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# INTEGRATED FUZZY MODEL FOR ASSESSING CULTURAL TOURISM POTENTIAL IN ETHNO-VILLAGES

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**Abstract.** This research examines the alignment of ethno-villages with cultural tourism to assess their commitment to preserving cultural values but attracting tourists in order to increase the efficiency of the economy, also. By engaging tourism experts, this research categorizes criteria into distinct groups and uses an integrated fuzzy set approach to assess the cultural tourism potential of these destinations. By combining Improved Fuzzy SWARA (Step-Wise Weight Assessment Ratio Analysis) and fuzzy WASPAS (Weighted Aggregates Sum Product Assessment) methods with the Fuzzy DOMBI operator, the research presents a methodology to address uncertainties in decision-making. The IMF SWARA method determined the criteria's significance by assigning weights, while the fuzzy WASPAS method introduced uncertainty into the decision-making process through Z-numbers. The findings highlight ethno-villages like Ljubačke Doline and Kotromanjić, demonstrating admirable dedication to cultural immersion in their tourism offerings. These ethno-villages can serve as examples of how culture, tradition, and customs can be smoothly integrated to improve the tourism experience and economic system as a whole.

**Keywords:** cultural tourism, ethno-villages, MCDM, Z-numbers, IMF SWARA, fuzzy WASPAS, economic system.

**JEL Classification:** C44, C61, D81, Z32.

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## 1. Introduction

The global spread of informatics has accelerated globalization, leading to cultural shifts worldwide. In response, there is an increasing need to protect national cultural identities by actively maintaining the unique customs and traditions of each country. Preserving a people's culture has become crucial in regional tourism development. An increasing number of tourists are visiting specific destinations to experience the unique culture of a nation (Zandieh & Seifpour, 2020). As a result, some urban and rural areas are transforming into prominent tourist centers, known for their rich cultural and natural heritage, which further drives their growth (Đukanović et al., 2021).

Consumerism in tourism increasingly overshadows local traditions and cultures with universal values. Preserving a nation's culture has a significant influence on regional tourism development, while tourism, in turn, impacts the conservation of cultural heritage. A destination's appeal affects the protection of local culture, helping preserve fading traditions and craftsmanship (Duxbury et al., 2021). Communities must understand this mutual relationship, aiming to protect their culture and traditions. Culture should be central to the tourist experience, using a destination's cultural and natural assets as unique attractions (Grilli et al., 2021).

The integration of cultural offerings within tourism mainly occurs through ethno-tourism, which focuses on a nation's traditions and heritage (Prevolšek et al., 2020). This promotes cultural engagement for both foreign and domestic tourists. A key trend is preserving culturally significant objects and constructing or relocating historical artifacts using traditional techniques. This inspired the creation of ethno-villages that authentically represent rural life before industrialization (Hudović Kljuno & Halilovic, 2020), where tourists can interact with and experience these villages (Gabor et al., 2023).

However, a concern exists about how much these ethno-villages prioritize cultural tourism. Previous studies questioned whether they were mainly driven by commercial interests or a genuine desire to preserve cultural heritage (Čiča & Mlinar, 2010). A significant issue with the tourist attractions in such villages is their often insular and one-sided development, typically driven by individual efforts without proper consultation with relevant institutions and experts (Čiča & Mlinar, 2010). As a result, some ethno-villages may fail to accurately portray the historical reality of life in these areas, with the primary goal being to quickly generate income by capitalizing on the appeal of these villages (Raspor et al., 2020). There is also growing interest in their sustainability practices (Prevolšek et al., 2020).

Against this background, the key research question arises: to what extent do ethno-villages help promote and preserve a nation's culture and traditions, and are local customs and culture genuinely maintained in these settings? Despite existing research, a gap remains in understanding whether ethno-villages were truly created to protect traditions and cultural identity. This paper aims to explore the core motivations behind their creation and operation.

To explore this, a two-part approach is proposed: first, to assess how effectively local customs and culture are promoted within these villages, and second, to provide guidelines for using tourism to preserve cultural heritage – a key motivation behind this research. The methodology will rely on expert evaluations and employ the Multi-Criteria Decision-Making (MCDM) technique, which is according to Liao et al. (2022) often used in tourism industry, because according to Tan et al. (2025) performance evaluation is an important topic of concern in the tourism industry. The study will identify key criteria for evaluating the villages and then assess them based on these criteria. This will lead to a thorough evaluation of how well they incorporate culture into tourism. Finally, the findings will provide guidelines for conserving and leveraging culture for tourism, based on empirical evidence and expert insights.

Based on the above, this research is guided by the following objectives:

- To investigate the preservation and promotion of culture within ethno-villages.
- To assess how much observed ethno-villages integrate culture into their tourist experiences.

- To develop a comprehensive research model that systematically examines the preservation and use of culture within ethno-villages. We have integrated two MCDM methods in a unique model to provide the best and precise results based on the considered inputs. Additionally, applying Z numbers in WASPAS method allows better handling of consistency.

The research's contribution lies in its ability to offer insights into the following questions:

- To what extent do ethno-villages act as centers for preserving a specific community's culture in their local setting?
- To what extent is culture integrated into the tourist experience in ethno-villages?
- Can tourists gain a genuine understanding of a specific culture by visiting these ethno-villages?
- Is it possible to include uncertainty when evaluating ethno-villages through expert decision-making?
- Can a combination of different MCDM methodologies effectively assess the cultural aspects of ethno-villages?
- To what extent can the research model be used to address broader research questions?

The above questions form the central hypothesis of this paper: whether Bosnia and Herzegovina's ethno-villages can prosper through cultural tourism.

## 2. Literature review

Ethno-villages are vibrant centers of cultural tourism, representing indigenous culture, tradition, and heritage (Li et al., 2021). These settlements attract travelers seeking engaging experiences in local customs and heritage (Walter, 2019). They go beyond traditional tourism by encouraging visitors to participate in daily life, rituals, and craftsmanship actively (Shen & Chou, 2020). Ethno-villages serve as both keepers and creators of indigenous heritage (Benedetti, 2021).

Cultural preservation is central to ethno-villages (Ćurčić et al., 2021). These villages stand as guardians against globalization, dedicated to safeguarding traditions that shape their communities. They serve as living repositories, preserving and representing customs, lifestyles, and artistry that have been passed down through generations (Wu et al., 2022a). Visitors are active participants in this vibrant cultural tapestry (Wu et al., 2022b).

Tourist ethno-villages have developed in the Western Balkans, primarily in Bosnia and Herzegovina and Serbia (Prevolšek et al., 2020), as these regions offer an ideal setting due to their rich cultural heritage and natural resources (Hudović Kljuno & Halilovic, 2022). Ethno-villages showcase community culture through traditional architecture (Čiča & Mlinar, 2010) and foster rural entrepreneurship, boosting economic growth (Simić, 2015) and jobs (Raspor et al., 2020). They help revitalize rural areas by preserving local identity and cultural integration (Medojevic et al., 2011). Their development is based on recreating historical village aesthetics using intellectual capital (Radivojević & Makuljević, 2022). While architecture is preserved, interiors are often modernized to meet the needs of tourists (Trišić, 2020).

Cultural tourism's success depends on diverse factors (Bajrami et al., 2020; Mandić & Kennell, 2021; Mureşan et al., 2019; Febryano et al., 2022; Rahmawati et al., 2023). Research on

cultural tourism through ethno-villages has primarily focused on both material and immaterial aspects of culture (Hudović & Halilović, 2022), as well as the sustainability and rural impact of tourism (Prevolšek et al., 2020; Simić, 2015). MCDM methods help assess intangible aspects, such as preservation, experiences, and sustainability (Wei et al., 2021), offering a structured way to evaluate and prioritize complex criteria essential for researchers and practitioners. Integrating MCDM methods into cultural tourism research offers several advantages. It enables researchers to quantify layered elements, guiding decisions on the development and management of cultural destinations. MCDM provides a framework for weighing criteria that influence success, whether for ethno-villages or other attractions, balancing cultural authenticity, economic viability, and visitor satisfaction (Zhao et al., 2023), thereby improving decision-making.

For example, Huang and Nguyen (2022) discuss the balance between Indigenous cultural preservation and economic development through tourism. They present a mixed MCDM model using the fuzzy Analytic Hierarchy Process (FAHP) and the fuzzy Technique for Order Preference by Similarity to Ideal Solution (FTOPSIS) to help tribes select optimal cultural tourism modes, identifying material, institutional, and spiritual culture as key ranking criteria. Taghi Zad Fanid and Qudsi (2022) propose a framework using the Step-Wise Weight Assessment Ratio Analysis (SWARA) and Additive Ratio Assessment (ARAS) to select tourism villages based on governance criteria, including transparency, accountability, rule of law, participation, effectiveness, consensus, legitimacy, and equality. With SWARA weighting criteria and ARAS ranking villages, the results highlight participation as a key factor in good governance. Ştefan et al. (2021) explore the topic using cultural heritage in rural areas to redefine local development. They develop a decision-making model using qualitative research and an improved Analytical Hierarchy Process (AHP) to benefit from lesser-known heritage assets in international markets. Validated through a pilot in Southern Transylvania, Romania, the study highlights the significance of trademark potential and cultural tourism routes, offering insights for local authorities to use heritage for economic growth. Mahaptra et al. (2023) examine India's rural tourism sector, a key GDP contributor. Using an Analytical Hierarchy Process (AHP) model with data from 206 tourists and 25 experts, they identify nine main factors, with cultural factors being the most influential, followed by heritage and local quality.

Past studies used classical or fuzzy MCDM methods, ignoring decision uncertainty. The cultural aspect was often combined with economic and environmental factors (Mahaptra et al., 2023), lacking focus on the cultural dimension alone. This paper addresses these gaps by focusing on the cultural aspects of ethno-villages and considering uncertainty using Z-numbers.

## 3. Materials and methods

When evaluating the level of cultural tourism in ethno-villages, a questionnaire was developed to measure the use of culture for tourism while also preserving the culture and traditions of a specific nation. The criteria for assessing ethno-villages were divided into four main criteria. Based on the references, each criterion was further analyzed with four sub-criteria to evaluate the eight ethno-villages selected:

- Criterion C1 – Cultural Environment (Huang & Nguyen, 2022; Hou & Zhang, 2022; Lin et al., 2021);
- Criterion C2 – Quality of Cultural Offerings (He et al., 2021; Lin et al., 2021; Prevolšek et al., 2020);
- Criterion C3 – Preservation and Promotion of Culture (Prevolšek et al., 2020; Huang & Nguyen, 2022; He et al., 2021);
- Criterion C4 – Interaction and Cultural Education (Huang & Nguyen, 2022; Zheng et al., 2022; He et al., 2021; Prevolšek et al., 2020).

By selecting four main criteria, the study aimed to incorporate dimensions of cultural tourism to analyze ethno-villages (Huang & Nguyen, 2022; He et al., 2021; Prevolšek et al., 2020). Sub-criteria within these groups address specific elements of cultural tourism, offering a comprehensive understanding of the importance of ethno-villages and their role in preserving and transmitting culture. These criteria balance both material and non-material aspects of cultural heritage. Including additional criteria, such as economic or environmental, would require conducting different research that would not align with the set objectives of this paper.

To enhance research quality, ten tourism experts from Bosnia and Herzegovina, specializing in cultural, ethnic, and rural tourism, assessed the importance of certain criteria based on their professional judgment. Initially, 23 experts were identified; 14 agreed to participate, but only 10 completed the survey. These experts, affiliated with academic institutions and tourism stakeholders (including managers, NGOs, and travel agencies), have extensive practical and theoretical experience in ethno-villages, cultural tourism, and rural development. The group includes university professors, researchers, and representatives from travel agencies, offering a balanced perspective for evaluating the criteria.

This assessment focuses on a research sample of ethno-villages' cultural promotion rather than all villages. Bosnia and Herzegovina lacks a comprehensive register of these facilities in its tourism offerings, making it difficult to establish a foundational dataset. To address this gap, information from the websites and portals of rural tourism associations and agencies was examined, resulting in a list of 28 ethno-villages. These villages feature structures resembling ancient buildings, equipped with modern amenities. While similar, they do not fall into distinct categories, as all offer a combination of traditional and modern facilities to attract tourists. A random sampling method was then used, starting with an alphabetically organized list of all registered ethno-villages. From this list, eight villages were randomly selected, representing 28.5% of the total, to better illustrate how cultural tourism is applied and provide insights for future applications. The sample size was considered sufficient to ensure diversity and to test the research model. The primary goal was not to include every ethno-village but to demonstrate the model's applicability, which can be adapted to other villages. The sample villages were as follows:

- Ethno-village Čardaci (E-V 1): Located near the town of Vitez, this village features a complex of small houses. Guest services include traditional cuisine, a water park, and a souvenir shop. There are 60 accommodations with a total of 150 beds in this ethno-village. All the interior materials reflect the style of an old Bosnian house;

- Ethno-village Dodig (E-V 2), situated near Drvar, offers a variety of recreational activities, including horseback riding and cycling. Guests can enjoy scenic views of the surrounding mountains or river from their accommodations. The village has a total capacity of 10 beds and features a conference room suitable for seminars and conferences;
- Ethno-village Dolina Sreće (E-V 3): Located near Vitez, this village offers 10 holiday homes. Its services include local cuisine, a riding track, swimming pools, and various other activities. The total capacity of the ethno-village is for 20 people. Some holiday homes feature a jacuzzi, enhancing the tourist experience;
- Ethno-village Kotromanićevo (E-V 4): Located on the banks of the river Veličanka, this village offers accommodations with 30 beds in houses built from natural materials, surrounded by forest. During the summer, visitors can enjoy a restaurant, a beach volleyball court, and an ethno-market within the premises. Recreational activities such as paragliding, cycling, and mountaineering are available, and hunting and fishing can also be organized;
- Ethno-village Ljubačke Dolina (E-V 5): Located in Ljubačevo, this ethno-village functions as an open-air museum. All objects within the village are authentic and have been relocated from different locations. The village has a capacity of 10 beds, spread across three rooms. There is a multi-purpose hall where various seminars and conferences can be held. Additionally, near the village are the Ljubačke Doline, natural hollows in the ground several hundred meters deep;
- Ethno-village Natura Art (E-V 6) is located in Lohovo, nestled along the Una River. It offers various services in the traditional ambiance of old Bosnian houses, water mills, and forges. The village features six apartments, each accommodating up to 4 people, and also has a wellness center. Leisure activities include using sports fields and kayaking on the Una River;
- Ethno-village Remić (E-V 7): Located in Menjik, this village is perfectly situated for both summer and winter tourism. It features a motorcycle trail and a trim trail with a walking path. Recreational horseback riding services are also available. The ethno-village has a capacity of 25 beds, spread across five houses. Nearby mountains such as Vranica, Crni Vrh, Rabbit Mountain, Čvrsnica, and Ivan Mountain provide opportunities for mountain tourism;
- Ethno-village Semešnica (E-V 8): Located on the banks of the Semešnica River near Donji Vakuf, this village offers a menu focused solely on local cuisine. The buildings are crafted in an authentic Bosnian style. Accommodation is provided in three houses, each with four beds. Within this ethno-village, there are 19 trout ponds. Visitors can also enjoy the company of horses, donkeys, ducks, birds, hens, peacocks, and swans.

These ethnovillages are located in different regions across Bosnia and Herzegovina, with the majority found in the central part of the country.

Once the criteria and alternatives for this research were established, a research model was developed as the basis for creating the survey questionnaire. After the surveys are distributed to experts for completion, the collected data is processed, and the results are calculated. To determine these results, both the IMF SWARA method and the Z-fuzzy WASPAS (Weighted Aggregates Sum Product Assessment) method based on the Fuzzy DOMBI operator (Jana &

Pal, 2023; Saha et al., 2022) will be applied. The IMF SWARA method is used to determine the weights of the main and sub-criteria. At the same time, the WASPAS method is used to rank the selected ethno-villages based on their alignment with the research criteria and to identify which ethno-village best meets the research objectives. Additionally, result validation and sensitivity analysis will be conducted.

## 3.1. Preliminaries

To conduct this research, expert opinions expressed in linguistic terms will be used, and fuzzy numbers will be employed to interpret these ratings. Their role is to convert linguistic expressions into fuzzy numbers using a membership function (Table 1).

**Table 1.** Membership function

| Linguistic terms | TFN | Linguistic value | Fuzzy number B |
|---|---|---|---|
| Absolutely bad (AB) | (1, 1, 2) | Very small (VS) | (0, 0, 0.2) |
| Very bad (VB) | (2, 3, 4) | Small (S) | (0.1, 0.25, 0.4) |
| Bad (B) | (3, 4, 5) | Medium (M) | (0.3, 0.5, 0.7) |
| Medium bad (MB) | (4, 5, 6) | High (H) | (0.55, 0.75, 0.95) |
| Equal (E) | (5, 6, 7) | Very high (VH) | (0.8, 1, 1) |
| Medium good (MG) | (6, 7, 8) | | |
| Good (G) | (7, 8, 9) | | |
| Very good (VG) | (8, 9, 10) | | |
| Absolutely good (AG) | (9, 10, 10) | | |

Once linguistic expressions are converted into fuzzy numbers, it becomes necessary to perform operations with these fuzzy numbers (Bobar et al., 2020). If we have two fuzzy numbers, $\tilde{A}_1 = (a_1, b_2, c_3)$ and $\tilde{A}_2 = (l_1, m_2, n_3)$, the operations conducted with these fuzzy numbers are as follows:

Addition:

$$\tilde{A}_1 + \tilde{A}_2 = (a_1, b_2, c_3) + (l_1, m_2, n_3) = (a_1 + l_1, b_2 + m_2, c_3 + n_3); \quad (1)$$

Subtraction:

$$\tilde{A}_1 - \tilde{A}_2 = (a_1, b_2, c_3) - (l_1, m_2, n_3) = (a_1 - n_3, b_2 - m_2, c_3 - l_1); \quad (2)$$

Multiplication:

$$\tilde{A}_1 \times \tilde{A}_2 = (a_1, b_2, c_3) \times (l_1, m_2, n_3) = (a_1 \times l_1, b_2 \times m_2, c_3 \times n_3); \quad (3)$$

Division:

$$\tilde{A}_1 \div \tilde{A}_2 = (a_1, b_2, c_3) \div (l_1, m_2, n_3) = (a_1 \div n_3, b_2 \div m_2, c_3 \div l_1). \quad (4)$$

However, what makes this research stand out is the use of z-numbers. Including these numbers in the alternative evaluation accounts for the confidence level that the decision-maker, usually an expert, has in their assessments. To use these numbers further, they must be converted into traditional fuzzy numbers. If a z-number is represented as Z = (A, B), where A is a fuzzy number representing the linguistic evaluation, and B is a fuzzy

number indicating the dependency on fuzzy number A, it can be expressed as follows: $\tilde{Z} = \left\{\left(a_1, a_2, a_3; Z_A\right), \left(b_1, b_2, b_3; Z_B\right)\right\}$. The transformation is carried out as follows (Štilić et al., 2023):

**Step 1.** Converting B fuzzy number to a crisp number:

$$\alpha = \frac{b_1 + b_2 + b_3}{3}. \tag{5}$$

**Step 2.** Adding the weighted B fuzzy number to A fuzzy number:

$$\tilde{Z}^{\propto} = \left\{x, \mu_{A^{\alpha}}(x) \middle| \mu_{A^{\alpha}}(x) = \alpha\mu_A(x)\right\}. \tag{6}$$

**Step 3.** Converting the weighted Z-number into a regular fuzzy number:

$$\tilde{Z}' = \left\{x, \mu_{Z'}(x) \middle| \mu_{Z'}(x) = \mu_A\left(\frac{x}{\sqrt{\propto}}\right)\right\}; \tag{7}$$

$$\tilde{Z}' = \sqrt{a} \cdot \tilde{A} = \left(\sqrt{a} \cdot a_1, \sqrt{a} \cdot a_2, \sqrt{a} \cdot a_3\right). \tag{8}$$

## 3.2. IMF SWARA method

The IMF SWARA method was initially introduced in research conducted by Vrtagić et al. (2021). This method follows the same steps as the fuzzy SWARA method (Zolfani et al. 2021; Damjanović et al., 2024; Karaca et al. 2025); the only distinction lies in the scale of values used (Table 2).

**Table 2.** Membership function in the IMF SWARA method

| Linguistic variable | Abbreviation | TFN scale | | |
|---|---|---|---|---|
| absolutely less significant | ALS | 1 | 1 | 1 |
| dominantly less significant | DLS | 1/2 | 2/3 | 1 |
| much less significant | MLS | 2/5 | 1/2 | 2/3 |
| really less significant | RLS | 1/3 | 2/5 | 1/2 |
| less significant | LS | 2/7 | 1/3 | 2/5 |
| moderately less significant | MDLS | 1/4 | 2/7 | 1/3 |
| weakly less significant | WLS | 2/9 | 1/4 | 2/7 |
| equal significant | ES | 0 | 0 | 0 |

The method comprises the following steps:

**Step 1.** Identification of criteria, determination of their importance, and sorting based on priority (Keršulienė et al., 2010).

**Step 2.** Evaluation of criteria weights based on linguistic expressions (Stević et al., 2022; Badi & Bouraima, 2023).

**Step 3.** Determination of the relative importance of criteria (Keršulienė & Turskis, 2012). For the remaining criteria, the values $\tilde{s}_j$ are obtained by transforming linguistic expressions into fuzzy numbers based on their membership degree (Table 3).

$$\tilde{k}_j = \begin{cases} 1 & \text{if } j = 1 \\ \tilde{s}_j + 1 & \text{if } j > 1 \end{cases}. \tag{9}$$

**Step 4.** Recalculating the relative importances as $\tilde{q}_j$. The value of $\tilde{k}_j$ is assigned to the highest-ranked criterion as $\tilde{q}_j$, and the value of $\tilde{q}_j$ for the next ranked criterion is calculated by dividing the value of $\tilde{q}_j$ for the previous criterion by the value of $\tilde{k}_j$ of that criterion:

$$\tilde{q}_j = \begin{cases} 1 & \text{if } j = 1 \\ \dfrac{\tilde{q}_j - 1}{\tilde{k}_j} & \text{if } j > 1 \end{cases}. \tag{10}$$

**Step 5.** Computation of the criteria's weight. In this step, the individual values $q_j$ for the criteria are divided by the sum of the values $q_j$ for all criteria.

$$\tilde{w}_j = \frac{\tilde{q}_j}{\sum_{j=1}^{n} \tilde{q}_k}. \tag{11}$$

These weights will be used in fuzzy form.

### 3.3. Fuzzy WASPAS method

The WASPAS method was initially employed by Zavadskas et al. (2012) in their research. This method is a fusion of two techniques: the Weighted Sum Model (WSM) and the Weighted Product Model (WPM) (Rao & Sujatha, 2023). The specific steps for implementing these methods are as follows:

**Step 1.** Formation of the initial fuzzy decision matrix. During this process, experts evaluate alternatives based on observed criteria. Since Z-numbers are used, experts provide two evaluations for each alternative. First, they assess the alternatives relative to the observed criteria using a linguistic expression that represents a fuzzy A number. Then, they rate their confidence in the initial assessment using a linguistic expression that represents a fuzzy B number.

**Step 2.** Transformation of the z-number into a standard fuzzy number, as explained by Eqs (5)–(8).

**Step 3.** Normalization of the transformed initial decision matrix:

$$r_{ij} = \frac{x_{ij}^{l}}{\max x_j^{u}}, \frac{x_{ij}^{m}}{\max x_j^{u}}, \frac{x_{ij}^{u}}{\max x_j^{u}}, \text{ for benefit criteria;} \tag{12}$$

$$r_{ij} = \frac{\min x_j^{l}}{x_{ij}^{l}}, \frac{\min x_j^{l}}{x_{ij}^{m}}, \frac{\min x_j^{l}}{x_{ij}^{u}}, \text{ for cost criteria.} \tag{13}$$

**Step 4.** Weighting the normalized decision matrix.

$$\tilde{v}_{ij} = \left(v_{ij}^{l}, v_{ij}^{m}, v_{ij}^{u}\right) = \tilde{r}_j \times \tilde{w}_j. \tag{14}$$

**Step 5.** Determining the values of the optimality function:

$$Q_i = \sum_{j=1}^{n} v_{ij}. \tag{15}$$

Determining the WSM method's value for each alternative.

$$P_i = \prod_{j=1}^{n} (v_{ij})^{\tilde{w}_j}. \tag{16}$$

Determining the WPM method`s value for each alternative.

**Step 6.** Defuzzification of the values obtained by the WSM and WPM methods.

$$Q\left(\tilde{m}\right) = \frac{Q_1 + Q_2 + Q_3}{3}, \tag{17}$$

$$P\left(\tilde{m}\right) = \frac{P_1 + P_2 + P_3}{3}. \tag{18}$$

**Step 7.** In this step, the decision-maker evaluates the significance of the results from the WSM and WPM methods, and the final outcome is established as a compromise between these two results.

$$K_i = \lambda \sum_{j=1}^{m} Q_i + \left(1 - \lambda \sum_{j=1}^{m} P_i\right). \tag{19}$$

## 4. Results

During the research process for this paper, experts initially assessed the importance of the criteria used and then evaluated the selected ethno-villages. To identify which ethno-village best promotes cultural tourism, it is necessary to establish the weights of the criteria (Table 3). The IMF SWARA method was used to determine these weights. The experts first evaluated the main criteria, followed by the sub-criteria.

To harmonize the values and derive the final assessments from all experts, the Fuzzy DOMBI operator is used. This operator helps determine the weights for the main criterion. Then, a similar process is applied to calculate the weights for all sub-criteria (Table 4). The final values for the main criteria are obtained by multiplying the main criteria values by those of the sub-criteria.

**Table 3.** Weighing calculation of the main criteria using the IMF SWARA method.

| E1 | $s_j$ | $k_j$ | $q_j$ | $w_j$ |
|---|---|---|---|---|
| C1 | | (1.000, 1.000, 1.000) | (1.000, 1.000, 1.000) | (0.275, 0.278, 0.281) |
| C3 | (0.000, 0.000, 0.000) | (1.000, 1.000, 1.000) | (1.000, 1.000, 1.000) | (0.275, 0.278, 0.281) |
| C2 | (2/9, 1/4, 2/7) | (1.222, 1.250, 1.286) | (0.778, 0.800, 0.818) | (0.214, 0.222, 0.230) |
| C4 | (0.000, 0.000, 0.000) | (1.000, 1.000, 1.000) | (0.778, 0.800, 0.818) | (0.214, 0.222, 0.230) |
| SUM (3.556, 3.600, 3.636) | | | | |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| E10 | $s_j$ | $k_j$ | $q_j$ | $w_j$ |
| C2 | | (1.000, 1.000, 1.000) | (1.000, 1.000, 1.000) | (0.334, 0.345, 0.359) |
| C1 | (1/4, 2/7, 1/3) | (1.250, 1.286, 1.333) | (0.750, 0.778, 0.800) | (0.251, 0.268, 0.287) |
| C4 | (2/9, 1/4, 2/7) | (1.222, 1.250, 1.286) | (0.583, 0.622, 0.655) | (0.195, 0.215, 0.235) |
| C3 | (2/9, 1/4, 2/7) | (1.222, 1.250, 1.286) | (0.454, 0.498, 0.536) | (0.152, 0.172, 0.192) |
| SUM (2.787, 2.898, 2.990) | | | | |

**Table 4.** Weight values of sub-criteria obtained by the IMF SWARA method

| | Weights | | Weights | | Weights | | Weights |
|---|---|---|---|---|---|---|---|
| C1 | (0.230, 0.242, 0.253) | C2 | (0.242, 0.254, 0.267) | C3 | (0.240, 0.251, 0.262) | C4 | (0.224, 0.236, 0.248) |
| C11 | (0.058, 0.063, 0.068) | C21 | (0.053, 0.059, 0.065) | C31 | (0.056, 0.062, 0.067) | C41 | (0.049, 0.054, 0.060) |
| C12 | (0.054, 0.059, 0.064) | C22 | (0.059, 0.064, 0.070) | C32 | (0.055, 0.060, 0.065) | C42 | (0.056, 0.061, 0.067) |
| C13 | (0.050, 0.055, 0.060) | C23 | (0.053, 0.059, 0.065) | C33 | (0.057, 0.063, 0.068) | C43 | (0.059, 0.064, 0.070) |
| C14 | (0.054, 0.059, 0.064) | C24 | (0.061, 0.066, 0.072) | C34 | (0.055, 0.060, 0.065) | C44 | (0.045, 0.051, 0.057) |

After the weights for the criteria were established through expert evaluations, the process of calculating and ranking the ethno-villages was carried out. The first step in ranking these villages involved evaluating the selected ethno-villages using sub-criteria. Initially, experts assessed how well each ethno-village met the specified criteria, assigning linguistic values to fuzzy number A. Next, the experts expressed their confidence in these assessments using linguistic values for fuzzy number B. As a result, an expert-led linguistic evaluation of the ethno-villages was created (Table 5). To manage these values, operations for z-numbers were performed.

**Table 5.** Linguistic assessments of ethno-villages by experts

| E1 | C11 | | C12 | | C13 | | C14 | | C21 | | C22 | | C23 | | ... | C44 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| fuzzy | A | B | A | B | A | B | A | B | A | B | A | B | A | B | ... | A | B |
| E-V 1 | AG | H | E | H | G | H | VG | H | MG | H | MB | H | G | H | ... | VG | H |
| E-V 2 | G | H | VG | H | MB | H | MG | H | G | H | E | H | B | H | ... | MB | H |
| E-V 3 | G | H | AG | H | VG | H | E | H | MG | H | G | H | MB | H | ... | MG | H |
| E-V 4 | VG | M | AG | M | MG | M | G | M | MB | M | G | M | VG | M | ... | AG | M |
| E-V 5 | E | VH | G | VH | MG | VH | VG | VH | MB | VH | G | VH | MG | VH | ... | VG | VH |
| E-V 6 | MG | M | E | M | G | M | VG | M | MB | M | E | M | VG | M | ... | AG | M |
| E-V 7 | G | M | VG | M | MG | M | VG | M | E | M | MG | M | AG | M | ... | MB | M |
| E-V 8 | VG | M | G | M | MB | M | MG | M | AG | M | VG | M | G | M | ... | VG | M |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| E10 | C11 | | C12 | | C13 | | C14 | | C21 | | C22 | | C23 | | ... | C44 | |
| fuzzy | A | B | A | B | A | B | A | B | A | B | A | B | A | B | ... | A | B |
| E-V 1 | E | VH | MG | VH | VG | VH | MG | VH | VG | VH | MG | VH | VG | VH | ... | MG | VH |
| E-V 2 | VG | H | G | H | E | H | VG | H | VG | H | G | H | MG | H | ... | VG | H |
| E-V 3 | E | VH | G | VH | MG | VH | E | VH | MG | VH | VG | VH | G | VH | ... | G | VH |
| E-V 4 | G | H | MG | H | VG | H | E | H | MG | H | G | H | MG | H | ... | MG | H |
| E-V 5 | E | VH | G | VH | G | VH | VG | VH | VG | VH | G | VH | G | VH | ... | VG | VH |
| E-V 6 | MG | H | G | H | G | H | VG | H | G | H | MG | H | G | H | ... | VG | H |
| E-V 7 | VG | VH | G | VH | G | VH | G | VH | G | VH | G | VH | G | VH | ... | G | VH |
| E-V 8 | MG | H | E | H | VG | H | G | H | MG | H | G | H | MG | H | ... | VG | H |

To determine the initial decision-making matrix (Table 6), it is necessary to harmonize the experts' evaluations. This is done similarly to the IMF SWARA method, using the Fuzzy DOMBI operator. This decision matrix serves as the starting point for calculating the value in the fuzzy WASPAS method.

The next step in the fuzzy WASPAS method was normalization. As the WASPAS method includes both WSM and WPM, calculations for both methods were performed. Once these elements were calculated, addition was executed for WSM, while WPM involved the multiplication of corresponding elements of fuzzy numbers. This produced values $Q_i$ and $P_i$ (Table 7). To calculate the final ranking order, these values needed to be defuzzified, and the average values of these two methods were calculated, with their results being given equal weight by multiplying by 0.5. This approach ensured that both methods contributed equally to the final ranking. The results indicated that ethno-village E-V 5 achieved the top ranking, followed by ethno-village E-V 4, while ethno-village E-V 3 recorded the lowest performance (Table 7).

The Z-WASPAS results highlight Ljubačke Doline (E-V 5) as the top performer in cultural tourism development, with Kotromanićevo (E-V 4) following closely behind. These villages serve as model examples, setting a standard for others to follow. Ljubačke Doline serves as an outdoor museum, providing visitors with an experience of regional history. Moving forward, other ethno-villages should aim to replicate their success to boost cultural tourism further.

**Table 6.** Summary fuzzy decision matrix for ethno-villages

| | C11 | C12 | C13 | C14 | ... | C44 |
|---|---|---|---|---|---|---|
| E-V 1 | (5.06, 5.99, 6.86) | (5.23, 6.12, 7.01) | (6.15, 7.06, 7.88) | (6.53, 7.44, 8.17) | ... | (4.91, 5.82, 6.72) |
| E-V 2 | (5.92, 6.81, 7.70) | (5.07, 5.99, 6.90) | (3.54, 4.53, 5.47) | (5.00, 5.89, 6.78) | ... | (4.05, 5.00, 5.94) |
| E-V 3 | (4.94, 5.84, 6.74) | (4.48, 5.40, 6.28) | (3.17, 4.19, 5.16) | (4.82, 5.74, 6.61) | ... | (4.31, 5.24, 6.16) |
| E-V 4 | (5.67, 6.57, 7.46) | (5.98, 6.91, 7.76) | (5.49, 6.44, 7.38) | (6.25, 7.19, 8.06) | ... | (6.30, 7.23, 8.07) |
| E-V 5 | (5.47, 6.42, 7.36) | (6.88, 7.81, 8.75) | (6.60, 7.55, 8.42) | (7.33, 8.27, 9.13) | ... | (7.81, 8.75, 9.34) |
| E-V 6 | (5.74, 6.63, 7.47) | (5.84, 6.72, 7.59) | (5.55, 6.44, 7.32) | (7.15, 8.01, 8.64) | ... | (5.18, 6.10, 6.95) |
| E-V 7 | (5.60, 6.49, 7.38) | (4.91, 5.84, 6.76) | (3.24, 4.30, 5.29) | (5.96, 6.85, 7.74) | ... | (4.71, 5.62, 6.52) |
| E-V 8 | (6.23, 7.11, 7.92) | (5.50, 6.38, 7.26) | (4.52, 5.43, 6.32) | (6.28, 7.15, 8.02) | ... | (4.47, 5.37, 6.27) |

**Table 7.** Results of the WASPAS method

| | $Q_i$ | | | $Q_d$ | $P_i$ | | | $P_d$ | $K_i$ | Rank |
|---|---|---|---|---|---|---|---|---|---|---|
| E-V 1 | 0.52 | 0.67 | 0.84 | 0.673 | 0.57 | 0.70 | 0.82 | 0.698 | 0.686 | 4 |
| E-V 2 | 0.45 | 0.60 | 0.76 | 0.600 | 0.48 | 0.62 | 0.75 | 0.621 | 0.611 | 7 |
| E-V 3 | 0.42 | 0.57 | 0.73 | 0.568 | 0.45 | 0.59 | 0.72 | 0.588 | 0.578 | 8 |
| E-V 4 | 0.60 | 0.76 | 0.93 | 0.760 | 0.67 | 0.80 | 0.90 | 0.793 | 0.777 | 2 |
| E-V 5 | 0.69 | 0.87 | 1.04 | 0.867 | 0.79 | 0.91 | 0.99 | 0.901 | 0.884 | 1 |
| E-V 6 | 0.49 | 0.63 | 0.80 | 0.637 | 0.52 | 0.66 | 0.78 | 0.655 | 0.646 | 5 |
| E-V 7 | 0.47 | 0.62 | 0.79 | 0.626 | 0.51 | 0.65 | 0.77 | 0.648 | 0.637 | 6 |
| E-V 8 | 0.53 | 0.68 | 0.84 | 0.684 | 0.59 | 0.71 | 0.82 | 0.711 | 0.698 | 3 |

*Notes*: $Q_i$ _ Fuzzy WSM values, $Q_d$ – defazified $Q_i$, $P_i$ – Fuzzy WPM values, $P_d$ – defazified, $P_i$, $K_i$ – final values of variants.

To confirm these results, a validation process will be used. This process relies on the same initial decision matrix and identical weights, but different multi-criteria analysis methods are applied to determine the final ranking (Đukić et al., 2022; Radovanović et al., 2023). Using this validation has become a common practice in applying multi-criteria analysis methods (Pamučar et al., 2019; Khan et al., 2023; Biswas et al., 2023; Hadžikadunić et al., 2023, Baydaş et al., 2024). In this study, besides the WASPAS method, six other methods will be used, all in the form of Z-numbers: fuzzy MARCOS (Measurement of Alternatives and Ranking according to the Compromise Solution), fuzzy SAW (Simple Additive Weighting), fuzzy MABAC (Multi-Attributive Border Approximation area Comparison), fuzzy ARAS, fuzzy TOPSIS, and fuzzy CRADIS (Compromise Ranking of Alternatives from Distance to Ideal Solution). The FMARCOS, FSAW, FTOPSIS, and FCRADIS approaches will examine how their steps affect the ranking of alternatives, while the FMABAC and FARAS methods will assess the impact of different normalization techniques. These methods use different normalization procedures compared to the FWASPAS method. The results show that all methods produce the same ranking order, confirming the results obtained with the Z-WASPAS method (Figure 1).

In addition to this analysis, a sensitivity analysis (Figure 2) is performed to evaluate how changes in the importance of individual criteria affect the ranking of alternatives (Gao et al., 2025; Kou et al., 2025; Więckowski et al., 2023). In this analysis, the weight of each criterion is adjusted by 30%, resulting in its weight varying from 70% to 40% and then down to 10% of its original value. Since there are 16 criteria, this analysis covers 48 scenarios (Figure 2). The results show that the rankings of ethno-villages E-V 6 and E-V 7 changed in only two scenarios, as shown in Figure 2. This occurred because ethno-village E-V 6 received higher expert evaluations for criteria C13 – Variety of Facilities and C24 – Availability of Souvenirs and Handicrafts. When the importance of these criteria was decreased, ethno-village E-V 7 moved ahead of E-V 6 in the rankings. Therefore, E-V 7 could improve its ranking by strengthening these specific criteria. Despite this, the analysis indicates that all ethno-villages kept their original rankings.

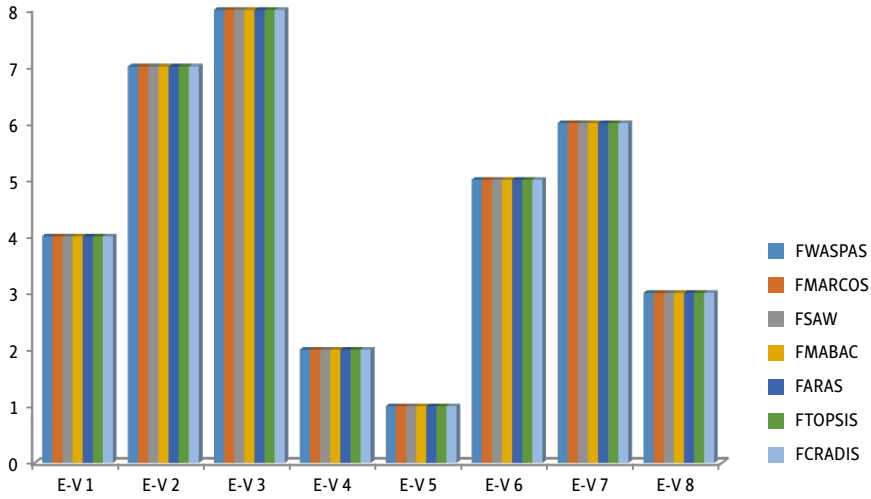


**Figure 1.** Validation of ranking results

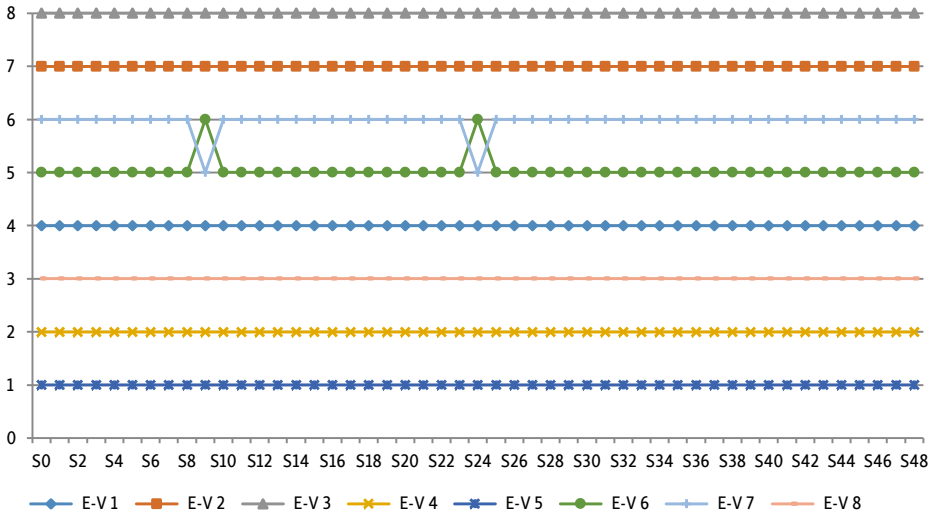


**Figure 2.** Sensitivity analysis

Further analyses confirm that E-V 5 is the top-ranked ethno-village, with E-V 4 close behind, while E-V 3 ranks the lowest among the observed villages. It is important to note that these rankings are based on the current evaluation, and those with lower scores might consider strengthening their cultural tourism efforts to improve their promotion in this sector. Additionally, some ethno-villages primarily focus on cultural tourism to maximize profits, often prioritizing other types of tourism within their overall offerings.

## 5. Discussion

Cultural identity attracts tourists (Masoud et al., 2019), who seek new experiences and diverse cultures (Han et al., 2019). Ethno-villages showcase a nation's traditions, giving visitors a glimpse into past life (Hudović & Halilovic, 2022), and this study examines how cultural tourism elements are integrated into these villages.

To investigate this, 16 criteria were used, divided into four main areas. The first assesses ambiance, focusing on the authenticity of buildings and placement, which attracts tourists with visual appeal. The second examines the quality of offerings, including cultural products, souvenirs, and handicrafts that showcase regional culture. The third evaluates how offerings support local culture and traditions, with traditional cuisine helping preserve cultural heritage. The fourth examines educational services, where tourists learn about culture through customs, activities, and traditions (Li et al., 2021). These criteria evaluate the state of cultural tourism in the ethno-villages.

The initial step involved establishing a set of 28 ethno-villages in Bosnia and Herzegovina, from which villages were randomly selected for observation to ensure fairness. Eight villages were selected by generating random numbers and assessed based on the criteria provided by experts. Due to limited information, experts used z-numbers to express confidence levels, taking into account uncertainty. The Z-WASPAS method was applied, introducing uncertainty into the initial decision matrix and steps that followed.

The results of this research showed that Ethno-Villages Ljubačke Doline (E-V 5) performed the best, a finding also confirmed by sensitivity analysis. The sensitivity analysis indicated that changes in the weights did not affect the ranking of the ethno-villages, except for E-V 6 and E-V 7, demonstrating that the model used is robust and that the rankings of these villages were not due to chance, but rather the result of expert assessments. The reason for these results lies in the fact that the ethno-village Ljubačke Doline is highly ranked due to the authenticity of its offerings, making the ethno-village an open-air museum. The ethno-village Kotromanjićevo is highly ranked because it combines cultural and modern tourist attractions.

Other ethno-villages are designed to appear as if they were built 150 years ago, but are not entirely authentic. Therefore, it is recommended that lower-ranked ethno-villages focus on authenticity and improve their educational content, allowing them to better showcase aspects of cultural tourism to visitors and tourists. Alongside cultural tourism, ethno-villages often provide additional services to meet tourists' expectations better. While the unique ambiance attracts visitors, offering complementary amenities is crucial for improving their overall experience. Balancing cultural authenticity with extra offerings helps satisfy diverse preferences.

The use of IMF SWARA and ZWASPAS demonstrates the ability to incorporate uncertainty into decision-making processes, and for new methodologies to explore how ethno-villages promote culture through tourism products. Additionally, this framework can be applied in various research contexts involving uncertainty and fuzzy numbers, and further modifications of this approach could be necessary to customize decisions or evaluations of alternatives to the specific needs of different research studies.

## 5.1. Theoretical implications of the research

This paper contributes to understanding cultural tourism, particularly through the concept of ethno-villages. Cultural tourism aims to showcase local customs, with ethno-villages serving as spaces where tourists explore historical artifacts and traditional lifestyles. The research demonstrates how cultural tourism can effectively attract visitors. Ethno-villages preserve old houses by reconstructing or relocating them and furnishing them with period-appropriate items. Visitors can even stay overnight in these authentic settings, blending ethno- and cultural tourism (Prevolšek et al., 2020). Understanding ethno-villages and their tourist services informs the development of cultural tourism, highlighting their role in preserving traditions amid globalization.

## 5.2. Managerial implications of the research

This research provides practical insights into evaluating the current state of cultural tourism implementation, with a focus on ethno-villages as examples. The paper examines the application of cultural tourism through expert opinions, using a uniform linguistic scale for criteria and ethno-villages. The importance of the criteria was determined using the IMF SWARA method, which calculates individual weights, and then harmonized with the fuzzy DOMBI operator. Experts' assessments involve uncertainty, addressed by Z-numbers, and confidence levels are expressed through B fuzzy numbers, giving more weight to highly

confident evaluations. The study's managerial implications relate to the approach used and provide new guidelines for evaluating cultural tourism in ethno-villages, aiding future research and decision-making.

### 5.3. Research limitations and future research directions

Like any research, this study has certain limitations. The first relates to the selection of experts. Due to the lack of tourism experts in Bosnia and Herzegovina, only 10 experts with varying levels of experience were involved. Second is related to the selection of villages for analysis, where certain villages are included and others are excluded. To mitigate this limitation, a random sampling method was employed, ensuring that all villages in the base set had an equal opportunity to be selected for the sample. However, some non-sampled ethno-villages may apply cultural tourism to a greater or lesser extent than the observed ones. Therefore, future research should incorporate other ethno-villages to provide a comprehensive assessment of the state of cultural tourism application in these villages.

Third, it was conducted using an example of an ethno-village from Bosnia and Herzegovina. However, the goal of this study is that future research, by developing the methodology, will focus more on the cultural aspect. Additionally, the methodology used can be applied to other countries with similar traditions and cultures, such as Serbia, Montenegro, and Romania. Still, some criteria need to be adjusted for these countries. The methodological limitations may also relate to the subjective assessment by experts. Therefore, future research should involve both tourists and the local community to gather more comprehensive information about individual ethno-villages, reducing reliance on expert opinions. This approach enables the analysis of the cultural tourism offerings of a single ethno-village, rather than the entire set of ethno-villages. Since the same respondents will not be surveyed across all ethno-villages, this is an advantage of relying on expert opinions. Additionally, future studies should compare similar research in other countries to examine how cultural tourism in ethno-villages varies across different contexts.

Fourth, the criteria used in assessing cultural tourism were limited by previous research, which often combined cultural with economic, social, and ecological aspects. This study focuses solely on cultural elements and does not include other aspects. Therefore, future research should explore additional perspectives, such as ecological or economic analysis.

The choice of research methods can also be a limitation, as some methods are preferred over others. Validating results by comparing different methods is recommended. Future studies should replicate this analysis and consider alternative criterion weightings, although this was beyond the scope of this study.

## 6. Conclusions

Ethno-villages should protect traditions and enrich tourism. However, many prioritize profit over culture, often overshadowing the importance of cultural tourism. Emphasizing cultural tourism can generate revenue while preserving and promoting cultural heritage.

This paper enhances our understanding of cultural tourism, focusing on ethno-villages that base their offerings on a nation's culture and traditions. Research findings were obtained

by employing a unique methodological model to assess the current state of cultural tourism implementation, combined with expert opinions and the application of the IMF SWARA and Z-WASPAS methods. The methodology involved expert opinions to assess how well culture is integrated and whether they preserve local community culture through their services. Experts examined the offerings, evaluating their use of culture and tradition preservation. The IMF SWARA method calculated criteria weights, showing that criteria related to the preservation and promotion of culture (C3) were considered most important.

Using Z-numbers with the fuzzy WASPAS method, ethno-villages were ranked, revealing which embrace cultural tourism and to what extent. Ljubačke Doline and Kotromanjić achieved the best results, validated by multiple MCDM methods and sensitivity analysis. Other ethno-villages should follow their example, as some prioritize tradition and culture as their core offerings, while others add cultural elements solely to attract tourists. Additionally, research results offered guidelines for evaluating the current state of tourism and suggested ways to improve it. According to experts, ethno-villages should focus on preserving and showcasing their culture, creating an authentic atmosphere that enhances the overall tourist experience.

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