markets by setting up new innovative products. To ensure the competitiveness of Slovakia in the tourism market, it is necessary to stabilize the organizational structure of tourism on the regional, local, and national levels (Malachovský, 2014). It is important to mention that the positive and negative impacts of tourism affect the sustainable development of tourism. For greater tourism development, it is important to maximize positive tourism impacts and minimize negative tourism impacts. Therefore, comprehensive, systematic, and legislative changes are needed (Štrba et al., 2022). Regarding Slovakia, it is important to implement nature-friendly forest management to ensure the sustainability of natural resources in mountainous regions, which are vital for tourism development (Kovalčík, 2020). To stay competitive, Zemanová (2023) recommends in her dissertation thesis Slovakia to participate in exhibitions and B2B meetings organized under the brand Discover Central Europe. Moreover, Slovakia should increase the number of direct flights from countries targeted by the DCE brand, such as Germany, Austria, Holland, etc.

2 METHODOLOGY

The main objective of this research is to identify the six most developed tourism regions in Slovakia. Additionally, we aim to compare our results with a cluster analysis from 2019 and the existing map of tourism region categorization. In this study, we utilized secondary sources of information, primarily statistical data from the Statistical Office of the Slovak Republic. Our main source was the document "Správa o hospodárskom vývoji v krajoch SR v roku 2020 ". Based on this source, we compiled datasets that were subsequently utilized in the analysis. Several indicators were selected to assess the level of tourism development in each region. Specifically, the analysis considered the number of accommodation facilities, the number of beds in these facilities, the number of domestic and foreign tourists, the number of overnight stays by both domestic and foreign tourists, and the revenues of accommodation facilities generated from domestic and foreign visitors. Additionally, we used the average utilization rate of accommodation facilities, as well as the average number of overnight stays by domestic and foreign tourists.

The data and datasets were processed using Microsoft Word and Microsoft Excel, where we calculated mathematical relationships and created the necessary tables. Additionally,

hierarchical cluster analysis was conducted using the statistical software R. The subject of our investigation includes all tourism regions in Slovakia. A total of 21 tourism regions were defined in 2005, and all of them were analyzed through cluster analysis to determine which regions exhibit the highest level of tourism development.

Hierarchical cluster analysis

To achieve the goals of this research, we employed hierarchical cluster analysis as the primary data processing method. The selection of tourism regions was conducted using a multivariate statistical approach within the R statistical software. We have chosen to proceed with hierarchical cluster analysis according to Gáll et al. (2021).

1. Choice of input database. As a input dataset we have chosen the data from the document "Správa *o hospodárskom vývoji v krajoch SR v roku 2020* ". In this document, we have identified several indicators reflecting tourism development in the regions.
2. Determination of the Euclidean distance. At the beginning of the research, the same number of clusters (six) was determined. They will be used in the results of all hierarchical cluster analysis techniques. Moreover, the Euclidean distance will be adjusted to three decimal places. Euclidean distance is otherwise known as the geometric distance, which is one of the most used metrics given by the following relationship:

$$d_{ij} = \sqrt{\sum_{k=1}^{n}(K_{ik-} K_{jk})^2}, \quad (1)$$

where:
d_{ij} = Euclidean distance
n = number of variables
X_{ik} = value of the k-th variable for the i-th object
X_{jk} = value of the k-th variable for the j-th object (Stankovičová and Vojtková, 2007)

3. Types of clustering techniques. The result of the cluster analysis represents the five clustering techniques. We used Complete linkage, Single linkage, Average linkage method, Wards method, and Centroid method.
4. Verification of the results. To verify the correctness of the results, we used the Cophenetic correlation coefficient calculated for the Euclidean distance to find out which cluster analysis method gives the best cluster model. The best cluster model had the highest Cophenetic correlation coefficient.
5. Identification of clusters. After choosing the most relevant cluster model, we can easily identify the tourism regions belonging to all six clusters.
6. Evaluation of individual clusters. Before evaluating all clusters, the average values of the selected indicators must be calculated. Based on the calculated average, the clusters can be ordered according to their level of development (Gáll et al., 2021).

3 RESULTS AND DISCUSSION

Tourism plays a significant role in regional development, contributing to economic growth, employment, and infrastructure improvements. Understanding the varying levels of tourism development across different regions is essential for effective policy-making and strategic

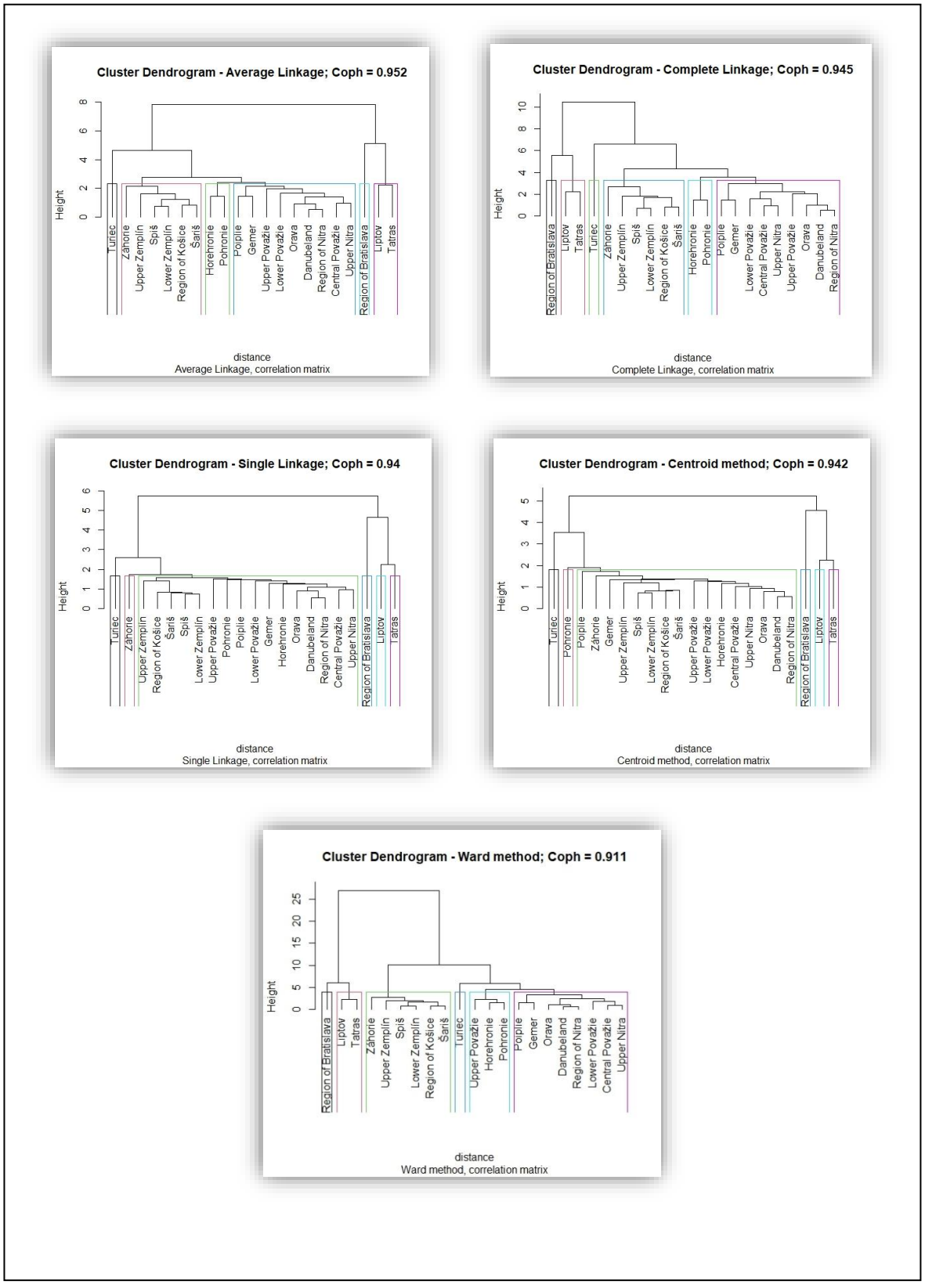
planning. Slovakia, with its diverse natural landscapes and rich cultural heritage, offers distinct tourism potential across its regions. By analyzing key indicators, such as visitor numbers, overnight stays, and revenue, we aim to group regions with similar characteristics, providing valuable insights into their relative development levels.

3.1 Cluster analysis of tourism regions in Slovakia

The following subsection focuses on the application of hierarchical cluster analysis, which categorizes tourism regions into clusters using pre-prepared datasets. These datasets are based on the data from documents called "Výsledky hospodárenia krajov". By applying this stochastical method, we can identify the level of tourism development in each tourism region in Slovakia. At the beginning of the research, we determined that the analysis would be conducted using six clusters. This number of clusters was consistently applied across all agglomerative hierarchical clustering techniques. On average, each cluster was expected to contain 4-5 objects. Considering the total number of investigated objects (21 tourism regions), the number of clusters resulting from the analysis is suitable. However, the results of all hierarchical clustering techniques are diametrically different. Very discrepant clusters were formed when all techniques were used (regarding the number of objects in every cluster). In certain cases, disproportionately large or small clusters emerged, and in some instances, individual regions formed standalone clusters.

The first phase of the cluster analysis involved the formation of clusters. The results from the cluster analysis are presented in Figure 2, which illustrates the outcomes of selected hierarchical clustering techniques in the form of the five different dendrograms. These dendrograms visualize the result of the cluster analysis based on the collected data. Figure 2 presents five dendrograms, which consist of six clusters. The conclusion of each clustering technique is different, but some similarities are retained. In all dendrograms, the Region of Bratislava is always in its own cluster, indicating its relative distance from other investigated regions. The same applies to the Turiec region. The other clusters consisting of regions Liptov, Tatras, Horehronie, and Pohronie indicate relative proximity, as they often appear in common clusters. Compared to the clusters mentioned above, the rest of the clusters consist of more than five tourism regions. Moreover, clusters containing up to 16 variables have emerged within the two clustering techniques. We can further note that despite the total number of regions we worked with, not a single dendrogram came out with the same result. Although each dendrogram provides an interesting evaluation of the input variables, it is not yet possible to determine the statistical significance of individual clusters at this stage of hierarchical cluster analysis.

Fig. 2 Cluster dendrograms



Source: own processing in statistical program R

To validate and compare the applied clustering techniques, the cophenetic correlation coefficient, which is recalculated for Euclidean distance, will be used to determine the

adequacy of the clustering technique and to determine the best clustering model. The resulting values of the cophenetic correlation coefficient are presented in Table 1.

Tab. 1 Cophenetic correlation coefficients

Euclidean distance	
Hierarchical clustering technique	Cophenetic correlation coefficient
Average Linkage	0.952
Complete Linkage	0.945
Single Linkage	0.94
Centroid method	0.942
Ward method	0.911

Source: own processing

As shown in Table 1, the Average Linkage method achieved the highest cophenetic correlation coefficient (0.952), indicating the best preservation of the hierarchical clustering structure. While other methods, such as Complete Linkage (0.945), Single Linkage (0.940), and the Centroid method (0.942) produced similar results, Average Linkage was ultimately selected due to its balanced approach between compactness and separation of clusters. In contrast with other applied methods, the Single Linkage and Centroid method led to the formation of one large cluster and numerous very small ones, consisting of only one tourism region, which suggests that these techniques might not be ideal for capturing meaningful outcomes in this case. Finally, the Ward method, which had the lowest cophenetic correlation coefficient (0.911), is designed to minimize intra-cluster variance. However, it may distort the true cluster structure, especially when clusters vary in size or density (Rodriguez et al., 2019). Given the relative performance of all methods, Average Linkage was chosen for its better overall performance and cluster consistency. Therefore, the Average Linkage technique will be used for further research. This clustering technique has resulted in six clusters representing the following regions:

Cluster 1. Turiec

Cluster 2. Záhorie, Upper Zemplín, Spiš, Lower Zemplín, Region of Košice, Šariš

Cluster 3. Horehronie, Pohronie

Cluster 4. Poiplie, Gemer, Upper Považie, Lower Považie, Orava, Danubeland, Region of Nitra, Central Považie, Upper Nitra

Cluster 5. Region of Bratislava

Cluster 6. Liptov, Tatras

Tab. 2 Identified clusters sorted by their level of importance

Order	Average value in Cluster analysis	Cluster	Regions
1.	1.967	Cluster 5	Region of Bratislava
2.	1.185	Cluster 1	Turiec
3.	0.280	Cluster 3	Horehronie, Pohronie

Order	Average value in Cluster analysis	Cluster	Regions
4.	-0.035	Cluster 6	Liptov, Tatras
5.	-0.131	Cluster 4	Poiplie, Gemer, Upper Považie, Lower Považie, Orava, Danubeland, Region of Nitra, Central Považie, Upper Nitra
6.	-0.521	Cluster 2	Záhorie, Upper Zemplín, Spiš, Lower Zemplín, Region of Košice, Šariš

Source: own processing (1. position: the most important tourism regions - 6. position: regions with the lowest importance)

In Table 2, we can see all six clusters in order from the most important cluster in the first place to the cluster with the lowest importance of tourism regions in the sixth place. The outcome of the Hierarchical cluster analysis is the determination of six categories, representing each cluster, which consists of one or several regions:

Category 1

To the first category belongs the Claster 5 with the Region of Bratislava. In terms of tourism, this region is, according to Hierarchical cluster analysis, the most developed in Slovakia. The region has perfect localization prerequisites for tourism development. This is reflected in the various indicators we used in this study. The region of Bratislava is a well-developed tourism region, and its impacts are significant at the regional, national, and international levels.

Category 2

Cluster 1, which achieved the second-best average values, consists of only one region: Turiec. Turiec is located in the northern part of Slovakia, close to the Czech and Polish borders. It is precisely this location and its various attractions that predestine it for attracting more foreign tourists.

Category 3

Cluster 3, which includes the regions Horehronie and Pohronie, took third place. Within the regions, we can find plenty of castles, historical cities, and one of the most renowned ski centers in the country. These regions are located in the central part of Slovakia, close to the border of Hungary, so their future potential has an international reach.

Category 4

In the fourth category, we have another two popular tourist destinations. Cluster 6 consists of the Liptov and Tatras regions. These regions are popular among tourists because of their historical and natural beauty. In these two regions, our two highest mountain ranges are located, which creates perfect prerequisites for attracting domestic and foreign tourists. Therefore, the regions Liptov and Tatras can be considered national and international destinations.

Category 5

In fifth place, we can see Cluster 4, which consists of several regions. Namely: Poiplie, Gemer, Upper Považie, Lower Považie, Orava, Danubeland, Region of Nitra, Central Považie and Upper Nitra. All of these regions have high-quality localization and implementation prerequisites for tourism development, however, their potential is not yet fully exploited.

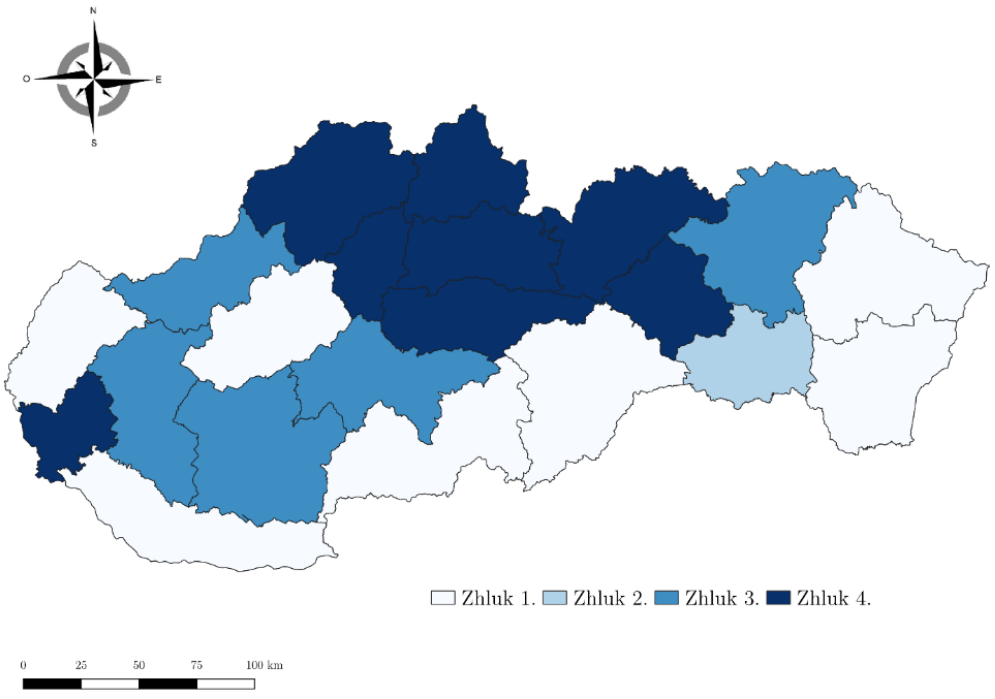
Category 6

The last place has been taken by Cluster 2. As in the case of Cluster 4, Cluster 2 also contains several regions. These regions are Záhorie, Upper Zemplín, Spiš, Lower Zemplín, Region of Košice and Šariš. Some of these regions, mainly in eastern Slovakia, don't have the right localization and implementation prerequisites. The studied indicators are not as significant as in the other researched regions. Therefore, the outcome of this analysis ranks these regions among the least developed in terms of tourism.

3.2 Benchmarking of cluster analysis results

Furthermore, we can now benchmark three different maps, which can give us a clear view of the importance of the tourism regions in Slovakia. Two maps represent the results of the Hierarchical cluster analysis, which are based on datasets from 2019 and 2020. This comparison can show us the most successful regions in both years. Moreover, we are now able to identify the changes that have occurred as a result of the COVID-19 pandemic. The Cluster analysis from 2019 (the best year for tourism overall) shows us four clusters representing the different levels of development of tourism. On the other hand, the cluster analysis of tourism regions from 2020 shows slightly different results. This year, the COVID-19 pandemic significantly impacted the economy, especially the tourism industry. Finally, the third map shows us the differences between the regions, namely regional importance, transregional importance, national importance, and international importance.

Fig. 3 Map of clusters of tourism regions according to the degree of importance in 2019

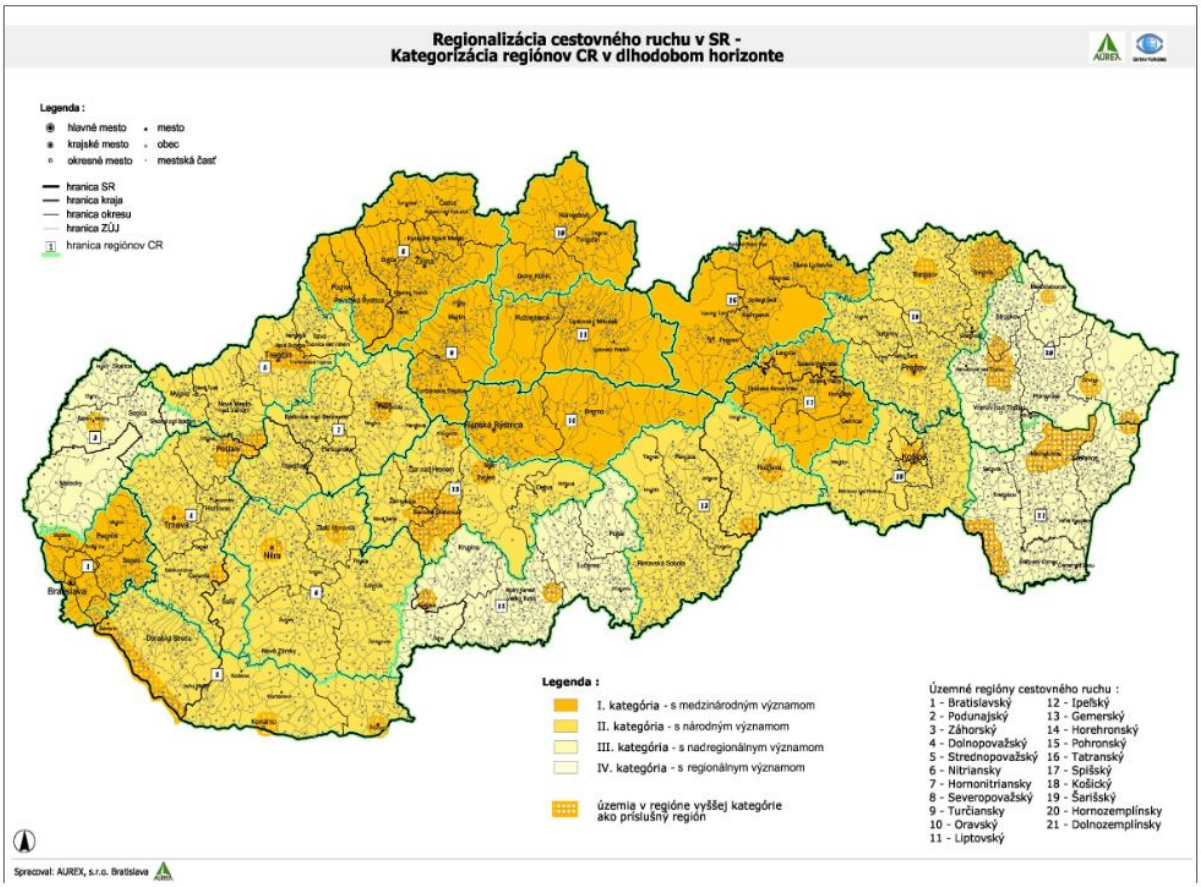


Source: author's own processing in the statistical program R, 2019 (Gall, 2021)

Figure 3 shows the four clusters containing the tourism regions resulting from their significant position in the tourism industry. The most important cluster is Cluster 4 with Upper Považie, Orava, Horehronie, Turiec, Liptov, Tatras, Spiš, and Region of Bratislava. From this map, we can see the two parts of Slovakia, where the most developed regions are located. Almost all

major tourism regions are focused in the northern part of Slovakia, only Region of Bratislava is located in the western part of Slovakia.

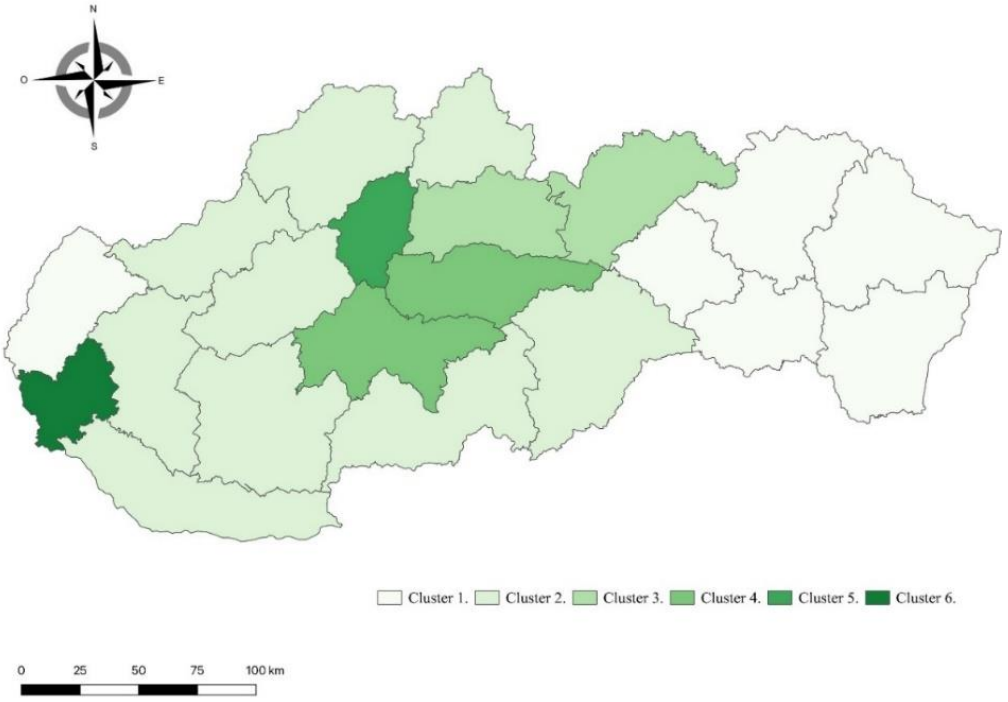
Fig. 4 Categorization of tourism regions in the long-term



Source: Regionalization of Tourism in the Slovak Republic, Ministry of Transport of the Slovak Republic

In the document, Regionalization of Tourism in the Slovak Republic, we can find many maps defining the potential of Slovak tourism regions in terms of tourism development. The most comprehensive map is the long-term categorization map of tourism regions. The regions are divided into four categories depending on their significance in tourism. The first category represents the regions of international importance, the second category represents the regions of national importance, and the other two categories represent the subregional and regional importance. Despite being nineteen years old, this document relatively accurately predicted the development of the tourism regions. In the first category of tourism regions, we can see a hundred percent match with the most successful tourism regions identified in the cluster map from 2019 (Figure 3).

Fig. 5 Map of clusters of tourism regions according to their degree of importance in 2020



Source: own processing in statistic program R based on the data from the document: Správa o hospodárskom vývoji v krajoch SR v roku 2020

The second map (Figure 5) shows 21 tourist regions in Slovakia, which are divided into six clusters according to their importance in tourism. This third map distinguishes from the above two almost identical maps. We can see that Upper Považie, Orava, and Spiš are not among the most successful tourism regions. On the other hand, the region of Pohronie was, according to the cluster analysis, assigned to the most developed tourism regions according to data gathered in 2020. The rest of the most developed tourism regions are identical to the previous maps. The other significant difference is that they are not located in the same cluster but are divided into 4 clusters. Despite this considerable segmentation, we can say that these six regions can be considered the most significant in terms of tourism development. The reason for the slightly different positions of some regions may be the strong impact of the COVID-19 pandemic on these regions. The year 2020 was challenging for all sectors of the economy. However, tourism was among the most affected sectors (Vărzaru, 2021). Therefore, we can also conclude that regions that have maintained their positions compared to 2019 are resilient and have the best prerequisites to overcome potential risk periods such as pandemics. These regions are the Region of Bratislava, Turiec, Pohronie, and Horehronie. Conversely, regions such as Liptov, Tatras, Spiš, and Orava have seen a decline in their tourism significance, losing their previously strong position in tourism development. This trend aligns with the findings of Michálková and Gáll (2021), who identified these areas as particularly vulnerable within Slovakia's tourism sector.

This study faces several limitations that should be considered when interpreting the results. First, the Slovak Statistical Office does not collect data at the level of tourism regions in Slovakia, which significantly restricts the scope of our analysis. As a result, we had to create datasets with the data from the district level, which may not fully capture the nuances of regional tourism dynamics. This methodological limitation could influence the accuracy of our findings at the regional level. Another important limitation is the use of time series data from the year 2020. This year was heavily impacted by the COVID-19 pandemic, which caused significant disruptions to the tourism industry. As a result, the data for 2020 may not accurately represent typical tourism trends. Lastly, the implementation of the outcomes and

recommendations of this research could be affected by the lack of coordination between relevant institutions in Slovakia. The absence of effective collaboration among academic, governmental, regional, and local authorities could limit the practical application of the study's recommendations, as coordinated efforts are often necessary to address complex issues within the tourism sector.

CONCLUSION

The research identifies the most developed tourism regions in Slovakia based on the outcomes of hierarchical cluster analysis. The findings indicate that the Bratislava Region, Turiec, Tatras, Liptov, Pohronie, and Horehronie demonstrate the highest levels of tourism development. Furthermore, a comparison of cluster analyses using data from 2019 and 2020 reveals certain differences in regional classification. Additional discrepancies emerge when comparing the 2020 cluster analysis results with the 2005 categorization of tourism regions. Despite these variations, the Bratislava Region, Turiec, Tatras, Liptov, and Horehronie consistently appear among the most developed tourism regions across all three maps. These insights provide valuable guidance for policymakers and tourism stakeholders in optimizing resource allocation, enhancing regional competitiveness, and promoting sustainable tourism development. To further strengthen tourism growth, we propose the establishment of two national tourism destinations. The first would encompass the Bratislava Region and its surrounding areas, while the second would integrate the Turiec, Tatras, Liptov, Horehronie, and Pohronie regions. The creation of these designated tourism destinations would enable responsible institutions to allocate resources efficiently and implement targeted strategies to support the continued development of these key regions.

ACKNOWLEDGEMENT

This contribution is the result of the internal grant project A-25-102/3020-02 of the University of Economics in Bratislava for young pedagogical staff, scientific and PhD. students entitled Digital technology in tourism: Generation Z in the spotlight.

REFERENCES

Gajdošíková, Z. et al. (2016). *Reengineering of tourism organization structure: The case of Slovakia* [cit. 2023-01-12]. ISSN 1877-0428. Retrieved 12 February 2024, from https://www.sciencedirect.com/science/article/pii/S1877042816311521

Gall, J. (2021). *Mapovanie klastrov cestovného ruchu*. Retrieved 12 February 2024, from https://opac.crzp.sk/?fn=detailBiblioFormChildI2SOO&sid=4BD9478A3A7038F606233AAC8853&seo=CRZP-detail-kniha

Gešš, M. (2021). *Slovakia economy briefing: Covid-19 and tourism problem in Slovakia, 42*(2), ISSN 2560-1601. Retrieved 13 February 2024, from https://china-cee.eu/wp-content/uploads/2021/08/2021e07_Slovakia.pdf

Gúčik, M. et al. (2021). *Geografia cestovného ruchu: Slovensko.* Banská Bystrica: Belanium. ISBN 978-80-557-1925-2.

Khan, N. et al. (2020). *Factors Affecting Tourism Industry and Its Impact on Global Economy of the World.* Retrieved 11 February 2024, from https://papers.ssrn.com/sol3/Papers.cfm?abstract_id=3559353

Kovalčík, M. (2020). *Profitability and Efficiency of Forest Contractors in Slovakia – Comparison of Mountain and Lowland Regions*. https://doi.org/10.3390/f11040370. Retrieved 17 February 2024, from https://www.mdpi.com/1999-4907/11/4/370

Malachovský, A. (2014). *Goals of tourism development in Slovakia in the contest of regional development and selected tourism markets*. https://doi.org/10.5817/CZ.MUNI.P210-6840-2014-102.

Michálková, A., Gáll, J. (2021). *Institutional provision of destination management in the most important and in the crisis period the most vulnerable regions of tourism in Slovakia, 13*(3). DOI: 10.2478/euco-2021-0014

Mydlár, J. (2015). *Význam klastrov cestovného ruchu v regionálnom rozvoji.* Retrieved 22 February 2024, from https://seanewdim.com/wp-content/uploads/2021/03/Importance-of-clusters-of-tourist-trade-in-regional-development-J.-Mydlar-1.pdf

Országová, K. (2020). *Regióny cestovného ruchu na Slovensku.* Banská Bystrica: Belianum. pp. 110. ISBN 978-80-557-1720-3.

Rodriguez, M. Z. et al. (2019). Clustering algorithms: A comparative approach. *PLoS ONE 14*(1), https://doi.org/10.1371/journal.pone.0210236

Stankovičová, I., Vojtková, M. (2007). *Viacrozmerné štatistické metódy s aplikáciami*. ISBN 978-80-8078-152-1.

Štrba, Ľ. (2022). *Perception of the Impacts of Tourism by the Administrations of Protected Areas and Sustainable Tourism (Un)Development in Slovakia,* https://doi.org/10.3390/su14116696

Ústav turizmu. (2005). *Regionalizácia cestovného ruchu v Slovenskej republike*. Bratislava: Ministerstvo hospodárstva SR, odvor cestovného ruchu.

Vašaničová, P., Litavcová, E., Jenčová, S. (2016). *On modelling of the development of share of inbound tourism on GDP in Slovakia*. Retrieved 23 February 2024, from https://msed.vse.cz/msed_2016/article/26-Vasanicova-Petra-paper.pdf

Vašaničová, P. et al. (2023). Do Travel and Tourism Competitiveness determine International Tourism Inbound Receipts? A Quantile Regression Model for 125 Countries. *Journal of Tourism and Services, 14*(26) 2024, from https://doi.org/10.29036/jots.v14i26.482

Varzaru, A. et al. (2021). Rethinking Tourism Industry in Pandemic COVID-19 Period. *Sustainability 2021, 13*(12), https://doi.org/10.3390/su13126956

Vongrej, M. (2014). Regional development strategy of tourism in Slovakia. *Menacment u chotelijerstvu i turizmu. Vrnjačka Banja: Univerzitet u Kragujevcu, Fakultet za chotelijerstvo i turizam u Vrňačkoj Bani, (1)* Č. 1, ISSN 2334-8267.

Zemanová, L. (2023). *Spolupráca krajín vyšehradskej štvorky (V4) v marketingovej podpore cestovného ruchu pod značkou „Discover Central Europe".* Retrieved 18 February 2024, from https://opac.crzp.sk/?fn=detailBiblioFormChildS6KS7&sid=C03CB0FBA6588971DF3D26D1B6BF&seo=CRZP-detail-kniha