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CIRCULAR ECONOMY PRACTICES IN MICRO AND SMALL ACCOMMODATION ENTERPRISES IN THE SLOVAK–POLISH CROSS-BORDER REGION: IMPLICATIONS FOR DIGITAL PASSPORTIZATION OF TOURISM*

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Abstract. International competitiveness and sustainability have become central themes in tourism development, particularly in the context of economic and geopolitical instability. The circular economy represents an important framework for improving resource efficiency and long-term resilience in tourism enterprises. Accommodation services, especially micro and small enterprises operating in environmentally sensitive regions, play a significant role in this transition. The concept of digital passportization enables the systematic collection and monitoring of sustainability-related data in tourism enterprises, which may support strategic planning and the evaluation of circular economy practices within tourism destinations. This study examines the perceived importance and selected application of circular economy tools among accommodation providers in the Slovak–Polish High Tatras cross-border region. A quantitative survey was conducted among 186 enterprises between December 2024 and March 2025. The standardized questionnaire focused on waste, water, and energy management, as well as sustainable materials and infrastructure. Descriptive statistics and the Mann–Whitney U test were applied to analyse differences according to country of operation and enterprise size. The results indicate a generally positive perception of circular economy practices as strategic instruments for development planning, competitiveness, and marketing positioning. Statistical testing revealed significant differences between Slovak and Polish enterprises, as well as between micro and small firms, with strong effect sizes observed. These findings suggest that circular economy perception is shaped not only by firm-level characteristics but also by broader institutional contexts. From a broader methodological perspective, the findings also demonstrate how circular economy practices implemented at the enterprise level can provide a relevant empirical basis for emerging digital passportization systems designed to monitor sustainability performance in tourism destinations. The study provides context-specific empirical evidence from a peripheral alpine border region and offers insights relevant to regional tourism stakeholders and sustainability-oriented policy development.

Keywords: circular economy; tourism innovations; accommodation services; tourism sustainable development

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1. Introduction

Digital passportization in tourism plays an increasingly important role in the planning, management and renovation of tourism infrastructure, attractions and public spaces. It provides systematic information about the condition, service life and material characteristics of tourism facilities, enabling more efficient resource management and supporting sustainable destination development (Mehdi, 2025). Its connection with the principles of the circular economy lies in the ability to optimize the use of existing resources, extend the life cycle of tourism infrastructure and minimize environmental impacts through renovation, reuse and responsible material management. In this context, digital passportization creates an information base that supports sustainable decision-making by local governments, tourism enterprises and destination managers. In recent years, the concept of digital passportization has emerged as a methodological approach for collecting and managing structured digital information about tourism enterprises and their sustainability practices within tourism destinations. Digital passportization in tourism refers to a structured digital system for collecting, managing and analysing standardized information about tourism services, sustainability practices and operational characteristics of tourism enterprises (Rodrigues et al., 2024). Such systems allow tourism stakeholders to systematically monitor sustainability practices, service quality indicators and operational characteristics of tourism enterprises, thereby supporting evidence-based destination management and strategic tourism planning (Buhalis & Yang, 2023). The concept of digital passportization is increasingly discussed as a methodological tool for systematically recording and evaluating key characteristics of tourism enterprises and their sustainability practices. Within tourism destinations, such digital information systems enable the collection of standardized data on operational, environmental and service-quality indicators, which can support strategic destination management and sustainable tourism development. In this context, digital passportization represents an emerging analytical framework that connects tourism data management with the principles of sustainable and circular tourism development. Within this framework, digital passportization can serve as an analytical tool for collecting standardized data on circular economy practices implemented by tourism enterprises, enabling systematic monitoring and evaluation of sustainability performance in tourism destinations. Tourism represents an important component of the global economy, generating employment, supporting regional development and facilitating cultural exchange. In many countries, tourism contributes significantly to national GDP and therefore represents a strategic sector of economic development. However, the COVID-19 pandemic significantly disrupted tourism activities worldwide and highlighted the need for more resilient and sustainable tourism models. In this context, the concept of the circular economy (CE) has gained increasing attention within tourism research. The circular economy represents an alternative to the traditional linear economic model based on the sequence “take–produce–consume–dispose”. Instead, circular economy principles emphasize the efficient use of resources, waste reduction, reuse of materials and the extension of product life cycles (Paja, 2025; Piccinetti, Elseify et al., 2025; Piccinetti, Kapiel et al., 2025). Despite the growing body of literature addressing sustainability in tourism, limited research focuses on the perceptions and implementation of circular economy practices among micro and small accommodation enterprises, particularly in cross-border regions (De Cantis & Sciortino, 2021). Previous studies tend to focus primarily on larger tourism organizations or urban destinations, while smaller enterprises operating in peripheral regions remain underrepresented in academic research. The aim of this paper is to examine the understanding and implementation of circular economy practices among micro and small accommodation enterprises in the Slovak–Polish cross-border region. The study further investigates whether enterprise size or national context influences the adoption of circular economy principles. The added value of this research lies in its empirical focus on micro and small accommodation enterprises operating in a cross-border mountain region, a context that remains relatively underexplored in circular economy research in tourism. By identifying statistically significant differences between national and organizational contexts, the study provides insights into how circular economy practices are perceived and implemented within small tourism enterprises. Methodologically, the study is based on a standardized questionnaire distributed to 186 enterprises between December 2024 and March 2025. The research focused on waste, water and energy management as well as sustainable materials and equipment. Descriptive statistics and non-parametric tests were applied to analyze the responses. From a broader methodological perspective, the study contributes to the research agenda focused on modelling digital frameworks for tourism development. The empirical identification of circular economy practices at the enterprise level provides a relevant data layer for emerging digital monitoring and passportization systems aimed at evaluating sustainability performance in tourism destinations. The remainder of the paper is structured

as follows. Section 2 describes the research methodology. Section 3 presents the research results and discusses the key findings. Section 4 provides conclusions and outlines implications for tourism policy and practice. The concept of digital passportization therefore provides a methodological framework that enables systematic monitoring of circular economy practices in tourism enterprises and supports evidence-based destination management. In this sense, the present study contributes empirical inputs that may support the development of digital passportization systems for monitoring circular economy practices in tourism enterprises. This study contributes to the emerging concept of digital passportization in tourism by providing empirical insights into circular economy practices implemented by accommodation enterprises.

2. Theoretical background

Tourism is once again one of the most dynamically developing areas of the world economy after the end of the strong manifestations of the COVID-19 pandemic. Among its greatest benefits, it contributes to global gross domestic product, employment, regional development and cultural exchange (OECD, 2024). Nevertheless, its activities also have a downside, and this is mainly related to the environmental impacts that participation in tourism causes. These include excessive consumption of natural resources, waste production, greenhouse gas emissions and pressure on local infrastructure and habitats (UNWTO, 2022; Pirani & Arafat, 2016). That is why in recent years, increasing attention has been paid to the application of the principles of sustainability and circular economy in the field of tourism. As tourism continues to recover, it is evident that small and medium-sized enterprises (SMEs) dominate the sector (Beresecká & Papcunová, 2020). These entities are particularly sensitive to economic shocks and simultaneously play a critical role in implementing innovation. Although large players may have greater resources, SMEs often exhibit flexibility and a high degree of local embeddedness. Their role in initiating circular economy transformation in tourism is therefore crucial (Geissdoerfer et al., 2017; Kraus et al., 2020). The process of post-pandemic recovery has revealed the urgent need for restructuring within tourism businesses, especially toward sustainability. The COVID-19 crisis exposed vulnerabilities in linear business models, prompting a search for resilient alternatives (Murray et al., 2017). In this context, circular economy strategies offer a promising way forward, enabling businesses not only to reduce costs and environmental harm but also to enhance long-term stability and competitiveness. Moreover, increasing regulatory and consumer pressure is forcing tourism providers to consider not just environmental impacts but also their strategic positioning. Tourists increasingly prefer eco-responsible destinations, and alignment with sustainability standards is becoming a differentiator in a crowded market. Tourism, as an activity closely tied to natural and cultural resources, must therefore adopt long-term circular thinking as a condition for future viability (Becken, 2019; Zhang et al., 2024). In summary, the theoretical background confirms that tourism operates at the intersection of multiple sustainability challenges. Applying circular economy principles in this sector is not only desirable but necessary in view of economic, environmental and societal demands. While existing literature has tended to focus on circular economy applications either in large urban tourism enterprises or within broad sustainability frameworks, the gap is apparent in empirical research on perceptions and actual applications of CE tools in micro and small enterprises operating in cross-border alpine regions. This study bridges this gap by focusing on the Slovak–Polish border and positioning itself within the framework of sustainability-driven innovation in rural tourism contexts. It offers an innovative empirical contribution that complements and adds to current knowledge, particularly through the examination of cross-border differences and sector-specific views of CE adoption.

Principles of the circular economy in tourism industry

The tourism industry is increasingly acknowledging the economic advantages of adopting green innovations, which are integral to the principles of the circular economy (Geissdoerfer et al., 2017). This model offers an alternative to the conventional linear economic approach, which is characterized by a "take–produce–consume–dispose" logic that depletes resources and generates significant waste (Kirchherr et al., 2017). In contrast, the circular economy emphasizes sustainability, regeneration, and the efficient use of resources.

Figure 1 visually compares these two models of economic development. The traditional linear model is depicted as a one-way flow, where materials are extracted, transformed into products, consumed, and ultimately discarded. On the other hand, the circular model promotes a closed-loop system that aims to minimize waste

and maximize the use of existing resources through activities such as reuse, repair, renovation, and recycling. This paradigm shift encourages long-term thinking and resource efficiency, which aligns closely with sustainable development goals (Murray et al., 2017). In the tourism sector, applying circular economy principles involves integrating eco-innovations across business operations—from sustainable infrastructure and energy-efficient technologies to waste reduction practices and local sourcing. These strategies lead to operational cost savings, improved brand image, and strengthened relationships with environmentally conscious consumers. For example, circular practices in hospitality may include reusing linens, repurposing materials in hotel renovations, or offering digital services to reduce paper consumption (Bocken et al., 2016).

Moreover, embracing circularity allows tourism enterprises to contribute to the green transformation of the economy while enhancing their competitiveness. It supports broader policy goals such as the European Green Deal and the UN Sustainable Development Goals, especially SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action) (UNWTO, 2022; Ellen MacArthur Foundation, 2019).

By integrating circular economy strategies, the tourism industry can become a driver of sustainable regional development and resilience, benefiting not only the environment but also the local economies and communities in which it operates.

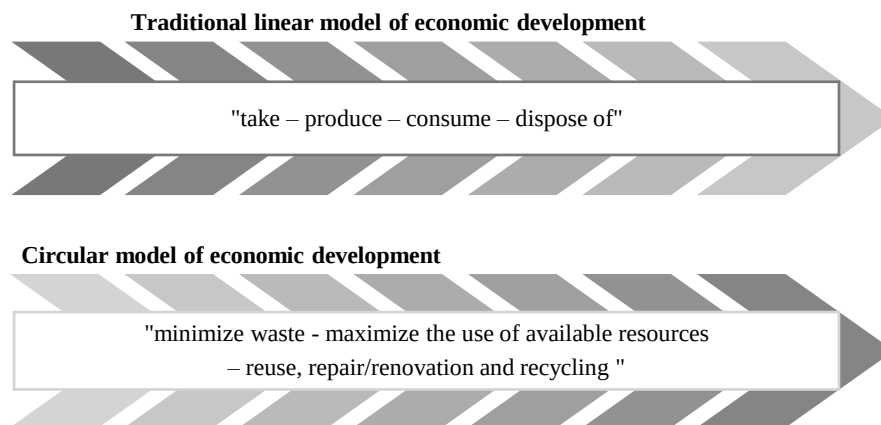


Figure 1. Comparison of traditional model and circular model of development

Source: own elaboration

Business implications of environmental Innovations

In the current age, environmental innovation has become part of business growth and strategy, especially in businesses that are by nature resource-demanding, such as tourism. Increasing climate and environmental issues have made firms realize the strategic value of sustainable innovation. The value is seen as a source of compliance and reputation as well as competitive advantage and survival in the long term (Bocken et al. 2016; Kraus et al. 2020).

Application of circular economy practices in the tourism sector has a high potential for transforming the industry into a sustainability paradigm. Reducing waste, energy consumption, water usage, and local resource loops that keep the influence on the environment to a minimum while creating economic renewal are examples of such practices. The "Zero Waste Hotel" initiative in Slovenia is a good case that shows how the hospitality business can minimize waste in general by separating all, composting, avoiding single-use plastics, and more (Díaz-Sarachaga et al., 2022; Zhang et al., 2024). Additionally, the Accor Hotels chain pioneered intensive sustainability measures like reducing the use of single-use plastics, installing rainwater harvesting systems, and providing eco-friendly transportation options. It is an addition to their longer-term "Planet 21" strategy, which aims to balance environmental and business performance (Antonova et al., 2021). Easy examples of urban tourist systems in action include Copenhagen's and Amsterdam's shared bicycles. These programs lower greenhouse gas emissions, boost regional economies, and satisfy travellers' growing desire for eco-friendly transportation options (Gössling, 2013).

From a business standpoint, environmental innovation promotes stakeholder relationship building, risk mitigation, differentiation, and cost reduction. Businesses that invest in green technology have a better chance of growing in the years to come in a market where consumers are becoming more conscious of environmental issues and regulations are becoming stricter. Environmental innovation is not only beneficial for business, but also essential in the tourism industry, where the quality of the natural and cultural surroundings has a significant impact on customer satisfaction (Kirchherr et al., 2017; Becken, 2019; UNWTO, 2022). Lastly, green innovations and the concepts of the circular economy are not utopian. They are concrete tools and techniques that assist businesses in becoming profitable while maintaining a sense of responsibility, particularly in industries like tourism that function at the intersection of the economy, the environment, and society.

Experimental-circular economy tool in tourism

Based on scientific abstraction of the circular economy principles and their intersection with the tourism industry, several gaps in research can be identified, particularly in the area of micro-regional and cross-border tourism development (Akhimien et al., 2021). For the purposes of this study, emphasis was put on a demarcated area between two countries—Poland and Slovakia—i.e., the border area linked by the High Tatras. This area is not just a significant natural and environmental area but also a socially and economically integrated tourist area. The tourism industries in this area, especially after the disruptions caused by the COVID-19 pandemic, are under significant pressure to innovate, bounce back, and become more resilient. Here, one of the research questions at its core is whether small and medium-sized tourism businesses (SMEs), and particularly those in the accommodation industry, are integrating circular economy tools as part of their post-pandemic renewal plans.

A conceptual model of essential circular tools in tourism businesses is presented in Figure 2, which also serves as the analytical framework of the research. The model divides innovations into six main areas:

- Waste Management Innovations, e.g., sorting, recycling technology, and the introduction of circular economy systems;
- Water Management Innovations, such as rainwater collection, water quality monitoring, and water-conservative irrigation;
- Technical and Material Equipment Innovations, all being concerned with energy-saving systems, eco-friendly building materials, and intelligent building technology;
- Automation and Robotics Innovations, featuring self-control systems and collaborative robots for maintenance and servicing activities;
- Landscape Architectures and Aesthetic Public Spaces Innovations, such as green roofs, intelligent lights, and multifunctional areas that are functional as well as induce environmental quality.

These are not only theoretical but are real channels through which the concepts of circular economy can be tackled in tourism infrastructure and management (Bocken et al., 2016; Díaz-Sarachaga et al., 2022).

Watching these characteristics within the Polish–Slovak border region offers insightful views on whether local SMEs are able to realize the added value created by these instruments, how intensively they apply them, and what helps or hinders their application. The comparative approach to two regions within two different national contexts allows for cross-border knowledge transfer and harmonization of environmentally sustainable practices. It also assists in building resilience in mountain tourism, whose management and protection of the environment sustainably is not only required for long-term business success but also for safeguarding natural and cultural heritage (UNWTO, 2022).

This research hence aims to bridge an empirical gap in knowledge by examining the internalization of circular economy principles at the micro-regional level within tourism enterprises which are still in the process of recovering from system shocks and need innovative strategies for sustainable development.

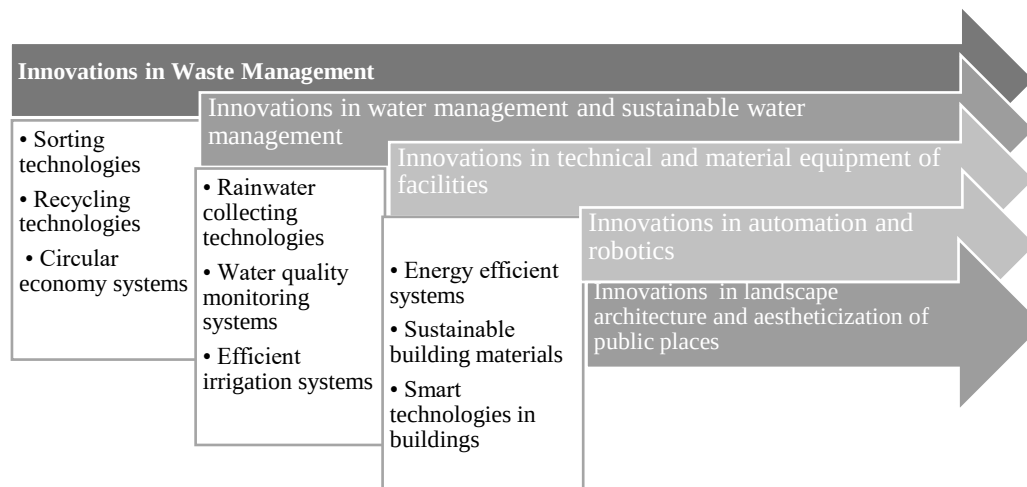


Figure 2. Model of basic circular tools in tourism establishments

Source: own elaboration

The authors aim to reveal how are the principles of the circular economy and their application perceived by accommodation services businesses in tourism, using the example of the bordering region of Poland and the Slovakia, and what tools of circular economy accommodation service companies in tourism are the most applied in the bordering region of Poland and Slovakia.

3. Research objective and methodology

The main aim of the paper is to provide a closer insight into the implementation of circular economy strategy tools into the operation of accommodation services businesses in the bordering area of Poland and Slovakia. Several research methods were chosen to create this research and obtain its comprehensive data. The theoretical and pilot concept of theoretical foundations was dominated by the method of scientific abstraction (Sanganyado, 2019; Yee, 2019). Based on the important findings of the theoretical concept, an author's questionnaire was created, which was oriented towards determining the attitude of accommodation service companies towards the application of circular economy principles in their operations. Questionnaire research as a method of conducting quantitative research has been described by many authors as ideal for data collection (Taherdoost, 2022; Ranganathan & Caduff, 2023). Respondents forming the research sample in both countries (Poland, Slovakia), i.e., small and medium-sized enterprises providing accommodation services in the Tatra region (Małopolska Voivodeship, Prešov Self-Governing Region) were approached to participate in the research from December 2024 to March 2025. The data collection was conducted using a combination of targeted sampling and convenience sampling. This approach subsequently led to a snowball effect, where participating enterprises recommended other cooperating accommodation providers to take part in the survey. The formulation of the questionnaire was projected into the MS Forms platform, from which the results were processed in MS Excel. The initial data were subsequently processed using descriptive statistics tools and later evaluated using more advanced statistical methods.

The questions in the questionnaire were based on a pre-implemented scientific abstraction focusing on tools contributing to the efficient operation of the principles of the circular economy. The content orientation was directed towards elements related more to the buildings of these enterprises, their equipment and their operations. The services themselves and the use of similar tools in them have already been given attention in another paper and published (Dzurov Vargová & Matušíková, 2025). All participating enterprises were enterprises classified as small and medium-sized, with no more than 250 employees, and were selected due to their dominance in the local market.

In the selection of a questionnaire-based research methodology, the validity and reliability of the resulting data constitute fundamental criteria. As emphasized in study (Labudová & Fordanová, 2023), these attributes represent essential prerequisites for any research instrument utilized within the framework of quantitative inquiry. Alongside characteristics such as objectivity, replicability, and the statistical generalizability of outcomes, they underpin the foundational principles of rigorous quantitative research. The administered questionnaire was specifically designed to assess attitudes toward the implementation of pro-environmental practices within tourism enterprises.

The questionnaire was created on six basic questions. First two questions were identification questions determining the size of the facility by the number of employees (specifically the division into small and medium-sized enterprises) and the second identifying feature was the location of the company where it provides its services within (the country: Slovakia - Prešov self-governing region/ Poland - Województwo małopolskie). Next three were focused to the perception of companies providing accommodation services of current circular economy options and tools and their importance in terms of competitiveness, stability and promotion of the business. The sixth question aimed to determine the most popular circular economy tools that they have so far applied to their operations, and which they also consider to be essential as the starting point (based on their current experience). Question regarding the size of the enterprise was built on a dichotomous scale dealing with the location (Slovakia/Poland). Question regarding the size of the enterprise was also built on a dichotomous scale with the options micro enterprise (less than 10 employees) and small enterprises (more than 10 and less than 50 employees), such as the standard division of micro and small enterprises, for example according. Their selection was intentional (targeted), as small, medium or micro enterprises play a significant role in the Slovak, Polish but also the European economy. For example, according to data from the Slovak Business Agency, small and medium-sized enterprises (SMEs) in our country make up 99.9% of the total number of business entities, provide employment opportunities for almost 75% of the active workforce and contribute to gross production and added value creation by more than 50%. Question 3, 4 and 5 were set on a 5-point Likert scale. According to Joshi et al. (20215) the selected method is appropriate for the present research context. The Likert scale, originally developed by Resins Likert, remains one of the most widely utilized forms of summative rating scales within educational and social science research. In the context of circular economy practices, the tools currently implemented by the participants in their operations serve as both a point of reference and a foundation, informed by their practical experience. The last question focused to the identification of what tools of circular economy the companies prefer to be applied, based on 7 options of which 4 were evaluated as the most relevant.

The total composition of the research sample was 186 micro and small businesses in the neighbouring border region of the Tatra Mountains. These were private companies operating in the tourism market in the guesthouse category. The key services provided in companies are based on accommodation services together with catering services. The data collected during the pilot phase were processed using Microsoft Excel, employing tools for descriptive statistical analysis. Initial descriptive results indicated an overall positive perception of circular economy tools among respondents. From a methodological point of view, as mentioned, the main method was questionnaire research focused on the views of companies providing accommodation services in connection with the deployment of circular economy tools.

The Mann-Whitney U-test was used to evaluate the hypotheses. For evaluation of ordinal-level data (responses on a Likert scale) where two independent groups could be compared, the Mann-Whitney U-test is highly appropriate. The Mann-Whitney U-test is a non-parametric statistical test used to evaluate whether there is a statistically significant difference between two independent groups on an ordinal or continuous outcome variable. In the context of this research, where responses were collected using Likert-scale items—representing ordinal data—the Mann-Whitney U-test is appropriate for evaluating differences in perceptions or attitudes between two independent groups (e.g., company types, size categories, or geographic locations). This test does not assume interval-scale data or normal distribution and is robust for assessing central tendency differences in ranked data.

Formulation of the hypotheses:

H0: The opinion on the principles of the circular economy and their application perceived by accommodation services businesses in tourism, using the example of the bordering region of Poland and Slovakia is the same.

H1: There are statistically significant differences in the perception of circular economy principles and their application in accommodation enterprises between companies operating in Slovakia and those operating in Poland.

H2: There are statistically significant differences in the perception of circular economy principles and their application in accommodation enterprises between micro and small tourism enterprises.

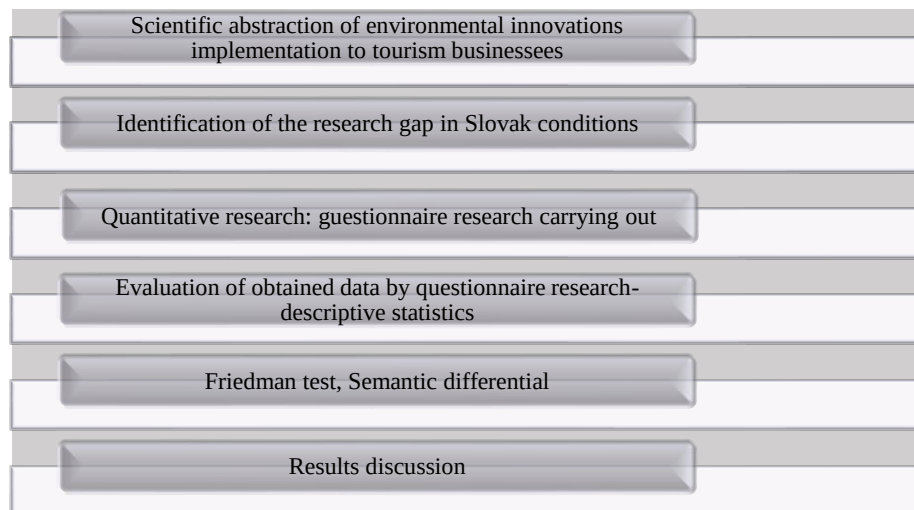


Figure 3. Methodological processes sequences

Source: own elaboration

4. Results and discussion

The research sample of the present research project was made up of enterprises providing accommodation services within the tourism sector. Their location was important, which focused on enterprises operating in the Carpathian Arc region, for example, the High Tatras. These form a natural border between the states of Poland and Slovakia. They are characterized by significant tourism performance and a high rate of attendance. Since the study was an international collaboration, this area was identified as suitable for the study and therefore the selection criteria were: an area with the same potential for tourism development, a region showing significant tourism performance, representation of a wide range of accommodation service enterprises in them and representation of a significant rate of small and medium-sized enterprises. 220 enterprises were approached in a pilot study. A total of 186 enterprises participated in the study. On both sides of the mountain range (both countries). The level of willingness to participate in the questionnaire research was therefore 84.5%.

Table 1. Distribution of research sample (tourism accommodation service companies) according to the country of the operation

Country	No. of participating companies	Cumulative frequency	Relative frequency	Cumulative relative frequency
Poland (Województwo małopolskie)	95	186	51.08%	100%
 Slovakia (Prešov region)	91	91	48.92%	48.92%
 Total	186	186	100%	100%

Source: own elaboration

Table 1 presents the distribution of the research sample according to the country of operation of the accommodation enterprises. The sample consists of 186 accommodation service companies, of which 95 operate in the Polish part of the cross-border region (Małopolskie Voivodeship) and 91 operate in the Slovak part (Prešov region). The relatively balanced distribution of respondents between the two regions allows for a comparative analysis of circular economy practices among accommodation enterprises operating in the Slovak–Polish cross-border tourism area.

Perception of applying circular economy tools in accommodation services

To analyse the perception of circular economy tools in accommodation enterprises, questionnaire research was used as the main research method. The questionnaire focused on four key research questions:

Q Question formulation:

Q1: Are circular economy tools perceived as a key element in setting the development strategy of the company?

Q2: Are circular economy tools perceived as a source of competitive advantage over other accommodation facilities providing these services?

Q3: Are circular economy tools perceived as an opportunity to reach environmentally aware tourism participants and build the company's marketing strategy?

Q4: Which circular economy tools are most frequently applied by accommodation enterprises?

The first three questions were evaluated using descriptive statistical methods and the results are presented in Tables 2, 3 and 4. Individual responses were measured using a five-point Likert scale ranging from agree, rather agree, neither agree nor disagree, rather disagree, to disagree. The questionnaire was completed by managers of accommodation facilities whose responses reflect their knowledge and practical experience with the implementation of circular economy principles in tourism enterprises.

Table 2. Key tool in setting out the development strategy of the company

Question 1	Frequency	Cumulative frequency	Relative frequency	Cumulative relative frequency
Agree	101	101	54.30%	54.30%
Rather agree	67	168	36.02%	90.32%
Neither agree nor disagree	16	184	8.60%	98.92%
Rather disagree	1	185	0.54%	99.46%
Disagree	1	186	0.54%	100%

Source: Own elaboration

The results presented in Table 2 indicate a strong positive perception of circular economy tools among accommodation enterprises. More than half of the respondents (54.30%) agreed and an additional 36.02% rather agreed that circular economy tools represent a key element in setting the company's development strategy. Only a very small proportion of respondents (1.08%) expressed disagreement with this statement. These results suggest that the majority of accommodation enterprises perceive circular economy principles not only as an environmental initiative but also as an important strategic component of business development in tourism enterprises.

Table 3. Circular economy tools perceived as a source of competitive advantage for accommodation enterprises.

Question 2	Frequency	Cumulative frequency	Relative frequency	Cumulative relative frequency
Agree	74	74	39.78%	39.78%
Rather agree	75	149	40.32%	80.10%
Neither agree nor disagree	32	181	17.21%	97.31%
Rather disagree	4	185	2.15%	99.46%
Disagree	1	186	0.54%	100%

Source: Own elaboration

The results presented in Table 3 indicate that circular economy tools are widely perceived as a potential source of competitive advantage among accommodation enterprises. A total of 80.10% of respondents either agreed (39.78%) or rather agreed (40.32%) that the implementation of circular economy tools can strengthen the competitive position of accommodation facilities. Only a small proportion of respondents (2.69%) expressed disagreement with this statement. These findings suggest that tourism enterprises increasingly perceive circular economy practices not only as environmental measures but also as strategic instruments that may enhance competitiveness and market positioning within the tourism sector.

Table 4. Circular economy tools perceived as a marketing opportunity to reach environmentally aware tourists.

Question 3	Frequency	Cumulative frequency	Relative frequency	Cumulative relative frequency
Agree	83	83	44.62%	44.62%
Rather agree	77	160	41.40%	86.02%
Neither agree nor disagree	20	180	10.75%	96.77%
Rather disagree	4	184	2.15%	98.92%
Disagree	2	186	1.08%	100%

Source: Own elaboration

The results presented in Table 4 demonstrate that circular economy tools are widely perceived as an effective marketing instrument for reaching environmentally aware tourists. A total of 86.02% of respondents either agreed or rather agreed with this statement, while only 3.23% expressed disagreement. These findings suggest that circular economy practices are increasingly viewed not only as operational sustainability measures but also as strategic marketing tools that may enhance the attractiveness of accommodation enterprises for environmentally conscious tourists.

Overall, the results presented in Tables 2–4 indicate a consistently positive perception of circular economy tools among accommodation enterprises. Respondents most frequently associated circular economy practices with strategic business development, competitive advantage and marketing opportunities. These findings suggest that circular economy principles are increasingly integrated into managerial decision-making within tourism enterprises.

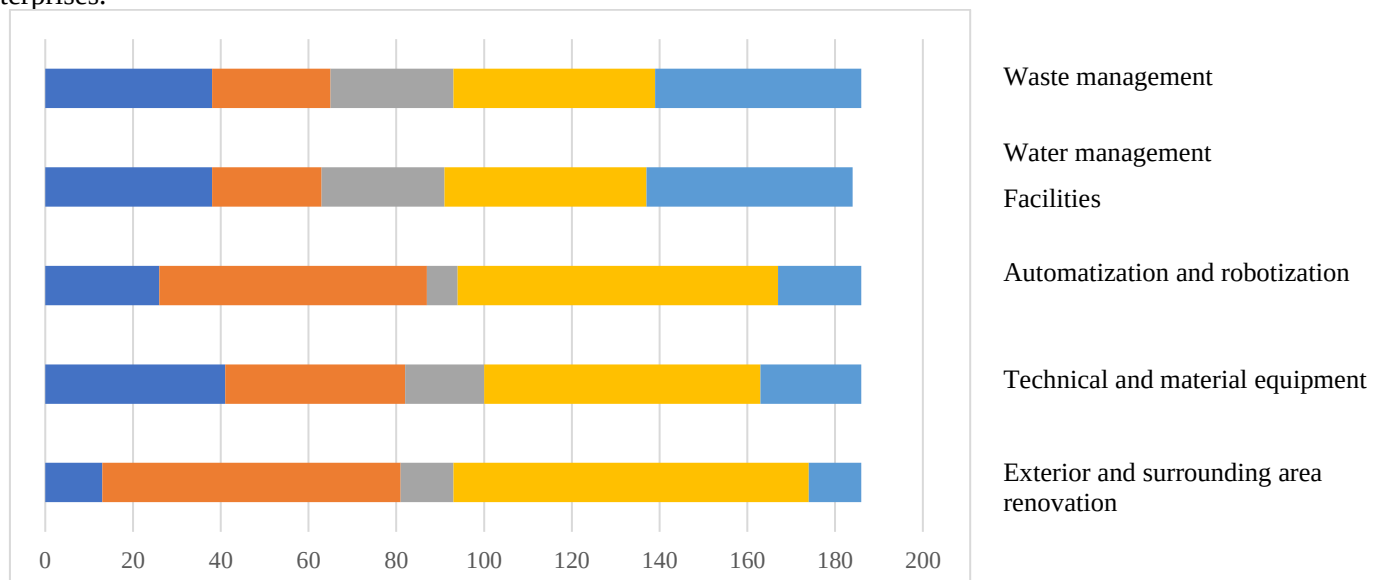


Figure 4. Implementation of concrete type of tools of circular economy

Source: Own elaboration

Legend:

yes rather yes neither yes or neither no rather no no

Figure 4 presents the most frequently implemented circular economy tools among accommodation enterprises. The results indicate that enterprises most commonly apply practices related to waste reduction, efficient water management and energy saving measures. These practices represent the most accessible forms of circular economy implementation within small tourism enterprises. Since the analysed variables were structured into two categories according to the place of operation (Slovakia/Poland) and company size (micro enterprise/small enterprise), the data were treated as ordinal variables and the assumption of normal distribution was not met. Therefore, non-parametric statistical methods were applied to test the hypothesis concerning differences in the perception of circular economy tools between accommodation enterprises operating in the Slovak and Polish parts of the cross-border region. In this case, the Mann-Whitney U test was applied. The first grouping variable represented the country of operation, where 0 indicated Slovak enterprises and 1 indicated Polish enterprises. The subsequent analysis therefore examines whether statistically significant differences exist between accommodation enterprises operating in the Slovak and Polish parts of the cross-border region. These differences may reflect variations in environmental policy implementation, financial support schemes for sustainability initiatives and different levels of awareness of circular economy principles in tourism enterprises.

Differences according to country of operation

The Mann-Whitney U test revealed statistically significant differences between Slovak and Polish enterprises in the perception of circular economy tools ($U = 4797.5$, $Z = -12.05$, $p < .001$). Therefore, the null hypothesis was rejected and Hypothesis H1 was confirmed.

Differences according to enterprise size

The Mann-Whitney U test also revealed statistically significant differences according to enterprise size ($U = 6110.5$, $Z = -10.79$, $p < .001$). The null hypothesis was rejected and Hypothesis H2 was confirmed.

The statistically significant cross-border differences indicate that circular economy perception is strongly embedded in national and institutional contexts. The very strong effect size ($r = 0.88$) suggests that these differences are not marginal but structurally relevant. This finding supports the argument of Kraus et al. (2020) that environmental innovation adoption is influenced by regulatory frameworks, financial support mechanisms, and market expectations rather than solely by managerial willingness. The significant variation between micro and small enterprises ($r = 0.79$) further confirms that organizational capacity plays a decisive role in sustainability integration. Smaller enterprises often face financial, technological, and human resource constraints, which may slow the implementation of circular practices. Similar structural barriers have been documented Díaz-Sarachaga et al. (2022), who emphasize that firm size and access to institutional support significantly determine sustainability performance in tourism. While previous studies have frequently focused on large urban destinations or multinational hotel chains, the present findings provide empirical evidence from a peripheral alpine border region, demonstrating that sustainability transitions in tourism are uneven and context-dependent. This reinforces the view that circular economy adoption in tourism should be analysed not only at the firm level but also through a regional and institutional lens. These findings further highlight the potential importance of digital passportization systems as analytical tools capable of systematically monitoring sustainability indicators and circular economy practices within tourism destinations.

Interpretation of research findings

The research focused on examining the perception and implementation of circular economy practices among micro and small accommodation enterprises operating in the Slovak-Polish cross-border region. In particular, the study aimed to answer the following research questions:

RQ1: Do accommodation enterprises perceive circular economy tools as an important element of their business development strategy?

RQ2: Do accommodation enterprises perceive circular economy tools as a potential source of competitive advantage?

RQ3: Do accommodation enterprises perceive circular economy practices as an opportunity to reach environmentally aware tourists through marketing activities?

RQ4: What types of circular economy tools are most frequently implemented in accommodation enterprises?

The results of the descriptive statistical analysis confirmed that circular economy tools are widely perceived as strategically important by accommodation enterprises. A large majority of respondents agreed or rather agreed that circular economy practices play an important role in the development strategy of tourism enterprises. This finding provides empirical support for RQ1 and indicates that sustainability principles are increasingly integrated into the strategic thinking of tourism enterprises.

Similarly, the results confirmed that circular economy practices are perceived as a potential source of competitive advantage. Most respondents expressed agreement that the implementation of circular economy tools may strengthen the market position of accommodation facilities. This finding provides empirical support for RQ2 and suggests that circular economy practices may contribute to competitiveness in tourism enterprises. The analysis also confirmed that circular economy practices are perceived as a marketing opportunity for reaching environmentally aware tourists. A large proportion of enterprises recognised that sustainability initiatives may enhance the attractiveness of tourism services for environmentally conscious customers. These findings provide empirical support for RQ3 and highlight the growing importance of sustainability communication in tourism marketing. Regarding RQ4, the results presented in Figure 4 indicate that the most frequently implemented circular economy practices among accommodation enterprises include waste reduction measures, water management improvements and energy-saving solutions. These practices represent the most accessible and operationally feasible forms of circular economy implementation for micro and small tourism enterprises.

Finally, the application of the Mann–Whitney U test allowed the identification of statistically significant differences in the perception of circular economy tools between accommodation enterprises operating in the Slovak and Polish parts of the cross-border region. The results provide insights into how national context and institutional environments may influence the adoption of circular economy practices in tourism enterprises.

Limitations of the Study

This study has several limitations that should be considered when interpreting the results. First, the research was geographically limited to micro and small accommodation enterprises operating in the Slovak–Polish cross-border region (High Tatras area), which may limit the generalizability of the findings to other tourism destinations or larger tourism markets. Second, the study focused exclusively on micro and small enterprises and did not include medium-sized or large accommodation providers, whose approaches to circular economy practices may differ. The data were collected using self-report questionnaires completed by managers and owners, which may introduce potential response biases, including social desirability bias or differing interpretations of circular economy concepts. Furthermore, the study applied a cross-sectional research design, capturing the perception of circular economy practices at a specific point in time during the post-pandemic recovery period (December 2024 – March 2025). Tourism market conditions and business attitudes may continue to evolve as the sector stabilizes. From a methodological perspective, the use of the Mann–Whitney U test allowed the identification of differences between groups but did not enable the analysis of more complex relationships between variables that could be explored using multivariate statistical techniques. Finally, the study relied solely on quantitative data, and the inclusion of qualitative methods could provide deeper insights into the motivations and barriers influencing the adoption of circular economy practices in tourism enterprises. Future research could therefore apply longitudinal approaches to examine the development of circular economy adoption over time and explore the integration of circular economy indicators into emerging digital passportization systems designed for monitoring sustainability performance in tourism destinations.

Conclusions

The article focused on identifying attitudes and analyzing circular economy tools in tourism enterprises while also examining the potential role of digital passportization as a supporting analytical mechanism for monitoring and evaluating sustainability practices. The results indicate that systematic digital passportization of tourism enterprises and infrastructure can provide an important information base for planning renewal, reconstruction and sustainability-oriented investments in accordance with the principles of circular economy. The study examined the perception and selected application of circular economy tools among micro and small accommodation enterprises operating in the Slovak–Polish cross-border region. The findings demonstrate a

strong overall recognition of circular economy practices as strategically important for development planning, competitiveness, and marketing positioning. Statistical analysis revealed significant differences in the perception of circular economy tools depending on both countries of operation and enterprise size. The effect size for cross-border differences was very strong ($r = 0.88$), indicating substantial variation between Slovak and Polish enterprises. Significant differences were also identified between micro and small enterprises ($r = 0.79$), suggesting that organizational capacity and structural characteristics may influence sustainability perception and strategic integration. These findings imply that the adoption and internalization of circular economy principles are not uniform across the studied region. National institutional environments, policy frameworks, and levels of business maturity may play a decisive role in shaping attitudes toward sustainability innovations. From a practical perspective, targeted policy instruments, cross-border knowledge exchange, and advisory mechanisms tailored specifically to micro enterprises may accelerate the diffusion of circular practices. The results highlight the need for differentiated support strategies rather than uniform sustainability programs. Although the study is limited to a specific alpine border region and relies on self-reported perceptions, it contributes empirical evidence to the discussion on circular economy integration within small-scale tourism enterprises. Future research should explore the underlying drivers of cross-border differences and incorporate qualitative methods to better understand managerial motivations and implementation barriers. The results suggest that circular economy practices implemented by accommodation enterprises may provide an important empirical foundation for the development of digital passportization systems aimed at monitoring sustainability performance within tourism destinations.

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