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**Assessment of Economic Vulnerability in Tourism Areas:
A Comparative Case Study of
Erhai Lake Area (China) and Balaton Lake Area (Hungary)**

Thesis for the Degree of Doctor of Philosophy (PhD)

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The results published in the thesis are not reported in any other PhD theses.

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**Comparative Assessment of Economic Vulnerability in Lake Area Tourism
Cities: A Comparative Case Study of Erhai Lake Area (China) and
Balaton Lake Area (Hungary)**

Dissertation submitted in partial fulfilment of the requirements for the doctoral (PhD)
degree
in Earth Science

Written by Li Tianyi certified by degree of Master of Science in Desert Studies of Ben-
Gurion University of the Negev

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Abstract

This study addresses the contrasting issues of vulnerability and sustainable development within tourism economies. Recognizing that heightened vulnerability can lead to tourism crises and disrupt sustainability, I delve into the vulnerabilities in the sensitive tourism sector, considering both internal instabilities and external disruptions. My examination is based on two lake regions, Erhai Lake in China and Lake Balaton in Hungary, and I adopt various analytical methods, including set pair analysis, entropy method, and comparative case study.

The dissertation begins by discussing the background, significance, and existing research on vulnerability. This lays the groundwork for an assessment of the balance of industrial structure in both regions, thereby providing an objective view of the tourism landscape.

The study then explores the driving factors of vulnerability within the internal tourism economy system and the external regional composite system. Through the lenses of sensitivity and resilience, an evaluation index for tourism economy vulnerability is established.

Drawing on this evaluative index, the dissertation studies Erhai Lake and Lake Balaton, using a decade's worth of data to assess their tourism economy vulnerabilities. This process allows for an examination of the temporal and spatial variations in these vulnerabilities and the identification of the key hurdles in reducing them.

The study concludes by suggesting sustainable development strategies for each region based on the principles of sustainable tourism. The strategies include acknowledging and addressing vulnerability issues, improving the tourism industry system, responsibly developing tourism resources, and ameliorating the tourism development environment.

The research finds that Erhai Lake region's fast-paced growth calls for economic diversification and enhancement of export capabilities. On the contrary, Lake Balaton region should focus on further industrial diversification and the stabilization of its economic and consumption growth. Both regions can benefit from sharing experiences and strategies. In essence, sustainable development in these regions hinges on striking a balance between resources, population, environment, and cultural preservation, which will bolster their resilience and ensure equitable sharing of growth benefits.

Key word: *tourism economy; economic resilience; vulnerability evaluation of tourism; Obstacle degree analysis; Lakeland tourism destination, regional development; sustainable development*

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1. Introduction

1.1. Background of Topic Selection and Problem Statement

1.1.1. Background to the selection of the topic

Tourism is an economic, cultural and social activity in which human beings take the natural and social environment that has certain characteristics and can satisfy some of their needs as a point of reference, and is a short experience with social, leisure and consumption attributes. Since the industrial revolution in the mid-19th century, with the increasing discretionary income of people, tourism activities have increasingly become a basic necessity for the general public, and the tourism industry has become one of the most promising industries in the world and one of the highlights of the world's economic development.

Lakeland region destinations are tourism areas with lakes as a core feature. These areas are located around lakes and offer tourism activities and services associated with lakes as the main attraction of the natural landscape. The concept of lake destinations emphasises the importance of lakes as a tourism resource and attracts visitors with their unique features such as their natural environment, waterside activities, scenic beauty and cultural heritage. These areas often boast magnificent natural landscapes such as lakes, mountains, forests and grasslands where visitors can enjoy outdoor activities such as boating, fishing, hiking, bird watching and wildlife observation. Lakes also offer visitors a rich variety of water activities such as swimming, sailing, boating, jet skiing, surfing and fishing. In addition, Lakeland region destinations often incorporate a rich cultural and historical heritage and visitors can visit old villages, castles, churches and traditional cultural events to learn about local traditions and folklore. Lakeland region destinations also offer opportunities for relaxation and recreation, where visitors can enjoy the beauty of the lakeside, walk or cycle along the lake, take part in recreational and sports activities, or relax in a lakeside resort. In addition, sustainable development plays an important role in the Lakeland region tourism destination, including limiting construction and development, managing visitor flows and promoting environmental education and awareness-raising to ensure the long-term protection and sustainable use of the lake's resources. Such efforts aim to balance tourism development and natural environmental protection to ensure the sustainability of tourism in the Lakeland region.

Sustainable development in lake tourism destination involves a harmonious development of population, resources, economy, and ecological environment. It requires meeting the demands of rapid economic development while prioritizing

protection of the lakes' ecological environment. In highland lake areas, the fragility of soil and water resources, the irreversibility of water pollution, and the urgency of human development necessitate balancing ecological and environmental restoration, the orderly use of water resources, and steady and rapid economic growth to achieve sustainable development. However, rapid economic development and the exploitation of soil and water resources can cause greater damage to the ecological environment. The contradiction between the scarcity of resources and the infinite desire of human beings is more pronounced in the process of economic and social development in the plateau lake area. Sustainable economic development requires finding a balance between economic growth and ecological protection, while maximizing economic growth within the constraints of resources and environmental conditions. Highland cities and lakes must reconcile the many contradictions between population, economy, resources, and environment to maximize the value of the lakes.

How can tourism activities be truly harmonised with the ecological environment in order to achieve sustainable development of the tourism industry? How can the management of the tourism environment be made more effective in order to eliminate conflicts between components or between components and the external environment and to achieve a harmonious coexistence between 'tourism' and 'ecology'? Only by facing up to the constant 'change' in the tourism ecosystem and including humans in it, by studying the complex interactions and impacts between human tourism activities and the ecosystem, and by enhancing the environment's ability to adjust itself through conscious human action, can the conflict between resources and the environment be effectively resolved and its dynamic sustainability achieved. The essence of facing up to 'change' is to break away from the traditional notions of 'speed' and 'efficiency' and to pay more attention to long-term interests and to the spatial interests of different populations. This systematic concern for human-earth relations is also in line with the central proposition of human geography research.

1.1.2. Problem Formulation and research question

In 1981, Timmerman introduced the concept of vulnerability and applied it to the field of natural hazards, which gradually expanded to include ecology, climate change, land use, sustainable development, and many other fields, developing into a new research paradigm. The concept of economic vulnerability emerged as a result. Currently, vulnerability research has become a research hotspot in sustainable development science.

The tourism industry is rapidly developing and has gradually become an important driving force in the national economy. The proportion of tourism output in GDP continues to grow, and the status of the tourism industry is rising, positioning it as a strategic pillar industry and a modern service industry. However, the industry has not been immune to unexpected crises, such as the global COVID-19 pandemic, which dealt a severe blow to the tourism economy. Tourism is a sensitive industry that is vulnerable to crisis events such as natural disasters, economic crises, and social unrest. The tourism economic system is vulnerable to external perturbations and is prone to reach a state of instability during perturbations. The ecological, social, and economic environments all affect the vulnerability of the tourism economy. At the same time, the internal structure of the system, such as the structure of tourism income and investment, can also greatly affect the vulnerability of the tourism economic system. Tourism economic system vulnerability and sustainable development are relative issues; when the vulnerability is too great, it may cause a tourism crisis and affect the sustainable development of tourism. Therefore, in the process of sustainable tourism development, tourism economic system vulnerability should be given high priority, followed by the implementation of effective regulatory measures. In the two typical tourism regions studied in this research (the Lake Balaton region in Hungary and the Erhai region in Dali, China), tourism is increasing its development as a pulling force for economic development, and is showing a new development trend. However, the issue of vulnerability is a constraint to the sustainable development of regional tourism and must be taken into account. Therefore, the research question of this study is how to qualitatively and quantitatively evaluate the vulnerability of the tourism economic system to boost sustainable tourism development in lake areas.

1.2. Research objectives, hypothesis and significance

1.2.1. Objectives of the study

The objective of this study is to conduct a rigorous assessment of the tourism vulnerability in the Erhai Lake Region in China and the Lake Balaton Region in Hungary. By examining the distinct characteristics and potential risks faced by these prominent tourist destinations, this research aims to provide valuable insights into the vulnerability of their tourism sectors.

Specifically, the study aims to accomplish the following goals:

- 1) Conduct an analysis of the regional industrial structure, assessing the tourism industry's share. Determine the level of tourism specialization in the study area and examine its impact on economic vulnerability.

- 2) Determine the factors that influence the vulnerability.
- 3) Investigate potential strategies for sustainable tourism development.

By accomplishing these study goals, this research seeks to contribute to the existing knowledge on tourism vulnerability assessment and provide valuable insights for policymakers, local communities, and tourism stakeholders in both China and Hungary. The findings will inform the development of effective strategies, policies, and actions to enhance the resilience and sustainability of these lake basin destinations, ensuring their long-term viability as tourist attractions.

Overall, this study aims to deepen our understanding of the complex interplay between tourism, vulnerability, and resilience in the Erhai Lake Region and the Lake Balaton Region, with the ultimate objective of fostering sustainable tourism development in these regions.

1.2.2. Hypothesis

Based on the objectives, the following hypothesis were proposed:

- (1) The regional industrial structure and level of tourism specialization are highly influencing economic vulnerability.
- (2) The vulnerability influence by system sensitivity factors and coping ability factors. And different factors have different level of importance.
- (3) Local policies contribute positively to the sustainable development and full utilisation of tourism resources.

1.2.3. Significance of the research

This study investigates the relationship between tourism destination vulnerability and the sustainable development of tourism resources in two lake areas. It strives to understand the laws governing tourism destination vulnerability and its impact on sustainable development. Using econometric models, both linear and non-linear relationships between vulnerability and sustainability are explored, ultimately providing insights for tourism emergency control. The study's relevance lies in its implications for the following stakeholders:

- **Policy Development:** The research provides policymakers with insights into the vulnerabilities of the Erhai Lake Region (China) and the Lake Balaton Region (Hungary), guiding the creation of policies to mitigate risks and foster sustainable tourism.
- **Community Empowerment:** By identifying local community challenges and adaptive capacities, the research aids in formulating targeted initiatives to bolster resilience and encourage active involvement in sustainable tourism.

- **Tourism Industry Resilience:** The findings support the development of effective risk management strategies, contributing to the resilience of the tourism industry in these regions.
- **Comparative Analysis:** The study's comparison of two distinct lake regions enriches the understanding of tourism vulnerability in such areas, offering adaptable strategies to similar destinations.
- **Research Advancement:** The study deepens theoretical and empirical understanding in the field of tourism vulnerability, providing a valuable resource for future research in lake areas or related contexts.

In conclusion, this research promotes sustainable decision-making, community empowerment, industry resilience, and contributes to a broader comparative analysis and advancement in the field of tourism vulnerability. It carries the potential to stimulate positive change and ensure the long-term success of lake tourism destinations.

1.3. Research content and research method

1.3.1. Research content

Chapter 1: Introduction - Presents the research's background, objectives, design ideas, and an overview of the thesis; **Chapter 2:** Literature Review - Reviews existing research in the field. **Chapter 3:** Research Area Introduction - Describes the area of study; **Chapter 4:** Methodology - Explains the methodology, divided into three sub-topics. **Chapter 5:** Results - Presents the results of the study, organized in three sub-topics; **Chapter 6:** Discussion - Analyzes and discusses the findings; **Chapter 7:** Conclusions and Recommendations - Offers conclusions and potential future directions of tourism development in study areas; **Chapter 8:** Study Overview - Summarizes the entire doctoral research process; **Chapter 9:** Bibliography; **Chapter 10** Annexes - Additional clarifications.

1.3.2. Research Methodology

This research employs various research methods to study the vulnerability of the tourism economic system in the Erhai region and the Balaton Lake area. The following methods are used:

1. Literature analysis method

The literature analysis method is used to sort out and summarize relevant literature. The literature review provides a solid theoretical foundation for the research study. The literature analysis method is an important research method that allows researchers to evaluate and understand existing research on the subject matter and identify gaps in the literature.

2. Quantitative analysis method

The quantitative analysis method is used to analyze the spatial and temporal distribution characteristics and differences of the vulnerability of the tourism economic system in the two regions. Traditional indicators such as standard deviation and coefficient of variation, as well as exploratory spatial data analysis methods, are applied to understand the vulnerability of the tourism economic system. The Obstacle degree method is also applied to analyse the obstacle factors of the vulnerability of the tourism economic system in the two regions, based on the evaluation results of the vulnerability.

3. Comparative research method

This study uses the comparative research method to analyse the impact of overall vulnerability on tourism emergencies. The study also includes the comparative analysis of the variability of economic vulnerability, social vulnerability, and environmental vulnerability on tourism development in the two regions. The comparative research method is an effective research method that allows for the comparison of data across different regions and helps researchers understand the differences and similarities between regions.

4. Inductive comparison and systematic analysis method

The inductive comparison and systematic analysis method is used to draw a general conclusion on the obstacle influence mechanism of tourism destination vulnerability. Based on the analysis of the sensitivity, coping capacity, vulnerability, and obstacle characteristics of the two destinations and the relationship between them, corresponding countermeasures are proposed for the effective control of tourism emergencies and the effective management of tourism destination vulnerability. This research method is an effective way to draw conclusions based on empirical data and identify practical solutions to address the challenges of tourism destination vulnerability.

In conclusion, these research methods are essential for the research study on the vulnerability of the tourism economic system in the Erhai region and the Balaton Lake area. Each method provides valuable insights into the subject matter and helps researchers understand the complex nature of tourism destination vulnerability.

1.4. Research design and framework of research

1.4.1. Research design

- 1) Analysis of the current state of the industry (tourism specialization orientation): This study aims to achieve sustainable economic development in the Erhai Lake area and the Balaton Lake area through a comparative

analysis of typical tourism specialization areas. It focuses on examining the balance of current state of the tourism industry in these regions.

- 2) Impact evaluation (vulnerability of tourism economic development): By conducting a comprehensive literature collection and quantitative data analysis, the study investigates the conceptual system and theoretical framework of economic vulnerability in tourism sites. It evaluates the impact of industrial development on the economic growth of the Erhai Lake area and the Balaton Lake area, specifically analysing the vulnerabilities that may hinder tourism economic development.
- 3) Obstacle degree analysis (constraints to the region and its development): The study assesses the degree of Obstacle degree and constraints that exist in the studied regions, which may impede their overall development. It identifies and analyses the specific factors limiting the growth and progress of the Erhai Lake area and the Balaton Lake area, taking into account their unique characteristics and challenges.
- 4) Sustainable development strategies (assessment and use of tourism resources): Based on theoretical and empirical research, this study proposes corresponding regulatory countermeasures to address the challenges faced by tourist sites. It aims to provide practical strategies and recommendations for sustainable economic development in the tourism industry.

By reorganizing the text into these four distinct sections, the focus and purpose of each aspect of the study are clarified, providing a clearer structure for the reader to follow (shown in Figure 1).

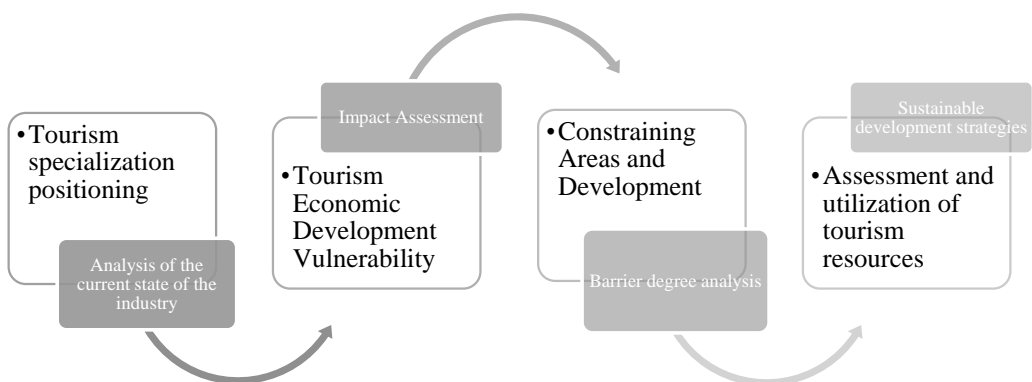


Figure 1. The Research Design (Source: self-drawn by the author)

1.4.2. The framework of research

This study is aimed at achieving sustainable economic development in the Erhai Lake area and the Balaton Lake area through comparative analysis of typical tourism specialisation areas.

The main empirical case sites are based on the principle that theoretical and empirical research should be promoted simultaneously and mirror each other. The technical route framework of this study is shown in Figure 2

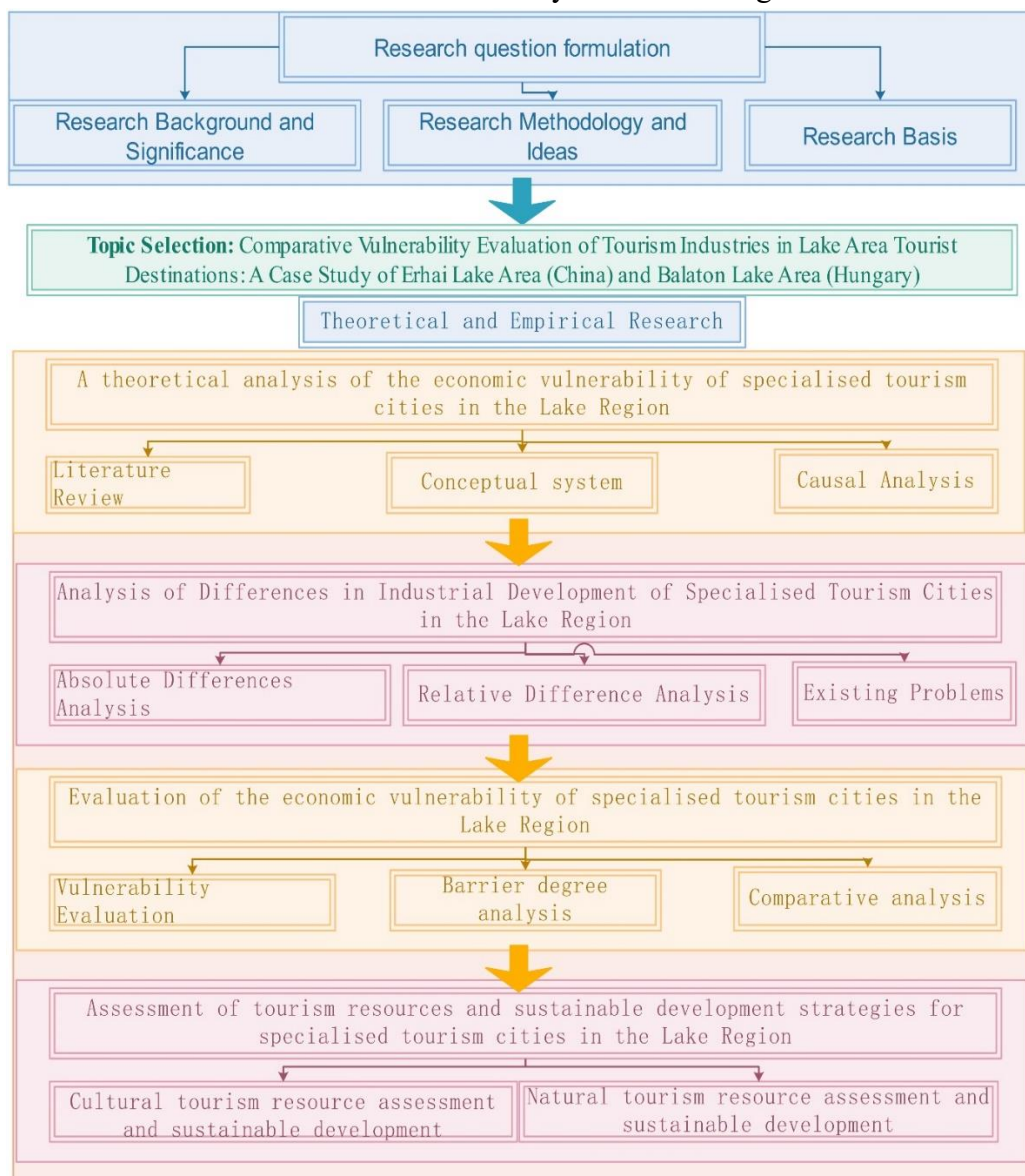


Figure 2 The framework of research (Source: self-drawn by the author)

2. Literature Review

2.1. Definition of concepts

2.1.1. Lakeland Cities

Lakes and rivers are important considerations for human settlement and site selection, and are important safeguards for the development of urban civilization, providing essential development elements for human production and life. As productivity developed and population increased, lakes were partly incorporated into cities, and cities were built around lakes on the water. The development and construction of cities were built around the lakes, and the resources of the lakes provided the necessary guarantee for local economic and social development, and in many places, the development and protection of the lakes were incorporated into urban development plans. Lakes are incorporated within urban sites and become lakes within cities, also known as urban lakes (Wordsworth, 2022; GCSE Geography, 2022).

Most of the urban lakes form or are shaped into beautiful local human and natural landscapes.

Urban lakes have the following characteristics:

- 1) large water volume, poor water mobility, long water exchange cycle, the fragile ecological environment around the lake, and the seasonal cycle of the lake's water volume will change significantly;
- 2) relatively concentrated population in the lake, the lake's economic and social development has a strong dependence on the lake's water resources, and the development of related industries has a huge impact on the lake's ecological resources;
- 3) low self-purification rate of the lake's water resources, high treatment
- 4) point source pollution, surface source pollution, lake bottom silt pollution and lake production and living pollution can threaten the urban lake ecosystem and sustainable development.

2.1.2. Tourism Specialization City

A systematic search of available academic resources reveals that there are few systematic studies on "tourism specialization", but some scholars have begun to focus on this phenomenon. Chen, Gang-Hua and Bao Jigang (2014) analysed the development history and dynamics of tourism specialisation in the case of Sanya City; Zhang, Wen-Ju (2014) analysed the extent and process of tourism specialisation in the case of Guilin, Huangshan, Lijiang and Zhangjiajie; Brau & Lanza & Pigliaru (2007), Adamou & Clerides (2009) C441, He Zhaoli & Sun Hui

(2015) and others have explored the relationship between tourism specialisation and economic development (Li & Bujdosó., 2023).

Therefore, this study refers to the views of the above-mentioned scholars and the relevant results of the author's previous research, and considers that specialised tourism cities are tourism destinations where the tourism industry is flourishing while other industries are developing slowly and the economic development is mainly dependent on the tourism industry (generally manifested as a contribution rate of more than 50%). Specifically, it is manifested as a region's leading industry, a region's main function, a region's main brand, a region's host environment formed by tourism, and a region's main work tasks clarified around tourism; in the region's city construction, product development, service system and talent provision in the region are clearly focused on, dependent on and serve the development of tourism function.

2.1.3. Vulnerability

"Vulnerability" is derived from the Latin word "vulnerare", which originally meant "the possibility of being harmed". The concept of vulnerability was first introduced by the geographer Timmerman in 1981, when he defined vulnerability as "degree", i.e., "the degree of impact on a system when a hazard occurs". Since then, the concept of vulnerability has been gradually brought to the attention of scholars from various disciplines and has been applied in various fields such as the natural environment, humanities and society, economics and finance, etc., and has yielded fruitful research results. As scholars in different fields differ in their research topics, research methods and research regions, their perceptions and definitions of vulnerability also differ to a certain extent. Among them, exposure, sensitivity, adaptive capacity, resistance and resilience are concepts that are more closely related to vulnerability, and they all reflect the characteristics and attributes of vulnerability at a certain level. In addition, scholars in different fields have different emphases in defining vulnerability. For example, Adger (2006) considers vulnerability as a combination of the likelihood of a system being exposed to a disaster and its resistance to damage, covering concepts such as exposure, sensitivity, adaptability and resilience. The IPCC (2001) defines climate vulnerability as "the extent to which a system is vulnerable to the adverse effects of climate change (including climate variability and extremes) and the ability of the system to cope with the impacts of climate change". This definition defines vulnerability as a function of climate change, system sensitivity and adaptive capacity.

The conceptual connotation of vulnerability has evolved in the descriptions of adaptation across disciplines, while there is disagreement in the academic community on the definition and understanding of the vulnerabilities. Among these, the question of whether the essential attribute of vulnerability is an endogenous attribute or a combination of endogenous and exogenous attributes has become a focal point of debate, manifested in the conceptual element of whether exposure should be covered in the conceptual framework of vulnerability. Scholars have gradually divided into two schools of thought on this debate. One group of scholars believes that the conceptual framework of vulnerability should not include external disturbance pressures, but that vulnerability is an intrinsic property of the system itself, and that this intrinsic property is only revealed by external disturbances (Gallopín, 2003). In fact, this view also considers that external disturbance pressures are important for the generation of vulnerability. Another school of thought sees vulnerability as a combination of endogenous and exogenous properties, with vulnerability originating from within and outside the system. Among them, the external component is the disturbance and pressure from the outside to which the system is subjected, which can be understood as the system exposure; the internal component is the system's response to external disturbance and pressure, which includes the sensitive response and adaptive capacity (Mitchell et al., 1989; Watts & Bohle, 1993). A large number of scholars have argued that the internal and external components of vulnerability are not separate from each other, but are interrelated and mutually influencing unities (Chambers, 2006). Focusing only on the internal or external components of vulnerability will not accurately measure system vulnerability (Watts & Bohle, 1993), so the exposure to external disturbances to which the system is exposed, the system's own sensitive response and its ability to adapt to disturbances need to be absorbed into the analytical framework of vulnerability at the same time, so that a systematic, complete and comprehensive vulnerability evaluation result can be obtained.

This study argues that vulnerability is the result of a combination of factors, including both the inherent properties of the system and the effects of external disturbances. Therefore, this study defines vulnerability as the degree to which a system is susceptible to adverse effects such as external disturbances, as well as the system's sensitive response to external disturbances and the system's adaptive capacity to the disturbances, which includes multidimensional evaluation directions such as sensitivity and adaptive capacity. Among them, sensitivity refers to the ease with which the system is affected by stress and disturbance and

changes; adaptive capacity refers to the ability of the system to withstand and disturbance and recover from it (Adger, 2006)

2.1.3.1. Vulnerability of Economic system

When applying the concept of vulnerability in regional economic development, it should be understood as a measure of the level of economic development of a given region, meaning that the region's economic development is unstable and that when external economic conditions change, the region tends to be more sensitive to such changes and tends to suffer more when subjected to the same degree of disruption and breakage by external factors. Vulnerability is always present in the system as a variable. The accumulation of quantitative changes leads to qualitative changes, and the accumulation of vulnerabilities leads to qualitative changes in the form of economic crises. At that point, the entire regional economy will move in a negative direction and the economic crisis will not only exist in the vulnerable regions, but may also spread to a wider area (Adrianto & Matsuda, 2002; Guillaumont, 2010; Wang, 2009).

Under the action of external factors, the stability of the regional economic system becomes less and less stable, and the uncertainty of the system increases, which may even cause the collapse of the whole economic system. As a result, some scholars have proposed that economic system vulnerability has the following three meanings (Wang et al., 2010; Yang & Wu, 2012; Guo et al., 2014; Ma et al., 2019): First, the basis for the proposed economic system vulnerability is the development of the regional economic system. Development means that the quantity and quality of the regional economic system expands over time. Secondly, it is the changes in external factors that lead to changes in the regional economic system, and the changes tend to be in the negative directions. There are two types of changes in external factors, one related to the regional economic system and one unrelated. It is only when it is related to the regional economic system that it has an impact in the system. Thirdly, when the influencing factors related to the system change, the changes within the system may have a lag and are not easily detected, and the negative effects may accumulate slowly and when they reach a certain level directly lead to the instantaneous collapse of the economic system.

2.1.3.2. Vulnerability of Tourism Economic System

The formation of the vulnerability of the tourism economic system is affected by many factors, which can be roughly divided into two aspects: external factors and internal factors of the system (Xie, 2008).

1) The external factors: The complex performance of the external environment of the tourist destination disturbs the tourism economic system. Xie Chaowu (2013) calls the external disturbance factors as emergencies outside the tourism industry, and divides them into political crises, social and cultural crises, and economic crises according to the nature of each event. There are four categories of crises and security crises, as shown in Figure 3.

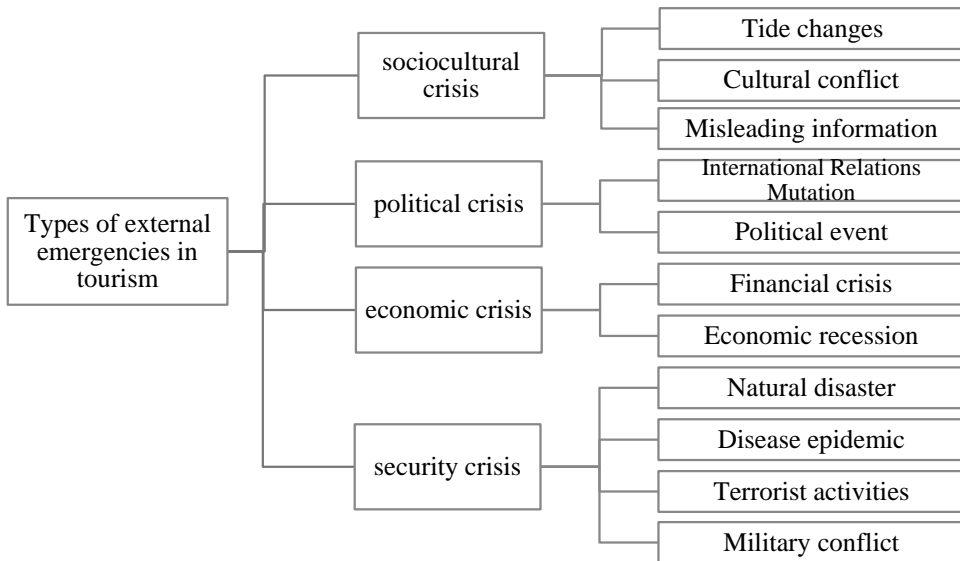


Figure 3 Types of external emergencies in tourism

(Source: Own compilation)

2) The internal factors: The vulnerability of the tourism economic system is influenced by internal factors, specifically sensitivity and coping capacity. High sensitivity combined with low coping capacity increases the system's vulnerability. Sensitivity refers to the impact on the economic system of a tourist city during internal disturbances and external shocks. Coping capacity, on the other hand, refers to the system's ability to respond to and recover from adverse impacts caused by various disturbances. This study considers both internal and external coping capabilities, using indicators that cover these factors. In summary, the vulnerability of the tourism economic system is determined by the balance between sensitivity and coping ability. When sensitivity outweighs coping capacity, the system becomes more vulnerable. Figure 4 illustrates how vulnerability increases with higher sensitivity.

Tourism economic system vulnerability has three main meanings: firstly, it indicates the existence of instability within the tourism economic system;

secondly, the tourism economic system is sensitive to external influences; and thirdly, the tourism economic system is vulnerable to some degree of loss or damage under the action of external influences. Accordingly, tourism economic system vulnerability is a manifestation of the combined attributes of various tourism economic indicators, which encompasses both sensitivity and coping capability.

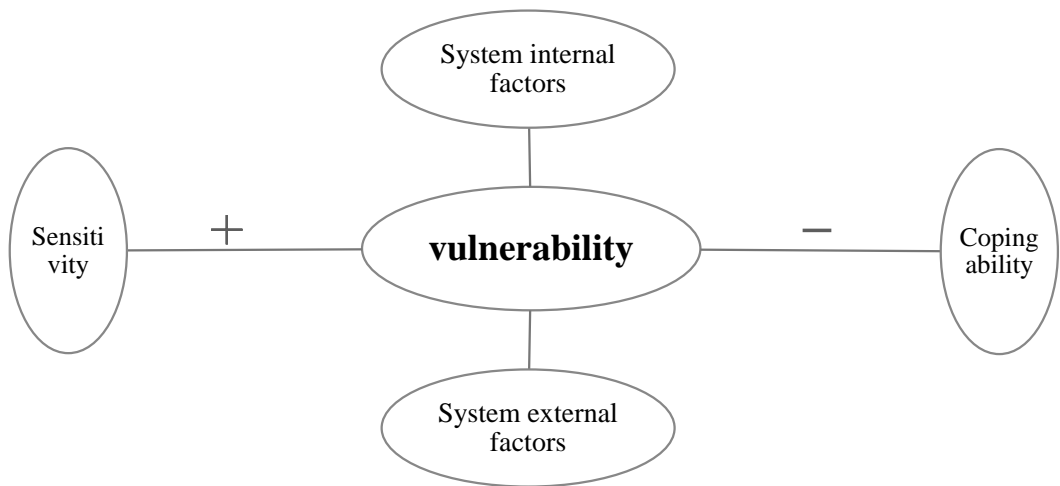


Figure 4 The formation mechanism of the vulnerability of the tourism economic system

(Source: Adrianto & Matsuda, 2002; Guillaumont, 2009; Melkonyan, 2014)

Sensitivity refers to the ability to resist negative influences when changes occur within the tourism economic system or when it is subjected to influences from outside. The weaker the sensitivity, the more stable the tourism economic system is, with a strong level of resistance to change. Coping refers to the speed and ability to return to a stable level after a crisis in the tourism economy, with higher coping indicating a higher level of self-maintenance and adaptability. The resilience of a tourism economic system can come from within the system, from outside the system, or as a result of a combination of internal and external forces. When the vulnerability of the tourism economic system is high, it means that the less it is able to resist various negative influences, the slower the tourism economic system will be able to return to a state of relative equilibrium, and vice versa, the more stable the tourism economic system will be.

Briguglio (1992) was the first to apply vulnerability theory to economic analysis, while domestic academics have mostly defined the concept of economic vulnerability in the context of resource-depleted cities, arguing that economic

vulnerability refers to the sensitivity to changes in various disturbances in economic development and the lack of coping capacity making economic development tend to be unsustainable (Li He & Zhang Pingyu, 2008; Lu Wanhe, Liu Jisheng, Na Wei, 2010 etc.). Therefore, this study views economic vulnerability (EV) as a relationship between sensitivity (S) and coping capacity (R) interactions, which can be expressed as :

$$EV = F(S, R) \quad (a)$$

This study considers economic vulnerability in specialised tourism cities as a special type of economic vulnerability, which refers to a state of high sensitivity and low coping capacity exhibited by economic development that is detrimental to the sustainable development of the regional economy due to the over-representation of tourism in the national economy at a specific period of time within a specific space of specialised lake tourism cities. The economic vulnerability of specialised tourism cities can therefore be seen as a function of the interaction between their sensitivity and their coping capacity. As tourism cities have a certain ability to recover after disturbances compared to resource-depleted cities, coping capacity can again be seen as a function of the interaction between coping force (R_u) and recovery force (R_e), which can be expressed as

$$\begin{cases} EV = F_1(S, R) \\ R = F_2(R_u, R_e) \end{cases} \quad (b)$$

2.1.3.3. Vulnerability of tourism destinations

Tourism destinations are complex systems that are susceptible to shocks and impacts from internal and external factors, and therefore there is also the issue of vulnerability in the development process of tourism destinations. From the literature, there is a paucity of academic research on the vulnerability of tourism destinations, with the limited studies mainly exploring the industry from a meso perspective. There are different perspectives on the vulnerability of the tourism industry in tourism research, which is also reflected in the debate on whether vulnerability is endogenous or a combination of endogenous-exogenous. Scholars who view the vulnerability of the tourism industry from an endogenous perspective argue that external disturbances are only the trigger for vulnerability and that the true vulnerability of the tourism industry is reflected in its own attributes (Sun, 2003). Some scholars also point out that the tourism industry does not possess vulnerability, but is characterised by sensitivity (Cao, 2011). Scholars who view tourism industry vulnerability from a combination of endogenous and exogenous perspectives argue that tourism industry vulnerability is the combined result of endogenous vulnerability and the vulnerability of the regional system in

which it is located, and that it stems from the structural vulnerability of the tourism industry itself and the vulnerability of the macroenvironment in which the tourism industry is located (Wang & Yang, 2009).

This study argues that the tourism destination system is a complex system of closely interlinked economic-social-environment, and that any disturbances and pressures from within and outside the system may disrupt the steady state of the destination economic-social-environment system (Wang et al., 2019; Wang & Lu, 2015) leading to deviations from the steady state of the system, which may lead to tourism emergencies. Therefore, this study further classifies tourism destination vulnerability into economic, social and environmental subsystem vulnerability (Calgaro et al., 2014): 1) The economic vulnerability is a combination of the degree to which the economic system of a tourism destination is exposed to external disturbances, as well as the system's sensitivity to external disturbances and its ability to adapt to them (Zhao & Zhang, 2006; Guillaumont, 2007; Wu & Yang, 2012); 2) similarly, the social vulnerability is a combination of the degree to which the social subsystem of a tourism destination is exposed to external disturbances, as well as the system's sensitivity to external disturbances and its ability to adapt to them (Fekete, 2009; Depietri et al., 2013; Frigerio et al., 2016); 3) Environmental vulnerability is the combined result of the degree to which the environmental subsystem is exposed to external disturbances and the system's sensitivity to and ability to adapt to external disturbances (Lin et al., 2018; Ma et al., 2020). All three subsystems of vulnerability depend on the total amount and performance of 'exposure-sensitivity-adaptability', where exposure refers to the extent to which the destination is exposed to pressures and disturbances, and sensitivity refers to the ease with which the destination is affected by pressures and disturbances and can change; Adaptive capacity refers to the ability of a destination to deal with and recover from stresses and disturbances (Adger, 2006).

This study argues that tourism destination vulnerability is influenced by a combination of internal and external factors. Tourism destination vulnerability is a comprehensive assessment of the vulnerability of a tourism destination system to adverse impacts such as external disturbances, as well as the degree of sensitivity to the impact of disturbances and the system's ability to adapt to such impacts, which depends on a combination of factors such as its sensitivity and adaptive capacity. Exposure, sensitivity and vulnerability are positively correlated, with vulnerability increasing as exposure and sensitivity increase; conversely, adaptive capacity and vulnerability are negatively correlated, with

vulnerability decreasing as adaptive capacity increases. Tourism destination vulnerability can be differentiated into sub-system vulnerability properties such as economic vulnerability, social vulnerability and environmental vulnerability. Therefore, tourism destination vulnerability should be analysed comprehensively in terms of sub-system vulnerability such as economic vulnerability, social vulnerability and environmental vulnerability, and the three forces acting on exposure, sensitivity and adaptive capacity should be evaluated systematically.

2.1.4. Theories of sustainable development

Sustainable development is development that meets the needs of modern people without compromising the ability of future generations to meet their needs (Brundtland, 1987). This means using a variety of approaches and methods, focusing on the renewable nature of resources when developing and using them, and managing the relationship between resources and population, economy and society to meet our own development needs and make resources available to future generations.

Vulnerability and sustainable development of the tourism economy are antithetical and have an opposite effect (Tianyi & Bujdosó, 2020). When vulnerability is low, the tourism economy can grow steadily and sustainably; when vulnerability is high, the growth of the tourism economy is dangerous and unsustainable. When vulnerability reaches a certain upper threshold, the tourism economic system is at risk of collapse. Specifically, vulnerability is related to the tourism economy in three main ways.

- 1) First, vulnerability undermines the sustainability of tourism economic development. Sustainable development requires that the tourism economy evolves in the present and has an inexhaustible drive to drive this development in the future. Vulnerability contributes to the instability of the tourism economy and hinders its sustainable development.
- 2) Secondly, vulnerability can affect the developmental nature of a region's tourism economy. When the vulnerability of a region is high and is affected negatively by internal and external factors, the growth rate of the tourism economy will decrease or even stop if the region does not have effective measures to address it. If vulnerability is too high, the risk of this happening is greatly increased. In severe cases this can bring about negative tourism economic growth or even the collapse of the local tourism economic system.
- 3) Thirdly, vulnerability and sustainable tourism economic development co-exist. In general, vulnerability and sustainable tourism economic development go hand in hand, and the two do not exist in isolation.

Vulnerability is not a question of existence or non-existence, only of size. The relationship between the two is counterproductive, with one side strengthening and the other weakening, depending on the balance of power between them.

2.2. Review of Research

2.2.1. Vulnerability Research Evolution

2.2.1.1. Development of theoretical models

With the continuous development and deepening of the understanding of the concept of vulnerability, the theoretical model of vulnerability has also developed and changed. In the process of development, the theoretical model of vulnerability has undergone the following changes: first, the content of the theoretical model of vulnerability has expanded from a single element to multiple elements; second, the theoretical model of vulnerability has developed from focusing on natural ecosystems to focusing on multiple systems, specifically focusing on both natural ecosystems and social and human systems; third, from vulnerability analysis based on a static perspective to vulnerability Fourth, from a one-way role to an interactive and feedback influence (Yang, Ma & Fang, 2019) During this development process, vulnerability theoretical models have gradually incorporated elements related to vulnerability such as exposure, sensitivity, adaptive capacity and resilience, and have included multiple systems such as natural, economic and social systems, and covered a variety of measurement indicators, enabling vulnerability theoretical models to be increasingly improved. These models include the R-H (risk-hazard) model, PAR (pressure and release) model, HOP (hazard of place) model, triangular model, AHV sustainability theory vulnerability model, VSD model, BBC model, MOVE model and ADV framework.

- The R-H Model by Burtcn et al. articulates vulnerability as an interplay of causal factors, exposure, and sensitivity of the hazard-bearing body. The model's limitation is its focus on ecosystems' vulnerability, overlooking socio-ecological interactions and the role of political, economic, and social structures (Bertram et al., 1979).
- PAR Model Blaikie's (1994) identifies vulnerability as a result of causal factors and a hazard-bearing unit's resource dependency. Although useful for assessing social groups' vulnerability, it doesn't account for sustainability and feedback effects.

- The HOP (Hazards-of-Place Model of Vulnerability) by Cutter et al. (1996) integrates natural hazard and social system vulnerability, however, it does not account for external factors.
- The Triangular Model by Watts & Bohle (1993) analyzes vulnerability from a socio-political perspective, specifically related to food security. It doesn't consider changes in the natural environment.
- AHV sustainability theory's models, including Turner et al.'s (2003) model, understand vulnerability as the result of multiple stresses in environmental and human interactions. However, practical application and correlation with risk are challenging.
- The VSD Model by Polsky et al. (2007) defines vulnerability as a mix of exposure, sensitivity, and adaptive capacity. The model provides a detailed vulnerability analysis framework but its practical application can vary.
- The BBC Model analyzes vulnerability at various levels, making it particularly useful for assessing flood impacts and social vulnerability. It reflects the closed-loop prevention and control process of social vulnerability.
- The MOVE Model by the United Nations University Institute for Environment and Human Security (UNU-EHS) uses a multi-perspective approach to assess vulnerability, considering the dynamic and non-linear interactions that shape vulnerability.
- The ADV framework by Acosta-MichlikL et al. (2008) advocates for an adaptation-oriented analysis, focusing on globalisation processes and global-local interlinkages.

2.2.1.2. Vulnerability studies in various fields

➤ Vulnerability studies in the field of ecology

Ecological vulnerability studies mainly focus on the construction and improvement of the evaluation index system of the vulnerability of ecosystems. These studies evaluate and monitor ecological vulnerability at different spatial scales, and some studies are also devoted to predicting the development trend of ecological vulnerability (Chang et al., 2017; Qiu et al., 2015). Scholars have absorbed ecological interface theory, human-earth relationship theory, ecological disturbance theory, ecological reconstruction theory and other related theories, and supplemented and improved ecological vulnerability from different theoretical perspectives, providing a solid theoretical foundation for ecological vulnerability research (Niu, 1989; Sun, 1995). In terms of the spatial scale of research, the existing ecological vulnerability studies cover a wide range of spatial scales, including a variety of spatial types such as geographical space (Lin

et al., 2018; Liu et al., 2019) and watershed space (Li & Chen, 2014; Chen et al., 2019) In terms of geographical space, it ranges from urban agglomerations, individual cities (Wang et al., 2019), counties (Wang et al., 2019), and villages (Lin, 2018)). With the continuous maturation of GIS, remote sensing and other geospatial analysis techniques, the research content of ecological vulnerability has gradually shifted from a single study of ecological vulnerability to the spatial characteristics of ecological vulnerability (Yanar et al., 2019), influencing factors, vulnerability of human-land relations, and vulnerability-related topics such as environmental sustainability (Li et al., 2018), ecological restoration and rehabilitation, and environmental vulnerability and poverty (Li et al., 2019).

➤ Vulnerability research in the field of sociology

In 2003, Turner & Kasperson et al. (2003) modified and extended the vulnerability theory model, focusing on the different characteristics of nature and human and the coupling of the two, and then proposed a vulnerability framework for the assessment of coupled human-environment systems. Along with the development of vulnerability theoretical models, relevant research has evolved from focusing only on natural environmental vulnerability to coupled human-natural vulnerability, and social vulnerability has gradually received the attention of scholars. Social vulnerability explains the differential consequences of the same hazard in different regions (Yanar et al., 2019), and is of great significance for disaster prevention and mitigation (Solangaarachchi et al., 2012). Social vulnerability has been explored at different spatial scales in various countries, regions and cities and communities, and it emphasises relevant demographic, economic and social characteristics (Cutter, 2003), and evaluation systems basically include indicators such as population (age structure, ethnicity, education level), socio-economic level, buildings and infrastructure, population density, urbanisation, and health care level (Frigerio et al., 2016; Zhou et al., 2014). Social and poverty vulnerability in rural areas (Wang et al., 2019), household livelihood security (Su et al., 2016), demographic and social vulnerability (Cutter & Finch, 2008; Holand et al., 2011), famine vulnerability (Turner et al., 2003) and other topics have also received more attention.

➤ Vulnerability studies in the field of resources and environment

Regional vulnerability focuses on the vulnerability of regional complex systems, not only for natural ecosystems or human systems, but also encompasses the integrated vulnerability of multiple natural-economic-social subsystems. From the spatial scale of vulnerability studies, there are comprehensive vulnerability studies for provincial (Ren et al., 2019) municipal (Fang & Wang, 2015) and

county (Lu et al., 2017) areas. In terms of the spatial characteristics of vulnerability studies, there are vulnerability studies for specific types of geographic areas, such as vulnerability of coal cities (Li et al., 2010), resource-based cities (Gao, 2014), mining cities (Li, 2011), resource-declining cities (Cheng et al., 2015), coastal cities (Shi et al., 2008), etc. The research objects are mainly concentrated in developed coastal areas such as Beijing, Tianjin, Hebei and the Pearl River Delta, or in central and western cities with complex topographic conditions, frequent disasters and relative lack of resources.

Research on resource vulnerability. The main research object of resource vulnerability research is water resources or groundwater resources. Some studies have combined artificial intelligence and fuzzy theory to construct function models to study groundwater risk (Nadiri et al., 2017; Shrestha et al., 2017), while others have explored the vulnerability of water resources under the climate change environment (Xia et al., 2012) and examined the role of human activities on water resources (Zambrano et al., 2017).

2.2.2. Vulnerability evaluation and analysis

Vulnerability evaluation and analysis methods are divided into two main categories: qualitative evaluation methods and quantitative evaluation methods. Among them, qualitative evaluation methods are more common in early vulnerability studies and are characterized by simple analysis methods and steps. Due to the lack of empirical testing, the evaluation accuracy of qualitative evaluation methods is low. As various types of quantitative analysis methods mature, qualitative evaluation methods gradually leave the academic stage. There are more specific types of quantitative evaluation methods, and the common ones are indicator system evaluation method, graph overlay method, function model evaluation method, fuzzy object element evaluation method, scenario analysis method, etc. Quantitative evaluation methods provide practical steps and measures for accurate assessment and prediction of vulnerability and are widely recognized in current vulnerability research.

- Indicator evaluation method. The indicator evaluation method is a prevalent approach in vulnerability research due to its wide applicability and clear steps (Wang, 2018; Zhang, 2017). It involves constructing an evaluation index system based on research objectives and available data. Next, indicators are normalized, often through extreme difference standardization. Then, weights are assigned to indicators using methods such as hierarchical analysis (Yang et al., 2014; Liu et al., 2017), expert scoring (Wang et al., 2008), entropy method, or TOPSIS (Zhang & Yong, 2014). Finally,

vulnerability index scores are calculated using the weights, and the results are analysed in the context of theory and practice.

- Layer stacking method constructs evaluation index system for each vulnerability element to gain their spatial variation. Its drawback is the inability to predict vulnerability dynamics. Hao Lu et al. (2003) used it for snowstorm vulnerability in Inner Mongolia, while Metzger et al. (2005) applied it to measure the impact of globalisation.
- Functional model approach identifies vulnerability components and their interrelations. Its limitation lies in the lack of a unified understanding of vulnerability components. Li T.Y. (2017) employed this approach to analyse vulnerability in Lanzhou City based on exposure, sensitivity, and adaptability.
- Fuzzy object element evaluation method resolves complexities and incompatibility issues within the vulnerability index system. Its major shortcoming is its over-dependency on the chosen reference system. This method was employed by Zou Jun et al. (2008) and Zhang Xin et al. (2009) to classify vulnerability levels.
- Scenario analysis method handles system uncertainties and analyses trends (Quan R S., 2014; Yang, Zhang & Wang., 2015)
- Recently, data envelopment analysis methods (WSBM) (Sun et al., 2016), BP neural networks (Peng et al., 2015), and set-pair analysis (Li, Yang & Su, 2016) have also been utilized in vulnerability analysis.

2.2.3. Vulnerability studies in the field of tourism studies

In recent years, vulnerability studies within the tourism sector have been extensive, as depicted in Annex 2. These studies exhibit four key features. Firstly, they focus on various aspects such as the vulnerability of the tourism industry, the tourism economic system, tourism social-ecological system, and tourism environment and resources. Secondly, the construction of vulnerability index systems in these studies is usually grounded in “sensitivity-adaptability” or “exposure-sensitivity-adaptability.” However, several studies employ an “economic-social-environment” or “endogenous-exogenous” perspective. Thirdly, the research encompasses various geographical and spatial scales, ranging from county to national levels. Lastly, the methodologies used in these studies are diverse and can be classified into theoretical and empirical analysis. For empirical analyses, methods like entropy power, set-pair analysis, AHP hierarchical analysis, neural networks, and expert scoring are employed.

Tourism industry vulnerability studies have their roots in the 1974 global energy crisis. Thereafter, events such as the Asian financial crisis in 1997, the SARS outbreak in 2003, the Wenchuan earthquake in 2008, the global financial crisis in 2008, and the COVID-19 pandemic in 2020 have served as focal points in vulnerability studies, highlighting the significant impacts on the tourism industry (Li, 2013; Li & Bujdosó., 2021; Czuczor et al., 2023). External factors such as political instability, natural disasters, and diseases contribute to the vulnerability of the tourism industry. However, the intrinsic characteristics of the industry also play a role (Sun, 2003). Cao Furong (2011) differentiates between the sensitivity and vulnerability of the tourism industry, arguing that its ability to recover swiftly from external shocks renders it more sensitive than vulnerable.

On the other hand, tourism economic system vulnerability studies have highlighted how the vulnerability of this system is influenced by both internal interconnections within the industry and external factors. Wang (1989) acknowledges the role of the tourism industry's complexity and comprehensive nature in its vulnerability. Li Jun and Bao Jigang (2011) assert that the vulnerability is relative, comparing tourism to other industries.

Additionally, research on the socio-ecological system vulnerability of tourism sites examines economic, social, and ecological subsystems as the main components. Main group et al. (2015) evaluated the resilience of socio-ecological systems, considering the economic, social, and ecological subsystems' vulnerability and coping capacities. Yin Peng et al. (2017) measured the vulnerability of the human-earth coupled system in island-type tourism destinations and analysed economic, social, and natural system vulnerabilities.

Studies on tourism environmental and resource vulnerability point out that ecological vulnerability leads to resource depletion, destabilization of ecological environments, and reduction in ecotourism income. These studies evaluate environmental vulnerability through different dimensions such as "cause-effect", "exposure-sensitivity-adaptation", and others.

In conclusion, scholars have extensively explored the vulnerabilities in tourism from different perspectives and employing varied methodologies. However, a comprehensive evaluation of tourism vulnerabilities that integrates economic, social, and environmental aspects from a macro perspective remains an area ripe for exploration. The summary table of vulnerability studies in the field of tourism in recent years please check the Annex 2.

3. Overview of the Study Areas

3.1. Geographical Location and Extent of the Research Areas

In this study two research areas were chosen from two countries. they are Erhai lake (China) and Balaton Lake (Hungary) separately.

Erhai Lake: Erhai Lake is situated in the Dali Bai Autonomous Prefecture, Yunnan Province, southwest of China. It is located in the watershed area of the Lancang River, Jinsha River, and Yuanjiang River, and is part of the Lancang-Mekong River system (Figure 5). The lake has a basin area of approximately 256 square kilometers. Geographically, Erhai Lake is positioned between 100°05' to 100°17' east longitude and 25°36' to 25°58' north latitude. It is the second largest highland freshwater lake in Yunnan Province (Table 1).

The primary sources of water for Erhai Lake are precipitation and snowmelt. Erhai Lake holds significant importance as a natural resource and a tourist destination. Its basin covers a wide range of landscapes, including mountains, hills, and plains. The lake itself provides opportunities for various recreational activities, such as boating, fishing, and sightseeing. The surrounding region boasts an array of attractions, including lakeside villages, ancient temples, and scenic viewpoints (Chen et al., 2021).

Table 1 Study area tourism socio-ecological system administrative area statistics (Erhai Lake)

Administrative district boundaries	Number of settlements	Settlement information
County district	2	Dali, Er Yuan
Townships	16	Xiaguan town, Dali town, Fengyi town, Xizhou town, Pyrenees Bihu town, Dengchuan town, Yusho town
Settlements	117	Wen bi , Longkang, Xiaowan etc. Other 114 vallages

Data Source: Yearbooks of Da Li Prefecture (2021)

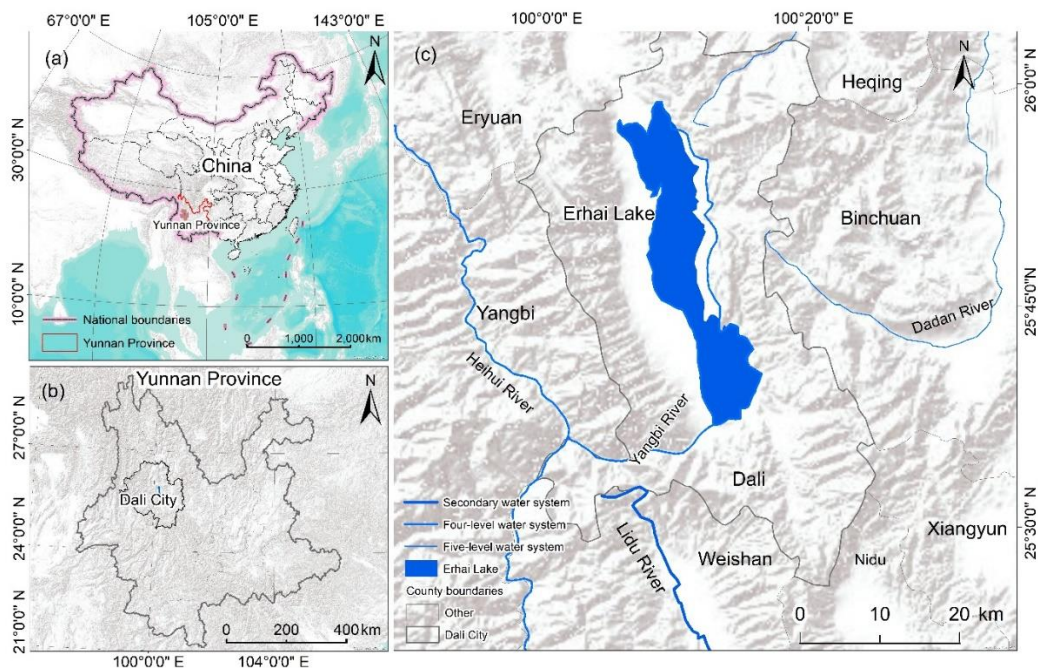


Figure 5 Map of the geographical location of Dali City and the Erhai Lake area and the water system of the Erhai Lake region (Source: self-drawn by the author)

Balaton Lake: Lake Balaton, situated in Hungary, is the country's largest freshwater lake and one of the largest in Europe. It is located in central Hungary, with geographical coordinates ranging from $46^{\circ}40'$ to $46^{\circ}58'$ north latitude and $17^{\circ}18'$ to $17^{\circ}34'$ east longitude (Figure 6). Covering an area of approximately 592 square kilometers, Lake Balaton has a shoreline of about 197 kilometers and a maximum width of approximately 14 kilometers (Table 2).

The lake is characterized by its elongated shape, stretching from north to south, and is surrounded by hills and low mountains. The terrain in the region around the lake is relatively flat, and the average depth of the lake is around 3 to 4 meters. The water of Lake Balaton is known for its clarity and vibrant green color. It primarily receives water from precipitation and small rivers in the surrounding area (Kutics, 2019).

Lake Balaton is not only renowned for its natural beauty but also offers a range of attractions in its vicinity. The lakeside beaches and thermal baths are popular destinations for leisure and recreation. The region is dotted with historic towns, castles, and vineyards, providing visitors with a rich cultural heritage and scenic landscapes to explore.

As one of Hungary's major tourist destinations, Lake Balaton attracts a significant number of visitors each year. The lake offers ample opportunities for water activities such as swimming, sailing, boating, and fishing. Additionally, lakeside

resorts and spa retreats provide comfortable accommodations, allowing visitors to relax and enjoy the tranquil environment.

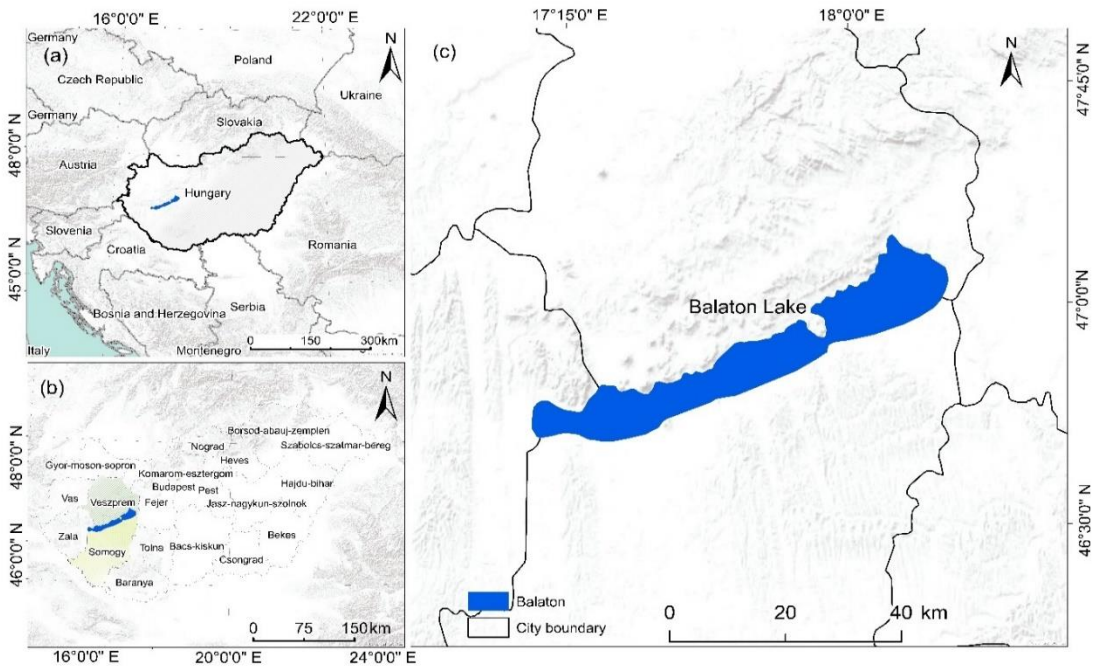


Figure 6 Map of the geographical location of the Lake Balaton area and the Lake Balaton basin water system (Source: self-drawn by the author)

Table 2 Study area tourism socio-ecological system administrative area (Lake Balaton)

Administrative district boundaries	Number of settlements	Settlement information
County district	3	Somogy, Veszprém, Zala
Settlements	176	Ábrahámhegy etc.other 175 villages

Data source: Lake Balaton and Beyond (2008)

3.2. Overview of Physical Geography

3.2.1. Geology and Topography

Both regions have been shaped significantly by their respective geological histories and processes (Table 3). In the case of Erhai Lake, the karst formations and tectonic activity have resulted in a rich array of geological features. On the other hand, Lake Balaton's formation, impacted by the Alpine orogeny and the erosive power of rivers, has given rise to its unique shallow depth. Despite their geographical distance, both areas demonstrate the impact of geology on the creation of unique and distinctive landscapes.

Table 3 Comparison of Geological and Topographical Features: Erhai Lake vs. Lake Balaton

Study Area	Location	Geographical Features	Unique Features
Erhai Lake	Yunnan Province, Southwest China	Characterized by karst formations from dissolution of soluble rocks such as limestone, dolomite, and gypsum. Part of the Hengduan Mountain system with diverse landforms ranging from high mountains to low plains.	Alpine fault lake formed due to tectonic movements; features like sinkholes, caves, and underground rivers.
Lake Balaton	Western Hungary	Part of the Pannonian Basin formed by geological events linked to the Alpine orogeny. Landscape consists of low mountains, rolling hills, and plains.	Largest freshwater lake in Central Europe; a shallow lake with an average depth of around 3 meters due to sedimentation and erosion by the ancient rivers.

Data sources: Yearbooks of Da Li Prefecture (2021); Lake Balaton and Beyond, (2008)

3.2.2. Climate and Hydrology

Here's the comparison table based on the climate and hydrology indicators of the Erhai Lake region and the Lake Balaton region: It's evident from the table that while both regions feature unique climates, there are distinct differences between the two (Table 4). The Erhai Lake region exhibits a plateau monsoon climate with a significant wet season, while the Lake Balaton Basin displays a temperate continental climate with relatively equal rainfall throughout the year.

Table 4 Comparison of climate and hydrology indicators: Erhai Lake vs. Lake Balaton

Study Area	Climate Type	Temperature and Rainfall	Hydrological Role
Erhai Lake	Erhai Lake Region is characterized by a plateau monsoon climate of the low-latitude zone, resulting in distinct dry and wet seasons.	The average year-round temperature is 17.1°C, with the majority of rainfall (annual total of 657.2mm) occurring during the summer monsoon.	Erhai Lake is the second largest freshwater lake in Yunnan, it greatly influences the local climate and water cycle due to its thermal inertia. It contributes significantly to the humidity and temperature, and serves as an essential water source for local agriculture.
Lake Balaton	The Lake Balaton Basin exhibits a temperate continental climate, marked by warm summers and cold winters.	The average annual temperature is around 10°C. Precipitation is evenly distributed throughout the year, averaging around 600-700mm annually.	Despite its shallowness, Lake Balaton plays a significant role in moderating the local climate, particularly in terms of temperature and humidity. It is also an important source of water for supply and irrigation, supporting human activities and local biodiversity.

3.2.3. Geological Characteristics and Biology

This comparison shows significant differences in the geological conditions, biological diversity, and unique features of the two regions. Here's the comparison table based on the soil and biology indicators of the Erhai Lake region and the Lake Balaton region (Table 5):

Table 5 Comparison of Soil and Biology indicators: Erhai Lake vs. Lake Balaton

Study Area	Geological Conditions	Flora and Fauna	Special Features
Erhai Lake	The Dali where Erhai Lake is located, is rich in various types of minerals. Among the metallic ores are manganese, titanium, iron, tin, antimony, lead, zinc, copper, gold, silver, platinum, and palladium. Non-metallic minerals include coal, rock salt, marble, graphite, gypsum, and diatomaceous earth. Notably, marble reserves are significant, with proven reserves of 100 million cubic meters.	The Dali Prefecture boasts a complex composition of flora and diverse vegetation types. There are more than 600 kinds of Chinese herbs managed nationally. The region is also rich in animal resources, with animal groups ranging from protozoa to vertebrates. There are 51 species of animals protected at the national or provincial level.	The region has 3 national nature reserves, 1 world geopark, 3 provincial-level nature reserves, and 22 state-level nature reserves. The forest coverage rate is 65.9%. Dali Prefecture is one of the main medicinal herb-producing areas in Yunnan Province.

Lake Balaton	The soils around Lake Balaton are diverse and highly dependent on the topography, climate, vegetation, and human activity. Around the lake, soils are primarily sandy due to the lake's geological history, which contributes to the region's viticulture. The Balaton Uplands exhibit a more varied soil composition.	The region is biologically diverse, with the lake itself providing habitat for a variety of fish species. It's also a critical stopover site for migratory birds. The surrounding land, including forests and wetlands, hosts a plethora of flora and fauna, some of which are endemic to the region.	The region is known for its viticulture, supported by its distinctive sandy soils.
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Both regions are rich in their unique ways, with the Erhai Lake region known for its diverse minerals and medicinal herbs, while the Lake Balaton region is famous for its viticulture and habitat diversity.

3.3. Overview of Socio-economics

3.3.1. Administrative Division and Population Distribution

Here's a comparison table based on the administrative division and population distribution of the Erhai Lake region and the Lake Balaton region (Table 6).

Table 6 Comparison of Administrative Division and Population Distribution indicators

Study Area	Administrative Divisions	Key Towns/Cities	Population Distribution
Erhai Lake	The prefecture includes the city of Dali and towns such as Shuanglang, Xizhou, and ZhouCheng. Dali serves as the region's political, economic, and cultural center.	Dali, Shuanglang, Xizhou, and ZhouCheng	The population in Dali Prefecture is over 3 million, with approximately 970,000 people residing around the Erhai Lake Region. The distribution varies, with higher density in urban areas like Dali city and sparser distribution in more rural and mountainous regions. The region is home to several ethnic groups, including the Bai, Yi, Han, Hui etc.
Lake Balaton	Lake Balaton is part of several administrative counties, primarily Veszprém, Zala, and Somogy.	Balatonfüred, Keszthely, and Siófok	The population distribution around Lake Balaton is uneven, with a higher concentration in towns and sparse populations in the surrounding rural areas. There are 317 municipalities with a total permanent population of 350 thousand people in the watershed of Lake Balaton. The region sees a significant influx of temporary residents and tourists during the summer months.

This comparison shows the key differences between the two regions in terms of administrative divisions, key towns and cities, and population distribution. Both regions have their unique characteristics, with the Erhai Lake region having a high level of ethnic diversity and the Lake Balaton region being a popular tourist destination, especially during the summer months.

3.3.2. Overall Economic Situation and Industrial Structure

Here's a comparison table based on the overall economic situation and industrial structure of the Erhai Lake region and the Lake Balaton region (Table 7):

Table 7 Comparison of Economic Situation and Industrial Structure: Erhai & Balaton

Study Area	Economic Sectors	Key Industries	Economic Development
Erhai Lake	Agriculture, Tourism, and Service sectors	Farming, Fishing, Tourism, Retail, Hospitality, Finance, and Real Estate	The economy of the Dali Erhai Lake Region is a mix of several industries. In 2021, the gross regional product of Dali Prefecture was 163.30 billion CNY. The primary industry added 37.19 billion CNY, the secondary industry added 46.12 billion CNY, and the tertiary industry added 79.99 billion CNY. The economic development level varies, with urban areas generally being more economically developed than rural areas.
Lake Balaton	Tourism, Agriculture, and Service sectors	Tourism, Viticulture, Retail, Healthcare, and Education	The economy of the Lake Balaton region is a blend of several industries. The region attracts millions of tourists annually, contributing significantly to the local economy. Agriculture, especially viticulture, also plays a significant role in the local economy. The service sector is increasingly vital, particularly in larger towns.

3.3.3. Urbanization Level and Transportation Infrastructure

This comparison shows an overview of the urbanization level and transportation infrastructure in both regions. While both regions are experiencing urbanization, the level and pattern differ. The transportation infrastructure in both regions seems to be well-developed, supporting local economic activities and connections to other regions (Table 8).

Table 8 Comparison of Urbanization Level and Transportation Infrastructure: Erhai & Balaton

Study Area	Urbanization Level	Transportation Infrastructure
Erhai Lake	Urbanization in the Dali Erhai Lake Region is on an upward trend. The city of Dali exhibits rapid urbanization with increasing infrastructure development and population density. Significant portions of the population still reside in rural areas, maintaining traditional lifestyles.	Dali City is the intersection of Yunnan-Myanmar Highway and Yunnan-Tibet Highway, serving as a significant transit point. The transportation network includes rail, highway, and airlines, connecting urban and rural areas and radiating to the surrounding regions. The north can lead to Sichuan-Tibet and India, and the south can lead to Laos, Vietnam, and other countries.
Lake Balaton	Urbanization varies in the Lake Balaton region, with larger towns like Balatonfüred and Siófok exhibiting higher levels of urbanization compared to more rural areas. These urban areas offer a wider range of services and infrastructure and attract more permanent residents.	The transportation infrastructure around Lake Balaton is well-developed. The M7 motorway and railway line provide convenient connections to Budapest and other parts of the country. Local roads and ferry services across the lake enhance the connectivity within the region. However, challenges can arise during peak tourist season, and accessibility might be less optimal in remote and rural areas.

3.4. Overview of Tourism Resources

Section 5.3.2 of the dissertation provides an in-depth analysis of the tourism resources in the two locations (refer to Table 24), which is summarized here.

Erhai, located in China, boasts a wealth of tourism resources, with more than 130 scenic spots. The natural beauty and cultural significance of Erhai and Cang Shan have earned them national recognition as treasures. Dali, the region's capital, is a remarkable historical city renowned for its heritage, culture, and tourism.

Lake Balaton, situated in western Hungary, is a highly popular destination that attracts millions of visitors annually. Known as the 'Sea of Hungary' due to its vast size, it offers a wide range of recreational activities. The surrounding area of Lake Balaton is abundant in natural beauty and cultural heritage, including notable sites like Balaton Uplands National Park, Tihany Peninsula, and Festetik Palace. Furthermore, the Lake Balaton region boasts a thriving wine culture, with numerous vineyards where visitors can explore local winemaking traditions.

3.5. Overview of Ecology

Here is a comparison table based on the ecological conditions of Erhai Lake and Lake Balaton (Table 9):

Table 9 Comparison of Ecological: Erhai Lake & Lake Balaton

Study Area	Aquatic Ecosystem	Terrestrial Ecosystem	Ecological Challenges	Measures Taken
Erhai Lake	Freshwater lake with diverse aquatic species. Vital for climate balance and irrigation.	Comprised of mountains, plains, and wetlands. Features diverse flora and fauna due to differing altitudes.	Threatened by urbanization, population growth, and over-exploitation. Eutrophication from agricultural and sewage runoff.	Launched comprehensive treatment project for water quality, pollution control, and biodiversity preservation. Limited tourism activities, fishing, and construction.
Lake Balaton	Diverse aquatic ecosystems, suitable for various fish species. Significant habitat for bird species.	Varied topography hosting wide variety of flora and fauna. Features a protected national park.	Faces challenges from human activities and climate change. Eutrophication from agricultural and human settlements runoff.	Established Lake Balaton Development Coordination Agency (LBDCA) for sustainable development and environmental management. Measures taken for water quality, waste management, biodiversity conservation, and public awareness.

This comparison indicates that while both areas boast rich aquatic and terrestrial ecosystems, they are facing challenges brought about by human activities and environmental changes. Measures have been taken in both areas to address these issues and protect the ecological environment.

Summary of Chapter

In conclusion, while the Dali Erhai Lake Region and the Lake Balaton Basin share some commonalities as significant tourism destinations with rich biodiversity and cultural heritage, they are uniquely defined by their geographical settings, tourism focuses, and environmental challenges. Here is a scholarly summary of their similarities and differences:

Similarities:

- 1) **Tourism Appeal:** Both the Dali Erhai Lake Region and the Lake Balaton Basin are renowned for their natural beauty, featuring extensive freshwater lakes and diverse surrounding landscapes. They are key tourist destinations in their respective countries, attracting both domestic and international visitors.
- 2) **Biodiversity:** Each region boasts a wealth of biodiversity, providing habitats for a diverse range of flora and fauna. The aquatic ecosystems of both Erhai Lake and Lake Balaton host numerous species, while the terrestrial ecosystems in their surroundings add to the ecological richness.
- 3) **Cultural Heritage:** Both regions have a profound cultural and historical significance. Dali, in the Erhai Lake Region, is recognized as a historical and cultural city in China. Similarly, towns around Lake Balaton, like Balatonfüred and Keszthely, are known for their rich cultural and historical heritage.

Differences:

- 1) **Geographical Setting:** The Dali Erhai Lake Region, located in the Yunnan Province of China, is characterized by its subtropical highland climate, large freshwater lake, and surrounding mountains, notably the Cangshan Mountain range. On the other hand, the Lake Balaton Basin in Hungary, the largest freshwater lake in Central Europe, is situated in a continental climate, and features a diverse landscape ranging from gentle slopes and plains on the southern shore to the Balaton Uplands on the northern shore.
- 2) **Tourism Focus:** While both areas rely heavily on tourism, the focus varies. The Erhai Lake Region emphasizes its natural landscapes like Erhai Lake and Cangshan Mountain, and cultural sites, notably the historical city of Dali. In contrast, the Lake Balaton Basin leverages its wide variety of attractions including the lake itself, the historic towns, the Balaton Uplands National Park, and a strong tradition of viticulture.
- 3) **Environmental Challenges:** The regions face distinct environmental challenges. The Dali Erhai Lake Region is grappling with issues like eutrophication of Erhai Lake due to excessive nutrient runoff. In contrast, Lake Balaton has experienced issues with water quality, primarily due to agricultural and human-induced nutrient runoffs, resulting in algal blooms.

4. Research Methodology

4.1 Evaluation of industrial structure balance

The aim of analyzing the industrial structure is to assess the proportion of the tourism industry within the tourism region and ascertain whether it is a city specializing in tourism. This is important as regions overly reliant on tourism face heightened economic vulnerability.

4.1.1 Analysis of current industry situation.

Economist Justin Yifu Lin (1999) has pointed out that the true meaning of economic development is not the crane-like growth of one or a few industries, but the improvement of comprehensive economic strength. Therefore, this chapter will draw on the relevant concepts of regional economic development difference analysis(Wu & Yang, 2012; Perez et al., 2014), and will creatively apply the research method of applying to explore the differences in economic or industrial development of different regions to the analysis of the differences in the development of different industries in the same region, by comparing the tourism, industrial and agricultural development of the typical case sites in the Erhai lake region (2004 to 2021) area and the Lake Balaton region from (2011 to 2019) The differences are used to examine the current situation of tourism prosperity and industrial structure in tourism specialized cities.

4.1.2 Analysis of industry structure differentiation

4.1.2.1. Selection of indicators

With reference to the analysis indexes commonly used in academic research on economic development differences of different regions, the analysis of economic differences of different industries in the same region can be divided into two types: comprehensive indexes and single indexes. Compared with the comprehensive indicators, the single indicators have certain shortcomings but are closely related to the comprehensive indicators, and the appropriately selected single indicators can reflect most of the information about the economic development of a region more accurately. The focus of this chapter is to analyze the differences in the development of different industries in the same region and their changing trends, and to ensure the availability of data and comparability of indicators, a single indicator is selected for analysis.

With reference to the statistical standard of GDP, "*output value of primary industry*" and "*output value of secondary industry*" are selected as the indicators reflecting the development status of primary and secondary industries in the region. The "*gross output value of tourism industry*" is selected to reflect the tourism industry in the region.

4.1.2.2. Data sources

This case of the Erhai Lake region uses the National Economic and Social Development Statistical Bulletin of the region in 2004-2021 as the main data source channel, supplemented by the Dali Prefecture Statistical Yearbook of previous years;

And the case of the Balaton Lake region data from *Regional Statistical Yearbook of Hungary* of 2011 to 2021 and Hungary statistical office (KSH statistic <https://stainfo.ksh.hu>)

4.1.2.3. Data processing

In this study, two types of absolute difference indicators, namely, range and standard deviation, and four types of relative difference indicators, namely, extreme value ratio, coefficient of variation, priority status, and Gini coefficient, were selected for statistical analysis.

➤ Absolute difference analysis

1) Range

The Range is the difference between the maximum value and the minimum value within a set of measurement values, expressed as R. The meaning is the maximum range of the measured value change, applicable to the case of a small sample size ($n < 10$). The formula is:

$$R = Y_{max} - Y_{min} \quad (c)$$

Where equation (c): R is the range, Y_{max} is the maximum value among the output value of the primary industry, the output value of the secondary industry, and the total tourism revenue, and Y_{min} is the minimum value among the three. The larger the extreme difference, the more serious the absolute difference between the three industries, and vice versa.

2) Standard Deviation

Standard Deviation is the square root of the arithmetic mean of the standard value of a set of data and the square of its mean deviation, which is used to measure the distance of the data from the mean. Its formula is:

$$S_t = \sqrt{\frac{\sum_{i=1}^n (Y_{ti} - Y_t)^2}{n}} \quad (d)$$

Where equation (d): S_t - standard deviation: Y_{ti} - primary industry output value or secondary industry output value or total tourism revenue in year t; n - the number of measurements ($n = 3$); Y_t - mean of three measurements. The larger the standard deviation, the more serious the absolute difference between the three industries. The larger the standard deviation, the more serious the absolute difference between the three industries, and vice versa.

➤ Relative Difference Analysis

1) Extremum ratio

The extremum ratio is the ratio of the maximum value to the minimum value within a set of measurements, expressed as RHL, and calculated by the formula is:

$$RHL = Y_{max}/Y_{min} \quad (e)$$

Where equation (e) : RHL an extreme value ratio, Y_{max} -primary industry output value, secondary industry output value, total tourism revenue in Y_{min} - the minimum value of the output value of the primary industry, the output value of the secondary industry, and the total tourism income. The greater the extreme value ratio, the more serious the relative differences among the three industries, and vice versa.

2) Coefficient of variation

Coefficient of Variation (CV), also known as "coefficient of dispersion", is a relative indicator used to illustrate the degree of variation, it usually refers to the ratio of standard deviation to the overall average, calculated as follows:

$$CV = S_t/Y_t \quad (f)$$

Where equation (f): CV - coefficient of variation; S_t - standard deviation; Y_t - wide measurement of the average value. The larger the coefficient of variation, the more serious the relative difference situation among the three industries.

3) Priority status

The priority status was first proposed by M. Jefferson (1939), an American scholar, and was first used in a study related to the size of cities in some countries. A priority of less than 2,000 indicates a normal structure and greater than 2 indicates structural imbalance and over-concentration and is calculated by the formula

$$S = Y_1/Y_2 \quad (g)$$

Where equation (g): S – the value of priority status; Y_1 - the maximum value of the output value of the primary industry, secondary industry output value, total tourism income; Y_2 - the second largest value of the output value of the primary industry, the output value of the secondary industry, the total tourism income. The greater the Priority status, the more serious the relative difference situation among the three industries.

4) Gini Coefficient

Gini Coefficient (Gini Coefficient) is proposed by the Italian economist Corrado Gini (1912) on the basis of the Lorenz curve (Lorenz curve), generally used to measure the income distribution gap, calculated by the formula equaiton(h):

$$G = 1 - \frac{1}{n} \left(2 \sum_{i=1}^{n-1} W_i + 1 \right) \quad (h)$$

Where: G is the Gini coefficient; n is the number of measurements ($n=3$); W_i indicates the sum of the i th measurement value accumulated from the i th measurement value to the i th measurement value after comparing the output value of the primary industry, the output value of the secondary industry and the total tourism income in ascending order. The Gini coefficient is used to measure the relative degree of inequality between the primary industry, secondary industry and tourism industry, indicating the relative differences between the primary industry, secondary industry and tourism industry economies. According to international practice, the Gini coefficient is less than 0.2, which indicates a high degree of average; 0.2-0.3 for relatively average; 0.3-0.4 for relatively reasonable; 0.4-0.5 for a large gap; and 0.5 for a large gap. The larger the Gini coefficient, the more serious the relative differences in development between industries. It is worth mentioning that the Gini index of 0.4 is generally considered as the "warning line", but according to the Golden Mean, its exact value should be 0.382.

4.2. Evaluation of Tourism Economic System Vulnerability

This section firstly elaborates on the driving factors of tourism economic system vulnerability from internal and external factors, then constructs the internal tourism economic system and external regional composite system from two aspects and two perspectives of sensitivity and responsiveness to Tourism economic system vulnerability index system, and finally the vulnerability evaluation model is introduced, including entropy value method and set-pair analysis method, aiming to lay the foundation for the following empirical research on the vulnerability of tourism economic system in two lake areas.

4.2.1. Creating the indicator system and developing the model

The construction of indicator system is the first step of tourism economic system vulnerability evaluation, the selection of indicators largely affects the evaluation results, and an objective and reasonable indicator system is the basis of evaluation accuracy.

4.2.1.1. Principles of evaluation index system construction

The tourism economic system is a relatively complex system, and its vulnerability arises from the multiple influences of the internal structure of the system and the external environment of the system, which is a manifestation of the combined properties of multiple indicators. However, it is impossible to include all the influencing factors into the index system in the study, and we can only try to select the more dominant indicators to construct. In order to objectively and comprehensively build the tourism economic system vulnerability evaluation index system, the following principles should be followed in the process of selecting indicators.

The principle of scientific. The construction of tourism economic system vulnerability index system must be based on the premise of science, the selected indicators should be able to objectively and reasonably reflect the connotation of vulnerability, fully reflect the level of vulnerability, to provide the basis for a comprehensive analysis of the causes of vulnerability. The system of indicators should be able to explain vulnerability in a comprehensive and reasonable manner, but also to be simple and simple, not to list a large number of indicators, blurring the focus.

Systematic principle. Tourism economic system is a relatively complex system, not only will be affected by the factors within the system, but also respond to the environmental system in which it is located. Therefore, when evaluating the vulnerability of the tourism economic system, we should take into account both the internal factors of the tourism economic system and the factors of the regional composite system in which it is located, starting from the system, to clarify the relationship between internal and external factors, reflecting vulnerability from different levels and directions, and grasping the comprehensive effect of indicators in all directions.

Comparability principle. Tourism economic system vulnerability evaluation indicators to use a unified measurement standard, the choice of quantitative indicators to ensure the comparability of evaluation objects and the continuity of data acquisition; through the collection and analysis of data, a reasonable expression of the real situation of vulnerability, to enhance the accuracy of the evaluation results.

Operability principle. In the process of indicator selection, it is not only necessary to understand the meaning and nature of indicators, but also to ensure the applicability of their application and the availability of data, and indicators that are difficult to achieve data collection and calculation cannot be included. The integrity of data is the basis for evaluating the vulnerability of the tourism economic system, and only by ensuring that indicator data are available within capacity can the evaluation be better completed.

4.2.1.2. Selection of evaluation indicators

Tourism economic system vulnerability is the result of the combined influence of various indicators, covering economic, social, ecological and other factors, mainly manifested as the instability of the system, the sensitivity in the face of disturbances and the coping capability to crisis situations.

For the selection of tourism economic system vulnerability indicators, different scholars have different selection criteria.

Wang Zhaofeng and Yang Weishu studied the vulnerability evaluation index system of tourism industry and believed that the index selection should be made

from two perspectives: tourism system involves various aspects such as tourism industry structure, cluster development level, and crisis handling ability, and regional conforming system includes natural, economic, and social subsystems (Wang & Yang, 2009).

Zheng Jiangning and Yan Cheng selected indicators reflecting sensitivity and coping capability from two aspects of macroeconomic, tourism economy and social factors, respectively, where the sensitivity indicators mainly include the index of regional GDP, the proportion of tourism revenue to GDP, the growth rate of tourism fixed assets, the urban unemployment rate, and the growth rate of education expenditure, and the coping capability indicators mainly include average GDP, growth rate of total tourism revenue, labor productivity of tourism industry, urban employment rate, mileage of transportation network, etc (Zhen & Yan, 2013).

Su Fei et al. constructed an index system for evaluating the vulnerability of the economic system of tourism cities from two aspects of sensitivity and coping capability, and the selected indexes are sensitivity indexes such as the proportion of total tourism revenue to GDP, tourism growth elasticity coefficient, growth rate of total tourists, concentration of source market, and GDP per capita, growth rate of total tourism revenue, index of industrial structure diversification, and the proportion of education expenditure to local fiscal expenditure responsive indicators (Su, Chen & Zhang, 2013).

Li Feng constructed the evaluation system of tourism economic system vulnerability from sensitivity-coping capability perspective and environment-structure perspective, respectively, in which the sensitivity and coping capability indicators include three aspects of economic comprehensive category, tourism economic category and social comprehensive category, with 31 indicators; tourism environment indicators involve natural environment, economic environment and social environment, mainly There are climate comfort index, natural disaster rate of scenic spots, tourism asset profit rate, tourism labor productivity, poverty index, urbanization rate, etc.; tourism structure indicators cover investment structure, market structure, organizational structure and resource structure, mainly the growth rate of reception capacity, concentration of source market, basic units of tourism enterprises, abundance of tourism resources, etc (Li, 2013; Li et al., 2014).

From the analysis of literature, it is clear that the vulnerability index system of tourism economic system rests mainly from the sensitivity-coping capability perspective, covering the internal and external environmental indicators of tourism economic system.

Based on the above index system research, under the premise of following the principles of scientific, systematic, operability and comparability of index selection, this dissertation constructs the index system from two aspects of internal tourism economic system and external regional composite system, and from two perspectives of sensitivity and coping capability

I finally selected indicators from two aspects: sensitivity and coping ability (Shown in Table 10). In terms of sensitivity indicators, I mainly select five indicators directly related to the tourism economic system; in terms of coping ability indicators, I mainly focus on external economic and social factors.

Table 10 Tourism economic system vulnerability evaluation index system

Objective Level	Criteria Level	Indicator Level	code	properties
Tourism economic system vulnerability evaluation index system	Sensitivity index	Tourism revenue as a share of GDP (%)	S ₁	+
		Industrial Structure Gini Coefficient	S ₂	+
		The first degree of tourism industry	S ₃	+
		Proportion of tourism foreign exchange earnings in exports	S ₄	+
		Elasticity coefficient of tourism to GDP growth	S ₅	+
		Elasticity coefficient of tourism to industrial growth	S ₆	+
		Elasticity coefficient of tourism to agricultural growth	S ₇	+
		The ratio of tourist arrivals to local population	S ₈	+
	Coping capability index	National economy (GDP) output value -	R ₁	-
		National economy (GDP) growth rate (%)	R ₂	-
		Fixed asset investment growth rate	R ₃	-
		Urban and Rural Consumption Growth Rate	R ₄	-
		export growth rate (%) -	R ₅	-
		Industrial Structure Diversification Index	R ₆	-
		Growth rate of total tourism revenue (%)	R ₇	-
Tourist growth rate	R ₈	-		

“+” indicates a positive correlation, “-” indicates a negative correlation.

The indicators are selected from two aspects: internal and external tourism attraction factors. The positive and negative values of the indicator represent the direction of impact on vulnerability, the positive value represents a positive correlation between the indicator and vulnerability, and the negative value represents a negative correlation between the indicator and vulnerability.

4.2.1.3. The meaning and properties of evaluation indicators

Tourism economic system vulnerability is a combination of sensitivity and coping capability, sensitivity positively reflects vulnerability, that is, the stronger the sensitivity, the more vulnerable the tourism economic system is to shocks, weak resistance, and high vulnerability; while coping capability inversely reflects

vulnerability, that is, the stronger the coping capability, the stronger the tourism economic system's ability to protect and recover itself, and low vulnerability.

Meaning and properties of sensitivity indicators

In the tourism economic system vulnerability evaluation index system, there are eight sensitivity indicators: (Table 11 as below)

Table 11 Meaning and properties of tourism economic system sensitivity evaluation index

Criteria Level	code	Indicator Level	Indicator explanation
Sensitivity index	S1	Tourism revenue as a share of GDP (%)	Reflects the degree of economic dependence on tourism
	S2	Industrial Structure Gini Coefficient	Reflects the degree of unbalanced industrial development
	S3	The first degree of tourism industry	Reflecting the concentration of industry development structure
	S4	Proportion of tourism foreign exchange earnings in exports	Reflecting the contribution of tourism foreign exchange earnings to exports
	S5	Elasticity coefficient of tourism to GDP growth	Reflects the degree of responsiveness of tourism development to economic growth
	S6	Elasticity coefficient of tourism to industrial growth	Reflects the extent to which tourism responds to industrial growth
	S7	Elasticity coefficient of tourism to agricultural growth	Reflects the extent to which tourism responds to agricultural growth
	S8	The ratio of tourist arrivals to local population	Reflects the level of regional tourism development

Under the condition of certain coping ability, sensitivity and vulnerability are positively correlated. That is, the higher the sensitivity, the higher the vulnerability, and vice versa. Because the economic development of specialized tourism cities is highly dependent on tourism, tourism is the main influencing factor of the economic sensitivity of specialized tourism cities. Therefore, this dissertation focuses on the relevant indicators reflecting the level of dependence of regional economy on tourism to characterize the sensitivity of economy, which can be divided into two categories: one is the indicators directly reflecting the degree of dependence of regional economic development on tourism, such as S1, S4, S5 and S8; The other is an indicator that indirectly reflects the dependence of regional economic development on tourism through comparison with other industrial development, such as S2, S3, S6 and S7. Among them, S1 reflects the dependence of the economy on tourism, S4 reflects the contribution of tourism foreign exchange income to exports, and S8 reflects regional tourism, The level of industry development can be calculated by directly querying relevant data; S2 reflects the unbalanced degree of industrial development and S3 reflects the concentration degree of industrial development structure. S5 (equation 1) reflects the response of tourism development to economic growth, S6 (equation 2)

reflects the response of tourism to industrial growth, and S7 (equation 3) reflects the response of tourism to agricultural growth. The calculation method is as follows (Dritsakis, 2004; Sofield, 2003):

$$S_5 = \frac{\text{Growth rate of tourism income}}{\text{Growth rate of GDP}} \quad 1.$$

$$S_6 = \frac{\text{Growth rate of tourism income}}{\text{Growth rate of secondary industry}} \quad 2.$$

$$S_7 = \frac{\text{Growth rate of tourism income}}{\text{Growth rate of primary industry}} \quad 3.$$

The proportion of tourism revenue to GDP reflects the degree of dependence of the regional economy on tourism and is a positive indicator, indicating that the higher the degree of dependence of the regional economy on tourism, the greater the sensitivity of the tourism economic system and the weaker its ability to withstand shocks. Tourism is by nature a sensitive industry, susceptible to external environmental influences, so the more dependent a region is on tourism development, the more vulnerable it is to external environmental and internal tourism structural problems, and the greater the likelihood of a tourism crisis.

The proportion of tourism foreign exchange earnings to total tourism revenue reflects the structure of tourism revenue as a positive indicator, indicating that the more dependent tourism development is on inbound tourism, the more sensitive the tourism economic system is to unexpected events. Relatively speaking, the inbound tourism market is a long-distance market, which will be constrained by the travel distance and tends to significantly reduce the demand for inbound tourism when the destination is affected by an unexpected event. Therefore, the dependence of regional tourism development on inbound tourism can be directly to the development of the tourism economy.

The share of inbound tourism in total tourist arrivals reflects the tourism market structure and is a positive indicator, indicating that the greater the share of inbound tourism, the greater the sensitivity of the system. The size of a region's attractiveness to inbound tourists will directly affect the sensitivity of the tourism economy system, the more inbound tourists, the more the adverse environmental impact of tourism demand reduction, the tourism economy will inevitably be affected.

Tourism growth elasticity coefficient reflects the elasticity of tourism development to regional economic growth, as a positive indicator, indicating that the greater the elasticity, the greater the sensitivity of the system. The indicator is expressed by the ratio of tourism revenue growth rate to GDP growth rate, the larger the value of the indicator indicates the greater the elasticity, the more the

tourism economy is affected by macroeconomic events. This leads to a strong sensitivity of the tourism economy system under the influence of economic events.

The growth rate of tourism employment reflects the employment capacity created by the tourism industry and is a negative indicator, indicating that the stronger the tourism industry's ability to promote the growth of employment, the weaker the sensitivity of the tourism economic system. The continuous growth of the tourism workforce indicates a progressive progress in tourism development and an optimized tourism employment structure. Under unfavorable conditions, an optimized tourism employment structure contributes to a less disrupted tourism economy and reduces adverse impacts. Therefore, the growth of tourism employment will reduce the sensitivity of the system in the face of perturbations. The growth rate of fixed assets of tourism enterprises reflects the impact formed by the development of tourism industry on tourism investment, which is a negative indicator, indicating that the more the investment in fixed assets of tourism enterprises grows, the weaker the sensitivity of the tourism economic system. The development of tourism industry will promote the increasing tourism investment, and when the level of tourism development is increasing, it will generate the demand for tourism investment. The growth of tourism investment then means the improvement of tourism supply level and tourism service facilities, which helps to improve the ability of tourism economic system to withstand damage and reduce sensitivity.

The level of consumption of the population reflects the change in the consumption of the population, as a negative indicator, indicating that high consumption levels create a low sensitivity of the tourism economic system. The growth of consumption level indicates that other consumption of local residents in meeting the basic material conditions is increasing, which means that the consumption of residents available for tourism is in the growth stage, which will greatly stimulate the generation of tourism demand in the region, ensure the normal operation of the tourism economic system, and reduce the sensitivity of the tourism economic system to the regional environment.

The GDP growth rate reflects the regional economic development and is a negative indicator, which means that the faster the development of the regional economy, the better it is for the tourism economic system to resist external disturbances and reduce sensitivity. The development of the regional economy will create a good economic environment for the tourism industry, which is a strong guarantee for the operation of the tourism economic system and a strong backing for the tourism economic system to resist disturbances. The growth of the regional economy will, to a certain extent, promote the optimization of the

structure of the tourism economic system, to ensure the improvement of the tourism public service system, and thus improve the system's ability to withstand shocks and reduce sensitivity.

Meaning and properties of Coping capability

In the tourism economic system vulnerability evaluation index system, there are eight coping capability indicators: (Table 12 as below)

Table 12 properties of tourism economic system coping capability evaluation index

Criteria Level	Code	Indicator Level	Indicator explanation
Coping capability index	R1	National economy (GDP) output value -	Reflects overall economic strength
	R2	National economy (GDP) growth rate (%)	Reflects economic growth capacity
	R3	Fixed asset investment growth rate	Reflects investment's contribution to economic development
	R4	Urban and Rural Consumption Growth Rate	Reflecting the contribution of consumption to economic development
	R5	export growth rate (%) -	Reflecting the contribution of exports to economic development
	R6	Growth rate of total tourism revenue (%)	Reflecting industrial structure on economic development
	R7	Industrial Structure Diversification Index	Reflect the regional tourism economic growth capacity
	R8	Tourist growth rate	Reflecting the attractiveness of regional tourism

There are three main considerations in the selection of coping capacity indicators: one is an indicator reflecting the overall economic strength, R₁ reflects the economic aggregate, and R₂ reflects the economic growth capacity; R₆ reflects the contribution of the industrial structure to economic development, which reflects; the economic development capacity. Since investment, consumption and net export are the three major factors driving economic growth, they are represented by R₃, R₄ and R₅ respectively; the third is an indicator reflecting the resilience of the tourism industry. R₇ reflects the growth capacity of tourism economy, and R₈ reflects the attractiveness of tourism. Among them, R₁, R₂, R₃, R₄, R₅, R₇, and R₈ can be directly queried. The calculation method of the R₇ industrial structure diversification index is as follows (Herfindahl & Hirschman, 1950):

$$H = \frac{1}{\sum_{i=1}^n X_i} \quad 4.$$

(The diversification index formula, also known as the Herfindahl-Hirschman Index (HHI), was developed by economists Orris C. Herfindahl and Albert O. Hirschman independently in the 1950s).

In the industrial structure diversification index formula, X_i is the proportion of the added value of the i th industry to GDP, and i is 1, 2, and 3 respectively)

The growth rate of total tourism revenue reflects the tourism economic development capacity, which is a positive indicator, indicating that the faster the tourism economic growth rate, the stronger the tourism development capacity and the stronger the ability to cope with the crisis. Tourism industry in the process of continuous development, tourism internal structure in the continuous optimization, which makes the tourism economic system in the encounter of external disturbances, has a strong ability to adapt and recovery, can adjust the system state as soon as possible.

The growth rate of total tourist volume reflects the attractiveness of regional tourism, which is a positive indicator, indicating that the stronger the ability of regional tourism to attract tourists, the stronger the recovery ability of the tourism economic system. The rapid growth of tourist volume is an important sign of the development of regional tourism, as well as the rest of the gradual expansion of demand for tourism. When the system is affected by the crisis, the number of tourists tends to decline, but the motivation for tourism still exists. After the crisis, the tourism system is driven by the motivation to be able to return to a stable state more quickly.

GDP per capita reflects the macroeconomic support for the development of the tourism economy and is a positive indicator, indicating that the stronger the regional economic base is, the better it is to support the tourism economic system to cope with the disruption. The operation of the tourism economy is closely related to the general economic environment, the economic base of the region, tourism development environment is relatively good, tourism facilities system, economic support policies are more perfect. Therefore, the operation of the tourism economic system in areas with a strong economic foundation will be smoother and more capable of coping with emergencies.

4.2.2. Data sources

Evaluation Indicators		Data source	
	indicators	Erhai Lake Region	Lake Balaton Region
S1	Tourism revenue as a share of GDP (%)	the National Economic and Social Development Statistical Bulletin of the region in 2004-2021	Regional Statistical (Somogy, Veszprém, Zala) Yearbook of Hungary of 2011 to 2021
S2	Industrial Structure Gini Coefficient	the National Economic and Social Development Statistical Bulletin of the region in 2004-2021	Regional Statistical (Somogy, Veszprém, Zala) Yearbook of Hungary of 2011 to 2021

S3	The first degree of tourism industry	the National Economic and Social Development Statistical Bulletin of the region in 2004-2021	Regional Statistical (Somogy, Veszprém, Zala) Yearbook of Hungary of 2011 to 2021
S4	Proportion of tourism foreign exchange earnings in exports	the National Economic and Social Development Statistical Bulletin of the region in 2004-2021	Regional Statistical (Somogy, Veszprém, Zala) Yearbook of Hungary of 2011 to 2021
S5	Elasticity coefficient of tourism to GDP growth	the National Economic and Social Development Statistical Bulletin of the region in 2004-2021	Regional Statistical (Somogy, Veszprém, Zala) Yearbook of Hungary of 2011 to 2021
S6	Elasticity coefficient of tourism to industrial growth	the National Economic and Social Development Statistical Bulletin of the region in 2004-2021	Regional Statistical (Somogy, Veszprém, Zala) Yearbook of Hungary of 2011 to 2021
S7	Elasticity coefficient of tourism to agricultural growth	the National Economic and Social Development Statistical Bulletin of the region in 2004-2021	Regional Statistical (Somogy, Veszprém, Zala) Yearbook of Hungary of 2011 to 2021
S8	The ratio of tourist arrivals to local population	the Dali Prefecture Statistical Yearbook of previous years in 2004-2021	Hungary statistical office (KSH statistic https://statinfo.ksh.hu)
R1	National economy (GDP) output value -	the National Economic and Social Development Statistical Bulletin of the region in 2004-2021	Regional Statistical (Somogy, Veszprém, Zala) Yearbook of Hungary of 2011 to 2021
R2	National economy (GDP) growth rate (%)	the National Economic and Social Development Statistical Bulletin of the region in 2004-2021	Regional Statistical (Somogy, Veszprém, Zala) Yearbook of Hungary of 2011 to 2021
R3	Fixed asset investment growth rate	the Dali Prefecture Statistical Yearbook of previous years in 2004-2021	Hungary statistical office (KSH statistic https://statinfo.ksh.hu)
R4	Urban and Rural Consumption Growth Rate	the Dali Prefecture Statistical Yearbook of previous years in 2004-2021	Hungary statistical office (KSH statistic https://statinfo.ksh.hu)
R5	Export growth rate (%)	the National Economic and Social Development Statistical Bulletin of the region in 2004-2021	Regional Statistical (Somogy, Veszprém, Zala) Yearbook of Hungary of 2011 to 2021
R6	Growth rate of total tourism revenue (%)	the National Economic and Social Development Statistical Bulletin of the region in 2004-2021	Hungary statistical office (KSH statistic https://statinfo.ksh.hu)
R7	Industrial Structure Diversification Index	the Dali Prefecture Statistical Yearbook of previous years in 2004-2021	Hungary statistical office (KSH statistic https://statinfo.ksh.hu)
R8	Tourism revenue growth rate	the Dali Prefecture Statistical Yearbook of previous years in 2004-2021	Hungary statistical office (KSH statistic https://statinfo.ksh.hu)

4.2.3. Data processing

4.2.3.1. Analysis of Economic Vulnerability

The evaluation index weights are determined to reflect the degree of their influence on the vulnerability of the tourism economic system, so as to conduct a more effective evaluation. In order to ensure the objectivity of the weight determination, this dissertation selects the entropy method to calculate.

Entropy method

The basic concept of "entropy" originated from thermodynamics, is a measure of the uncertainty of the system state, the greater the entropy value, the greater the uncertainty of the state. In information theory, information is a measure of the degree of order in a system, and entropy is a measure of the degree of disorder in a system, the two are equal in absolute value and opposite in sign. The smaller

the information of an indicator, the greater the degree of variation of its value, the greater the amount of information provided, and the greater the weight of the indicator; conversely, the greater the information entropy of an indicator, the smaller the degree of variation of its value, the smaller the amount of information provided, and the smaller the weight of the indicator. Entropy method (Entropy Weight Method) is an objective weighting method for multi-criteria comprehensive evaluation.

It provides a reliable basis to calculate the weight of each indicator based on the degree of variation of the value of each indicator, using the tool of information entropy.

The original information of the entropy method comes directly from the objective environment, and the weight coefficients of the corresponding indicators are determined according to the size of the information halo provided by each indicator, which effectively overcomes the defects of subjective determination of weights.

Suppose there are **m** evaluation indicators and **n** sets of data, forming the original indicator data matrix:

$$X_{ij} = (x_{ij})_{n \times m} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \cdots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix} \quad 5.$$

In the formula, $i = 1, 2, \dots, n; j = 1, 2, \dots, m$

The steps to determine the indicator weights using the entropy method are as follows:

- (1) Dimensionless processing of indicators. Since the meaning and measurement units of each evaluation index are different, and the magnitudes are very different, in order to facilitate statistical comparison, it is necessary to remove the difference in pegging between different indicators and the influence of individual extreme values on the evaluation results before comprehensive evaluation, and standardize these indicators so that they all fall into a certain dimensionless interval.

For positive indicators, those where the larger the indicator value is, the better the indicator, the equation for the dimensionless treatment of the indicator is:

$$x_{ij}' = \frac{x_{ij} - \min x_j}{\max x_j - \min x_j}, (i = 1, 2, \dots, n; j = 1, 2, \dots, m) \quad 6.$$

For the inverse indicator, which means that the smaller the indicator the better the indicator, the equation for the dimensionless treatment of the indicator is :

$$x_{ij}' = \frac{\max x_j - x_{ij}}{\max x_j - \min x_j}, (i = 1, 2, \dots, n; j = 1, 2, \dots, m) \quad 7.$$

Accordingly, the normalized matrix X' is obtained

$$X_{ij}' = (x_{ij}')_{n \times m} = \begin{bmatrix} x'_{11} & x'_{12} & \cdots & x'_{1m} \\ x'_{21} & x'_{22} & \cdots & x'_{2m} \\ \vdots & \vdots & \cdots & \vdots \\ x'_{n1} & x'_{n2} & \cdots & x'_{nm} \end{bmatrix} \quad 8.$$

- (2) Calculate the contribution of the j th index of the i th year or the i th evaluation object, and the calculation formula is:

$$P = \frac{x_{ij}}{\sum_{i=1}^m x_{ij}} \quad 9.$$

$$P_{ij} = (p_{ij})_{n \times m} = \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1m} \\ p_{21} & p_{22} & \cdots & p_{2m} \\ \vdots & \vdots & \cdots & \vdots \\ p_{n1} & p_{n2} & \cdots & p_{nm} \end{bmatrix} \quad 10.$$

- (3) Calculate the information entropy of the j th index of the i th year or the i th evaluation object, and the calculation formula is:

$$e_j = \frac{1}{\ln n} \sum_{i=1}^n p_{ij} \ln p_{ij} \quad 11.$$

where \ln is the natural logarithm, $e_j \geq 0$

- (4) Calculate the effect value of the j th index of the i th year or the i th evaluation object, and the calculation formula is

$$d_j = 1 - e_j \quad 12.$$

The larger the d_j is, the more important the indicator is

- (5) Calculate the weight value of the j th index of the i th year or the i th evaluation object, and the calculation formula is:

$$w_j = \frac{d_j}{\sum_{i=1}^n d_j} \quad (j = 1, 2, \dots, n) \quad 13.$$

Set-pair analysis method

The set pair analysis method is to analyze the same, opposing and differential degrees of connection for deterministic and uncertain problems. The basic idea is to consider the set E and the set U as a set pair H , in the context of the problem Q , by analyzing the characteristics of the set pair H , and derive N characteristics, of which S are common to the set E and the set U , P are relative, and $F = N - S - P$ are uncertain about the relationship, then the degree of connection of the two sets is:

$$u = \frac{S}{N} + \frac{F}{N}i + \frac{P}{N}j = a + bi + cj \quad 14.$$

where a, b, c are the degree of identity, difference and opposition between the set E and the set U under the problem Q, and a+b+c=1, i takes the value of [-1,1], and j is specified to take a constant value of -1.

Specifically, let the vulnerability problem of the tourism economic system of the western provinces (cities and autonomous regions) be $Q=\{E,G, W,D\}$, where the evaluation scheme $E=\{e_1, e_2, \dots\}$, each evaluation scheme has m indicators $G=\{g_1, g_2, \dots, g_n\}$, indicator weights $W=\{w_1, w_2 \dots\}$, the values of the evaluation indicators are noted as $(k=1,2, \dots, n; p=1,2, \dots, m)$, then the evaluation matrix D of the problem Q is:

$$D_{ij} = \begin{bmatrix} d_{11} & d_{12} & \cdots & d_{1m} \\ d_{21} & d_{22} & \cdots & d_{2m} \\ \vdots & \vdots & \cdots & \vdots \\ d_{n1} & d_{n2} & \cdots & d_{nm} \end{bmatrix} \quad 15.$$

The optimal evaluation set $U = \{u_1, u_2, \dots\}$ and the inferior evaluation set $V = \{v_1, v_2, \dots\}$ are chosen, and the homogeneity a_{kp} and the opposition C_{kp} of d_{kp} are obtained according to the set $\{v_p, U_p\}$

When d_{kp} has a positive effect on the evaluation results:

$$\begin{cases} a_{kp} = \frac{d_{kp}}{u_p + v_p} \\ c_{kp} = \frac{u_p v_p}{d_{kp}(u_p + v_p)} \end{cases} \quad 16.$$

When d_{kp} acts negatively on the evaluation results:

$$\begin{cases} a_{kp} = \frac{u_p v_p}{d_{kp}(u_p + v_p)} \\ c_{kp} = \frac{d_{kp}}{u_p + v_p} \end{cases} \quad 17.$$

The closeness u of the set pair $\{E_k, U\}$ on the interval $[V, U]$ is:

$$\begin{cases} u_{\{E_k, U\}} = a_k + b_k i + c_k j \\ a_k = \sum w_p a_{kp} \\ c_k = \sum w_p c_{kp} \end{cases} \quad 18.$$

The closeness of scheme E_k to the optimal evaluation set r_k is

$$r_k = \frac{a_k}{a_k + c_k} \quad 19.$$

A larger r_k indicates greater vulnerability and less stability of the tourism economic system; conversely, the opposite is true.

4.2.3.2. Analysis of the Obstacle degree

Based on the evaluation of the vulnerability of the study area in the previous chapter, this chapter aims to evaluate and analyze Erhai Lake and Lake Balaton to analyze the obstacle factors of vulnerability. Since vulnerability includes both sensitivity and responsiveness, sensitivity and responsiveness are also analysed simultaneously. Analysis of the causes of vulnerability of tourism destinations in the two lakes at different spatial scales.

Obstacle degree measurement Calculation of obstacle degree

The obstacle degree assessment model is mainly used to measure the degree of Obstacle degree of each indicator to reduce the economic vulnerability of tourism places, so as to determine the main influencing factors of vulnerability (Cutte,1996; Watson et al., 1998; Briguglio, 1992). The larger the value of the obstacle degree, the greater the Obstacle of the indicator to reduce the vulnerability of the tourism economic system; the smaller the value of the obstacle degree, the smaller the Obstacle of the indicator to reduce the vulnerability of the tourism economic system. The formula of the obstacle degree assessment model is shown below (Su & Zhang, 2010):

$$Q_i = \frac{w_i \times F_i}{\sum_{i=1}^{16} w_i \times F_i} * 100\% \quad 20.$$

In the formula, Q_i is the fragility Obstacle degree of the economic system; F_i is the index deviation degree, $F_i = 1 - x_i$ * (x_i * is the standardized value of the i th index) (Zhang et al.,2021; Zhao et al., 2022; Chen et al., 2022)

4.3. Explore strategies for tackling sustainable development

4.3.1. Research Design

The research object by developing and utilizing tourism resources in the two study areas and conducting a comparative analysis of policies and measures aimed at safeguarding these resources, I aim to explore a path that promotes the sustainable development of tourism cities in the Lakeland cities.

Investigate potential strategies for sustainable tourism development from the following three aspects: 1) Categorization of tourism resources through statistical analysis; 2) Explore the potentials of cultural resources, including intangible cultural heritage; 3) Sustainable utilization of natural resources for regional economic tourism development.

4.3.2. Data Collection

4.3.2.1. In-depth Interviews

The research process entails selecting participants, developing an interview guide, and then implementing and recording the interviews.

The interviewees of this study are experts and scholars from relevant departments (Tourism Bureau, Cultural Bureau, Statistical Bureau, Environmental Protection

Bureau) within the jurisdictions of China and Hungary; face-to-face interview methods are used in the Chinese regions, while email interviews are adopted in the Hungarian regions.

4.3.2.2. Literature Analysis

The processes begin with the collection of development planning documents from government and planning departments, followed by the analysis and compilation of the document content.

The documents and literature on the tourism development in the two regions studied in this research primarily come from planning and government departments. Here are some of the documents:

Action Plan for Lake Balaton Region (November 2020)

Lake Balaton Towards an integrated development? Annex to the Final report (October 2021)

"Fourteenth Five-Year" Cultural and Tourism Development Plan of Yunnan Province

Implementation Plan and Five-Year Action Plan for Dali Prefecture to Establish a Truly Historic and Cultural City

4.3.3. Data Analysis

The research is conducted in three steps: 1) Analysis of Interview Data involves transcribing, organizing, and then analyzing the interview records using coding or thematic analysis. 2) Analysis of Document Data requires summarizing and organizing document content, followed by content analysis. 3) Cross-Regional Comparative Analysis aims at identifying and comparing the similarities and differences between the two study regions.

4.3.4. Exploration of Strategies for Sustainable Development

A. Summary of Sustainable Development Strategies derived from Interviews and Document Analysis

B. Discussion of Differences and Similarities in Strategies between the two Study Region

5. Results

5.1. Evaluation of industrial structure balance

5.1.1. Analysis of the current situation of industrial development

In this section of my research, I plan to split my investigation into two distinct components. The first component will delve into the current situation pertaining to the development of the industrial structure. I will examine factors such as the existing industries, their interrelations, and their contributions to the economy.

The second component will focus on the current status of the tourism industry. This part will examine aspects like tourist inflow, contribution of tourism to the economy etc.

By adopting this bifurcated approach, I aim to provide a comprehensive and in-depth analysis of both the broader industrial structure and the specific dynamics within the tourism sector.

5.1.1.1. Current Situation of Industry Structure

➤ Erhai Lake Region

From 2004 to 2021, the GDP of the Erhai Lake region grew from CNY 20,122.2 million to CNY 163.3 billion, showing a stable economic growth trend. During this period, the growth rate from 2004 to 2013 is relatively stable, usually remaining above 12%, and peaking at 15.6% in 2012, showing a healthy growth phase (as shown in Figure 7).

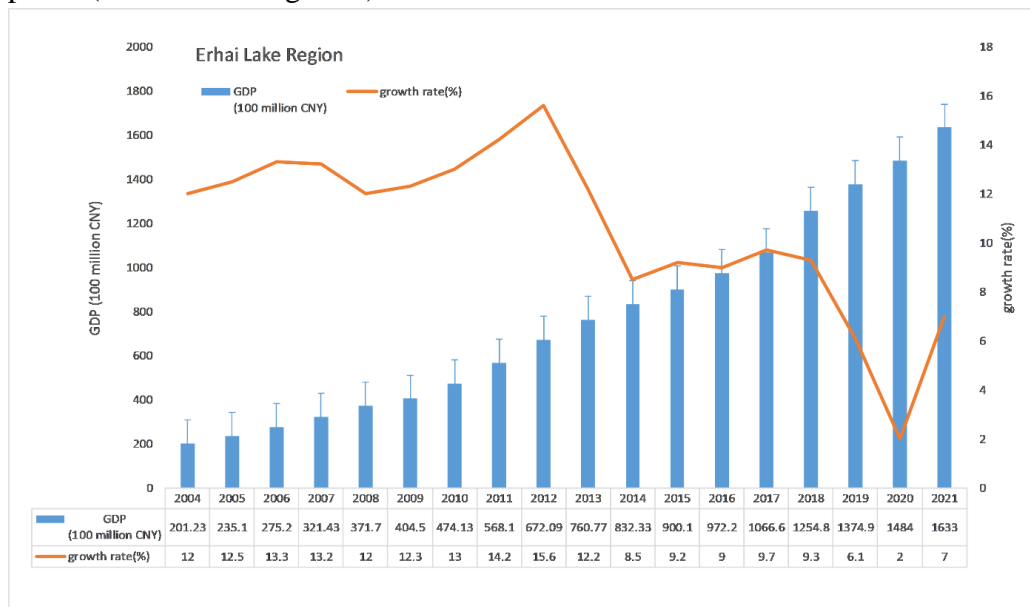


Figure 7 The GDP and GDP growth rate of the Erhai lake region from 2004-2021

Deceleration Period: From 2014 onwards, the growth rate started to decrease, reaching the lowest point of 2% in 2020. This might be related to the global economic downturn due to the COVID-19 pandemic, affecting many regions worldwide. This suggests a period of slowdown for the region; Recent Rebound: The growth rate rebounded to 7% in 2021, which indicates a possible recovery from the previous year's slowdown; Interesting Points: The growth rate in 2012 (15.6%) is notably higher than in surrounding years, suggesting an especially productive year for the region. On the other hand, the growth rate decreased sharply in 2020 (2%), probably influenced by the global COVID-19 pandemic. From 2004 to 2021, the Erhai Lake region exhibited a consistent augmentative trajectory in both primary and secondary industry output values, indicating a sustained development in the agriculture, fishing, mining, manufacturing, and processing sectors. The primary industry demonstrated an accelerated growth pattern in the later years, suggesting a potential strategic shift or efficiency enhancement. However, a temporary regression in the secondary industry was observed in 2019 and 2020, before rebounding in 2021, indicating the sector's resilience in face of external adversities. Intriguingly, despite the generally increasing trend of the tourism sector, a precipitous decline was discerned in 2020—likely a direct consequence of the global COVID-19 pandemic and its deleterious impact on international travel. Although a modest recovery ensued in 2021, the sector has yet to regain its pre-pandemic performance, reflecting the persistent ramifications of the pandemic. The interplay and individual growth dynamics of these sectors have evidently contributed to the overall GDP trajectory of the region, with the drastic dip in tourism income in 2020, in spite of robust primary and secondary industry outputs, likely influencing the observed attenuated GDP growth rate in that year. This multi-sector analysis elucidates the interdependencies within an economy and the subsequent ramifications on macroeconomic indicators such as GDP.

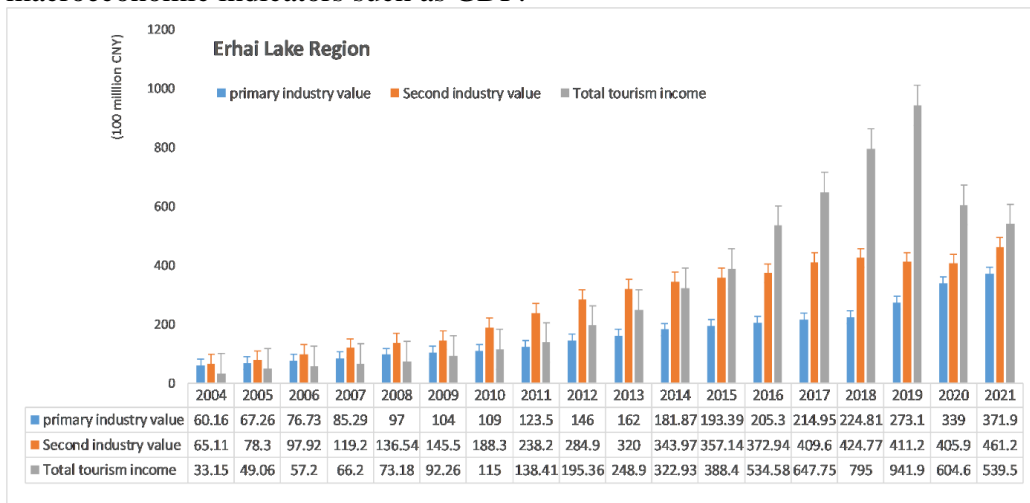


Figure 8 Output Value of Primary Industry, Output Value of Secondary Industry and Total Tourism Revenue in the Erhai lake Region, 2004-2021

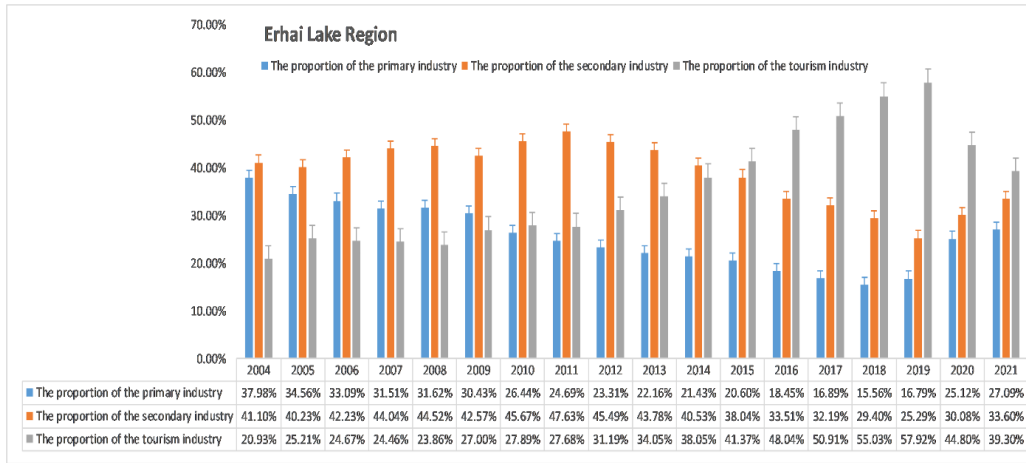


Figure 9 Changes in the share of primary and secondary industries and tourism in GDP of Erhai Lake Region, in 2004-2021

From 2004 to 2021, the Erhai Lake Region exhibited discernible transformations in the proportional contributions of its primary, secondary, and tourism industries to its GDP. While the primary and secondary industries' GDP shares have generally exhibited a decreasing trend—shrinking from 37.98% to 27.09% and from 41.10% to 33.60%, respectively—the tourism industry's GDP share significantly expanded from 20.93% to 39.30%. Notably, the year 2020 marked a temporary aberration in this trajectory, presumably instigated by the COVID-19 pandemic, as the primary and secondary sectors' proportions spiked, while tourism declined. These evolving proportions elucidate a transition towards economic diversification, with an escalating role for the service sector, emblematically represented by tourism. Nevertheless, the recent COVID-19 perturbation underscores the inherent vulnerability of the tourism industry to global crises, reflecting an abrupt reversion towards traditional industries in response to these exigencies. This cyclical analysis underscores the dynamic interplay within the regional economy, reflecting its coping capability to both internal evolutions and external shocks.

It is worth noting that in 2017, 2018 and 2019 (50.91%, 55.03% and 57.92%), tourism revenue contributes more than 50% of GDP, forming the phenomenon of specialized tourism cities as defined in Chapter 2. However, it's important to note that while a high share of tourism in GDP can bring benefits, such as job creation and foreign exchange earnings, it can also make the economy vulnerable to fluctuations in global travel patterns, as seen with the impact of the COVID-19 pandemic on the tourism sector in 2020 and 2021. Therefore, while it is advantageous to leverage the strengths of the region, it is also essential to

continue supporting and diversifying other sectors to ensure a balanced and resilient economy.

In the Figure 10, the growth rate of the primary industry has been relatively stable, hovering around 5-8%. This suggests a steady, consistent expansion in this sector. The secondary industry exhibited substantial growth in the initial years, peaking at 21.4% in 2012. However, post that peak, a general decline is observed, with a brief increase in 2018. This could indicate either a maturation of the sector or the impact of external economic factors. In 2020, it experienced a contraction of -3.2%, likely due to the impact of the COVID-19 pandemic, before rebounding slightly in 2021. The tourism industry has seen significant fluctuations, with impressive growth rates until 2019, peaking at 41.15% in 2012. However, the most substantial changes occur in 2020 and 2021, with a sharp decline of -35.8% in 2020, likely due to global travel restrictions from the COVID-19 pandemic. In 2021, while it shows signs of recovery, it's still in the negative territory with -10.8%.

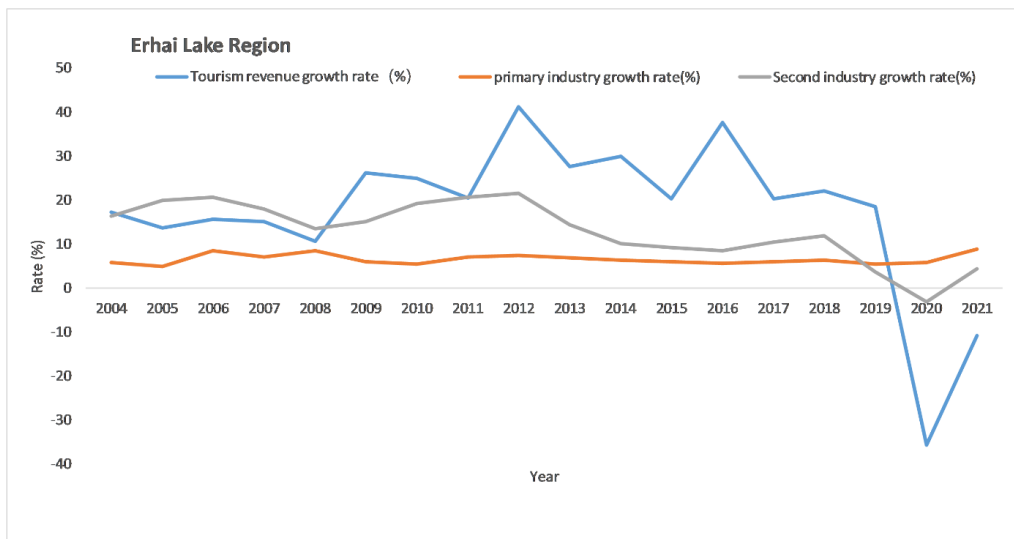


Figure 10 Growth rates of primary industry, secondary industry and tourism in the Erhai Lake region in 2004-2021

This data underscores the dynamic nature of economies, with varying growth rates across different sectors. It also highlights the significant impacts of global events such as the COVID-19 pandemic on local economies. These impacts are particularly noticeable in sectors like tourism that rely heavily on conditions outside the local environment. This analysis demonstrates the importance of diversification and adaptability in a regional economy to weather such disruptions and uncertainties.

➤ Lake Balaton Region

As shown in Figure 11 The GDP and GDP growth rate of the Lake Balaton region from 2012-2019. The Lake Balaton region's gross domestic product (GDP) exhibited a robust and continually expanding trajectory from 2012 to 2019. Although initially modest, with a growth rate of 1.47% in 2012, this increased to 5.26% by 2013, further accelerating to 6.78% and 6.57% in 2014 and 2015 respectively. A brief slowdown to 3.05% in 2016 was succeeded by a dramatic surge in growth, peaking at 11.95% by 2019. This pattern attests to the region's resilience, vibrancy, and capacity for sustained economic development. These dynamic trends could be attributed to a combination of regional strategic initiatives, sectoral developments, and external economic conditions.

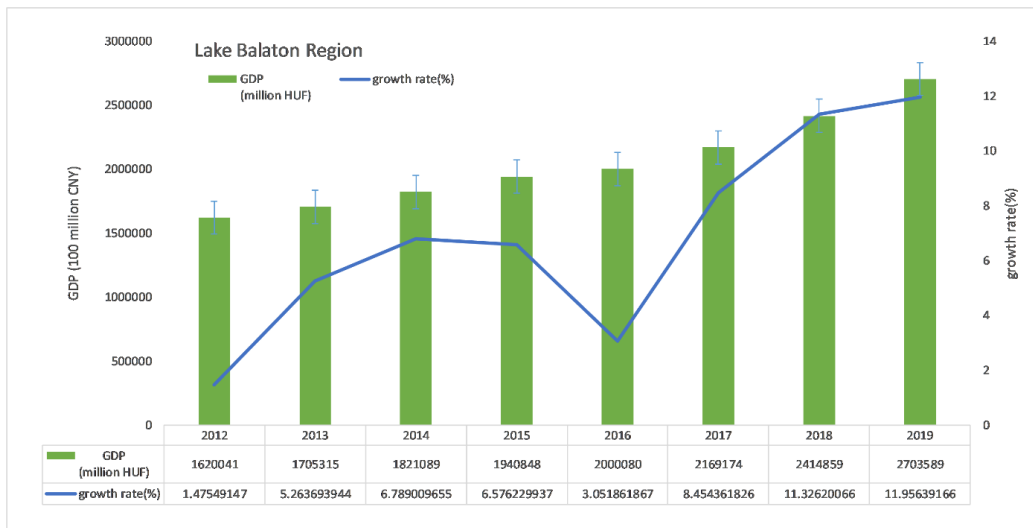


Figure 11 The GDP and GDP growth rate of the Lake Balaton region from 2012-2019

Lake Balaton, Central Europe's largest lake, is renowned for its natural beauty and recreational opportunities, positioning tourism as a vital GDP contributor. Its economic performance could reflect successful tourism promotion, infrastructure development, and favorable global tourism trends, possibly augmented by a rise in domestic tourism as Hungary's economy grew. The surrounding region's agricultural and viticultural productivity, along with a thriving real estate market catering to demand for holiday homes, are also likely GDP drivers.

The surge in economic performance might also be linked to significant investment in infrastructure, promoting growth across various sectors. Hence, policymakers and stakeholders should consider strategies focusing on sustainable tourism, agricultural sector support, responsible real estate development, and infrastructure investment. However, it is essential to strike a balance between economic growth and natural beauty preservation, ensuring that the region remains an attractive destination for tourists and residents alike.

Data (Figure 12 and Figure 13) from 2011 to 2019, the Lake Balaton region displayed significant growth in the output values of its primary industry, secondary industry, and tourism. The primary industry witnessed steady growth throughout these years, with output value rising from 129,933 million HUF in 2011 to 192,094 million HUF in 2019. The secondary industry also exhibited an upward trend, with output increasing from 526,582 million HUF in 2011 to 851,691 million HUF in 2019. This sustained expansion suggests that the region's industrial sector consistently contributed to its economic strength. However, it is the area of tourism that proved to be remarkable. Starting with a total income of 160,211.87 million HUF in 2011, it reached 334,876.22 million HUF in 2019, more than doubling its contribution to the economy. This remarkable increase attests to the fact that tourism is a vital and rapidly growing component of the Lake Balaton region's economy. These data reflect a balanced economic growth, with each sector contributing its share to the overall prosperity of the Lake Balaton region.

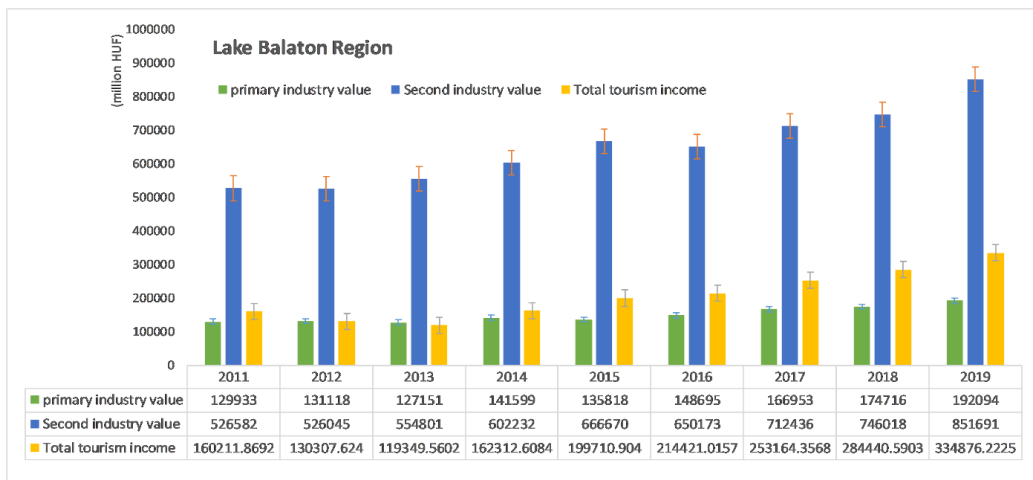


Figure 12 Output Value of Primary Industry, Output Value of Secondary Industry and Total Tourism Revenue in the Lake Balaton region from 2012-2019

During this period, the proportion of the GDP attributed to the primary industry exhibited minor fluctuations, with a slight overall decrease from 16.65% in 2012 to 13.93% in 2019. This trend suggests a gradual transition away from primary industries (Shown in Figure 13).

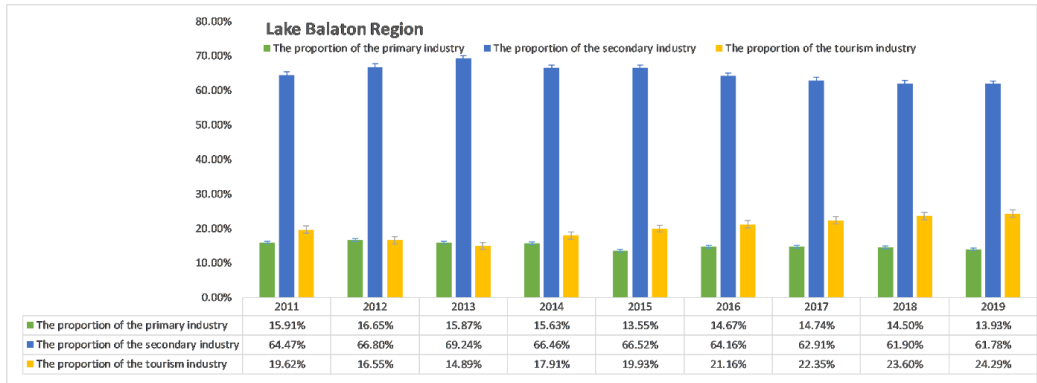


Figure 13 Changes in the share of primary and secondary industries and tourism in GDP of Lake Balaton region

In contrast, the secondary industry's share in the GDP also demonstrated a decreasing trend, but with a larger magnitude. From 66.80% in 2012, the sector's contribution dwindled to 61.78% in 2019. Although still contributing the majority share, the downward trajectory indicates a possible decline in traditional manufacturing and industrial activity, or a growth in other sectors outpacing that of the secondary industry.

The tourism sector, however, has seen a steady rise in its GDP share, growing from 16.55% in 2012 to 24.29% in 2019. This is indicative of the Lake Balaton region's increasing reliance on tourism as a source of income, and underscores the potential of this sector in driving future growth.

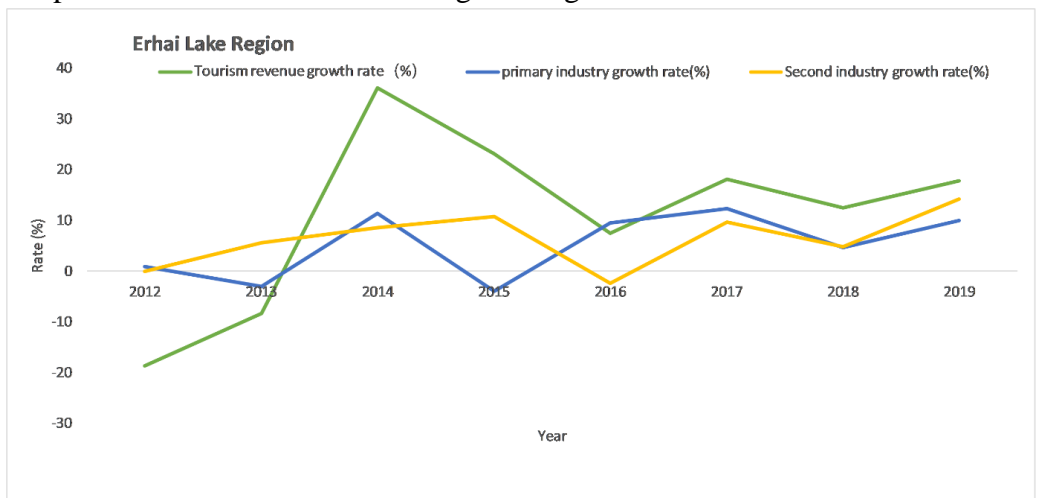


Figure 14 Growth rates of primary industry, secondary industry and tourism in the Lake Balaton region from 2012-2019

An examination of the Lake Balaton region's growth rates for the primary and secondary industries, as well as tourism revenue, from 2012 to 2019 reveals a variety of trends and fluctuations (shown in Figure 14).

Concerning the primary industry, while experiencing modest growth of 0.91% in 2012, it endured negative growth in 2013 and 2015. Despite this, it bounced back in 2014, 2016, and 2017 with remarkable growth rates of 11.36%, 9.48%, and 12.28% respectively, peaking in 2017. The industry demonstrated resilience once more with growth of 4.65% and 9.95% in 2018 and 2019, indicating a steady recovery; The secondary industry's growth rate displays a similarly mixed pattern. Despite a minor dip in 2012 and a notable decrease in 2016, the industry maintained positive growth throughout the remaining years, culminating in a robust 14.16% growth rate in 2019; In stark contrast to the primary and secondary industries, tourism revenue encountered pronounced negative growth in 2012 and 2013, but remarkably rebounded with a stunning 36% growth in 2014. Following this remarkable recovery, the growth rate remained consistently positive, ranging between 7.37% and 23.04% until 2019, underscoring the buoyancy of the region's tourism sector.

In summary, while the growth rates of the primary and secondary industries demonstrate a degree of volatility, they generally indicate an upwards trajectory. Meanwhile, the resilience and robust growth of the tourism sector emphasize its significant role as an economic driver in the Lake Balaton region. This analysis underscores the importance of a diverse economic structure that can adapt to and overcome periods of slowdown or decline in any one sector.

5.1.1.2. Current Situation of Tourism Development

Data from 2004-2021 highlights Erhai Lake region's fluctuating tourism sector (Table 13), showcasing growth, contraction, and recovery phases. Total tourism income rose steadily until 2019 but faced significant drops in 2020 and 2021 due to the COVID-19 pandemic. Both domestic and inbound tourist trends mirrored this, with a more pronounced decline among international visitors, emphasizing the impacts of varied travel restrictions. This analysis reveals Erhai Lake's reliance on both local and global tourists and its vulnerability to worldwide disruptions like the pandemic. It also underscores the potential of domestic tourism as a buffer during international travel restrictions, highlighting the need for adaptive sector management.

Between 2011 and 2019, the Lake Balaton Region experienced varying trends in tourism development. Based on Table 14, tourism income consistently increased, with a notable jump from 130,308 million HUF in 2012 to 334,876 million HUF in 2019. Though there was a dip in the number of domestic and inbound tourists between 2012 and 2013, numbers gradually increased thereafter. By 2019, domestic tourists reached 3,861 thousand, while inbound tourists numbered 4,120 thousand. In total, the tourist population in the Lake Balaton Region grew

from 7,945 thousand in 2011 to 7,981 thousand in 2019, showcasing the region's sustained attractiveness to visitors.

➤ Erhai Lake Region

Table 13 Tourism Development in the Erhai Lake Region in 2004 - 2021

Year	Total tourism income (100 million CNY)	Number of domestic tourists (10,000 people)	Number of inbound tourists received (10,000 people)	Total tourist population (10,000 people)
2004	33.15	591	13.58	604.58
2005	49.06	678	17.39	695.39
2006	57.2	766	20.93	786.93
2007	66.2	869	26.44	895.44
2008	73.18	921.64	31.67	953.31
2009	92.26	1105.92	35.3	1141.22
2010	115	1297	40.75	1337.75
2011	138.41	1499.5	45.52	1545.02
2012	195.36	1791.1	56.23	1847.33
2013	248.9	2170.23	70.68	2240.91
2014	322.93	2567.18	80.83	2648.01
2015	388.4	2841.26	87.25	2928.51
2016	534.58	3765.77	93.44	3859.21
2017	647.75	4120.45	102	4222.45
2018	795	4606.27	104.58	4710.85
2019	941.9	5206.51	93.49	5300
2020	604.6	3916.8	4.4	3921.2
2021	539.5	4450.9	0.9	4451.8

➤ Lake Balaton Region

Table 14 Tourism Development in the Lake Balaton Region in 2011 - 2019

Year	Total tourism income (Million HUF)	Number of domestic tourists (Thousand people)	Number of inbound tourists received (Thousand people)	Total tourist population (Thousand people)
2011	160212	4568	3377	7945
2012	130308	4160	3165	7325
2013	119350	3498	2210	5708
2014	162313	3620	2964	6584
2015	199711	3595	3679	7274
2016	214421	3637	3622	7259
2017	253164	3748	3788	7536
2018	284441	3703	4097	7800
2019	334876	3861	4120	7981

5.1.2. Analysis of Industry structure differentiation

Using the output value of the primary industry, the output value of the secondary industry, and the total tourism revenue of the Erhai lake region as indicators, I analyzed the overall differences and changes of the primary industry, secondary industry, and tourism in the Erhai lake region during the 17 years from 2004 to 2021 and the Lake Balaton region from year 2011 to 2019. The results are shown in Table 15 and Table 16.

Table 15 Indicators of Industrial Development Differences in the Erhai lake Region in 2004-2021

Year	Range	Extreme value ratio	Standard deviation	Coefficient of variation	Priority status	Gini coefficient
2004	31.96	1.964103	17.20215	0.325757	1.082281	0.134495
2005	29.24	1.596005	14.76538	0.227603	1.164139	0.100161
2006	40.72	1.711888	20.36564	0.263519	1.276163	0.117087
2007	53	1.800604	26.84311	0.297497	1.397585	0.130531
2008	63.36	1.86581	32.00337	0.313022	1.407629	0.137715
2009	53.24	1.577065	27.97194	0.24554	1.399038	0.103855
2010	79.3	1.727523	44.15386	0.321275	1.637391	0.128224
2011	114.7	1.928745	62.36511	0.374108	1.720974	0.1529
2012	138.9	1.95137	70.41192	0.337297	1.458333	0.147862
2013	158	1.975309	79.13156	0.324798	1.285657	0.144115
2014	162.1	1.891296	88.14478	0.31155	1.065153	0.127321
2015	195.01	2.008377	104.7379	0.334651	1.087529	0.138463
2016	329.28	2.603897	164.6491	0.44387	1.433421	0.197265
2017	432.8	3.013492	216.764	0.511115	1.581421	0.226781
2018	570.19	3.53632	289.3011	0.6008	1.871601	0.26314
2019	668.8	3.44892	353.0835	0.651365	2.290613	0.274177
2020	265.6	1.783481	138.1428	0.307098	1.489529	0.131209
2021	167.6	1.450659	83.86014	0.183288	1.169775	0.081403

Table 16 Indicators of Industrial Development Differences in the lake Balaton Region in 2011-2019

Year	Range	Extreme value ratio	Standard deviation	Coefficient of variation	Priority status	Gini coefficient
2011	396649	4.052719	220784.3	0.810985	3.286785	0.323771
2012	395737.4	4.036947	228245.5	0.869539	4.011997	0.335028
2013	435451.4	4.648538	249186.5	0.932931	4.363324	0.362287
2014	460633	4.253081	260173.3	0.861364	3.710322	0.338896
2015	530852	4.908554	289809.4	0.867521	3.338175	0.353125
2016	501478	4.372528	272543.5	0.806908	3.032226	0.329934
2017	545483	4.267285	293233.3	0.77674	2.814124	0.321093
2018	571302	4.269889	303171.9	0.754675	2.622755	0.316027
2019	659597	4.43372	347023.6	0.755132	2.543301	0.318955

5.1.2.1. Range (R) and standard deviation (St)

➤ Erhai Lake Region

As can be seen from Figure 15 (a) & (b), the trends of the range (R) and standard deviation (S_t) curves of the development of the three industries in the Erhai Lakes Basin region are basically the same, and generally show an upward trend, indicating that the absolute differences between the primary industry, secondary industry and tourism in the Erhai Lakes region are expanding, and the gap in output value is huge. Among them, the absolute differences between the development of primary industry, secondary industry and tourism in the Erhai Lakes Basin area from 2004 to 2009 were small and the development level was relatively average; after 2010, the local tourism industry flourished, and the absolute differences between the development of primary industry, secondary industry and tourism in the Erhai Lakes Basin area from 2010 to 2019 widened sharply, and the R-value and S_t -value both reached the peak in 2019. In 2020-2021, Covid-19 severely affects the local tourism industry, resulting in a decline in fluctuations.



Figure 15 The Industrial Development Range and Standard deviation of Erhai lake Region from 2004-2021

➤ Lake Balaton Region

The trends of the extreme difference (R) and standard deviation (S_t) curves of the development of the three industries in the Lake Balaton region are basically the same, and they have been showing an increasing trend from 2011 to 2019, indicating that the absolute differences between the primary industry, secondary industry and tourism in the Lake Balaton region are expanding, and the gap in output value is huge.

The rising range may also reflect the entry of new industries or expansion in existing ones, signifying the region's dynamic and evolving industrial landscape. However, one notable exception to this steady growth trend is the year 2016,

when the range contracted slightly compared to 2015, possibly implying a temporary economic slowdown or consolidation in the industrial sector.



Figure 16 The Industrial Development Range and Standard deviation of Lake Balaton region from 2011-2019

5.1.2.2. Ratio of extreme values (RHL) and coefficient of variation (CV)

➤ Erhai Lake Region

The extreme value ratio (RHL) and the coefficient of variation (CV) of industrial development in the Erhai Lake Region show a trend of slowly increasing with small fluctuations, indicating that the relative differences between the primary industry, secondary industry and tourism in the Erhai Lake Region are gradually increasing in general. Among them, the RHL and CV values increased significantly between 2015 and 2018, mainly due to the faster development of tourism after 2015, which led to the expansion of the relative economic differences between tourism and the three primary and secondary industries. The substantial and sharp decline after 2019 was due to the devastating impact of covid-19 on the local tourism industry

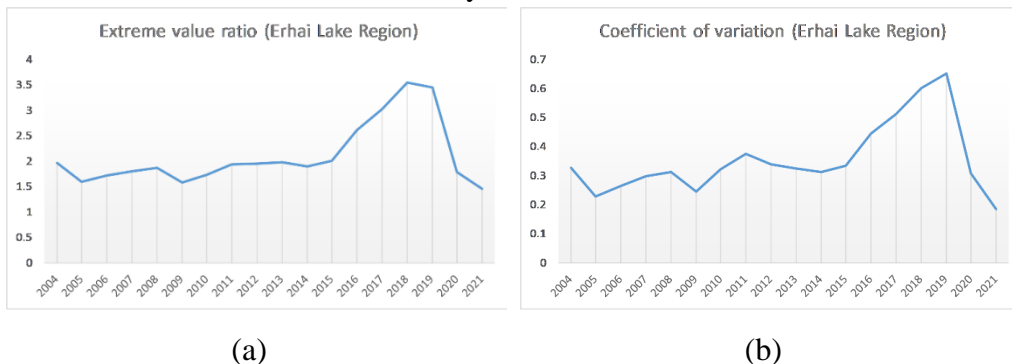


Figure 17 The Industrial Development Ratio of extreme values (RHL) and coefficient of variation (CV) of Erhai lake Region from 2004-2021

➤ Lake Balaton Region

The analysis of the Coefficient of Variation (CV) and Ratio of extreme value (RHL) for the primary and secondary industries, along with the tourism sector in the Lake Balaton region from 2011 to 2019, provides an insightful overview of the region's economic dynamism. The CV, which gauges the dispersion of data points around the mean, indicates a surge from 0.811 in 2011 to 0.933 in 2013, highlighting an increased variability in the growth rates of these sectors, potentially underpinned by fluctuating economic conditions, market uncertainties, or policy changes during this timeframe. However, the subsequent years witness a gradual decrease in CV, culminating at 0.755 in 2019, signifying a transition towards more predictable and stable growth. The cause of this change could be attributed to more consistent economic policies, improved market conditions, successful economic diversification, and infrastructure developments in the region. The relatively stable CV observed in 2018 and 2019 further underscores the consolidation of this stability. (Shown in Figure 18)

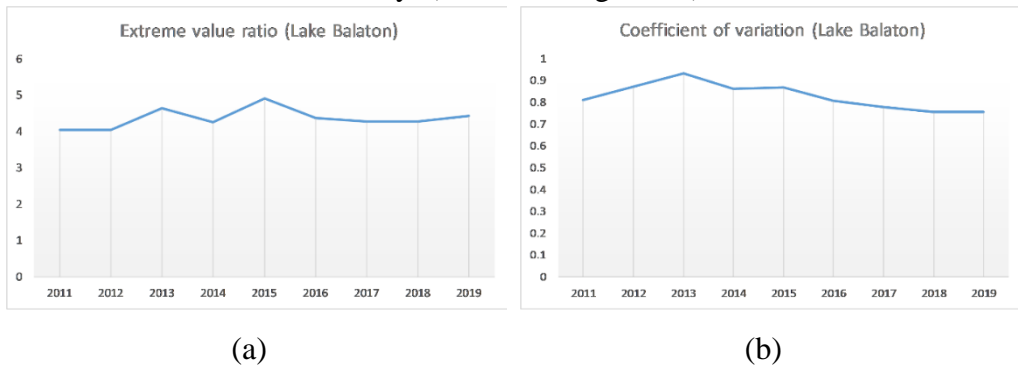


Figure 18 The Industrial Development Ratio of extreme values (RHL) and coefficient of variation (CV) of Lake Balaton region from 2011-2019

5.1.2.3. Degree of priority status (S) and Gini coefficient (G)

➤ Erhai Lake Region

Erhai Lake region the Priority status from 2004 to 2021, reflecting the dominance of a particular industry or sector in the region's economic framework, has witnessed significant fluctuations over the period, with the lowest value observed in 2004 (1.082) and the highest in 2019 (2.290). This volatile trend suggests that the region's economic structure has undergone changes over the years, possibly due to varying strategic efforts to balance sectoral contributions, cope with changing economic conditions, or respond to policy interventions.

The Gini coefficient, indicating the level of economic disparity among these sectors, varies from 0.081 in 2021 to 0.274 in 2019. From 2004 to 2019, there's a general trend of increasing Gini coefficient, suggesting a growing disparity in the economic contributions of different sectors. This could be attributed to varying factors such as shifts in market demands, policy changes, or industrial

developments favoring one sector over others. However, in 2020 and 2021, a significant drop in the Gini coefficient is observed, implying a substantial reduction in sectoral disparity. This might be due to equalizing factors like effective policy implementations or a shift towards a more balanced economic strategy.

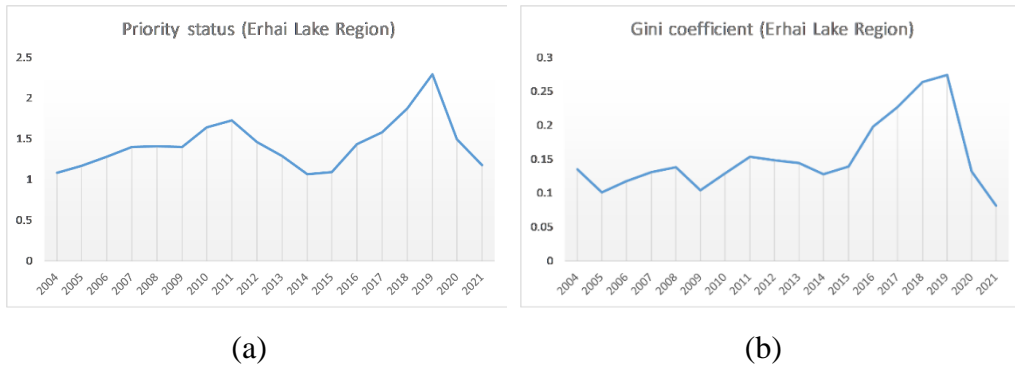


Figure 19 The Industrial Development priority status and Gini coefficient of Erhai lake Region from 2004-2021

➤ Lake Balaton Region

The data provided for the Lake Balaton region from 2011 to 2021 on the Priority status and Gini coefficient for primary and secondary industries, as well as the tourism sector, presents a noteworthy trajectory of economic developments.

The priority status indicates the dominance or influence of a certain industry or sector in the region's economy. The decreasing trend from 4.012 in 2012 to 2.543 in 2019 suggests a shift in the region's economic structure, possibly indicating diversification across these sectors. This could be due to deliberate efforts to avoid over-reliance on one industry, encourage innovation, and promote balanced development, thereby making the economy more resilient to market uncertainties and potential shocks.

The Gini coefficient, a commonly used measure of income inequality, ranges between 0 and 1, with 0 representing perfect equality and 1 representing perfect inequality. It serves as a critical tool in identifying income disparities and the distribution of wealth within a given population. In this context, the Gini coefficient seems to be showing the disparity between the economic contributions of the primary, secondary, and tourism sectors to the region's economy. The coefficients vary from 0.336 in 2012 to 0.319 in 2019, signifying a slight decrease in economic disparity among the sectors. This supports the inference drawn from the Priority status and suggests a more balanced contribution of each sector to the region's economy over time.

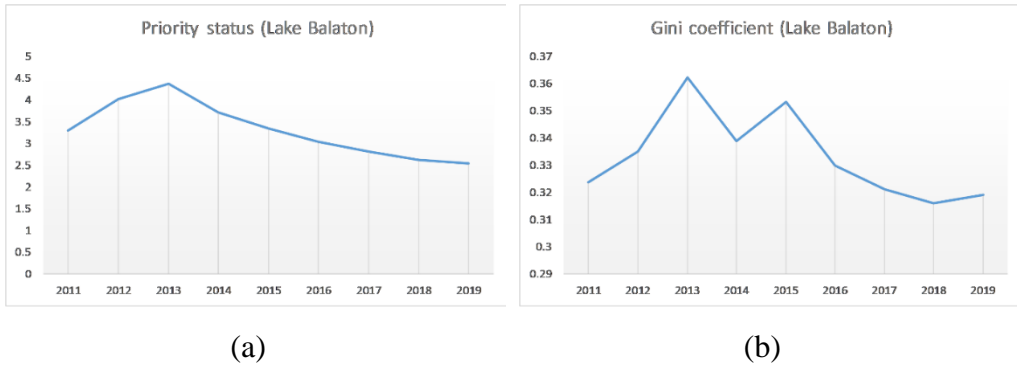


Figure 20 The Industrial Development priority status and Gini coefficient of Lake Balaton region from 2011-2019

5.2. Evaluation of Tourism Economic System Vulnerability

This section aims to evaluate and analyze the vulnerability of the tourism economic system of Erhai Lake and Lake Balaton, based on the construction of the vulnerability index system, the data of the first ten years of the extreme events of tourism development covid-19 are selected, the weights of each index are obtained, and the sensitivity, responsiveness, and vulnerability are evaluated by using the set-pair analysis method; then based on the western region tourism economic system the evaluation results of vulnerability, analyze it from the perspective of time and space, and further explain the change process of vulnerability.

5.2.1. Determination of indicator weights

Using the entropy method, the sensitivity, responsiveness, and vulnerability indicator data of the two study regions were substituted into the calculation to find the indicator weights. Since the selected data are panel data, it is necessary to average the data, i.e., to find out the mean value of each indicator data, and then to calculate the entropy method, and the results of the obtained weights are shown in Table 17 (Erhai Lake Region) and Table 18 (Lake Balaton Region).

➤ Erhai Lake Region

The results of the weight calculation for the Erhai lake region are shown in the following table:

Table 17 The weights of various indicators of the vulnerability of the tourism system

(Erhai Lake Region)

Sensitivity index		Coping capability index	
index	Weights	index	Weights
S ₁	0.146779	R ₁	0.264874
S ₂	0.065112	R ₂	0.042542
S ₃	0.029324	R ₃	0.158756
S ₄	0.026775	R ₄	0.055272
S ₅	0.117131	R ₅	0.227358
S ₆	0.248377	R ₆	0.001183
S ₇	0.094074	R ₇	0.113133
S ₈	0.272428	R ₈	0.136882

➤ Lake Balaton Region

The results of the weight calculation for the Lake Balaton region are shown in the following table:

Table 18 The weights of various indicators of the vulnerability of the tourism system (Lake Balaton Region)

Sensitivity index		Coping capability index	
index	Weights	index	Weights
S ₁	0.009216	R ₁	0.012681
S ₂	0.000591	R ₂	0.127708
S ₃	0.009859	R ₃	0.165419
S ₄	0.028205	R ₄	0.072749
S ₅	0.070192	R ₅	0.299182
S ₆	0.808681	R ₆	9E-05
S ₇	0.069974	R ₇	0.187987
S ₈	0.003281	R ₈	0.134185

5.2.2. Analysis of vulnerability

The vulnerability assessment calculation process includes essential data processing methods in this model, including matrix transformation of raw data, non-negativity constraint, normalization, and standard calculation process. Please refer to Annex 3 for details.

5.2.2.1. Vulnerability class classification

Economic system is divided into four levels: low vulnerability, moderate vulnerability, higher vulnerability and highly vulnerability.

In order to reveal the economic vulnerability among tourist city, the vulnerability mean and standard deviation ($M_1=0.4407$ & $Std_1=0.1074$ for Erhai Lake; $M_2=0.3077$ & $Std_2=0.2223$ for Lake Balaton) as the evaluation basis, the

economic vulnerability r_m is divided into four categories (Table 19), In-depth analysis from two aspects of economic sensitivity and coping capacity.

Table 19 Vulnerability classification evaluation of tourism economic system

Project		Grading standards			
		(0, M-Std]	(M-Std, M]	(M, M+Std]	(M+Std,1]
Vulnerability Index	Erhai lake	(0,0.333]	(0.333,0.441]	(0.441,0.548]	(0.548,1]
	Lake Balaton	(0, 0.085]	(0.085, 0.308]	(0.308, 0.530]	(0.530,1]
Degree of vulnerability		low vulnerability	moderately vulnerable	higher vulnerability	highly vulnerable
M stands for mean, Std stands for standard deviation					

5.2.2.2. Vulnerability evaluation results

➤ Erhai Lake Region

Base on Table 19, Table 20 and Figure 21 show that the vulnerability of Dali's (Erhai lake) tourism economic system has shown a fluctuating upward trend in the past fifteen years (2004-2019).

Sensitivity: The region's sensitivity to tourism shows an overall increasing trend from 2004 to 2019. This suggests that the region's economy is becoming increasingly dependent on tourism. Such a trend may result from the region's natural beauty, cultural heritage, and growing international awareness of these attractions.

Coping ability: This variable shows a bit of fluctuation over the years, but seems to have two major phases. From 2004 to 2010, the coping ability of the region increases, suggesting growing resilience and possibly diversification in the economy, improved infrastructure, or increased government support. However, from 2010 onwards, it declines, indicating that the region might be facing challenges in managing the impacts of the increasing tourism.

Vulnerability: Vulnerability has an overall increasing trend from 2004 to 2019, but it starts to increase more rapidly from 2014 onward. This coincides with the increase in sensitivity and decrease in coping ability around the same time.

Degree of vulnerability: The degree of vulnerability shows that the region has moved from a low/moderate level of vulnerability in the early years to a higher/highly vulnerable state by 2019. This suggests that despite the growth in tourism, the region has become more susceptible to negative impacts from changes in the tourism sector.

The increasing sensitivity and vulnerability could be due to several factors such as increased reliance on tourism for local economy, degradation of natural resources due to overuse, changes in tourist patterns, or increased competition. The decreasing coping ability might be due to lack of alternative employment opportunities, insufficient infrastructure to handle the increasing tourist influx, or lack of effective measures to mitigate the negative impacts of tourism. This analysis suggests that while tourism has grown, it's crucial for local authorities to manage the impacts effectively to maintain sustainable development. Measures such as improving infrastructure, diversifying the local economy, managing resources responsibly, and providing education and training for local residents can enhance coping capacity and reduce vulnerability. Some local intrinsic social factors might be causing this vulnerability of tourism system in Erhai lake region are:

Table 20 The evaluation results of the vulnerability of tourism economy in Erhai Lake Region

Particular year	Sensitivity	Coping ability	Vulnerability	Degree of vulnerability
2004	0.271748	0.46866	0.3670	moderately
2005	0.240159	0.503247	0.3231	low
2006	0.244324	0.437946	0.3581	moderately
2007	0.261539	0.521633	0.3339	moderately
2008	0.24231	0.445938	0.3521	moderately
2009	0.370759	0.578751	0.3905	moderately
2010	0.37002	0.685562	0.3505	moderately
2011	0.337589	0.645243	0.3435	moderately
2012	0.478494	0.655694	0.4219	moderately
2013	0.472507	0.657774	0.4180	moderately
2014	0.596404	0.563393	0.5142	higher
2015	0.53316	0.446586	0.5442	higher
2016	0.838263	0.666352	0.5571	highly
2017	0.649494	0.52269	0.5541	highly
2018	0.696765	0.546926	0.5602	highly
2019	0.917439	0.464007	0.6641	highly

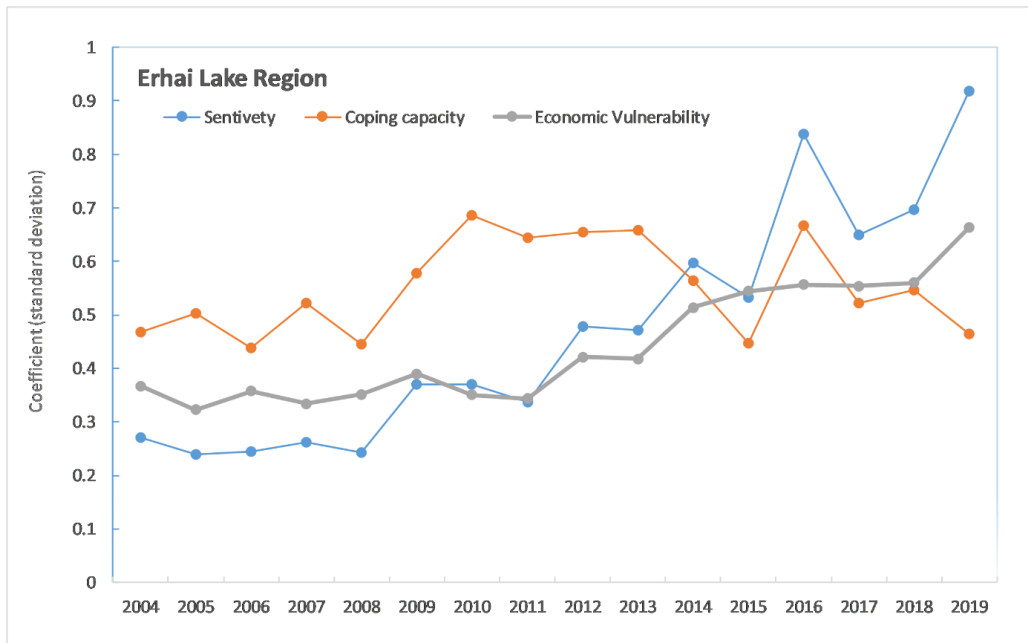


Figure 21 Line chart of tourism economic sensitivity, coping capacity, and vulnerability changes in Erhai lake region

In the 2008, the global financial crisis that broke and strong domestic inflation expectations, and the outbreak of the H1N1 virus, greatly affected the travel demand and travel ability of residents. The two reasons together led to the growth of Dali's tourism economic sensitivity and fluctuations; however, the government also quickly responded to the financial crisis with corresponding policies, and the coping ability was also significantly improved from 2009 to 2010. Therefore, after the 2008 financial crisis, Dali's tourism vulnerability did not have a significant effect.

From the year of 2015, the tourism industry in Dali Prefecture recovered rapidly. Sensitivity indicators such as the proportion of tourism revenue in GDP and the elasticity coefficient of tourism growth all maintained high values. Sensitivity has also increased, but the ability to respond has a downward trend relative to the sensitivity value from 2014, which led to a relatively fragile period for Dali's tourism economic system from 2015 to 2019.

The change of the vulnerability of Dali's tourism economic system is relatively stable, but in general the vulnerability of Dali's tourism economic system is at a high level in most years. In order to further explore the main factors hindering the decline of the vulnerability of Dali's tourism economic system, this dissertation adopts the Obstacle analysis degree model to carry out calculation and analysis, and obtain the research results.

➤ Lake Balaton Region

Base on Table 19, Table 21 and Figure 22 show that the vulnerability of Lake Balaton tourism economic system has shown a fluctuating upward trend in the past decade (2012-2019).

Table 21 The evaluation results of the vulnerability of tourism economy in Lake Balaton Region

Particular year	Sensitivity	Coping ability	Vulnerability	Degree of vulnerability
2012	0.846387	0.153086	0.846833258	highly
2013	0.146164	0.410203	0.262710771	moderately
2014	0.200961	0.762046	0.208680405	moderately
2015	0.164966	0.666919	0.198304208	moderately
2016	0.154395	0.33403	0.316108175	higher
2017	0.178136	0.776119	0.18667561	moderately
2018	0.180625	0.769518	0.190103349	moderately
2019	0.18696	0.553601	0.252457233	moderately

Sensitivity: Sensitivity in the Lake Balaton region dramatically drops from a very high value in 2012 to a much lower value in 2013, and then stabilizes in the range of 0.14 to 0.20 for the subsequent years. This suggests that the region's economy became less dependent on tourism after 2012. It's possible that some significant economic diversification took place in the region around this time.

Coping ability: Coping ability shows a drastic increase from 2012 to 2013, then dips in 2014 and 2016, but stays relatively high and stable for the rest of the period. The increase from 2012 to 2013 suggests that the region's resilience or ability to manage impacts from the tourism sector improved dramatically.

Vulnerability: Vulnerability also shows a significant decrease from 2012 to 2013, stabilizing afterwards with a slight upward trend in 2016 and then decreasing again. This trend mirrors the changes in sensitivity and coping ability, which influence vulnerability.

Degree of vulnerability: This data shows that the region moved from a highly vulnerable state in 2012 to a moderate level of vulnerability from 2013 onwards. The degree of vulnerability briefly increased to "higher" in 2016, which might be related to the dip in coping ability in that year.

This data suggests that the Lake Balaton region underwent significant changes around 2012-2013, which may have made it less economically dependent on tourism and more able to cope with changes in the tourism sector. The cause of these changes might be economic diversification, improved tourism management, better infrastructure, or government policies.

However, the slight upward trend in vulnerability and the drop in coping ability in 2016 indicate that there may be some emerging challenges that need to be addressed to maintain this resilience.

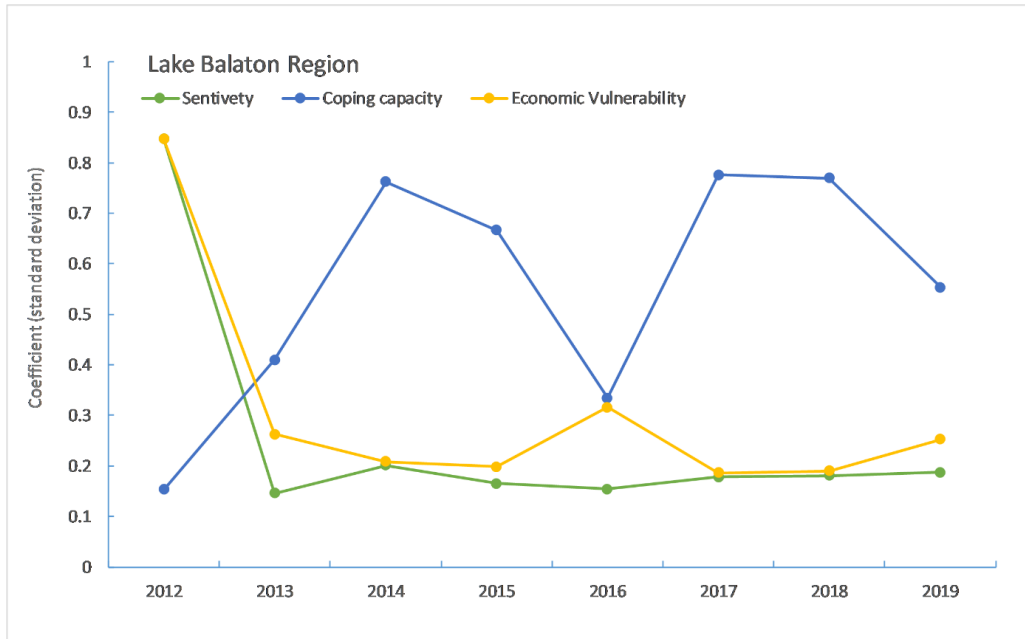


Figure 22 Line chart of tourism economic sensitivity, coping capacity, and vulnerability changes in lake Balaton

5.2.3. Analysis of Obstacle Factors

According to the Obstacle Analysis degree assessment model, the standardized data in Table 31, Table 32, Table 37, Table 38 were substituted into the calculation model, from which the top five indicators in the calendar year were screened out, and then the main factors hindering the reduction of the vulnerability of the regional economic development of the Erhai Lake and Lake Balaton were identified, and the analysis results are shown below.

Erhai Lake Region

Reducing system vulnerability is the key to sustainable economic development premise, in order to further reveal the Obstacle degree to the economic development of cities. The primary focus for reducing vulnerability entails the introduction of the Obstacle degree concept. By applying calculation formula 24, the Obstacle degree value of Dali's (Erhai Lake) tourism economic system vulnerability over the preceding ten-year period is determined. The subsequent analysis of these results is visually presented and documented in Figure 23 Visualization analysis applied in obstacle factor of Erhai Lake Region tourism economic (2004-2019).

According to the analysis of the visualization chart results, during the 2004 to 2019, the highly frequency Obstacle indicators to reduce the vulnerability of tourism economy in Dali Prefecture are sensitivity (S5, S6) and coping ability (R1); after the 2014 the coping ability (R3, R5) Obstacle degree become

increasingly prominent, during the 2014 to 2019 the mainly Obstacle indicators gradually changed to R3, R5.

Looking at the overall situation, in the early stage, it was restricted by the system's internal factors, which are the industrial structure of the region and its own economic development; in the later stage, it was restricted by external factors, that is, the boosting force of investment and exports to the industry.

And I select the top five indicators in each year (Table 22), and determine the main factors that hinder the reduction of the vulnerability of Dali's tourism economic system, On the whole, in the past fifteen years, the most frequent Obstacle degree to the vulnerability of the tourism economic system in Dali Prefecture are the ratio of tourist arrivals to local population (S₈), Elasticity coefficient of tourism to industrial growth (S₆) and National economy (GDP) output value. (R₁), which are the biggest Obstacle degree to reducing the vulnerability of Dali's tourism economy; It is worth noting that the Sino-US trade war broke out in 2018, China's export economy was seriously affected, and the impact of the export economy on the local tourism industry was also shown in the obstacle analysis. Export growth rate (R₅) is called the maximum obstacle degree in the 2019 annual data.

Table 22 Top 5 Obstacle Factors of Tourism Economic System in Erhai Lake Region

Year	1st obstacle		2nd obstacle		3rd obstacle		4th obstacle		5th obstacle	
	index	obstacle	index	obstacle	index	obstacle	index	obstacle	index	obstacle
2004	S ₈	0.1897	R ₁	0.1795	S ₆	0.1564	S ₁	0.0885	R ₈	0.0841
2005	S ₈	0.1866	R ₁	0.1747	S ₆	0.1711	S ₁	0.0812	S ₅	0.0690
2006	S ₈	0.1742	R ₁	0.1608	S ₆	0.1606	R ₅	0.1216	S ₁	0.0776
2007	S ₈	0.1840	S ₆	0.1707	R ₁	0.1668	S ₁	0.0844	S ₅	0.0701
2008	S ₈	0.1685	S ₆	0.1604	R ₁	0.1473	R ₅	0.0996	S ₁	0.0831
2009	S ₈	0.2014	R ₁	0.1780	S ₆	0.1560	R ₅	0.1100	S ₁	0.0932
2010	S ₈	0.2132	R ₁	0.1964	S ₆	0.1837	S ₁	0.1004	S ₅	0.0673
2011	R ₅	0.1970	R ₁	0.1876	S ₆	0.1528	S ₁	0.0930	S ₅	0.0757
2012	R ₅	0.2023	S ₆	0.1789	R ₅	0.1667	R ₁	0.1564	S ₁	0.0976
2013	S ₆	0.1780	S ₆	0.1777	R ₁	0.1360	R ₅	0.1009	S ₁	0.0882
2014	S ₆	0.1598	S ₆	0.1249	R ₁	0.1244	R ₅	0.1196	R ₃	0.1188
2015	R ₅	0.1575	S ₆	0.1375	S ₈	0.1170	R ₃	0.1042	R ₁	0.0897
2016	R ₇	0.2386	R ₃	0.1691	R ₁	0.1566	S ₈	0.1450	S ₆	0.0618
2017	S ₄	0.1860	R ₅	0.1780	R ₈	0.1164	R ₃	0.0901	S ₅	0.0718
2018	S ₅	0.2096	R ₃	0.1781	R ₅	0.1485	R ₈	0.1151	R ₇	0.0696
2019	S ₁	0.3672	R ₃	0.1672	R ₈	0.1342	R ₇	0.1011	S ₇	0.0735

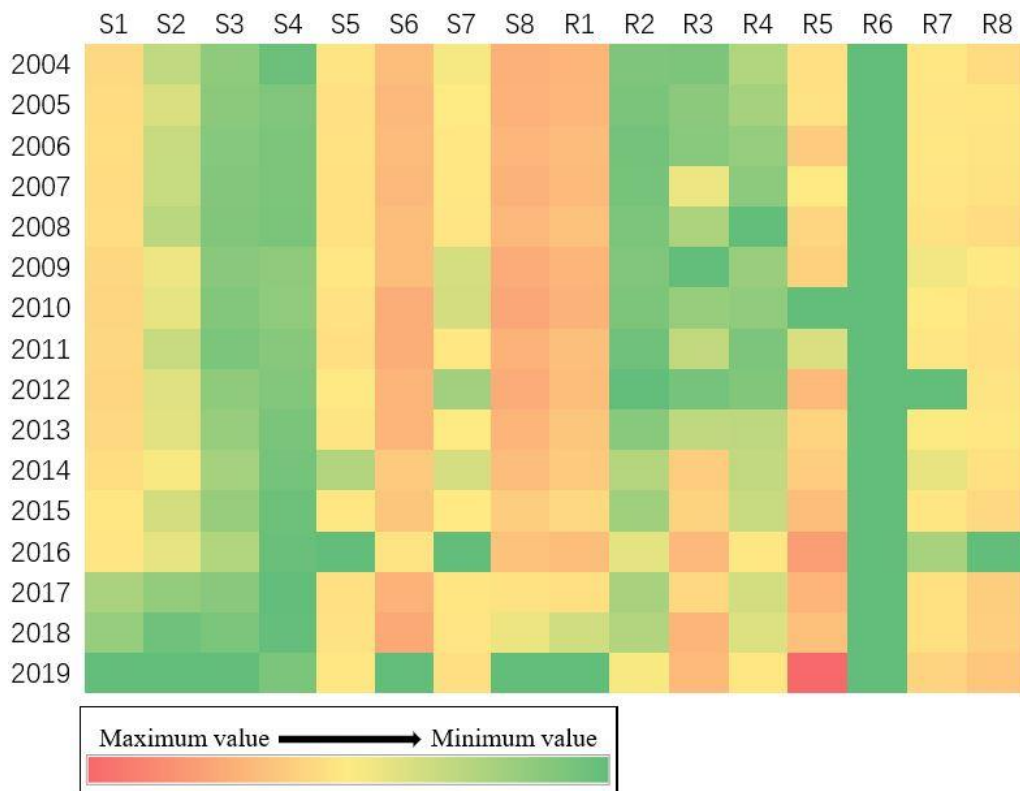


Figure 23 Visualization analysis applied in obstacle factor of Erhai Lake Region tourism economic (2004-2019)

Lake Balaton Region

By applying calculation formula (24), the obstacle degree value of Lake Balaton region tourism economic system vulnerability over the preceding seven-year period is determined. The subsequent analysis of these results is visually presented and documented in Figure 24 Visualization analysis applied in obstacle factor of Lake Balaton Region tourism economic (2012-2019).

According to the results of the analysis of the visualization chart, the high-frequency Obstacle indicators that reduced the economic vulnerability of tourism in Lake Balaton between 2012 and 2019 are sensitivity (S6, S5, S4) and coping capacity (R5, R7, R8, R2); it is worth noting that after 2012 sensitivity (S6), has been a very prominent Obstacle degree influencing factor in the Lake Balaton region and is the economic vulnerability of tourism is inherently constrained. In addition, the coping capacity indicators (R5, R7, R8, R2) and sensitivity indicators (S5, S4) have also been influential factors that have not improved in this last decade.

Table 23 Top 5 Obstacle Factors of Tourism Economic System in Lake Balaton Region

Year	1st obstacle		2nd obstacle		3rd obstacle		4th obstacle		5th obstacle	
	index	obstacle	index	obstacle	index	obstacle	index	obstacle	index	obstacle
2012	R ₅	0.2972	R ₇	0.1867	R ₃	0.1137	R ₂	0.1119	R ₈	0.0809
2013	S ₆	0.5558	R ₇	0.1051	R ₈	0.0906	R ₅	0.0898	R ₂	0.0495
2014	S ₆	0.7496	R ₅	0.1285	R ₂	0.0532	R ₄	0.0419	R ₁	0.0039
2015	S ₆	0.6731	R ₅	0.1644	R ₂	0.0492	R ₇	0.0379	R ₄	0.0161
2016	S ₆	0.5349	R ₅	0.1379	R ₃	0.1090	R ₇	0.0647	R ₂	0.0629
2017	S ₆	0.7530	R ₃	0.0635	R ₇	0.0586	R ₈	0.0385	R ₂	0.0358
2018	S ₆	0.7470	R ₇	0.0770	R ₅	0.0595	R ₈	0.0394	R ₃	0.0359
2019	S ₆	0.6274	R ₅	0.2303	R ₇	0.0496	R ₈	0.0362	R ₃	0.0294

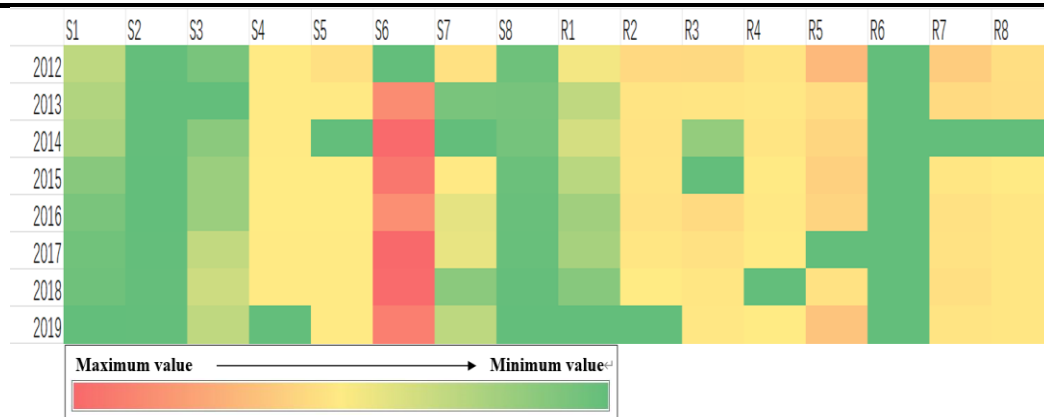


Figure 24 Visualization analysis applied in obstacle factor of Lake Balaton Region tourism economic (2012-2019)

From the overall situation, subject to the internal factors of the system are R7 (Growth rate of total tourism revenue (%)) and S2 (Industrial Structure Gini Coefficient) R6 (Industrial Structure Diversification Index), i.e. the industrial structure of the region and its own economic development, especially significant is the unusually high S6 (Elasticity coefficient of tourism to industrial growth), which reflects the sensitivity of the tourism industry to industrial growth and changes in the industrial structure of the region; Subject to external factors are R3 (Fixed asset investment growth rate) R5 (Export growth rate (%)), i.e. the pull of investment and exports to the industry.

Evaluation results of obstacle factors

A comparison outlines the key factors that significantly influenced tourism vulnerability in the past ten years in these two regions, as:

- For Erhai Lake region, in the obstacle degree analysis of Table 22 for these 15 years, the factors that have the highest frequency of influence on the economic vulnerability of tourism in the were:

S6 Elasticity coefficient of tourism to industrial growth > **R1** National economy (GDP) output value > **S1** Tourism revenue as a share of GDP (%)> **R5** export growth rate (%)> **S8** The ratio of tourist arrivals to local population.

The obstacle degree analysis reveals that the over-dependence on tourism and the lack of own economic development capacity are the main influencing factors leading to the high vulnerability of the economic development of the Erhai Lakes region. Specifically, the lack of economic development driven by fixed investment and industrial structure diversification, the excessive reliance on tourism for economic development (high S1 and S8), the mismatch between tourism development level and economic development level, and the de-industrialization and caused by the tourism boom are the most important reasons for the high vulnerability of regional economic development.

- For Lake Balaton, during the 2012-2019 period of time Table 23, the most frequency of the effect the vulnerability were:

R5 export growth rate (%) > **R7** Industrial Structure Diversification Index > **S6** Elasticity coefficient of tourism to industrial growth > **R2** National economy (GDP) growth rate (%)

> **R4** Urban and Rural Consumption Growth Rate

In summary, the Lake Balaton region's tourism vulnerability is influenced by factors such as export growth rate, product mix diversification, the impact of tourism on industrial growth, national economic growth rate, and urban consumption growth rate. These indicators highlight the region's vulnerability in terms of its economy, industries, and markets. It emphasizes the importance of reducing dependence on specific industries, promoting economic diversification, and improving economic and consumption stability to enhance the resilience and sustainable development of the region's tourism industry.

5.3. Explore strategies for tackling sustainable development

5.3.1. Recognize the problem of vulnerability objectively

Tourism system vulnerability reflects the sustainability of the regional tourism economy. Higher vulnerability levels pose greater challenges to sustainable development.

The Lakeland region boasts abundant tourism resources and significant development potential. In recent years, the tourism industry in this region has experienced rapid growth, expanding in scale and improving its overall system. It has become a crucial industry in the cities surrounding the Lake Basin. However, the development of tourism in the area has brought to light internal

conflicts within the tourism system, structural issues, and ecological and environmental concerns. These factors contribute to vulnerability problems in the tourism economic system, greatly impacting the sustainable development of tourism in the region.

Vulnerability issues often arise alongside tourism development and cannot be disregarded in favor of sustainability. When vulnerability becomes excessive, it hinders achieving sustainable development. Therefore, the key to achieving long-term and healthy tourism growth lies in a proper understanding of vulnerability, effective reduction measures, and finding a balance between vulnerability and sustainability.

From the preceding chapters, it is evident that both study areas, affected by sensitivity and responsiveness, have experienced high and increasing vulnerability in the Erhai basin, while the Lake Balaton area remains relatively stable. However, when faced with external shocks such as the Covid-19 pandemic in 2019, the regional tourism economic system exhibits instability, vulnerability to disturbances, and reduced crisis coping capabilities. This indicates that the tourism economic system in the western region has yet to achieve a stable state and strike a balance between vulnerability and sustainable development, as vulnerability remains a significant concern.

In conclusion, to regulate the vulnerability of the tourism economic system in the Lakeland region, it is essential to accurately comprehend the vulnerability of each region. Only through a comprehensive understanding of the vulnerability exhibited by each region can we effectively address and solve vulnerability issues.

5.3.2. Sustainable development of tourism resources.

5.3.2.1. The essence of sustainable tourism resources

Geographical variations and regional complexities exist in environmental protection and economic development. In tourism cities, the assessment and implementation of sustainable tourism development at the regional level pose significant challenges to overall sustainable development.

The sustainable development of urban lake areas exhibits systematic, intricate, and holistic characteristics. It is a dynamic and balanced process that necessitates harmonious and well-ordered interactions among the economy, resources, society, and environment. An imbalanced state can disrupt the economic and social systems of the entire lake area and degrade the environmental ecosystem. Establishing an effective indicator system and studying the interrelationships among these indicators is crucial for comprehending complex systems.

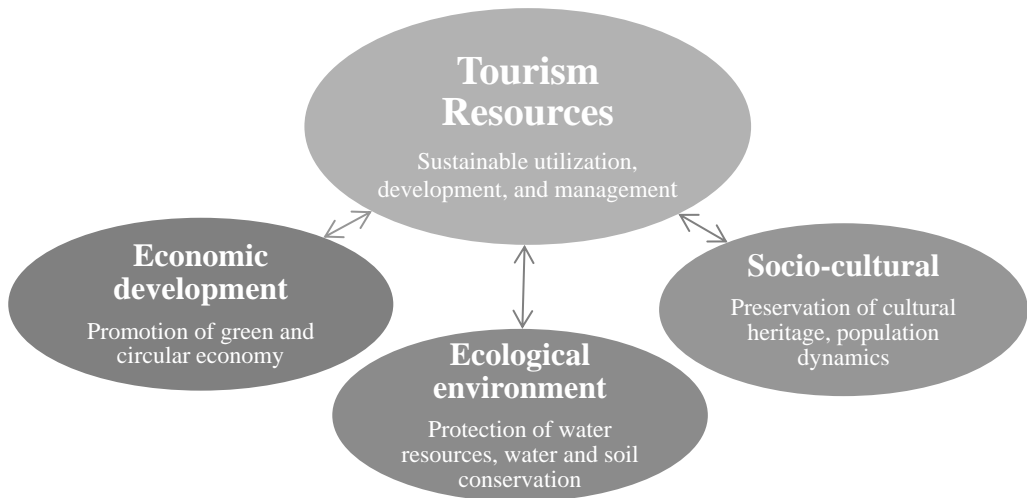


Figure 25 Relationship Map of Sustainable Tourism Development System Framework in Lakeland City

Capacity building for sustainable development involves the comprehensive development of the **resource-environment-economy-society** complex system. It requires the coordination and integration of sustainable **resource** development, **environmental** preservation, **economic** viability, and **social** progress. The goal of sustainable development research should be to achieve a harmonious and coordinated development of resources, environment, economy, and society. The sustainable development capacity of urban lake tourism depends on whether the interaction between people and nature, as well as people and society, within the region can maintain a dynamic equilibrium. This dynamic equilibrium signifies a state where all subsystems within a complex and interconnected system interact and adapt to one another, reflecting the comprehensive and dynamic balance of the system. Regional tourism sustainable development primarily involves three aspects: the development of cultural resources, economic growth, and the preservation of ecological (resources and environment) assets. Next part provides a comprehensive comparison between cultural tourism resources and natural tourism resources in two regions.

5.3.2.2. Evaluation of tourism resources

By seamlessly incorporating these abundant natural and cultural tourism resources, individuals who venture to both the Erhai lake region and the Lake Balaton region are provided with the unique opportunity to partake in a comprehensive and enriching experience. This immersive encounter allows them to fully appreciate the mesmerizing wonders of nature and delve into the rich tapestry of history, art, and traditions that grace the surrounding area. The subsequent Table 24 enumerates the customary tourism resources of the two regions.

Table 24 Classification and Categorization of Tourism Resources in Study Areas

Study area	Tourism Resources	
	Cultural Tourism Resources	Natural Tourism Resources
Erhai Lake region	<p>Ethnic Minority Cultures: The Erhai Lake region is inhabited by various ethnic minority groups, including the Bai, Yi, and Naxi peoples. These communities have preserved their unique traditions, customs, and architecture. Visitors can explore traditional Bai villages like Xizhou and Zhoucheng, where they can witness traditional ceremonies, visit local markets, and admire distinctive architecture.</p> <p>Ancient Towns: The region is dotted with ancient towns that showcase the rich history and culture of the area. Dali Ancient Town, with its well-preserved city walls and traditional Bai architecture, offers a glimpse into the region's past. Visitors can explore narrow cobblestone streets, visit ancient temples, and browse local handicraft shops.</p> <p>Temples and Monasteries: The Erhai Lake region boasts a number of Buddhist temples and monasteries that reflect the region's religious heritage. The Chongsheng Temple complex, with its iconic Three Pagodas, is a significant Buddhist site. Visitors can also visit temples like Guanyin Palace and the Zhonghe Temple, immersing themselves in the spiritual ambiance and admiring the intricate architectural details.</p> <p>Cultural Festivals: The region celebrates various cultural festivals throughout the year, offering visitors a chance to witness vibrant traditions and performances. The Butterfly Festival in Butterfly Spring, the Torch Festival celebrated by the Yi ethnic group, and the Bai Torch Festival are among the notable events that showcase the region's cultural diversity.</p>	<p>Erhai Lake: The centerpiece of the region is Erhai Lake, a sparkling freshwater lake known for its breathtaking scenery. With its clear blue waters and surrounded by lush mountains, it provides a tranquil setting for activities such as boating, fishing, and lakeside walks.</p> <p>Scenic Landscapes: The area surrounding Erhai Lake is blessed with diverse landscapes. Visitors can explore the Cangshan Mountain range, with its snow-capped peaks, alpine meadows, and gushing waterfalls. The Jade Belt Road, a scenic road that winds along the lake's eastern shoreline, offers panoramic views of the lake and its surroundings.</p> <p>Nature Reserves: The region is home to several nature reserves, such as the Caicun and Haixi Wetlands, where visitors can observe a wide array of migratory birds and other wildlife. These reserves offer opportunities for birdwatching, nature walks, and eco-tours, allowing visitors to immerse themselves in the region's natural biodiversity.</p> <p>Hot Springs: The Erhai Lake region is known for its hot springs, which are believed to have therapeutic properties. Visitors can relax and rejuvenate in the mineral-rich waters while enjoying the surrounding natural beauty.</p>
Lake Balaton region	<p>Historic Towns and Villages: The Lake Balaton region is dotted with charming historic towns and villages, each with its unique character. Tihany, for example, is famous for its medieval Benedictine abbey and cobblestone streets. Other notable towns include Keszthely, with its grand Festetics Palace, and Balatonfüred, known for its historic waterfront and promenade.</p> <p>Wine Culture: The region is renowned for its vineyards and winemaking tradition. Wine tourism is a significant cultural attraction, allowing visitors to explore the vineyards, taste local wines, and learn about the winemaking process. The Balatonfüred-Csopak and Badacsony wine regions are particularly notable.</p> <p>Museums and Galleries: The Lake Balaton region boasts a range of museums and galleries that showcase the area's history, art, and culture. The Helikon Castle Museum in Keszthely houses an extensive collection of art and historical artifacts, while the Marzipan Museum in Szentendre offers a unique display of marzipan sculptures.</p> <p>Festivals and Events: The region hosts various festivals and events throughout the year, showcasing local traditions, music, and cuisine. The Balaton Sound music festival, the Keszthely Wine Week, and the Tihany Lavender Festival are among the popular annual events.</p>	<p>Lake Balaton: The lake itself is a significant natural resource and the focal point of the region's tourism. It is the largest freshwater lake in Central Europe and provides opportunities for swimming, water sports, and leisurely boat cruises.</p> <p>Beaches: Lake Balaton has numerous beaches with sandy shores, providing visitors with places to relax, sunbathe, and enjoy the scenic beauty of the lake.</p> <p>Balaton Uplands National Park: This protected area encompasses the hilly region surrounding Lake Balaton. It offers diverse flora and fauna, hiking trails, and panoramic viewpoints, making it a paradise for nature lovers and hikers.</p> <p>Thermal Springs and Spas: The Lake Balaton region is known for its thermal springs, which have given rise to several spas. These spas offer natural hot springs with healing properties and wellness treatments, providing a unique experience for relaxation and rejuvenation.</p>

In terms of similarities, both the Lake Balaton and Erhai Lake regions offer breathtaking natural landscapes and a plethora of outdoor activities for visitors to

enjoy. Nature enthusiasts can revel in the beauty of these regions while engaging in activities such as boating, hiking, and soaking in the scenic views. The serene waters of Lake Balaton and the tranquil ambiance of Erhai Lake provide the perfect backdrop for leisurely boat rides and the exploration of hidden coves. Adventurers can embark on exhilarating hikes through the picturesque landscapes that surround both lakes, encountering awe-inspiring waterfalls, verdant forests, and diverse wildlife along the way. Furthermore, both regions boast a rich cultural heritage, inviting visitors to delve into their history and traditions. Historic towns and villages are scattered throughout the Lake Balaton and Erhai Lake areas, offering glimpses into the past and showcasing traditional architecture. Places like Tihany in Lake Balaton region and Dali Ancient Town in the Erhai Lake region exude an old-world charm with their narrow cobblestone streets, well-preserved city walls, and ancient temples. These cultural gems provide insights into the historical significance of the regions and allow visitors to immerse themselves in the local way of life.

While there are similarities, the Lake Balaton and Erhai Lake regions also possess distinct characteristics that set them apart. Lake Balaton is known for its sandy beaches that stretch along the shoreline, providing visitors with idyllic spots for sunbathing and relaxation. The region's vineyards and wine culture are an integral part of its identity, allowing visitors to indulge in wine tastings and explore the winemaking traditions that have flourished for centuries. On the other hand, Erhai Lake stands out with its mountainous landscapes that frame the azure waters, creating a dramatic and enchanting setting. Ancient towns like Dali in the Erhai Lake region offer a glimpse into the rich heritage of the Bai ethnic minority culture, which flourishes in the area. Visitors can witness traditional ceremonies, partake in local festivals, and appreciate the intricate art forms and handicrafts of the ethnic communities.

In summary, both the Lake Balaton and Erhai Lake regions offer captivating tourism experiences that blend natural beauty with cultural heritage. Whether it's basking in the sun on sandy beaches, exploring historic towns, or immersing oneself in the traditions of ethnic minority cultures, visitors to these regions can embark on unforgettable journeys filled with awe-inspiring landscapes, enriching cultural encounters, and a deep appreciation for the natural and cultural treasures that define each unique destination.

This comprehensive study takes a fresh perspective on sustainable tourism development, prioritizing the fundamental needs of travelers. Specifically, it highlights the inherent longing for a mesmerizing amalgamation of profound cultural opulence and awe-inspiring natural surroundings that embrace the expansive lake area. In the forthcoming sections of this article, a profound

exploration of this captivating subject matter will unfold, unraveling its intricate facets and implications.

5.3.3. Coordinate tourism-culture-society development

The two research areas in this study are both regions with a large number of cultural resources and distinctive religions, and this study is interested in building sustainable cultural tourism development from the perspective of intangible cultural heritage preservation and development in both places.

Identification and documentation: Identify and document the specific intangible cultural heritage elements present in the regions under study. This could include traditional rituals, performing arts, culinary traditions, handicrafts, or other forms of cultural expressions.

Table 25 National Intangible Cultural Heritage List of Dali Prefecture (Erhai lake)

serial number	category	project name	Declaration area
1	folklore	Bai people around three spirits	Dali Bai Autonomous Prefecture
2		Yi people playing songs	Weishan Yi and Hui Autonomous County
3		Shibao Mountain Song Club	Jianchuan County
4		Dali March Street	Dali City
5		Bai Nationality Three Course Tea	Dali City
6	traditional skills	Bai nationality's tie-dye technique	Dali City
7		Jianchuan woodcarving	Jianchuan County
8		Heqing Silverware Forging Techniques	Heqing County
9		Xiaguan Tuo Tea Production Techniques	Dali Bai Autonomous Prefecture
10	traditional dance	Yi nationality jumping vegetables	Nanjian Yi Autonomous County
11		ear song	Dali Bai Autonomous Prefecture
12	traditional drama	Baiju	Dali Bai Autonomous Prefecture
13	Traditional Music	Midu Folk Song	Midu County
14		Jianchuan Baiqu	Dali Bai Autonomous Prefecture
15	traditional art	Painted houses of the Bai people	Dali City

Data source: Dali Bai Autonomous Prefecture Intangible Cultural Heritage Collection.

The fundamental stages of the study entail: 1. The initial stage entails the identification and documentation of distinct components of intangible cultural

heritage prevalent within the study region. This encompasses a wide range of elements, such as traditional rituals, performing arts, culinary traditions, handicrafts, and other forms of cultural expressions. 2. Following an examination of cultural resource preservation measures in both regions, the subsequent step involves presenting policy recommendations to pertinent stakeholders, including policymakers, tourism authorities, and community leaders. These recommendations aim to delineate effective strategies for the safeguarding and promotion of intangible cultural heritage, while concurrently facilitating sustainable development within the cultural tourism domain.

The Intangible Cultural Heritage within the two study areas has been summarized in the following Table 25 and Table 26:

Table 26 Intangible Cultural Heritage List of Hungary (Lake Balaton region)

serial number	Category	project name	Declaration area
1	3	'Busó' Festivities at Mohács – a Masked End-of-Winter Carnival Custom (2008)	Hungary
2		'Tikverőzés' in Moha – a Masked Carnival Custom (2011)	Fejér
3		The Pilgrimage Tradition of the Devotion to the Virgin Mary in Hungary (2016)	Hungary
4	4	Falconry in Hungary (2010)	Hungary
5		Artisanal Fishing in the Lower Region of the Danube (2013)	Dunaföldvár, Mohács
6		The breeding of Lipizzan horses (2022)	Hungary
7	5	The Hungarian Tradition of Blueprinting (2015)	Hungary
8		Pottery Tradition of Magyarszombatfa (2014)	Magyarszombatfa
9	2	Circus Arts in Hungary (2016)	Hungary
10		Bagpipe Tradition in Hungary (2016)	Hungary
11		Nagyecsedí magyar és cigány táncgyományok (2017)	Hungary
12		The Hungarian folk string band tradition (2022)	Hungary

United Nations Educational, Scientific and Cultural Organization: **1**-Oral traditions and expressions. **2**. Performing arts. **3**. Social practices, rituals and festive events. **4**. Knowledge and practices concerning nature and the universe. **5**. Traditional craftsmanship.

Data Source: UNESCO. <https://ich.unesco.org/en/state/hungary-HU?info=elements-on-the-lists>

The National Intangible Cultural Heritage List of Dali Prefecture (Erhai lake), China, and the Intangible Cultural Heritage List of Hungary (Lake Balaton region) showcase an interesting mix of traditions that reflect the unique cultures and histories of these two regions.

In Dali, the intangible heritage includes practices such as the folklore of Bai people around three spirits and the Yi people playing songs, which represent the local indigenous cultures. The tie-dye technique of Bai nationality and Jianchuan woodcarving indicate traditional skills that have been passed down through generations. Traditional drama, dance, and music are also well-represented, with elements like Baiju and Yi nationality jumping vegetables. These are often community activities, promoting social cohesion and identity.

In contrast, the Hungarian list features several traditions with a broader geographical application, such as the ‘Busó’ festivities at Mohács and the Pilgrimage Tradition of the Devotion to the Virgin Mary. Falconry, artisanal fishing, and the breeding of Lipizzan horses represent knowledge and practices concerning nature, showcasing a strong link with the environment. The Hungarian tradition of blueprinting and pottery tradition of Magyarszombatfa highlight the country's rich craftsmanship heritage.

There are both similarities and differences between the two lists. Both regions honor traditional craftsmanship, local music, and folklore, reflecting the shared importance of these elements in maintaining cultural continuity and identity. However, the specifics of these traditions are unique to each location, embodying their individual histories, natural environments, and cultures. A key difference lies in the Hungarian list's focus on nationwide traditions, contrasting with Dali's emphasis on practices specific to local ethnic groups. It underscores the differing societal structures and cultural landscapes of the two regions.

5.3.4. Coordinate tourism-ecology-environment development

Both Lake Balaton and Erhai Lake are crucial local water sources and recognized tourist destinations. From the outset, there was an understanding of the importance of ecological preservation for these lakes. Their environmental governance shares similarities, with efforts aimed at protecting their unique ecosystems. Challenges, such as declining water quality due to urbanization, agricultural pollution, and tourism growth, have arisen. Historically, there have been numerous initiatives for both lakes aimed at preserving their ecosystems, improving water quality, and promoting sustainable development. The following table details and compares these efforts:

Table 27 key historical milestones in the environmental stewardship and protection

	Timeline of key historical milestones
Lake Balaton	<ul style="list-style-type: none"> • Late 1970s to early 1980s: The gradual rise in awareness regarding the environmental challenges faced by Lake Balaton led to increased attention. The focus centered on deteriorating water quality, sewage discharge, and environmental harm, drawing both local and international interest. • 1984: The establishment of the Lake Balaton Environmental Protection Zone marked the official commencement of safeguarding the lake's ecosystem. • 1995: Launch of the Lake Balaton Management Plan, which outlined a range of measures and objectives aimed at enhancing water quality and environmental conditions in the lake. • 1998: Initiation of sewage treatment projects in the Lake Balaton basin with the objective of mitigating the impact of sewage discharge on the lake's water quality. These endeavors encompassed the construction of sewage treatment facilities and the enhancement of domestic sewage treatment systems in rural areas. • 2001: Creation of the Lake Balaton Environmental Protection Fund to offer financial assistance for environmental conservation and sustainable development of the lake. • 2008: Introduction of the Agricultural Environmental Protection Plan for the Lake Balaton Basin, aiming to minimize the impact of agricultural activities on water quality while implementing measures to promote sustainable agricultural practices.
Erhai Lake	<ul style="list-style-type: none"> • Sewage Treatment: Starting in the 1980s, Dali City has consistently built sewage treatment facilities, purifying urban wastewater before releasing it. This effort aims to reduce Erhai Lake's contamination. • Lake Protection Law: China introduced the Lake Protection Law in 2008, setting clear standards for lake conservation and management. This law has been instrumental in Erhai Lake's protection. • Special Initiatives for Erhai Lake: From 2010, the Yunnan Provincial Government undertook dedicated measures for Erhai's protection and management. Steps included shutting down contaminating industries, modernizing sewage treatment facilities, creating wetland parks, and reinforcing water protection strategies. • Ecological Corridor around the Lake: To bolster Erhai Lake's ecological landscape, the Dali Municipal Government introduced the Ecological Corridor Construction Project in 2015. The initiative comprises afforestation efforts, safeguarding and rejuvenating wetlands, and founding ecological parks. • Green Tourism Advocacy: Dali City emphasizes sustainable tourism to minimize its environmental impact on Erhai Lake. Strategies involve capping visitor numbers, improving service standards in tourism, and endorsing eco-conscious tourism practices.

Lake Balaton and Erhai Lake began addressing environmental concerns in the late '70s and early '80s, primarily tackling sewage pollution. Both lakes now

prioritize sustainable and holistic ecosystem strategies. However, they differ in legislative and financial approaches. Balaton has its Environmental Protection Zone and a specific conservation fund, while Erhai relies on China's overarching Lake Protection Law without a mentioned dedicated fund. Balaton emphasizes controlling agricultural and sewage impacts, whereas Erhai has more comprehensive initiatives, such as shutting down polluting industries and enhancing eco-tourism. Analyzing regional eco-tourism development plans reveals both regions emphasize "**green tourism**" and "**low-carbon tourism**" for future sustainability.

In the “Action Plan for Lake Balaton Region” (Nov. 2020) written by:

“Main goal: Low-carbon mobility.

The Feasibility Study contains 110 such measures. The goal is to make a zero-emission zone in shore of Lake Balaton. Each of the five actions planned in this document aims to do so. Each of the actions is based on the Maas group of measures, which in itself, as a Smart intervention. This provides more information and a cost-saving solution.

- 1. Goal - Reduction of car use*
- 2. Goal – Carbon-free transport*
- 3. Goal – Development of cycling tourism*
- 4. Goal – Development of railway transport and electric bus use.*
- 5. Goal – Development of non-motorized transport in local transport:*
- 6. Goal – Create mobility points*
- 7. Goal – Development of strategic mode of mobility around the lake”*

About the cycling tourism two study areas have the similar planning and measures and also achieve results. The results of the comparative analysis are as follows:

Table 28 Action for planned in two stay area

Lake Balaton	Erhai Lake
<p>The following actions are planned:</p> <ul style="list-style-type: none"> •Cycle road passing through Alsóörs and Felsőörs settlements, which also connects these villaged. This cycle path is branched out from the Balaton Bike Circle. Building of a 9 kms long road, which is a green zone today, a unpaved road, so the whole trail will be new, in accordance with the planning parameters. •Supply and installation of equipment for route lighting, particularly close to crossing points. •Innovative bicycle-friendly technical solutions (for example: toilet) •Building of green zone, installation of a sustainable urban environment •Placement of street furniture •Supply of a cycle path and road maintenance machines 	<ul style="list-style-type: none"> • The 129-kilometer-long Erhai Ecological Corridor consists of a walking path and two cycling paths,. • covering more than 790 hectares of ecological restoration and wetland construction. • It connects many popular scenic spots such as downtown Shimonoseki, Dali Old Town and Xizhou Ancient Town. • From the start of construction in 2019 to completion in 2021, the Erhai Ecological Corridor has long been a unique scenic route integrating sports and tourism in Dali.

6. Discussion

6.1. Evaluation of industrial structure balance

The analysis of the dataset reveals evolving industrial development in the Erhai Lake Region region from 2004 to 2021. The Range and Extreme Value Ratio peaked in 2019, indicating increased fluctuations and relative disparity in industrial growth. Standard deviation showed the highest variance in 2019. The Coefficient of Variation peaked in 2016, indicating the highest relative variability. The Priority Status and Gini Coefficient both peaked in 2019, indicating a shift in focus and higher inequality before declining in 2020 and 2021.

The analysis of data from 2011 to 2019 in the Lake Balaton region reveals increasing variability in industrial outputs, with the highest range observed in 2019. Fluctuations in the extreme value ratio indicate phases of growth and contraction across sectors. The standard deviation rises, indicating greater variation in the data, while the coefficient of variation decreases, suggesting relative stability in industrial output dispersion. The declining priority status implies a more balanced development across sectors. The Gini coefficient shows reduced disparities and increased economic equality among sectors. Overall, the findings highlight dynamic changes and the effectiveness of balanced growth strategies in achieving stability and reduced disparities in the Lake Balaton region.

Key Similarities:

1. Both regions showed an increasing trend in the range of values, implying an expansion in the dispersion of industry outputs. This suggests growth and diversification in the economic activities within these regions.
2. Both areas showed fluctuations in the extreme value ratio, indicating periodic phases of rapid expansion and contraction across their primary, secondary, and tourism sectors.
3. Both regions displayed an increase in the standard deviation over time, confirming an increased spread and variation in the data, pointing to diverse development paths within the sectors.
4. Both regions experienced a decline in the coefficient of variation, hinting at increased stability in the dispersion of their industrial outputs relative to the mean.

Key Differences:

1. The priority status in the Erhai Lake Region showed an initial increase followed by a decrease, implying an initial rapid growth in the maximum values followed by a slowdown. Conversely, the priority status in Lake Balaton shows a steady decrease, suggesting a more gradual and consistent balancing of economic activity.

2. The Gini coefficient in the Erhai Lake Region saw a general increase, peaking in 2019, indicating growing inequality in sector outputs. On the other hand, Lake Balaton region's Gini coefficient peaked earlier in 2013, and decreased from there, indicating an improvement in economic equality among the sectors.

6.2. Evaluation of Tourism Economic System Vulnerability

Based on the assessment of tourism economic vulnerability in both Erhai Lake Region and Lake Balaton Region, several key findings emerge.

For the Erhai Lake Region, there has been a worrying trend towards increased vulnerability from 2014 onwards. Sensitivity is increasing over time, while coping ability is not keeping pace, leading to high degrees of vulnerability in recent years. The factors contributing to this heightened vulnerability include an over-reliance on tourism, evidenced by the high frequency of influence from the elasticity coefficient of tourism to industrial growth and tourism revenue as a share of GDP. The region also struggles with its own economic development capacity, with the national economy output value and export growth rate significantly impacting vulnerability. These results suggest that the region needs to diversify its economic base, reduce dependence on tourism, and invest in developing its capacities for economic growth and export.

For the Lake Balaton Region, the degree of vulnerability was at its highest in 2012 but has generally oscillated between moderate and higher levels since then. The factors contributing to this vulnerability are varied, encompassing export growth rate, industrial structure diversification, elasticity coefficient of tourism to industrial growth, national economy growth rate, and urban and rural consumption growth rate. These factors underscore the vulnerabilities in the region's economy, industries, and markets. It suggests that for reducing vulnerability, the region should focus on diversifying its industrial structure, boosting export growth rate, enhancing economic stability, and promoting consumption growth.

In conclusion, both regions have experienced significant vulnerabilities in their tourism economies due to various factors related to their economic structures and dependence on tourism. A balanced, diversified economy and enhanced capacity for growth and development are key to reducing these vulnerabilities and creating more resilient and sustainable tourism economies in both the Erhai Lake Region and Lake Balaton Region.

Enhancing the Tourism Industry System: A Vital Step towards Optimizing the Internal Structure of the Tourism Economic System and Ensuring Resilience. Meanwhile, Tourism depends on external factors like economy, transport,

facilities, and ecology, which affect vulnerability. A favorable environment enhances resilience and reduces vulnerability.

1) Regional Tourism Industry Structure Adjustment

A rational distribution of the tourism market shares can effectively mitigate the susceptibility of the tourism economic system. Regions overly reliant on tourism or inbound tourism face greater vulnerability to disruptions in their tourism economic system due to the inherent difficulty in controlling the inbound tourism market, which tends to experience significant fluctuations when impacted by external factors.

Within the vulnerability evaluation index system for the tourism economic system, the proportion of tourism revenue to GDP and the elasticity coefficient of tourism to industrial growth serve as indicators of the economic dependence on tourism and the responsiveness of tourism to industrial growth. Analyzing the vulnerability factors in the study area's tourism economic system reveals that the excessive weightage of tourism income to GDP is the primary obstacle hindering vulnerability reduction in the Erhai Lakes region. To address this, emphasis should be placed on achieving a balanced industrial composition in the region, avoiding excessive economic reliance on tourism, and fostering the development of specialized tourism cities.

Similarly, in the Erhai Lakes Basin region and Lake Balaton region, the elasticity coefficient of tourism to industrial growth acts as the main obstacle to vulnerability reduction in the tourism economic system. Hence, these regions should prioritize adjusting the market shares of each industry and strive to comprehensively develop a balanced mix of industries such as industry, agriculture, and tourism within the region.

2) Boosting Exports to Enhance Economic Development Capacity

Reflecting the capacity for economic development, investment, consumption, and net exports are vital indicators driving economic growth. Accordingly, R3, R4, and R5 represent reasonable tourism investment, consumption, and exports, respectively, fostering the rapid advancement of the tourism economy. By optimizing the structure of the tourism economy, we can propel sustainable development.

Within the vulnerability evaluation index system for the tourism economic system, the growth rate of exports mirrors the responsiveness of exports in driving economic development. In both regions of the study area, the export growth rate stands as the primary obstacle to reducing vulnerability within the local tourism economic system.

Insufficient tourism exports impede the development of tourism resources, hinder the construction of tourism services and facilities, and prevent the transformation

of tourist destinations into economic advantages. Furthermore, it impacts the optimization process of the tourism economic system and introduces factors of instability. Therefore, it is imperative to pursue continuous development of new funding channels, establish diverse export routes, maximize capital utilization, and enhance the allocation of tourism market resources.

3) *Enhancing Economic Support*

Economic support is crucial for ensuring the sustainable development of the tourism economic system. A favorable economic development environment contributes to the growth of tourism investment, optimization of the tourism structure, and efficient tourism management. This, in turn, fosters positive growth within the tourism economic system, enhancing its responsiveness. Simultaneously, it stimulates tourism demand and optimizes the development of the tourism economy.

Within the vulnerability evaluation index system for the tourism economic system, the total GDP, GDP growth rate, GDP per capita, and the proportion of the tertiary industry to GDP collectively assess the comprehensive capacity of economic support. Analysis of the vulnerability factors hindering the tourism economic system in the study area reveals that the total GDP and GDP growth rate are the primary obstacles impeding the reduction of vulnerability in the Erhai Lake and Lake Balaton regions.

Regions with relatively developed economies enjoy greater protection in terms of tourism development and experience fewer economic disturbances. Thus, to ensure a lower level of vulnerability within the tourism economic system, it is crucial to actively promote local economic development, optimize economic structures, and achieve steady growth in economic strength. These measures will effectively enhance support for tourism development.

7. Conclusions and recommendations

The conducted analysis and evaluations on the industrial structure and tourism economy vulnerability in Erhai Lake Region and Lake Balaton Region have provided a broad understanding of the respective intricacies of these areas' economic landscapes. While the overall paths of industrial development in these regions demonstrate growth and diversification, there are nuanced differences in their trajectories and the factors influencing their vulnerabilities.

Erhai Lake Region's initial rapid growth has led to an uneven development among sectors, with certain areas benefiting more than others from this economic surge. This imbalance poses the challenge of unequal distribution of growth benefits, underscoring the need for interventions fostering equitability in regional development.

On the other hand, Lake Balaton Region's development approach appears more gradual, stable, and balanced. This suggests that policy measures in this region might have been more successful in promoting an equitable growth and a balanced industrial structure. Thus, the narrative of economic development in both regions presents unique lessons that could be beneficial to the other.

In terms of tourism economy vulnerability, both regions share a strong dependence on tourism, reflected in the significant weight of tourism revenue as a proportion of GDP and the elasticity coefficient of tourism to industrial growth. This dependence increases their sensitivity to fluctuations in tourism markets, which are typically affected by a variety of external factors.

However, unique regional factors also shape their tourism economic vulnerabilities. In Erhai Lake Region, the national economy output value and the export growth rate have notable influences. In Lake Balaton Region, the diversification of industrial structure, national economic growth rate, and urban and rural consumption growth rate play key roles.

Given these nuanced scenarios, tailored strategic recommendations emerge for each region:

- **Erhai Lake Region**, diversifying its economy to decrease its heavy reliance on tourism and boosting its export capabilities should be top priorities. Economic diversification can be achieved through nurturing other sectors, which allows for a more even spread of economic risk. Boosting export capabilities might involve effective overseas marketing of local products or strengthening export-supportive infrastructures.
- **Lake Balaton Region** should focus on further industrial diversification to counterbalance its tourism sector dependency and stabilize its economic and consumption growth. Encouraging growth in non-tourism sectors ensures a

more balanced economy, while policies that stabilize economic growth and strategies that boost consumer spending can mitigate vulnerability.

Moreover, both regions can greatly benefit from exchanging their experiences and strategies in managing tourism economic vulnerability. This collaborative approach will allow each region to learn from the other's successes and setbacks, contributing to more effective mitigation of their respective challenges.

Ultimately, sustainable development in both regions relies on leveraging their rich culture and natural tourism resources, and finding a balance among resources, population, environment, and cultural preservation. This balance will ensure that these regions continue to thrive, bolstering their resilience and ensuring the benefits of their growth are shared across all sectors of their communities.

8. Summary

8.1. New Scientific Achievements

Developing a comprehensive multidimensional assessment system to understand of tourism region economic vulnerability.

A Holistic Approach: By considering multiple dimensions, the assessment system provides a holistic view of the economic vulnerability of tourism cities. It reflects the complex interplay of factors that influence vulnerability, far beyond a singular economic lens.

A Quantifiable Framework: The system developed provides a quantifiable way to evaluate economic vulnerability in tourism cities. The inclusion of multiple dimensions means that a wider array of factors can be measured and considered, which can lead to more accurate and nuanced evaluations.

Application and Adaptability: The multi-dimensional system is adaptable to various tourism cities with different characteristics, making it a universally applicable tool. It can be customized to reflect the unique circumstances of each city, enhancing the precision of vulnerability assessments.

Guiding Strategic Decisions: The system can provide important insights to policymakers, planners, and stakeholders in the tourism industry. These insights can guide decisions related to urban planning, tourism development, and resource allocation. By identifying areas of high vulnerability, strategies can be devised to address these issues and bolster the city's resilience.

Advancing Research and Knowledge: This innovative system expands the field's understanding of economic vulnerability in tourism cities. It also serves as a basis for future research, paving the way for further exploration and development in this area.

Promoting Sustainable Tourism Development: The ultimate goal of this assessment system is to promote sustainable tourism development. By accurately evaluating economic vulnerability, tourism cities can develop and implement strategies to reduce their vulnerability, ensure their long-term viability, and promote sustainable economic growth.

8.2. Limitations and Future Work

Limitations

This research, while providing valuable insights into the vulnerability of tourist destinations, specifically focuses on the economic vulnerability within the tourism industry. However, the concept of vulnerability in tourism is multi-dimensional and encompasses not only economic factors but also other elements such as cultural vulnerability, ecological vulnerability, environmental vulnerability, and the vulnerability of tourist safety. This study, due to its scope

and focus, does not fully address these other aspects of vulnerability in tourist destinations.

Future Work

Given the above limitations, there is a promising direction for future research to expand the scope of vulnerability assessment in tourism destinations. Subsequent studies could aim to develop a comprehensive vulnerability evaluation system that integrates the various facets of vulnerability, including cultural, ecological, environmental, and safety dimensions.

In constructing such a comprehensive framework, different evaluation indicators could be chosen to better represent each dimension of vulnerability. For example, indicators related to local cultural preservation, biodiversity, pollution levels, or the frequency of tourist-related accidents could be incorporated into the model. By doing so, future research could provide a more holistic understanding of vulnerability in tourist destinations, thus offering a more comprehensive basis for policy-making and strategic planning in tourism management. In this way, it could contribute to the sustainable and resilient development of tourism destinations, encompassing not only economic, but also cultural, ecological, and safety considerations.

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10. Annexes

Annex 1 the Scenic Beauty of Erhai Lake and Lake Balaton

Erhai Lake (China)



Lake Balaton (Hungary)



Annex 2 Vulnerability studies in the field of tourism in recent years

Author	Theme of the study	Study Area	Dimensions of the evaluation indicators	Evaluation method
FebbyDt. Bangso (2023)	tourism resilience, crisis management	—	—	bibliometrics analysis
Bo Wan, Dr. Chuanchen Bi	rural tourism; new trend of sustainable	Xi'an, China	corresponding strategic	SWOT analysis
Xingshan Wang et al. (2022)	tourism recovery	Indonesia	Tourism Flow Networks;	DBSCAN Algorithm; Markov Chains
Da Van Huynh et al. (2022)	tourism resilience	Vietnam	resilience empowerment and adaptive recovery of the local	semi-structured interview
Li, Feng et al. (2014)	Tourism industry vulnerability	31 provinces, autonomous	External tourism environment vulnerability and internal tourism	Principal component analysis method
Cao Furong (2011)	Identifying the sensitivity and	—	—	Theoretical analysis
Wang Zhaofeng, Yang Weishu	Tourism industry vulnerability	—	Tourism Crisis Division; The ability to manage, natural	Theoretical analysis
Sun Chunhua (2003)	Tourism industry vulnerability	—	—	Theoretical analysis
Xie Xia (2019)	Tourism economic vulnerability	Xin Jiang, China	Sensitivity - Coping capability	Set-Pair Analysis
Ma Huiqiang et al. (2019)	Tourism economic system vulnerability	30 provinces in China	Sensitivity-Coping capability	BP artificial neural network model,
Yang Yi et al. (2019)	Economic vulnerability of tourism-dependent	Zhnag Jiajie, Aba, Lijijng	S/R model and obstacle degree model	Entropy method
Lu Youbin et al. (2017)	Vulnerability of the tourism economic	Xinjiang	Obstacle-sensitivity	Set-Pair Analysis

Tianli et al. (2017)	Tourism economic system vulnerability	Dali	Sensitivity-Coping capability	Entropy method, The TOPSIS model
Yang Youbao (2015)	Border ethnic areas Tourism economic	Yanbian	Sensitivity-Coping capability	Incentive value
Guo Xiaodong (2015)	Vulnerability of the economic systems of	Dunhuang	Sensitivity-Coping capability	Set-Pair Analysis
Chihuly et al. (2014)	Tourism economic system vulnerability	Dunhuang	Coping capability	Set-Pair Analysis
Su Fei (2013)	Economic vulnerability and Obstacle degree in a	China	Sensitivity-Coping capability	Set-Pair Analysis
Su Fei (2013)	Tourism City Economy System vulnerability	Zhoushan	Sensitivity-Coping capability	Set-Pair Analysis
Chen Yuan and Wang Guo Xin	Vulnerability of economic systems in	China	Sensitivity-Coping capability	Set-Pair Analysis
Li Feng (2013)	China's Tourism Economy	China	Sensitivity and coping capability	Set-Pair Analysis
Li Jun and Bao Jigang (2011)	Tourism economic vulnerability	Zhangjiajie	Comparison of industry fluctuations between tourism and	
Liang Zengxian and Sword of	Vulnerability of economic systems in	Guilin	Exposure - Sensitivity - Coping skills	Factor analysis method
Liu Jia et al. (2015)	Tourism economic system vulnerability	Shandong	Sensitivity-Coping capability	Set-Pair Analysis
Lu Bao I (2018)	Tourism in Border Provinces	Yunnan	Sensitive disobedience - coping skills	Entropy method
Jaffe et al. (2017)	Tourism economic system vulnerability	Ningxia	Exposure - Sensitivity - Coping skills	
Liu, Xiaoyan et al. (2016)	Economic vulnerability of tourist cities in the	Xin Jiang	Sensitivity-Coping capability	Set-Pair Analysis
Chen Yuan (2013)	Characteristics and causes of vulnerability	China	Sensitivity-Coping capability	Set-Pair Analysis

Zou Jun et al. (2018)	Vulnerability of	China	The internal damage - exposure' model	Field research, questionnaires, factor
Lin Mingshui et al. (2018)	ecological vulnerability and its driving factors in	Fu jian	"Cause - effect model	Spatial Principal Component Analysis
Chen Jia et al. (2015)	Rural tourism socio-ecological system	China	Sensitivity-adaptability	
Wang Qun et al. (2019)	Socio-ecological system vulnerability in tourism	China	Social vulnerability, economic vulnerability and ecological	Questionnaires and field research
Wang Xiaomei et al. (2009)	Environmental vulnerability	China	Structural vulnerability due to internal factors and coercive	
Wu, Lianglin et al. (2008)	Vulnerability of tourism resources	China	Sensitivity - Load-bearing capacity - Vulnerability -	Entropy and composite index
Old Hei Chau (2006)	Vulnerability of ecotourism resources	—	Damage to resources, loss of ecological balance and stability,	
Sun Daojiao et al. (2005)	Ecological vulnerability of mountainous tourist	China	Vegetation, species, climate, soils, mountain hazards, tourist	Theoretical analysis
Chen Jinhua and Zheng Hu (2014)	Environmental vulnerability of tourism-	Meizhou Island	Riskiness - Sensitivity - Adaptability	
Li, Man et al. (2010).	Vulnerability of tourism resources	China	Ecosystem vulnerability - Ecological factor vulnerability -	Theoretical analysis
Lv Lijun et al. (2009)	Environmental vulnerability of a typical	Kunming	Socio-ecological quality, natural ecological quality, economic	
Li, B.H. et al. (2018)	Ecological vulnerability of rural tourism sites	China	Exposure - Sensitivity - Adaptability	Theoretical analysis
Wan Ziyou and He Xiaorong	Ecological vulnerability and sustainable tourism	China	Exposure - Sensitivity - Adaptability	Expert Scoring Method
Ma et al (2020)	Ecological vulnerability of tourist-oriented	Zhoushan, China	Exposure - Sensitivity - Adaptability	1-9 Scaling methods, expert scoring
Dogru et al (2019)	The impact of climate change vulnerability on	90 countries of world	Health, food security, ecosystems, human habits, water	Theoretical analysis

Scott et al (2019)	Climate change	181 countries	Tourism assets, tourism operating costs tourism demand,	Delphi method, AHP method
Kurniawan et al (2016)	The vulnerability of	Indonesia	Shoreline change, coral reef area change, live coral area change	AHP method
Aznar-Crespo et al (2020)	Social vulnerability to natural hazards in	Spain	Sensitivity-adaptability	
Gallego & Font (2019)	Vulnerability of tourism destinations to air	Spain	Source market, seasonality, commercialization, accessibility	AHP method
Wassler & Kuteynikova	Vulnerability of travellers' lives	—	Intrinsic, environmental and pathogenic vulnerability	
Calgaro et al (2014)	Vulnerability and resilience of tourism	—	Exposure - Sensitivity - Adaptability	Entropy method

Annex 3 Vulnerability assessment calculation process

➤ Erhai Lake Region

a) The raw data for the evaluation were obtained through statistics and calculations of yearbook and socio-economic bulletin data in the year of 2004 to 2019, as shown in the following Table 29, Table 30:

Table 29 Raw Data of Sensitive Indicators of Regional Economic Development of Erhai Lakes

Year	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈
2004	0.1647	0.1345	1.0823	0.1243	1.4367	1.0577	3.0246	1.7869
2005	0.2087	0.1002	1.1641	0.0860	1.0880	0.6869	2.7755	2.0276
2006	0.2078	0.1171	1.2762	0.0917	1.1729	0.7573	1.8571	2.2878
2007	0.2060	0.1305	1.3976	0.0934	1.1364	0.8380	2.1429	2.5903
2008	0.1969	0.1377	1.4076	0.0978	0.8733	0.7821	1.2329	2.7435
2009	0.2281	0.1039	1.3990	0.0742	2.1195	1.7380	4.3450	3.2456
2010	0.2426	0.1282	1.6374	0.0783	1.9123	1.2948	4.6037	3.7943
2011	0.2436	0.1529	1.7210	0.0888	1.4331	0.9879	2.9071	4.3557
2012	0.2907	0.1479	1.4583	0.1014	2.6378	1.9229	5.6370	5.1912
2013	0.3272	0.1441	1.2857	0.1121	2.2623	1.9301	4.0000	6.2785
2014	0.3880	0.1273	1.0652	0.1195	3.5071	2.9515	4.8081	7.3713
2015	0.4315	0.1385	1.0875	0.1273	2.2011	2.2253	3.3750	8.1702
2016	0.5499	0.1973	1.4334	0.1376	4.1822	4.4810	6.7214	10.7043
2017	0.6073	0.2268	1.5814	0.1434	2.0825	1.9423	3.3667	11.6681
2018	0.6336	0.2631	1.8716	0.1406	2.3656	1.8487	3.4921	12.9854
2019	0.6851	0.2742	2.2906	0.1197	3.0164	5.1111	3.4717	14.5373

Table 30 Raw Data of Economic Development Coping Capacity Indicators of Erhai Lake

Year	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈
2004	201.2282	12	31.03	11.45	28.7	2.9713	17.24	7.20
2005	235.1	12.5	30	13.3	30.5	2.9601	13.6	15.02
2006	275.2	13.3	30.1	15.1	-8.9	2.9600	15.6	13.16
2007	321.4275	13.2	23.2	17	43.3	2.9387	15	13.79
2008	371.7	12	27.4	23.14	6.19	2.9308	10.48	6.46
2009	404.5	12.3	33.01	16.32	13.85	2.9212	26.07	19.71
2010	474.1287	13	30.1	18	72.6	2.8598	24.86	17.22
2011	568.1	14.2	27.4	20	55.5	2.8164	20.35	15.49
2012	672.09	15.6	32.1	20	-0.8	2.8116	41.15	19.57
2013	760.77	12.2	28.3	14	28	2.8047	27.6	21.31

2014	832.33	8.5	12.26	13.7	21.5	2.8239	29.81	18.17
2015	900.1	9.2	10.91	11.1	-9.09	2.8215	20.25	10.59
2016	972.2	9	15.59	12.1	12.5	2.8094	37.64	31.78
2017	1066.55	9.7	17.5	12.3	-2.3	2.7789	20.2	9.41
2018	1254.79	9.3	5	12.3	15.5	2.6363	22	11.57
2019	1374.93	6.1	11.5	9	-42.9	2.6233	18.4	12.51

b) As there are negative numbers in the original data series, first out of the table non-negative processing, and then normalized to the data normalization process, then get Table 31 and Table 32:

Table 31 Standardized Data of Sensitivity Indicators of Erhai Lakes Region

Year	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈
2004	0.2405	0.4905	0.4725	0.8666	0.3435	0.2069	0.4500	0.1229
2005	0.3046	0.3653	0.5082	0.6000	0.2601	0.1344	0.4129	0.1395
2006	0.3034	0.4270	0.5571	0.6398	0.2805	0.1482	0.2763	0.1574
2007	0.3006	0.4761	0.6101	0.6513	0.2717	0.1640	0.3188	0.1782
2008	0.2874	0.5023	0.6145	0.6822	0.2088	0.1530	0.1834	0.1887
2009	0.3329	0.3788	0.6108	0.5177	0.5068	0.3400	0.6464	0.2233
2010	0.3541	0.4677	0.7148	0.5461	0.4572	0.2533	0.6849	0.2610
2011	0.3556	0.5577	0.7513	0.6195	0.3427	0.1933	0.4325	0.2996
2012	0.4243	0.5393	0.6367	0.7070	0.6307	0.3762	0.8387	0.3571
2013	0.4776	0.5256	0.5613	0.7817	0.5409	0.3776	0.5951	0.4319
2014	0.5664	0.4644	0.4650	0.8335	0.8386	0.5775	0.7153	0.5071
2015	0.6299	0.5050	0.4748	0.8878	0.5263	0.4354	0.5021	0.5620
2016	0.8027	0.7195	0.6258	0.9597	1.0000	0.8767	1.0000	0.7363
2017	0.8865	0.8271	0.6904	1.0000	0.4979	0.3800	0.5009	0.8026
2018	0.9249	0.9597	0.8171	0.9804	0.5656	0.3617	0.5195	0.8932
2019	1.0000	1.0000	1.0000	0.8347	0.7212	1.0000	0.5165	1.0000

Table 32 Standardized Data of Economic Development Resilience Indicators of Erhai Lake

Year	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈
2004	0.1464	0.7692	0.9400	0.4948	0.6202	1.0000	0.4190	0.2264
2005	0.1710	0.8013	0.9088	0.5748	0.6358	0.9963	0.3305	0.4726
2006	0.2002	0.8526	0.9118	0.6525	0.2950	0.9962	0.3791	0.4142
2007	0.2338	0.8462	0.7028	0.7347	0.7465	0.9890	0.3645	0.4339
2008	0.2703	0.7692	0.8301	1.0000	0.4255	0.9864	0.2547	0.2034
2009	0.2942	0.7885	1.0000	0.7053	0.4918	0.9832	0.6335	0.6202
2010	0.3448	0.8333	0.9118	0.7779	1.0000	0.9625	0.6041	0.5419
2011	0.4132	0.9103	0.8301	0.8643	0.8521	0.9479	0.4945	0.4875
2012	0.4888	1.0000	0.9724	0.8643	0.3651	0.9463	1.0000	0.6157
2013	0.5533	0.7821	0.8573	0.6050	0.6142	0.9439	0.6707	0.6704

2014	0.6054	0.5449	0.3714	0.5920	0.5580	0.9504	0.7244	0.5716
2015	0.6547	0.5897	0.3305	0.4797	0.2933	0.9496	0.4921	0.3333
2016	0.7071	0.5769	0.4723	0.5229	0.4801	0.9455	0.9147	1.0000
2017	0.7757	0.6218	0.5301	0.5315	0.3521	0.9353	0.4909	0.2962
2018	0.9126	0.5962	0.1515	0.5315	0.5061	0.8873	0.5346	0.3640
2019	1.0000	0.3910	0.3484	0.3889	0.0009	0.8829	0.4471	0.3935

c) According to the formula 11, 12 and 13 respectively, the two evaluation matrices are substituted, and the information moisture value, utility value and weight value of each column can be calculated, and the specific results are shown in Table 33 and Table 34.

Table 33 Index Weights of Sensitivity Indicators for Economic Development of Erhai Lakes

	S₁	S₂	S₃	S₄	S₅	S₆	S₇	S₈
entropy value	0.9599	0.9822	0.9920	0.9927	0.9680	0.9321	0.9743	0.9255
utility value	0.0401	0.0178	0.0080	0.0073	0.0320	0.0679	0.0257	0.0745
weight values	0.1468	0.0651	0.0293	0.0268	0.1171	0.2484	0.0941	0.2724

Table 34 Index Weights of Sensitivity Indicators for Economic Development of Erhai Lakes

	R₁	R₂	R₃	R₄	R₅	R₆	R₇	R₈
entropy value	0.9472	0.9915	0.9684	0.9890	0.9547	0.9998	0.9775	0.9727
utility value	0.0528	0.0085	0.0316	0.0110	0.0453	0.0002	0.0225	0.0273
weight values	0.2649	0.0425	0.1588	0.0553	0.2274	0.0012	0.1131	0.1369

d) The evaluation result of each indicator can be obtained by multiplying the standardized value of each indicator with the weight value, and then the economic development sensitivity value and the coping capacity value can be calculated by weighted summation, and then the economic vulnerability level of the Erhai Lake region and Lake Balaton region in all years can be obtained by substituting into the evaluation model, as shown in Table 20 , Table 21, Figure 21 and Figure 22

➤ Lake Balaton Region

The same computational steps to process the Lake Balaton data are as follow steps:

a) Raw Data:

Table 35 Raw Data of Sensitivity Indicators of Regional Economic Development of Lake

Balaton

Year	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈
2012	0.0804	0.3350	4.0120	5.2942	-12.6503	183.0332	-20.4663	7.6633
2013	0.0700	0.3623	4.3633	3.0187	-1.5976	-1.5384	2.7795	6.0028
2014	0.0891	0.3389	3.7103	3.6484	5.3023	4.2107	3.1680	6.9730
2015	0.1029	0.3531	3.3382	5.2198	3.5037	2.1534	-5.6436	7.7714
2016	0.1072	0.3299	3.0322	4.4789	2.4135	-2.9766	0.7769	7.8181
2017	0.1167	0.3211	2.8141	4.9046	2.1372	1.8868	1.4715	8.1738
2018	0.1178	0.3160	2.6228	4.9407	1.0908	2.6209	2.6569	8.5168
2019	0.1239	0.3190	2.5433	9.1322	1.4830	1.2518	1.7827	8.7564

Table 36 Raw data of the indicators of the coping capacity of the economic development of Lake Balaton

Year	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈
2012	1620041	1.4755	-6.0135	3.1662	-1.8567	2.1494	-18.6654	-7.8021
2013	1705315	5.2637	12.2013	4.3532	11.0711	2.1208	-8.4094	-22.0696
2014	1821089	6.7890	30.8452	4.2364	10.7974	2.1490	35.9977	15.3338
2015	1940848	6.5762	31.4448	7.8270	6.2661	2.1418	23.0409	10.4908
2016	2000080	3.0519	-22.7671	4.4357	5.0024	2.1191	7.3657	-0.2127
2017	2169174	8.4544	9.5972	8.2297	21.0750	2.1398	18.0688	3.8230
2018	2414859	11.3262	19.0410	10.5526	16.2564	2.0683	12.3541	3.5025
2019	2703589	11.9564	19.2655	8.9020	-1.2917	2.0782	17.7315	2.3128

b) Standardized Data:

Table 37 Standardized Data of Sensitivity Indicators for Economic Development of Lake Balaton Region

Year	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈
2012	0.6494	0.9248	0.9195	0.5797	0.0191	1.0000	0.0221	0.8752
2013	0.5650	1.0000	1.0000	0.3306	0.6230	0.0079	0.9839	0.6855
2014	0.7196	0.9354	0.8503	0.3995	1.0000	0.0388	1.0000	0.7963
2015	0.8307	0.9747	0.7651	0.5716	0.9017	0.0277	0.6354	0.8875
2016	0.8655	0.9107	0.6949	0.4904	0.8422	0.0001	0.9011	0.8928
2017	0.9422	0.8863	0.6449	0.5371	0.8271	0.0263	0.9298	0.9335
2018	0.9509	0.8723	0.6011	0.5410	0.7699	0.0302	0.9789	0.9726
2019	1.0000	0.8804	0.5829	1.0000	0.7913	0.0229	0.9427	1.0000

Table 38 Standardized Data of Economic Development Resilience Indicators of Lake Balaton

Year	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈
2012	1620041	1.4755	-6.0135	3.1662	-1.8567	2.1494	-18.6654	-7.8021
2013	1705315	5.2637	12.2013	4.3532	11.0711	2.1208	-8.4094	-22.0696
2014	1821089	6.7890	30.8452	4.2364	10.7974	2.1490	35.9977	15.3338
2015	1940848	6.5762	31.4448	7.8270	6.2661	2.1418	23.0409	10.4908
2016	2000080	3.0519	-22.7671	4.4357	5.0024	2.1191	7.3657	-0.2127
2017	2169174	8.4544	9.5972	8.2297	21.0750	2.1398	18.0688	3.8230
2018	2414859	11.3262	19.0410	10.5526	16.2564	2.0683	12.3541	3.5025
2019	2703589	11.9564	19.2655	8.9020	-1.2917	2.0782	17.7315	2.3128

c) Index weights:

Table 39 Index weights of economic development sensitivity indicators for Lake Balaton

	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈
entropy value	0.9599	0.9822	0.9920	0.9927	0.9680	0.9321	0.9743	0.9255
utility value	0.0401	0.0178	0.0080	0.0073	0.0320	0.0679	0.0257	0.0745
weight values	0.1468	0.0651	0.0293	0.0268	0.1171	0.2484	0.0941	0.2724

Table 40 Index weights of economic development coping capacity indicators of Lake Balaton

	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈
entropy value	0.9472	0.9915	0.9684	0.9890	0.9547	0.9998	0.9775	0.9727
utility value	0.0528	0.0085	0.0316	0.0110	0.0453	0.0002	0.0225	0.0273
weight values	0.2649	0.0425	0.1588	0.0553	0.2274	0.0012	0.1131	0.1369

Annex 4 Interview Questions Script

My interview process was systematically planned and executed in the following manner:

- Initial Interviews: In the period of January to February 2022, I initiated the process by engaging with Chinese authorities. I conducted face-to-face interviews with experts and scholars associated with various organizations including the Dali Environmental Protection Bureau, the Cultural Tourism Bureau, the Intangible Cultural Heritage Protection Bureau, and the Housing and Urban-Rural Development Bureau.
- Follow-up Correspondence: The next phase of my interviews took place in October 2022, followed by sessions in February and May 2023. During these periods, I conducted interviews with experts from Hungarian institutions including the Hungarian Central Statistical Office, the Intangible Cultural Heritage Institutions, and several Tourism Research Institutions. Due to geographic constraints, these interviews were conducted via email correspondence.

There are questionnaire below:

Q1. Please briefly introduce the intangible cultural heritage in region BALATON LAKE, including but not limited to traditional skills, music and dance, folk culture, etc. (Could please give me the list of all intangible cultural heritage of the Lake Balaton area registered)

A: Your answer (if English is not convenient, you can reply in Hungarian)

Q2. For the intangible cultural heritage in region BALATON LAKE, what protection measures and programs are there, such as whether relevant policies and regulations have been formulated, and whether there are special institutions or teams responsible for protecting and maintaining these heritages?

A: Your answer (if English is not convenient, you can reply in Hungarian)

Q3. At present, is there a crisis of disappearing or forgetting the intangible cultural heritage in region BALATON LAKE? If so, what measures have been taken to address this issue?

A: Your answer (if English is not convenient, you can reply in Hungarian)

Q4. For the intangible cultural heritage in region BALATON LAKE, what role do local governments and social forces play in protecting and inheriting it? Are there synergies?

A: Your answer (if English is not convenient, you can reply in Hungarian)

Q5. As an important part of local culture and tourism, intangible cultural heritage has an impact on local tourism? Are there any negative effects? If so, are there corresponding countermeasures?

A: Your answer (if English is not convenient, you can reply in Hungarian)

Q6. What is the impact of tourism projects centered on intangible cultural heritage on

local economic and social development? Can it drive local employment and economic growth?

A: Your answer (if English is not convenient, you can reply in Hungarian)

Q7. The inheritance and protection of intangible cultural heritage needs to attract more young people and social forces to participate. How do you think it should be promoted? What roles should the government and social forces play?

A: Your answer (if English is not convenient, you can reply in Hungarian)

Q8. Finally, in what aspects do you think the protection and inheritance of intangible cultural heritage should be strengthened and improved? Any other suggestions or ideas?

A: Your answer (if English is not convenient, you can reply in Hungarian)

Another one for environment department:

1. Can you provide an overview of the tourism resources in the Lake Balaton area?

A: Your answer (if English is not convenient, you can reply in Hungarian)

2. What are the supporting policies and measures for the development of sustainable tourism in the Lake Balaton region in the past ten years? (Can you provide some relevant information)

A: Your answer (if English is not convenient, you can reply in Hungarian)

3. Before and after the covid epidemic in 2019, what is the transformation of the tourism model? Or is there any countermeasure?

A: Your answer (if English is not convenient, you can reply in Hungarian)

4. The Lake Balaton area is a resort and a residential area with relatively high housing prices. Does the local government have corresponding management policies for new immigrants? What impact did the new immigrants have on the development of the area?

A: Your answer (if English is not convenient, you can reply in Hungarian)

5. What are the policies and laws regarding ecological protection measures for Lake Balaton? What are the environmental protection projects that have been effective in the last decade? (Please provide some relevant information)

A: Your answer (if English is not convenient, you can reply in Hungarian)

6. What are the future plans and objectives regarding the development of tourism in Lake Balaton?

A: Your answer (if English is not convenient, you can reply in Hungarian)