‘HARMONY IN THE KARST’

How to balance tourism development with ecological and cultural sustainability in Karst areas of Puzhehei?

COLOPHON

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How to balance tourism development with ecological and cultural sustainability in Karst areas of Puzhehei?

Location: Puzhehei, Yunnan, China

Keywords: Overtourism, Sustainable Tourism Planning, Ecological Security Pattern (ESP) , Stakeholder Management , Karst Landscape

Jing Tian/6018289/
First mentor: Ana Petrović/Urban Studies
Second mentor: Diwen Tan/Spatial Planning & Strategy

Delft University of Technology, Msc track Urbanism/
Graduation Lab Urbanism Studio/
Planning Complex Cities Studio 2024-2025/

This report made responsible and transparent use of Artificial Intelligence (AI) tools,notably ChatGPT, to support specific aspects of the research and writing process.
ChatGPT was employed to assist with language refinement, summarisation of complex texts, and initial brainstorming of structure and content ideas. At no point did AI replace the authors'own critical analysis, original ideas, or ethical reflections; rather, AI outputs were carefully reviewed, verified, and contextualised within the broader research conducted by the authors. The limitations and potential biases inherent in AI-generated content were acknowledged, and extra measures were taken to cross-check accuracy against reliable academic and professional sources.

ABSTRACT

This research investigates how tourism development can be balanced with ecological and cultural sustainability in the karst region of Puzhehei, Yunnan, China. In recent years, Puzhehei has experienced rapid tourism growth, resulting in overtourism and placing significant pressure on its fragile karst ecosystems and rich ethnic cultural heritage. The study identifies key challenges, including ecological vulnerability, cultural homogenization, and the absence of integrated governance.

A mixed-methods approach was employed, combining field surveys, stakeholder interviews, GIS-based spatial analysis, and ecological security pattern (ESP) modeling. The research evaluates the economic, ecological, and cultural effects of tourism. Based on the ESP analysis, the research develops a typological zoning framework that classifies the landscape into four categories: priority tourism development areas with ecological resilience, strictly protected fragile zones, ecologically important zones unsuitable for tourism, and potential reserve areas for future activation. This typology informs targeted planning principles and strategies that align tourism development with long-term ecological and cultural sustainability.

The research highlights the urgent need for a paradigm shift toward ecology- and culture-based tourism planning, emphasizing the integration of ecological science, local knowledge, and participatory governance. The analytical methods and design principles presented offer a replicable model for sustainable tourism development in ecologically sensitive areas, aiming to preserve both the natural and cultural distinctiveness of karst landscapes.

Figure 1- Peach Blossom Spring (Source:Qiuying, Ming)

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CHAPTER 1: BACKGROUND AND PROBLEM

1.1 MOTIVATION

I have always had a deep love for natural landscapes. When I was in elementary school, I studied Tao Yuanming's "Peach Blossom Spring," which portrayed a beautiful, idyllic scene that left a lasting impression on me. In college, I learned that Puzhehei is often referred to as the real-life "Peach Blossom Spring," and I was eager to visit. The unique karst landscape there truly moved me, and I was captivated by the natural beauty of the area.

However, as Puzhehei's popularity grew, the government began to pursue economic benefits through large-scale tourism development. In recent years, I've frequently seen negative news on social media about Puzhehei—unfinished homestay projects, the excessive number of tourists harming the local ecosystem, particularly the habitats of animals and plants. What saddens me even more is that the traditional festivals and customs of the local ethnic minorities have been overly commercialized. These celebrations, which once held deep cultural significance, have been reduced to mere performances aimed at attracting tourists, losing their original meaning.

When it came time to choose my graduation thesis topic, I knew without hesitation that I wanted to delve into this issue. I hope my research can contribute to the sustainable development of Puzhehei and help preserve its culture and environment.

1.2 PUZHEHEI, YUNNAN , CHINA

Puzhehei is located in Qiubei County in Wenshan Prefecture, Yunnan Province, in southern China near the borders with Guangxi and Guizhou. It's known for its unique karst landscape with connected lakes, limestone peaks, and caves. The area is beautiful and rich in natural resources, often called a "water paradise" or "hidden retreat," and has become popular for tourism and film locations.

Beijing to Puzhehei (about 2,100 km) is like the distance from Amsterdam to Istanbul. Shanghai to Puzhehei (about 1,900 km) is similar to Amsterdam to Rome. Guangzhou to Puzhehei (about 1,200 km) is comparable to Amsterdam to Vienna.

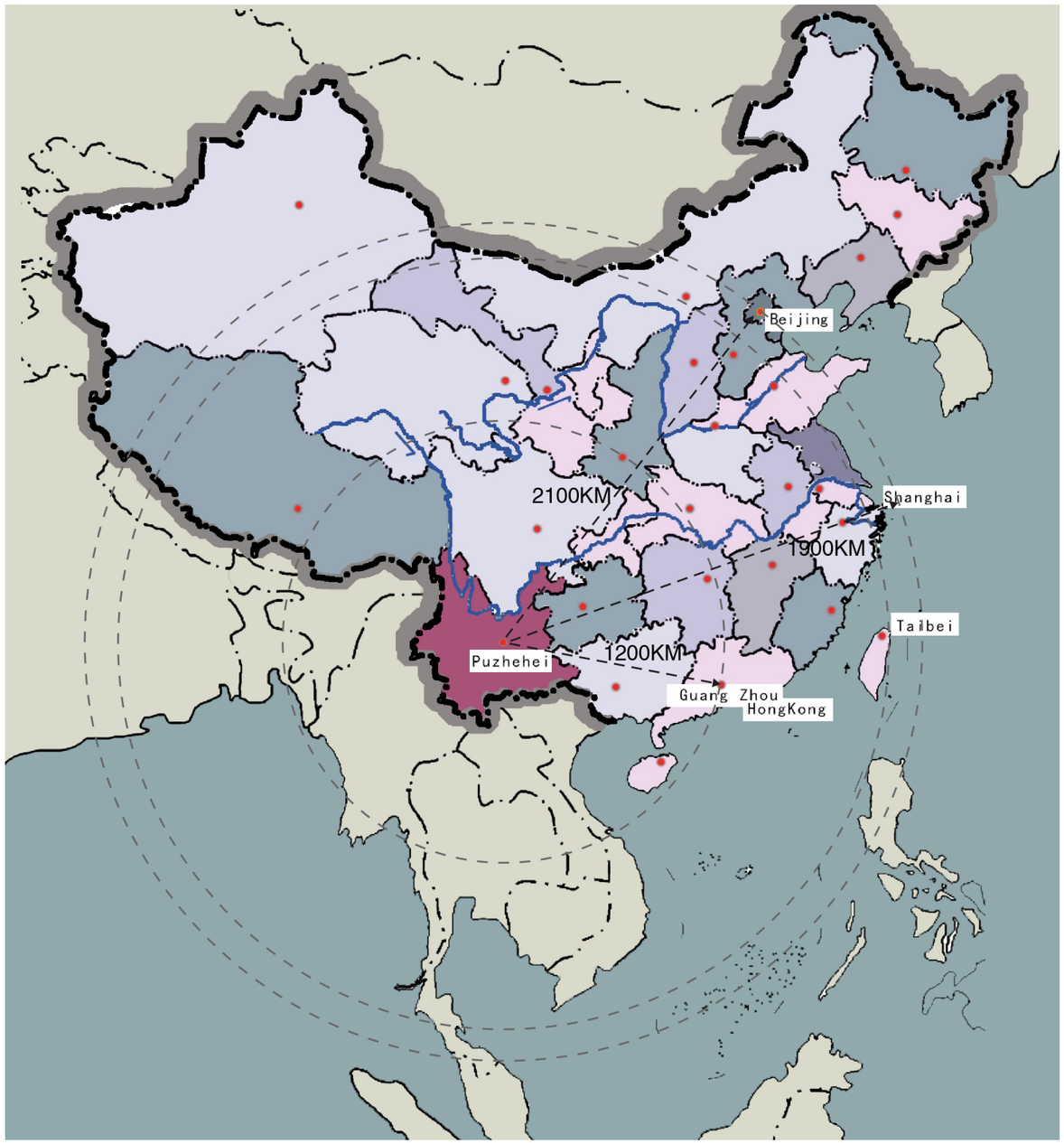

Figure 2- Puzhehei Location

1.3 UNDERSTANDING KARST LANDSCAPES: FORMATION MECHANISMS

A karst landscape forms as water gradually dissolves certain rock types, like limestone, dolomite, or gypsum. Over tens of thousands or even millions of years, rainwater and groundwater seep into cracks within these rocks, slowly dissolving them and creating a range of unique geological features.

Caves and Underground Passages: Water dissolves rock underground, forming extensive caves and tunnels. Examples include Slovenia's Postojna Cave and Hungary's Aggtelek Cave, both known for their complex cave networks and underground rivers, making them iconic European karst landscapes.

Sinkholes: When underground caves become too large, the surface above can collapse, creating sinkholes. Croatia's Red Lake is a famous example, a massive sinkhole lake over 200 meters deep, representing a classic karst feature.

Stalactites and Stalagmites: Inside caves, you often see stalactites hanging from the ceiling and stalagmites rising from the ground. These mineral deposits, as in France's Lascaux Cave, form over time as water drips down and leaves behind dissolved minerals.

Rock Towers and Columns: In certain areas, erosion leaves behind towering rock structures. For instance, in the Italian Alps, especially the Dolomites, these limestone formations appear like stone forests, creating a stunning karst landscape.

Figure 3 - Stalactites and Stalagmites (Source:Mafengwo, 2016)

Figure 4 - Karst hills and lakes(Source:Mafengwo, 2021)

Figure 5 - Grotta del Palatino cave(Source:Mafengwo, 2020)

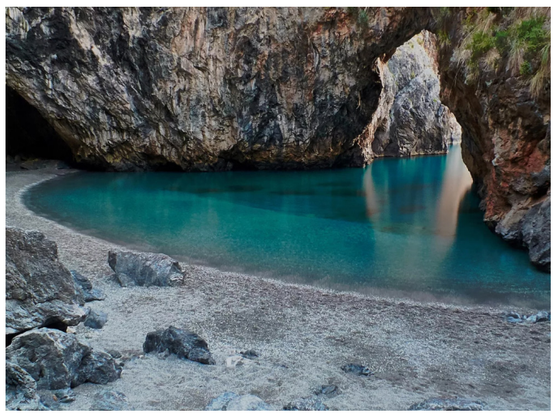

Figure 6 - Great Arch/Arco Magno(Source:Mafengwo, 2019)

The processes of carbonate rock deposition, uplift, and erosion:

Carbonate rock is formed through the long-term deposition of carbonate minerals and calcium-rich skeletons of marine organisms, with its origins tracing back hundreds of millions of years. During tectonic movements, these rocks were uplifted from the seafloor, experiencing dramatic geological transformations as oceans turned into land.

The processes of deposition, uplift, and dissolution are central to carbonate rock formation. As one of the primary soluble rocks, carbonate rock mainly consists of limestone and dolomite. Its unique property lies in its solubility—when it comes into contact with water, remarkable chemical reactions occur, dissolving the solid rock and carrying it away with the flow of water. This phenomenon is known as karstification, which leads to the development of karst landscapes, also referred to as karst topography.

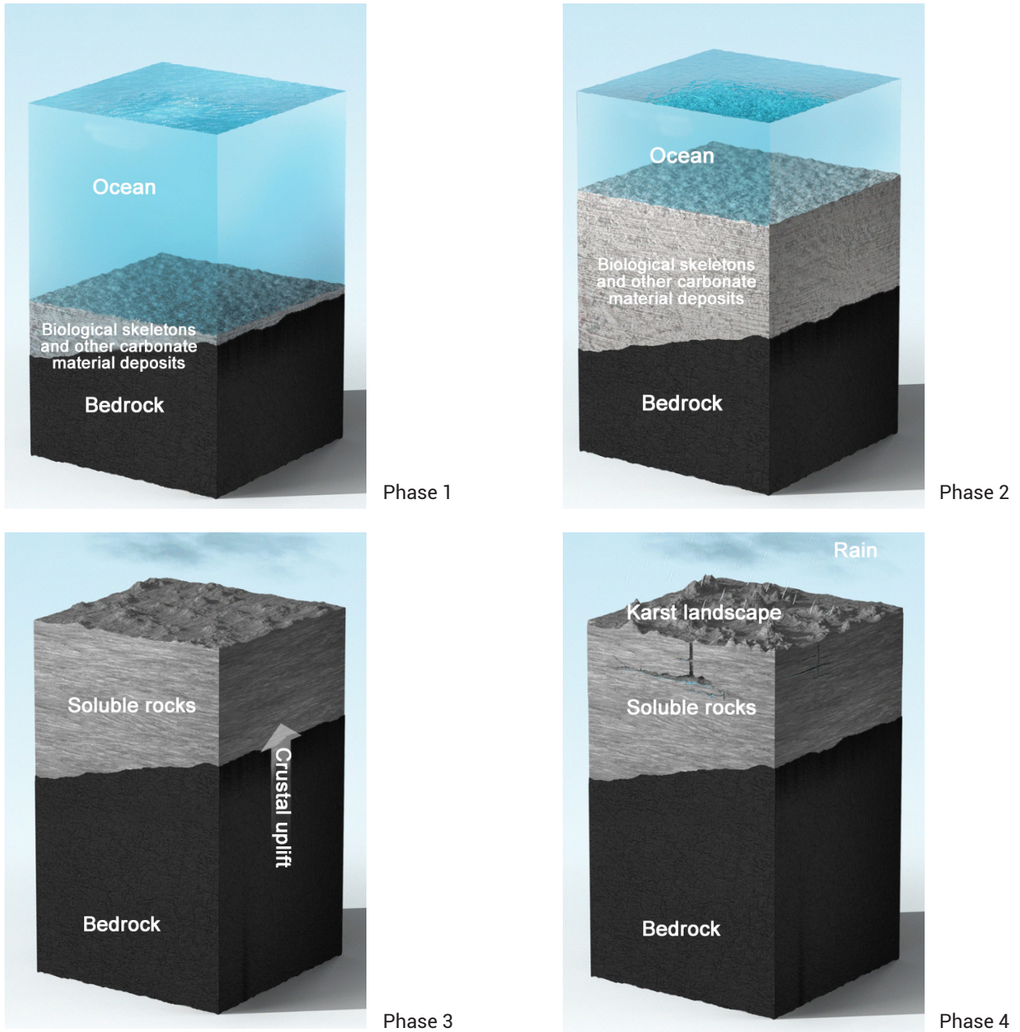

Figure 7- The processes of carbonate rock deposition, uplift, and erosion(Source:Planetary Research Institute, 2020)

1.3 UNDERSTANDING KARST LANDSCAPES: GLOBAL DISTRIBUTION OF KARST REGIONS

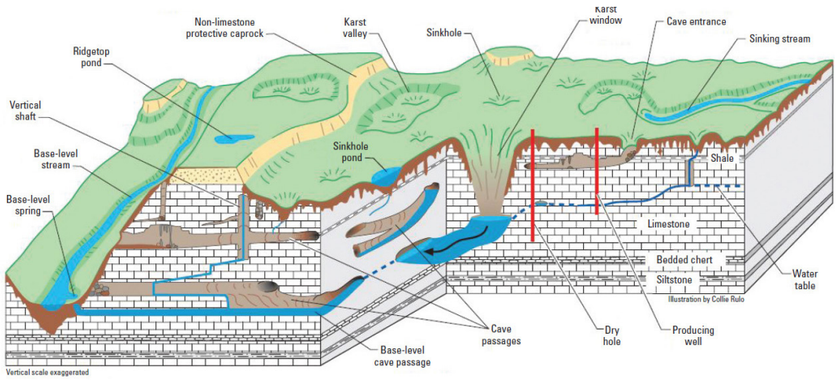

Figure 8 -Physiographic and hydrologic features typical of a well-developed karst terrane (modified from Currens, 2001, Kentucky Geological Survey, used with permission).Source:Taylor, C. J., & Greene, E. A. (2008).

Karst landscapes are primarily found in regions rich in limestone and other soluble rocks, including **North America, Europe, China, Southeast Asia, parts of Central Asia, and Africa.**

These karst areas not only showcase unique geological formations but also represent some of the world's most **ecologically vulnerable zones**, covering about **12% of the Earth's land surface** and directly impacting the lives of approximately **1.8 billion people**.

Among these, the **East Asian karst region,** centered on the Yunnan-Guizhou Plateau in China, stands out as the largest and most concentrated contiguous karst area globally, spanning over 550,000 square kilometers. This region features exceptionally diverse and complex karst formations, including tower karsts, caves, and sinkholes, making it one of the most representative and ecologically valuable karst landscapes in the world.

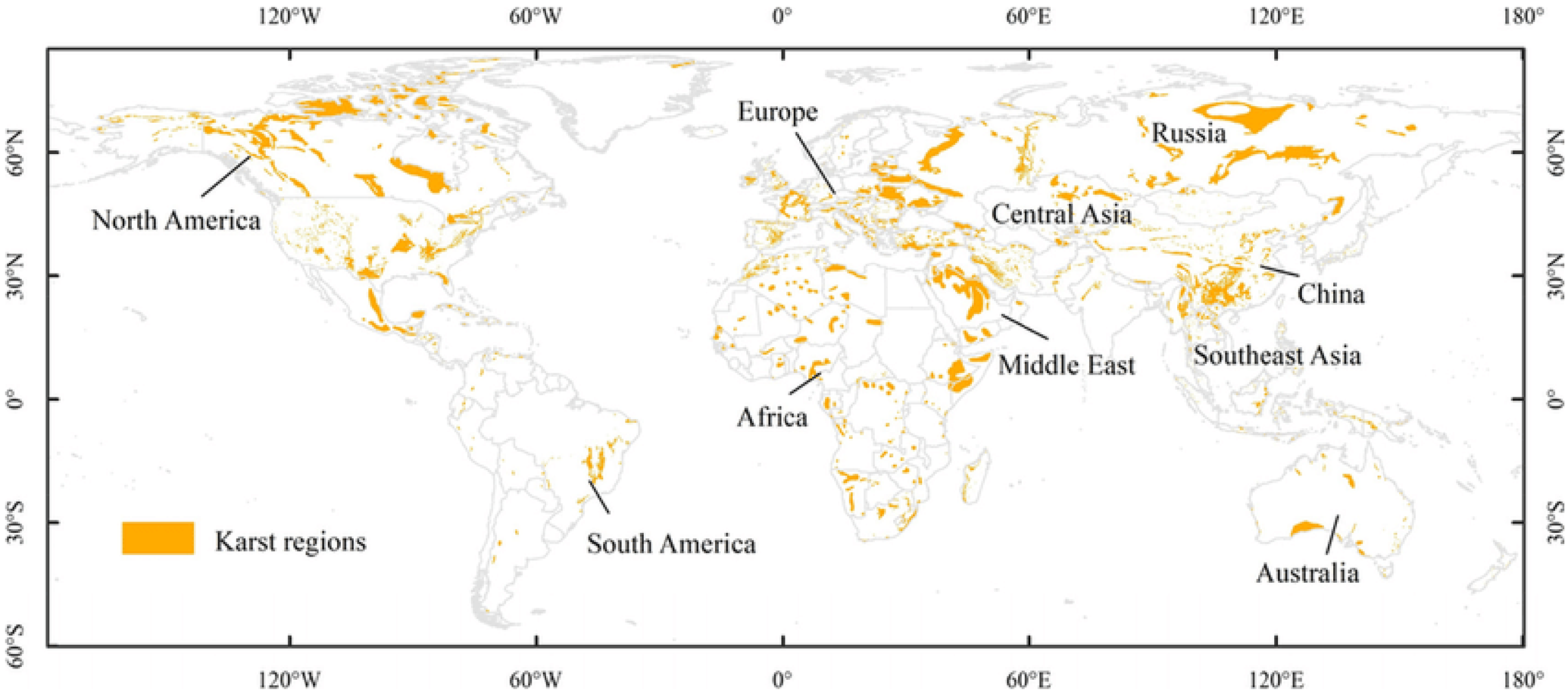

Figure 9 - Global Distribution of Karst Regions

1.4 CHALLENGES OF KARST LANDSCAPES: RESEARCH ON KARST LANDSCAPES

Research on karst landscapes primarily focuses on their unique **hydrogeological characteristics**, **carbon cycle functions**, and ecological vulnerability. Karst regions feature complex underground water systems and serve as natural carbon sinks, significantly impacting global water and carbon cycles and playing a crucial role in mitigating climate change. Due to their high sensitivity to **human activities** and **climate change**, research also emphasizes **watershed management** and **ecosystem assessments** to protect their fragile environments and water resources. Karst studies are vital for **sustainable development**, helping inform more effective ecological protection policies and management practices.

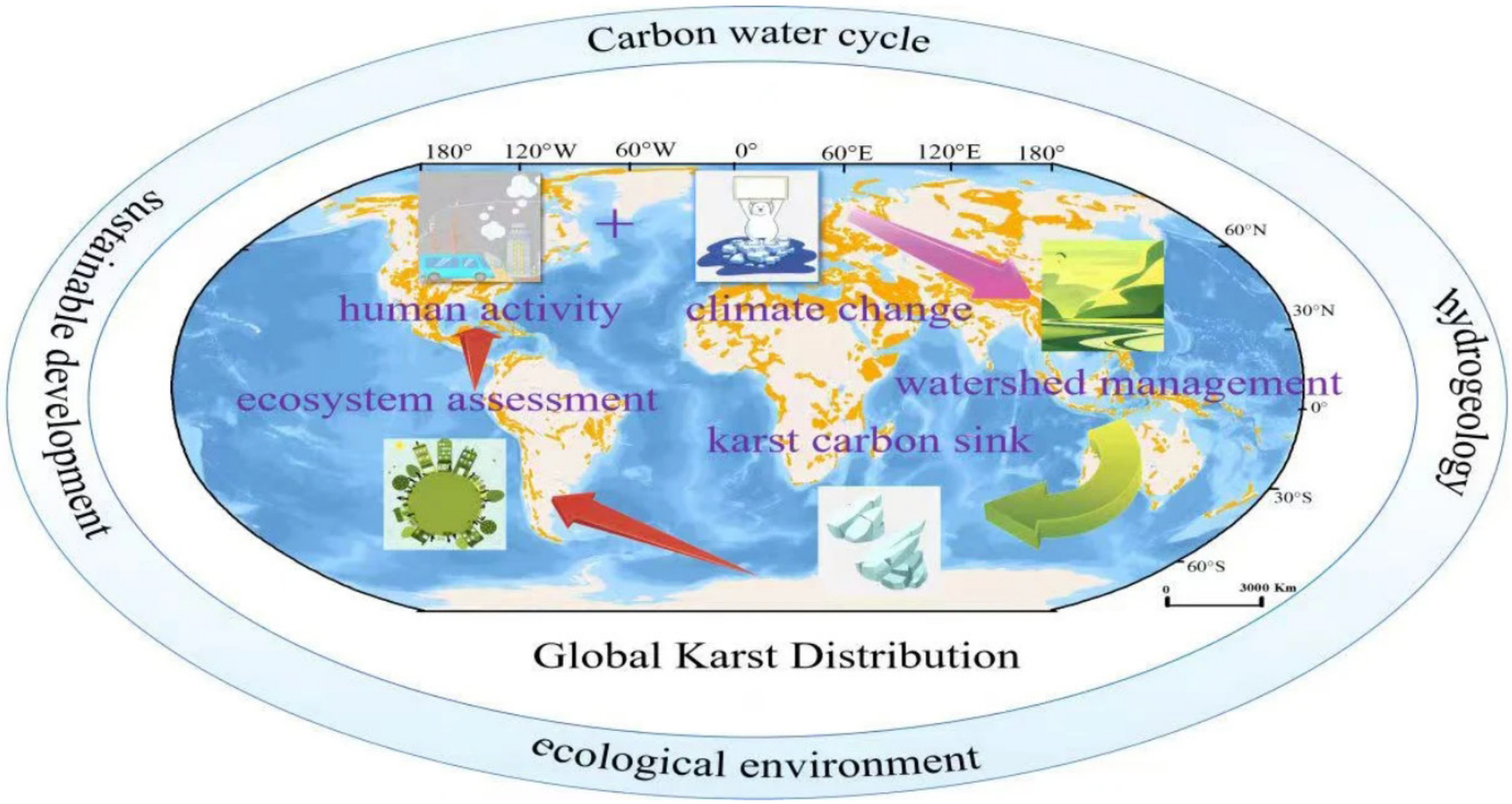

Figure 10 - Research on karst landscapes

1.5 PROBLEM STATEMENT

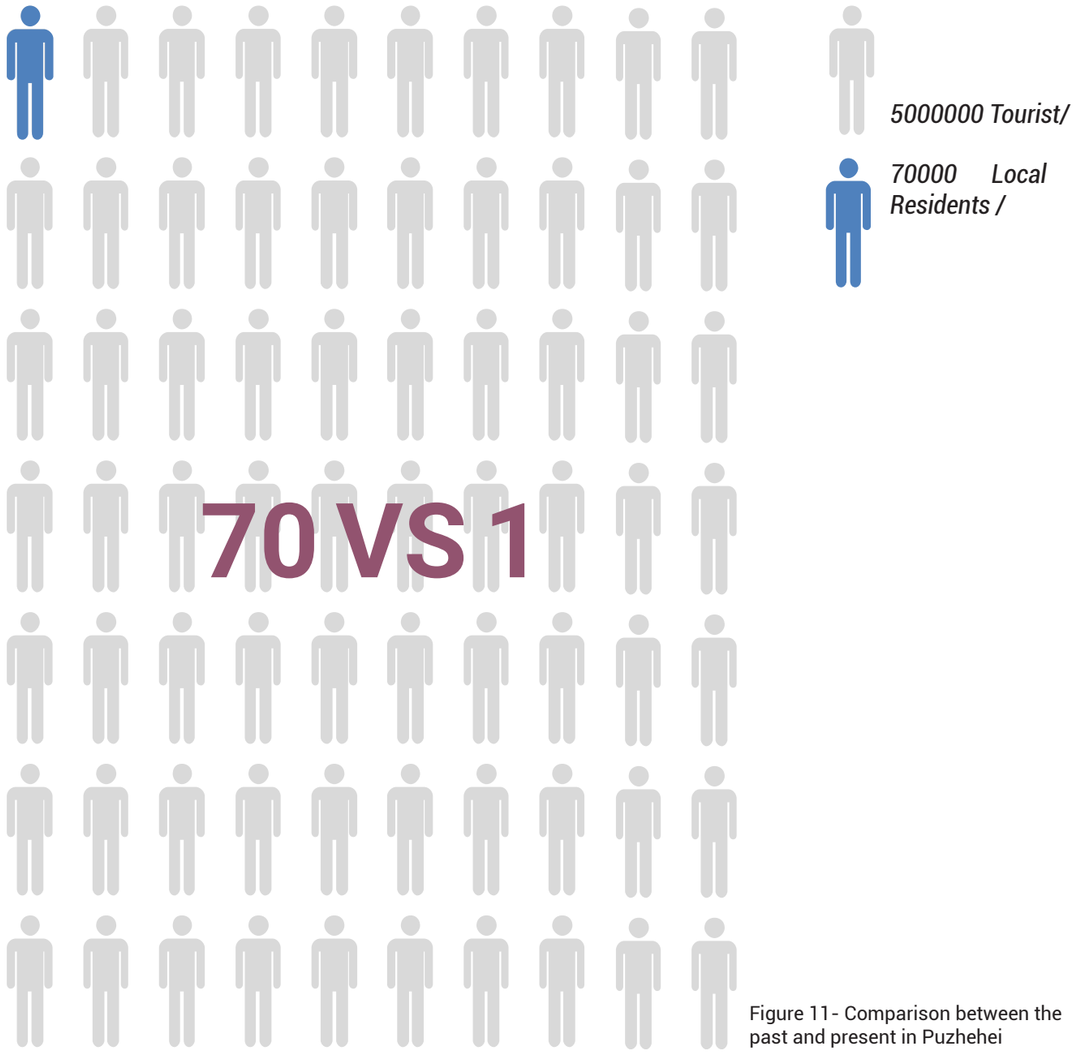

Figure 11- Comparison between the past and present in Puzhehei

Figure 12- Overtourism brings pollution(Source:flickr, 2018)

Figure 13- Negative effects of overtourism(Source:Instagram, 2018)

Figure 14- Comparison between the past and present in Puzhehei(Source:Mafengwo,2019&2020)

1.5 PROBLEM STATEMENT

Figure 15- Environmental Impacts of Overtourism in Puzhehei's Karst Wetland Landscape
This illustration highlights the multifaceted ecological pressures caused by unregulated tourism in Puzhehei, including water pollution, habitat destruction, wetland degradation, biodiversity loss, and damage from excessive tourist activity and construction.
Source: Author's own elaboration, based on multiple sources.

1.5 PROBLEM STATEMENT

Problem: Overtourism in karst landscapes

Context and Significance

Puzhehei, a representative karst landscape area in Yunnan Province, has recently witnessed a surge in tourist arrivals due to its unique natural scenery and vibrant ethnic cultural heritage. However, this rapid and often unregulated tourism boom has led to overtourism, exerting mounting pressure on the region's fragile ecosystem and culturally significant landscapes. The prevailing development model is heavily oriented towards short-term economic growth, often at the cost of environmental sustainability and cultural preservation.

Core Challenges & Research Gaps

Ecological Fragility – Karst landscapes are highly sensitive to tourism pressures, requiring strict carrying capacity management and ecological security planning.

Cultural Sustainability – Tourism development often leads to cultural homogenization and marginalization of local communities.

Fragmented Governance – Current approaches lack integrated spatial planning and cross-sector collaboration, leading to unsustainable outcomes.

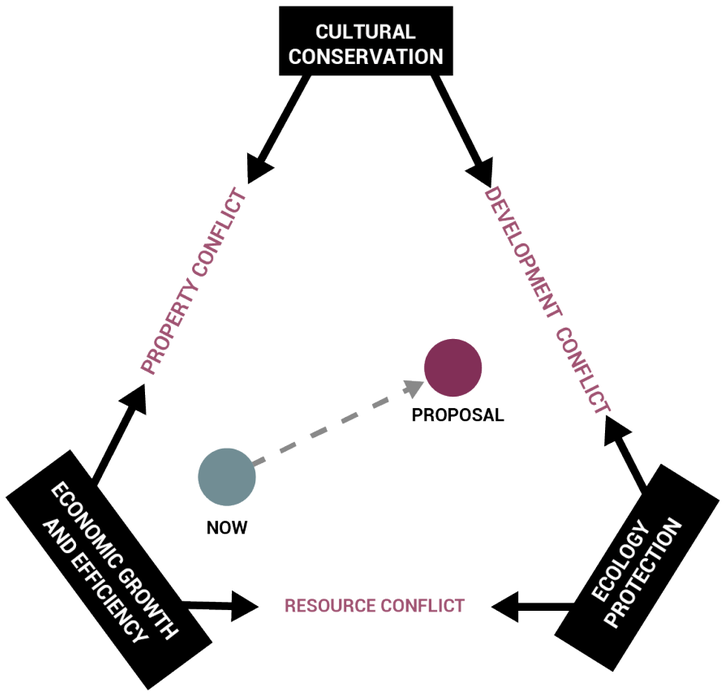

Figure 16- Triangle Conflict

Paradigm shift toward ecology & culture-based approaches

In light of the escalating challenges posed by overtourism, there is an urgent need to shift the development paradigm in karst regions like Puzhehei from growth-oriented tourism models to approaches rooted in ecological integrity and cultural authenticity. This paradigm shift emphasizes the value of ecological security, landscape resilience, and the cultural rights of local communities as fundamental pillars of regional planning. It calls for integrating ecological science, local knowledge, and cultural landscape theory into tourism planning processes. By moving away from mono-functional, economically driven land-use practices, this research advocates for a multi-dimensional planning approach that prioritizes long-term sustainability over short-term gains. Such a shift is not only essential for preserving the uniqueness of Puzhehei's karst environment but also for constructing a replicable model of sustainable tourism applicable to other vulnerable landscapes.

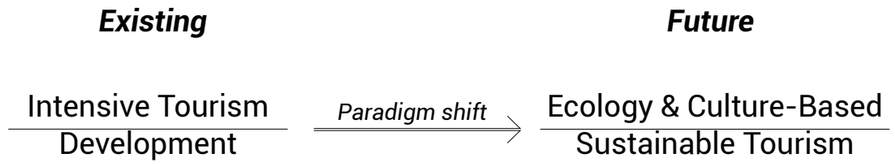

Figure 17- Paradigm shift

1.6 RESEARCH AIMS AND QUESTIONS

This research aims to explore how tourism development in Puzhehei can be balanced with ecological and cultural sustainability. It seeks to assess the socio-economic, ecological, and cultural impacts of tourism, identify ecologically secure zones suitable for development, and propose spatial planning strategies that ensure a harmonious integration of economic growth with environmental and cultural preservation.

How to balance tourism development with ecological and cultural sustainability in Karst areas of Puzhehei?

Sub-Question 1: **What are the economic, ecological, and cultural impacts of tourism development in Puzhehei?**

Sub-Question 2: **Which areas in Puzhehei are most suitable for tourism development based on an ecological security pattern?**

Sub-Question 3: **What spatial planning strategies can be developed to achieve economic, ecological, and cultural balance in Puzhehei?**

Sub-Question 1: What are the economic, ecological, and cultural impacts of tourism development in Puzhehei?

This sub-question aims to conduct a comprehensive assessment of the multifaceted impacts of tourism development in the karst region of Puzhehei.
The study will systematically investigate:

Economic impacts, including the extent to which tourism has contributed to local employment opportunities, income levels, and public infrastructure development, as well as the sustainability of such growth;
Ecological impacts, focusing on the disturbances caused by tourism activities to the karst ecosystem—particularly wetland degradation, water pollution, and threats to endemic or vulnerable species;
Cultural impacts, examining transformations in local traditions, ethnic customs, and intangible cultural heritage, with particular attention to risks of commercialization and cultural dilution.

Sub-Question 2: Which areas in Puzhehei are most suitable for tourism development based on an ecological security pattern?

This sub-question focuses on identifying spatial zones in Puzhehei that are appropriate for tourism development through the construction of an ecological security pattern (ESP). The aim is to delineate clear boundaries between conservation and development based on ecological sensitivity. The study will:

Construct the ESP by integrating key environmental indicators such as land use types, soil erosion susceptibility, hydrological features, and biodiversity distribution;
Identify tourism-suitable areas and protected core ecological areas
Apply GIS overlay analysis to identify areas where low-impact tourism development can be pursued with minimal ecological disruption.

Sub-Question 3: What spatial planning strategies can be developed to achieve economic, ecological, and cultural balance in Puzhehei?

This sub-question seeks to formulate practical and context-sensitive spatial planning strategies aimed at achieving a synergistic balance between economic development, ecological conservation, and cultural sustainability in Puzhehei. The research will:

Integrate findings from Sub-Q1 and Sub-Q2 to delineate functional zoning and land-use structure;
Develop targeted design strategies that respond to key local issues, including the protection of karst landforms, wetland systems, habitat connectivity, cultural landscapes, and mechanisms for stakeholder participation;
Select representative sites within the study area for in-depth spatial and design-based interventions.

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CHAPTER 2:

THEORETICAL PERSPECTIVES

2.1 HARMONY BETWEEN HUMANS AND NATURE

Daoist principles like "天人合一" and Western ecological philosophies.
Daoist philosophy sees humans as deeply connected and inseparable from nature, unlike the Western view that often separates humans from the natural world.
Comparative analysis of these perspectives on sustainable human-environment interactions.

The literature highlights three dimensions for categorizing HNR:

Positionality: Anthropocentric (human-centered) vs. ecocentric (nature-centered); humans as part of or separate from nature.
Character of Bond: Includes biophilia (love of nature) vs. biophobia, instrumental (utility-based) vs. intrinsic values, and emotional connectedness.
Understanding of Nature: Encompasses perceptions of nature's fragility or resilience, predictability, and the modes of learning about nature (experiential or scientific).

Ecosystem Services (ES) and HNR:

—ES focuses on the benefits humans derive from ecosystems, often framed in anthropocentric and utilitarian terms.
—Critiques of ES include its monetization focus and limited incorporation of cultural or intrinsic values of nature.
—ES lacks explicit discussion as a distinct HNR typology but interacts with HNR dimensions like positionality and values.
—ES include roles such as **"Master of Nature," "Steward of Nature," "Partner with Nature," and "Participant in Nature."**

Implications for Landscape Planning:
—Effective landscape planning should incorporate diverse HNR perspectives, recognizing the plurality of relationships people have with nature.
—Context-specific approaches are essential, as individuals' HNR perspectives can vary across time and situations.
—Operationalizing ES in planning requires integrating stakeholder values and resolving conflicts among different HNR viewpoints.

Source: Flint, C. G., Kunze, I., Muhar, A., Yoshida, Y., & Penker, M. (2013).

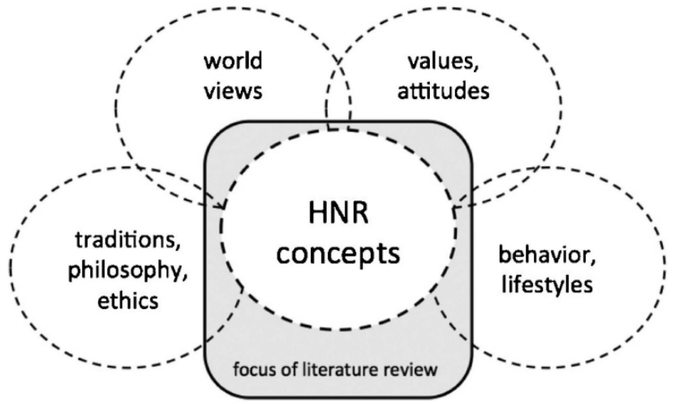

Figure 18- Domains of literature around HNR concepts Source: Flint, C. G., Kunze, I., Muhar, A., Yoshida, Y., & Penker, M. (2013).

2.2 KARST LANDSCAPE ECOSYSTEM SERVICES

1. Concept and Classification of Karst Landscape Ecosystem Services

Ecosystem services refer to the benefits provided by natural ecosystems and their processes to human societies. The unique geological and ecological characteristics of karst areas give rise to distinct ecosystem services.

Provisioning services: e.g., water resources, timber, biodiversity, and endemic medicinal plants.
Regulating services: e.g., climate regulation, soil and water conservation, and carbon sequestration.
Cultural services: e.g., tourism, aesthetic value, and religious or cultural heritage.
Supporting services: e.g., soil formation, nutrient cycling, and providing habitats for species.

2. Unique Ecosystem Service Features of Karst Landscapes

Water Resources: The underground rivers and cave systems in karst areas are critical for water supply and purification but are vulnerable to pollution and over-exploitation.
Carbon Sequestration and Climate Regulation: The karstification process absorbs atmospheric CO, playing an important role in mitigating climate change.
Biodiversity: The complex topography of karst areas provides habitats for many endemic species, though these ecosystems are highly fragile.

3. Threats and Challenges to Karst Ecosystem Services

Human Interference: Over-extraction of groundwater and mineral resources leads to ecosystem degradation. Expansion of large-scale agriculture and urbanization causes soil erosion and ecological damage.
Climate Change: Extreme weather events (e.g., droughts) severely impact karst ecosystem services, particularly water supply.
Tourism Development Pressure: The unique aesthetic value of karst landscapes attracts many tourists, resulting in environmental pollution and cultural impacts.

4. Conservation and Sustainable Development of Karst Ecosystem Services

Ecological Compensation Mechanisms:
Policies can encourage ecological compensation, such as payments to upstream residents for protecting water resources.
Nature-Based Solutions:
Enhance ecosystem services through vegetation restoration, wetland protection, and carbon sink management.
Community Engagement:
Encourage local communities to participate in conservation efforts, such as developing ecotourism, preserving traditional culture, and promoting environmental education.
Technology and Monitoring: Utilize remote sensing and GIS technologies to monitor changes in karst ecosystem services and establish long-term monitoring networks.

Source：Rodríguez, J. P., Beard Jr, T. D., Bennett, E. M., Cumming, G. S., Cork, S. J., Agard, J., ... & Peterson, G. D. (2006).
Su, B., & Liu, M. (2023).
Ring, I., Hansjürgens, B., Elmqvist, T., Wittmer, H., & Sukhdev, P. (2010).

Figure 19 - Classification of Ecosystem Services

2.3 ECO-TOURISM: CONCEPT AND EVOLUTION

1. Concept of Eco-Tourism

Definition: Eco-tourism is a form of sustainable tourism that emphasizes the preservation of natural and cultural environments while promoting responsible travel to natural areas. It focuses on minimizing environmental impact and maximizing benefits for local communities.

Core Principles:

Environmental Conservation: Protecting ecosystems and biodiversity.
Community Participation: Involving local communities in tourism planning and management.
Education and Awareness: Providing travelers with opportunities to learn about the environment, culture, and sustainability.
Sustainability: Ensuring tourism activities are economically viable and environmentally friendly.

2. Key Features of Eco-Tourism

Nature-Centric: Emphasizes pristine natural environments like national parks, protected areas, and biodiversity hotspots.
Low Impact: Limits environmental degradation through practices like small group sizes, eco-friendly accommodation, and responsible waste management.
Cultural Sensitivity: Highlights respect for and preservation of local cultures and traditions.
Economic Benefits for Locals: Encourages revenue generation for local communities through eco-tourism activities, services, and employment.

3. Evolution of Eco-Tourism

Early Development (1960s–1980s):

The concept of eco-tourism emerged as part of the broader environmental movement during the 1960s and 1970s. It was driven by a growing awareness of the need to conserve natural habitats and reduce the negative impacts of mass tourism.
Hector Ceballos-Lascurain, a Mexican environmentalist, is credited with coining the term “eco-tourism” in the early 1980s.
Institutionalization (1990s–2000s):

Organizations like the International Ecotourism Society (TIES, founded in 1990) formalized eco-tourism principles and practices, promoting sustainability and environmental education.
The UN declared 2002 as the International Year of Ecotourism, highlighting its importance in sustainable development.
Modern Development (2000s–Present):

Integration with Technology: The use of technology, such as GIS for eco-tourism planning and digital platforms for sustainable travel promotion.
Focus on Community Empowerment: Emphasis on participatory approaches to ensure benefits for local communities.
Climate Change Mitigation: Addressing climate change by promoting low-carbon tourism practices, including renewable energy use and carbon offset programs.

Source：Munt, I. (1994).
Ramaswamy, S., & Sathis Kumar, G. (2010). (March 5, 2010).

2.4 ECOLOGICAL SECURITY PATTERNS

Ecological Security Patterns (ESP) are spatial planning frameworks that aim to secure critical ecological processes and landscape integrity by identifying and protecting key areas—such as water bodies, biodiversity corridors, and core habitats—within a region. First conceptualized by Yu Kongjian (1996) in China, ESP draws on the principles of landscape ecology (Forman, 1995), emphasizing the connectivity, heterogeneity, and resilience of ecological networks as the foundation for sustainable land use and spatial development.

Contemporary research has further advanced the ESP framework by integrating ecosystem services assessments, land-use change modeling, and scenario planning (Peng et al., 2018; Zhang et al., 2020). Scholars have demonstrated that ESP can effectively guide regional spatial planning by preventing habitat fragmentation, maintaining ecological corridors, and supporting policy tools such as the ecological redline in China (Wang et al., 2022). This approach has been applied successfully in diverse contexts, from the Pearl River Delta and Yangtze River Basin to ecologically sensitive areas like karst regions, wetlands, and peri-urban zones (Yu et al., 2012; Xie et al., 2020).

In this research, ESP serves as both a theoretical and methodological foundation for addressing the complex relationship between tourism development and ecological conservation in the Puzhehei karst region. Specifically, I apply ESP to systematically identify zones of high ecological value or vulnerability—such as wetlands, water sources, and rare habitats—as well as areas that demonstrate greater resilience and are more suitable for tourism development. By conducting a GIS-based, multi-criteria spatial analysis, this research translates ESP theory into practical zoning maps, which inform targeted strategies for tourism planning and ecological protection.

The application of ESP is particularly relevant in Puzhehei, where intense tourism pressures risk degrading fragile karst landscapes and eroding both ecological and cultural values. By applying ESP, this study is able to balance ecological conservation with tourism planning, ensuring that development occurs only in areas with sufficient resilience while sensitive zones are preserved. Thus, ESP serves as both a theoretical foundation and a practical tool for achieving sustainable tourism in ecologically sensitive landscapes.

In summary, the ESP approach in this research builds on a strong academic foundation and responds to the urgent need for holistic, evidence-based planning in ecologically vulnerable and culturally significant landscapes, such as the karst areas of Southwest China.

2.5 GLOBAL COMPARATIVE CASE

Degradation of Dolines on Logaško Polje (Slovenia)

The study spans 50 years, comparing aerial photographs from 1944 and 2000. Results show that 77.5% of the dolines have disappeared, primarily due to waste dumping, construction, and filling with various materials. Only 22.5% were partially or fully preserved.

The degradation is attributed to anthropogenic activities, including agriculture, industrial development, and settlement expansion, which altered the landscape significantly. Dolines, essential to the karst landscape, have lost attention from both the public and authorities, despite their environmental and cultural value.

Breg calls for the classification of dolines as non-renewable natural resources. She suggests that protecting these geomorphological features requires integrating them into spatial planning and public awareness to prevent further degradation.

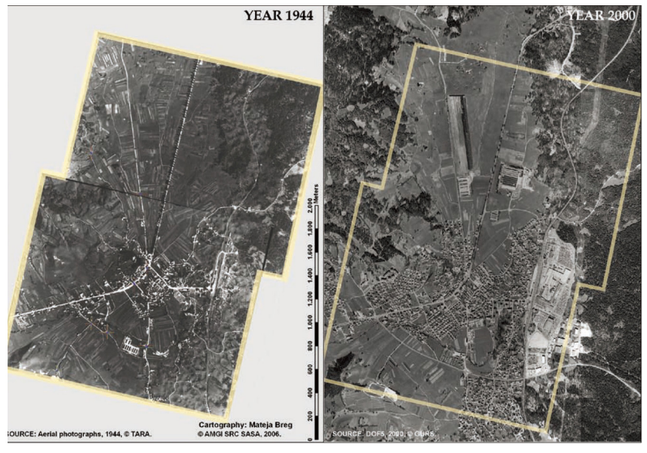

Figure 20 - Aerial photographs of study area in the years 1944 and 2000.(Source:Breg, M. (2007).)

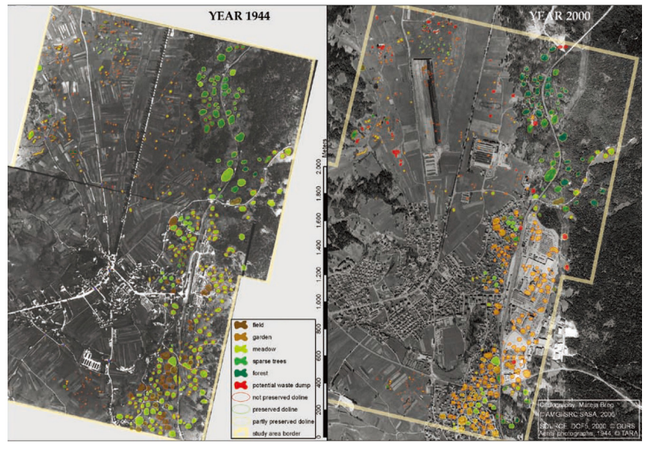

Figure 21 - Land use in dolines in the years 1944 and 2000 regarding doline preservation. (Source:-Breg, M. (2007).)

2.6 THEORETICAL FRAMEWORK

Initial State:
Overtourism in Karst Regions

The rapid expansion of tourism exerts pressure on the karst ecosystem.

Ecological Vulnerability: Karst landscapes are highly susceptible to erosion, and water resources are sensitive; excessive development may disrupt ecological balance. **Management Challenges:** The government prioritizes economic growth, lacking effective regulations for ecological protection, leading to resource overexploitation. **Cultural Impact:** Tourism may lead to the commercialization of local culture and the neglect of community interests.

Optimized Framework Pathway

-Ecological Security Patterns(ESP)

Utilize ESP as a spatial planning framework to identify and protect critical ecological corridors, core conservation zones, and buffer areas. This approach helps define development boundaries and informs land-use decisions that align with ecological resilience and landscape connectivity.

-Eco-Tourism

Develop low-impact, environmentally friendly sustainable tourism models, such as minimizing human intervention, promoting eco-friendly accommodations, and enhancing visitor awareness of environmental conservation. Encourage local community participation, ensuring they benefit from eco-tourism rather than merely bearing its negative impacts.

-Karst Landscape Ecosystem Services

Identify and quantify the ecological functions of karst landscapes, including water regulation, biodiversity conservation, and carbon storage, integrating them into tourism management decisions. Establish ecological compensation mechanisms to allocate a portion of tourism revenue toward environmental protection and restoration.

-Harmony Between Humans, and Nature

Balance ecological protection, cultural heritage preservation, and socio-economic development. Promote local cultural conservation, ensuring it remains an integral part of tourism rather than being commercialized or homogenized. Achieve a sustainable model of coexistence between ecology, culture, and society through institutional innovation and planning optimization.

Final Goal:
HARMONY IN THE KARST

This pathway encompasses a comprehensive transformation from ecological conservation to cultural and governance systems, ensuring that tourism activities are not only sustainable but also contribute to the long-term harmony and resilience of karst regions.

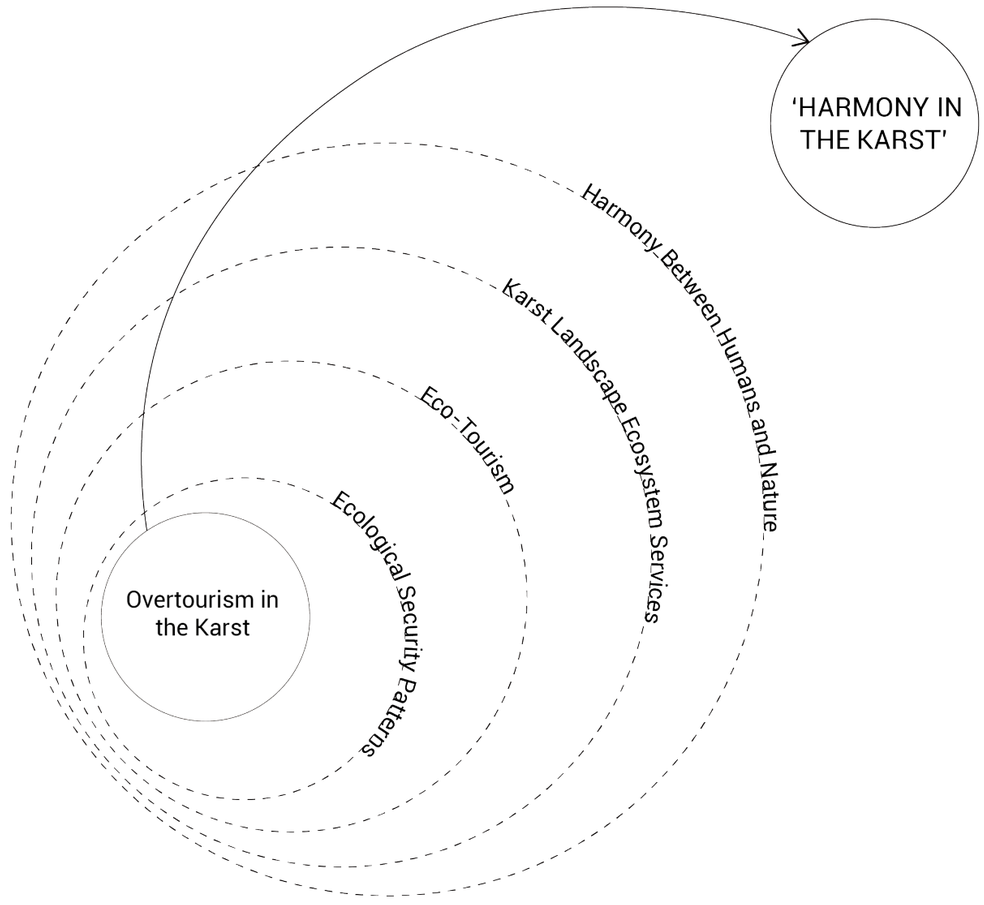

Figure 22 - Theoretical Framework

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CHAPTER 3: METHODOLOGY

3.1 CONCEPTUAL FRAMEWORK

This diagram illustrates a regional framework titled "Harmony in the Karst," which aims to achieve a dynamic balance among sustainable tourism development, ecological quality, and cultural security in karst regions. While the concept of eco-cultural tourism focuses on integrating ecological protection and cultural experience within tourism activities, "harmony" in this research refers to a broader and more systemic goal.

Specifically, "harmony" encompasses not only eco-cultural tourism as a strategy, but also the spatial planning, stakeholder participation, and long-term governance mechanisms needed to maintain the resilience of the entire landscape. The framework demonstrates how nature, culture, and tourism can interact in mutually supportive ways, ensuring that tourism contributes to both ecological conservation and cultural vitality, rather than causing conflicts or trade-offs. The model is operationalized through three core mechanisms: planning (ecological, cultural, and tourism), engagement (community and tourist participation), and collaboration (among government, NGOs, local communities, and research institutions). These elements collectively drive three transformation pathways—sustainable tourism, ecological resilience, and cultural conservation—which represent the desired long-term outcomes. Developed in response to the challenges of overtourism, ecological fragility, and cultural commodification, this framework provides both a conceptual lens and practical roadmap for achieving balanced and inclusive development in karst landscapes.

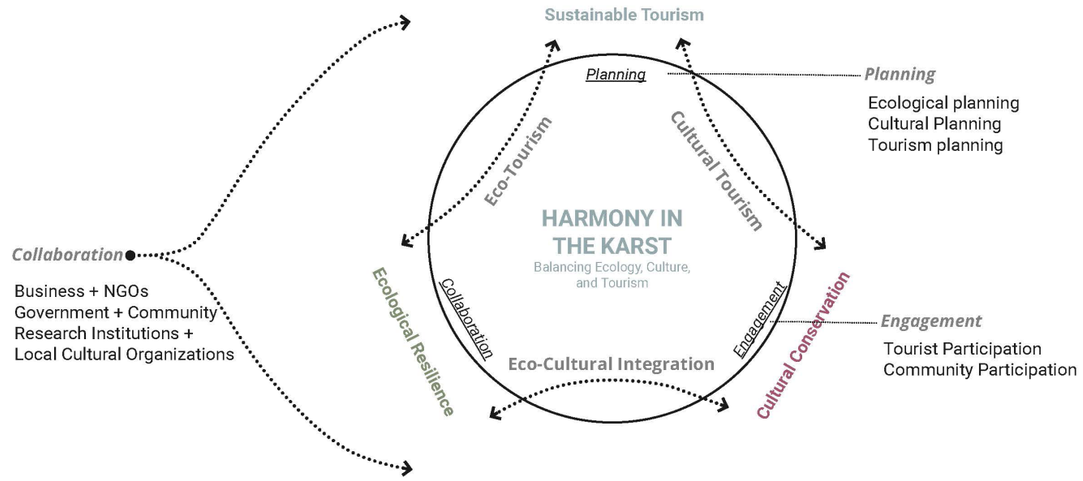

Figure 23- Conceptual Framework

3.2 METHODOLOGICAL FRAMEWORK

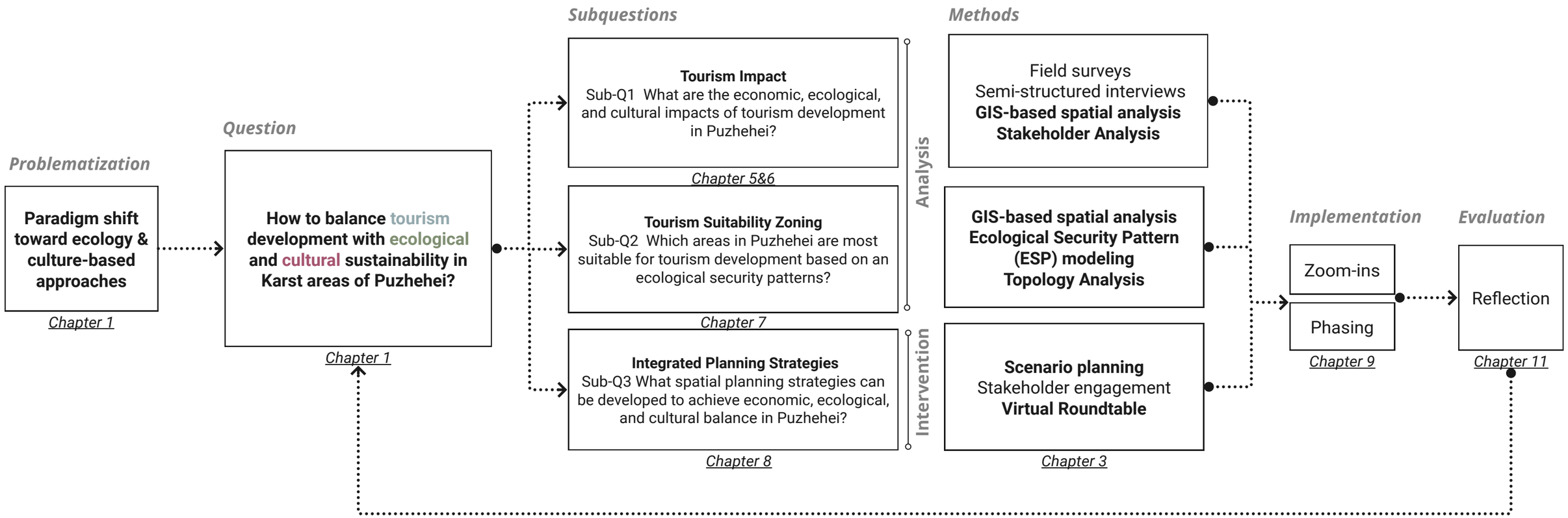

Figure 24- Methodology

1.Field Surveys
On-site field surveys were used to document existing land use, ecological features, tourism infrastructure, and the physical condition of traditional settlements. These surveys provided spatial and environmental observations and offered ground-truth evidence for tourism impacts.

2.Semi-Structured Interviews
Semi-structured interviews were conducted with local residents, tourism operators, planners, and village representatives to gain insights into how tourism has affected local livelihoods, resource access, and cultural identity. This method allowed for flexibility in exploring participant narratives while maintaining comparability across cases.

3.GIS-Based Spatial Analysis
Geographic Information Systems (GIS) were employed to analyze spatial patterns of land use change, ecological vulnerability, infrastructure distribution. GIS overlay techniques were used to visualize relationships between ecological constraints and tourism development potential at multiple scales.

4.Stakeholder Analysis
A stakeholder analysis was carried out to identify key actors involved in tourism, environmental governance, and cultural preservation. The analysis mapped their roles, interests, and influence across different administrative and social levels, using tools such as power-interest grids and onion diagrams to reveal potential conflicts and synergies.

5.Virtual Roundtable
In light of logistical constraints, a virtual roundtable was organized with experts, scholars, and planning practitioners familiar with Puzhehei or similar karst regions. This session enabled real-time dialogue and feedback on preliminary findings, and helped validate the proposed planning strategies through a collaborative lens.

6.Ecological Security Pattern (ESP) Modeling
ESP modeling was used to identify ecologically critical areas based on indicators such as water source protection, biodiversity distribution, soil erosion risk, and flood regulation. Resistance surface modeling and spatial zoning were applied to categorize areas into ecological core zones, and zones with development potential, buffers, and development-suitable areas.

7. Scenario Planning
Scenario-based forecasting is applied to explore multiple future pathways for tourism development under varying ecological and cultural governance models. This includes transitions from reactive management to proactive adaptation, integrating nature-based solutions, ecological compensation mechanisms, and cultural preservation strategies. Design-based research supports the spatialization and visualization of these scenarios.

3.2.1 VIRTURAL ROUNDTABLE

Stakeholder Discussion Framework

1.Standardized Questions & Stakeholder Priorities

Ask the same questions to all stakeholders to identify key concerns and priorities.
Observe differences in focus, such as economic needs, environmental protection, or policy challenges.

2.Individual Interviews for In-Depth Insights
Select diverse representatives from each stakeholder group.
Gather real-life experiences and perspectives on human-nature interactions in Puzhehei.

3.Synthesize and Compare Responses

Identify common themes, conflicts, and areas of consensus.
Categorize responses based on environmental, economic, and policy impacts.

4.Virtual Roundtable Reconstruction

Present findings as a collective discussion, maintaining distinct stakeholder voices.
Highlight key debates and potential compromises.

5.Actionable Recommendations

Develop targeted strategies for sustainable tourism, conservation, and local development.
Provide clear takeaways to guide policy and stakeholder collaboration.

HUMAN	RESIDENTS
	TOURISTS
	RESEARCH INSTITUTIONS
	NGOS AND GRASSROOTS ORGANIZATIONS
	LOCAL GOVERNMENT
NON-HUMAN	WATER(LAKE,WETLAND)
	ANIMALS(BIRDS,FISHES)
	KARST LANDSCAPE(KARSTCAVES,KARST TOWER)
	PLANTS(LOTUS, RAPESEED, PEACH)

Figure 25-Virtual Roundtable Stakeholder Discussion(Illustrative image only; the individuals depicted are not interview participants. Source: 699pic.com&qbpzh.net/, used with permission.)

3.2.2 CONSTRUCTION OF ECOLOGICAL SECURITY PATTERNS

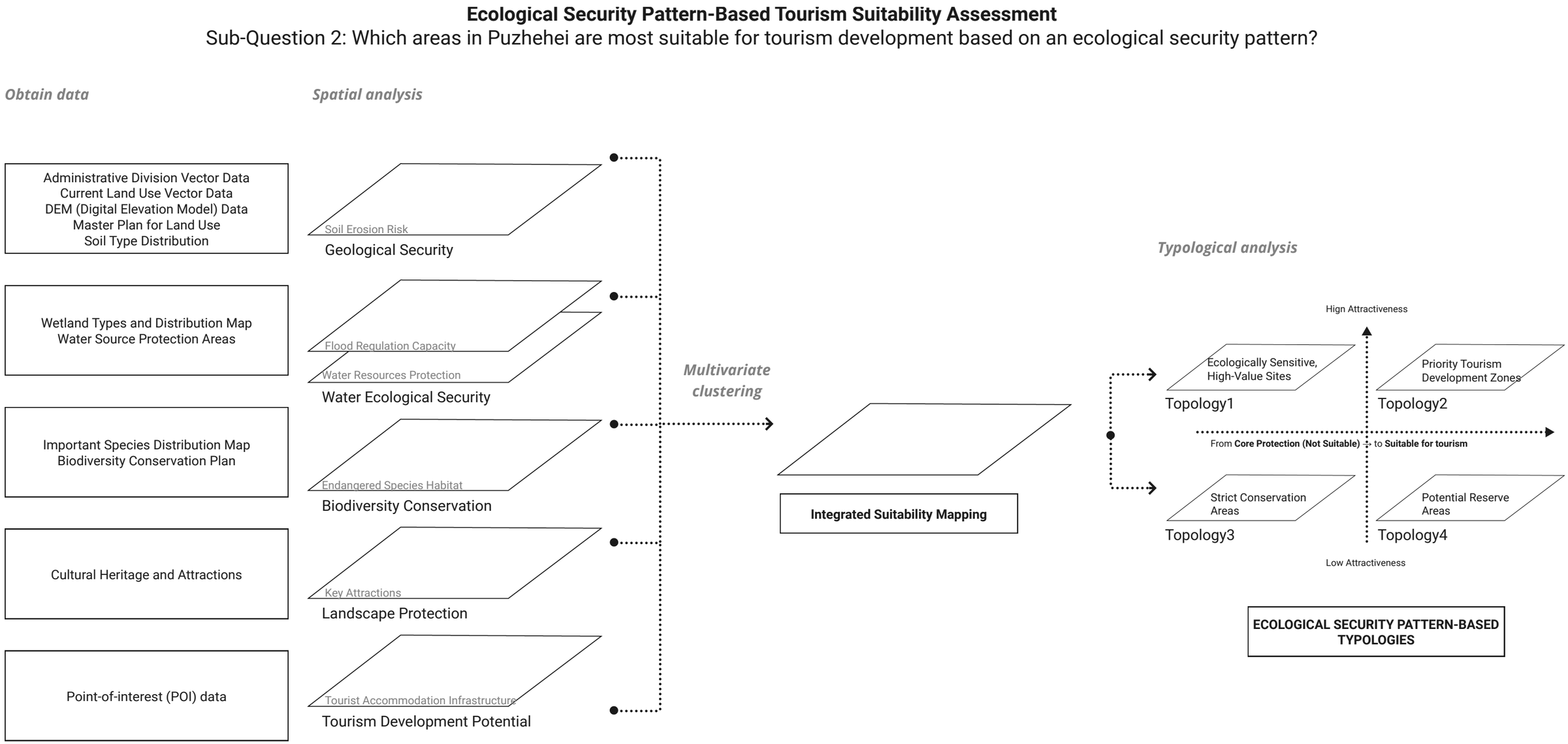

Figure 26- Ecological Security Patterns

This framework integrates multiple ecological and tourism-related indicators to construct a composite spatial model that supports tourism development planning in the karst landscape of Puzhehei. Key ecological layers—such as soil erosion risk, flood regulation, water source protection, and biodiversity conservation—are combined with indicators of tourism potential, including landscape attractiveness and accommodation infrastructure. These variables are analyzed through multivariate clustering, resulting in a synthesis map that reveals spatial variation in both ecological sensitivity and tourism readiness.

Building on this, a typological zoning approach is applied using two core dimensions: tourism suitability (reflecting ecological constraints) and resource attractiveness (based on cultural and natural tourism values). The resulting four spatial typologies—core conservation zones, priority development areas, ecological restoration zones, and reserve development areas—provide differentiated guidance for tourism planning. This enables planners to determine where tourism should be promoted, restricted, restored, or strategically cultivated, aligning spatial decisions with ecological resilience and cultural sustainability objectives.

3.3 RESEARCH TIMELINE

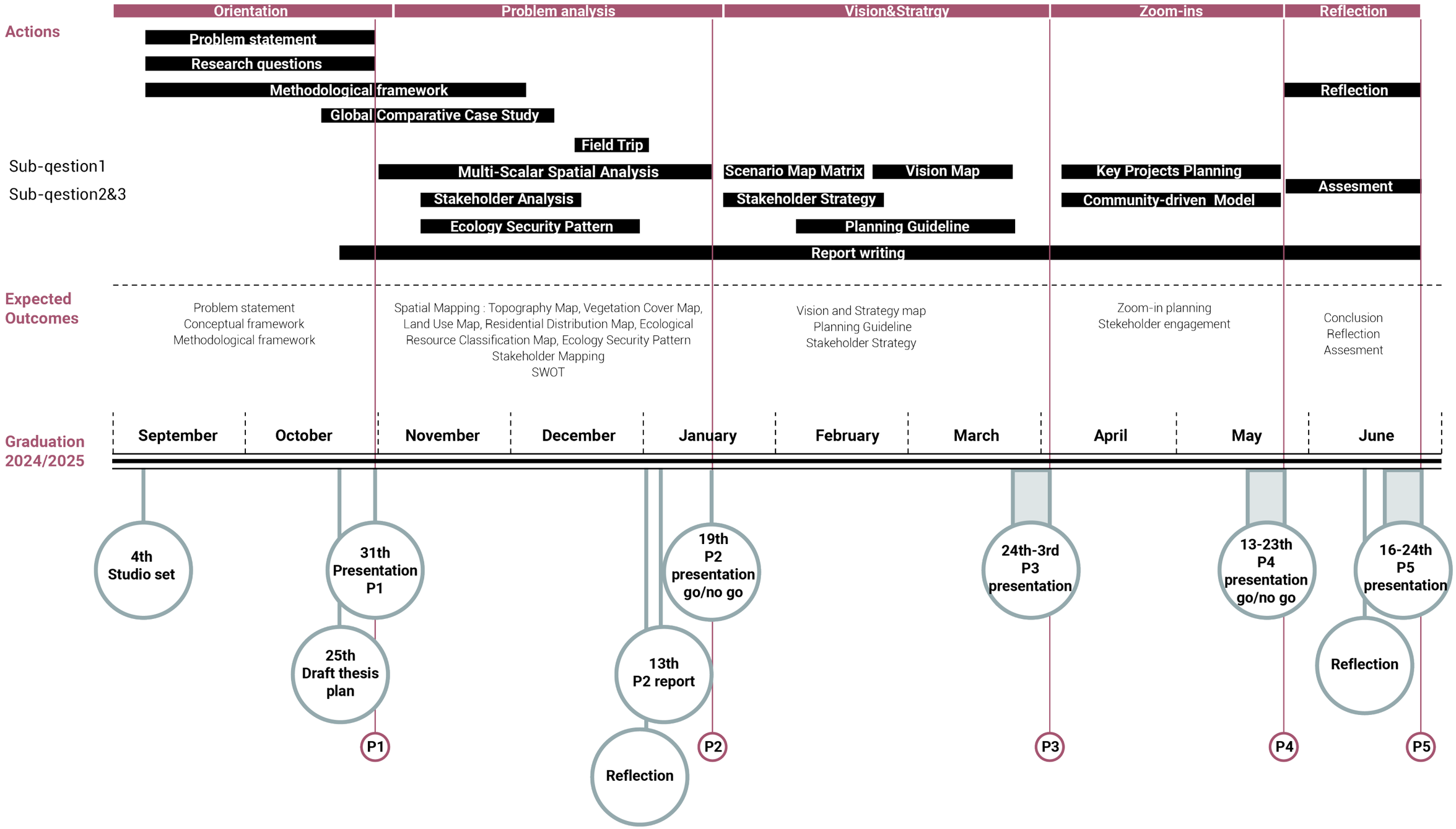

Figure 27-Research Timeline

3.4 ETHICAL CONSIDERATIONS

Who are the main actors and beneficiaries of planning?

This research involves extensive interviews with local communities and requires careful attention to ethical issues. Informed consent must be obtained from all participants, ensuring that they fully understand the purpose of the study and the potential risks. Confidentiality and anonymity must be maintained, especially when dealing with sensitive topics. Above all, this project must center on the interests of local communities to avoid exacerbating social inequalities or accelerating gentrification. Collaborating closely with residents ensures that research outcomes authentically benefit locals, preventing cultural resources from being commercialized or distanced from their origins.

Why must we leave when the community improves?

In Nantou Ancient City, there was once a barbershop run by a young man with a college diploma. Due to his education, residents often sought his advice on legal, marital, psychological, and even feng shui and health matters. Besides haircuts, he played the roles of a lawyer, matchmaker, counselor, feng shui consultant, and village doctor. His shop became a gathering place where kids waited for their parents after school, and neighbors exchanged news. Every Lunar New Year, even when others left town, he would keep his shop open and invite locals to celebrate together. This barbershop fulfilled community roles that one might expect from government initiatives. Yet, by 2020, it had turned into a modern tea shop, erasing the social ties that had developed over 1,700 years. If urban planners remove such spaces, what remains of the community's mutual support network?

In 2016, Chicago completed the highly successful 606 Trail urban renewal project. Land prices and rents in the surrounding area skyrocketed, displacing former residents. A well-known photograph from that time shows a local holding a cardboard sign that reads, "Why must we leave when the community improves?" This raises a critical question: who truly benefits from urban renewal, and can we find a more inclusive, sincere model of public participation? Is it possible to approach urban revitalization in a way that values and preserves existing residents and social structures?

Reflecting on these issues, we must consider how we can renew our cities without erasing the social fabric and community bonds that make them unique.

Figure 28 - Community Barbershop(Source:Public account He Zhisen mapping workshop, 2024)

Figure 29 - Modern Tea Shop(Source:Public account He Zhisen mapping workshop, 2024)

Figure 30 - 606 Trail(Source:Public account He Zhisen mapping workshop, 2024)

Figure 31 - "Why must we leave when the community improves?" (Source:Public account He Zhisen mapping workshop, 2024)

3.5 SCIENTIFIC AND SOCIETAL RELEVANCE

Scientific relevance

This research contributes to the theoretical development of overtourism management by integrating multi-scalar analysis, CES evaluation, and stakeholder collaborative governance. Through data-driven spatial planning and management methods, the study enriches the field of sustainable tourism. By incorporating VR/AR technologies, the research also introduces innovative tourism management approaches that minimize direct environmental impacts while enhancing the interaction between cultural and natural resources. Moreover, by comparing global karst destinations, the research deepens the understanding of karst ecosystem management and provides valuable lessons for other ecologically vulnerable areas worldwide.

Societal relevance

This research emphasizes community participation and social innovation in tourism development, ensuring that local communities actively engage in and benefit from tourism. The findings will help protect the cultural and ecological resources of Puzhehei while fostering inclusive and equitable tourism growth. The stakeholder collaborative governance framework will offer practical recommendations for policymakers to balance economic growth and resource conservation in tourism planning, ensuring the long-term sustainability of Puzhehei's development.

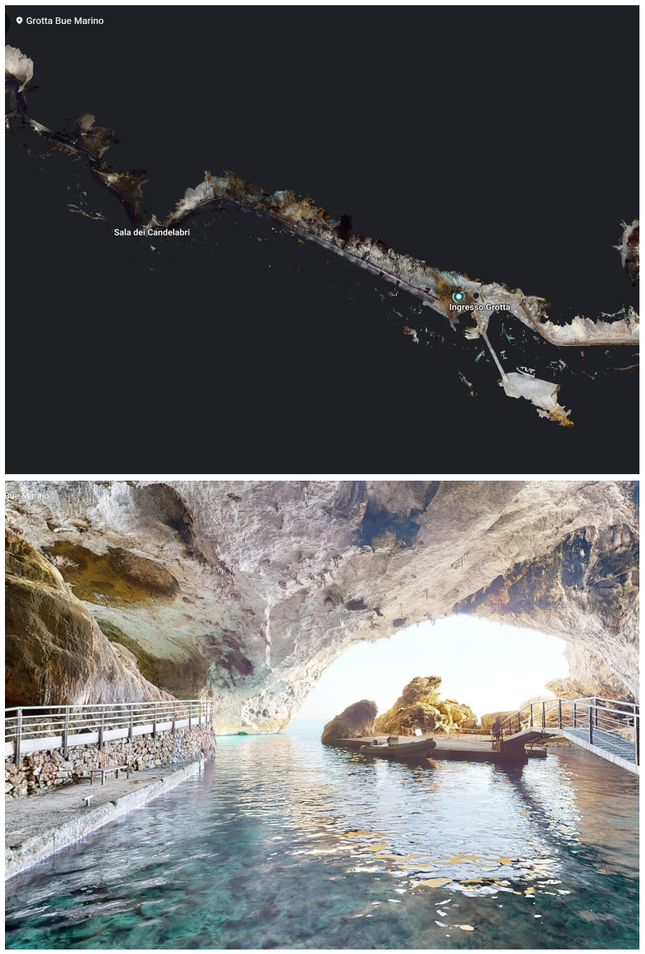

Figure 32 -VR/AR technologies

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CHAPTER 4: STUDY AREA – PUZHEHEI KARST REGION

4.1 KARST DISTRIBUTION IN CHINA

Karst Distribution in China and the Significance of the Southwest Karst Region

Karst landforms are widely distributed across China, accounting for approximately one-third of the national land area. These formations are primarily concentrated in the southern and southwestern provinces, including Yunnan, Guizhou, Guangxi, Sichuan, and Chongqing, where climatic, geological, and hydrological conditions have favored the long-term dissolution of carbonate rocks.

Among these, the Southwest Karst Region is the most representative and ecologically significant. It features some of the most typical and well-developed karst geomorphologies in the world, including:

Tower karst (fenglin), characterized by steep, isolated limestone hills;
Peak-cluster depressions (fengcong-depressions), where densely packed limestone peaks encircle closed basins;
Extensive subterranean hydrological systems, including underground rivers, sinkholes, and caves.

These landforms not only hold high scientific and aesthetic value, but also support unique ecosystems and traditional agricultural practices, such as rice-based valley farming adapted to the terrain. The region is also home to diverse ethnic communities whose cultural landscapes have co-evolved with the karst environment.

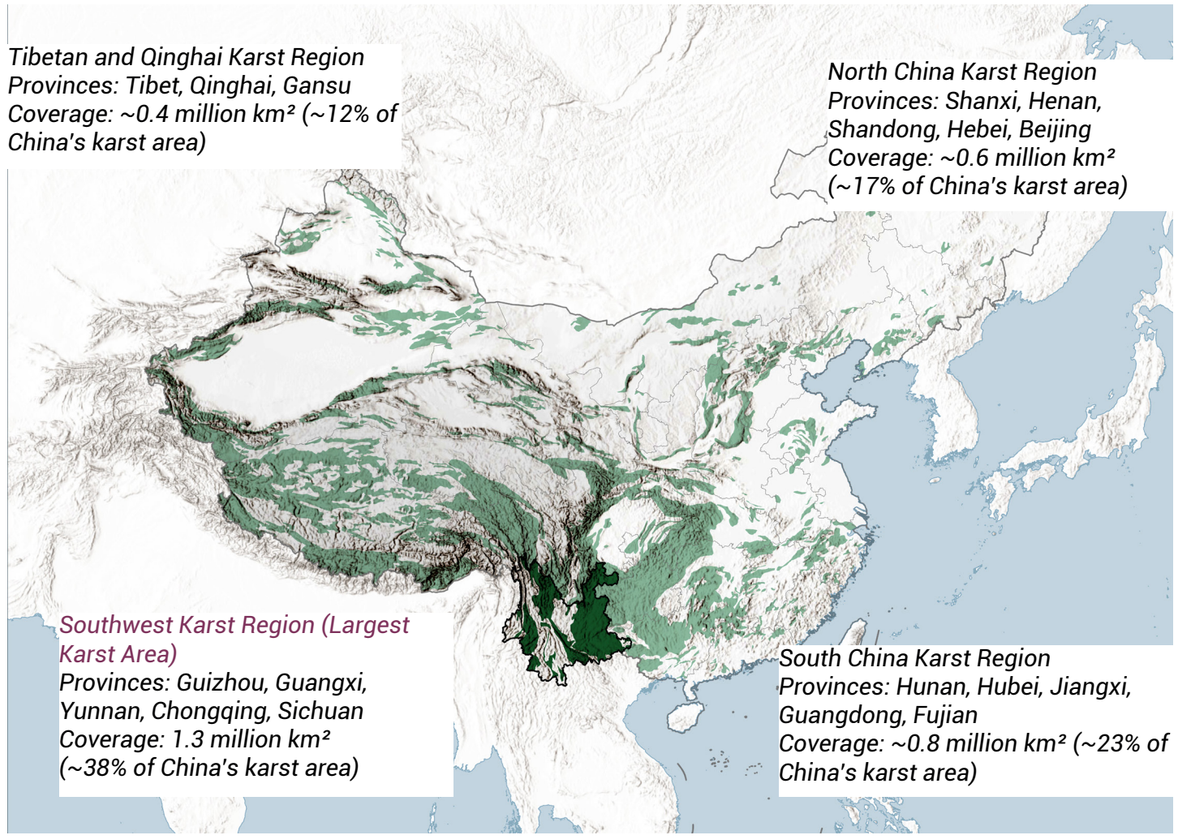


Figure 33- Karst Distribution In China

4.2 LOCATION

Waterbodies

Villages

Figure 34- Location

4.2 RATIONALE FOR LOCATION

Puzhehei serves as a representative study area for integrating ecological conservation, sustainable tourism, and cultural resilience in karst landscapes. Located in the Qiubei County of Yunnan Province, Puzhehei exemplifies the complex interplay between natural systems and human activities in a fragile karst environment. Its significance lies in the convergence of unique geomorphological features, rich biodiversity, and vibrant cultural heritage, which together provide an ideal context for exploring balanced development strategies. The key attributes of the area include:

Peak-Cluster and Cave Ecosystem
Puzhehei features classic karst geomorphological formations such as peak-cluster depressions, karst hills, and extensive cave systems, which together form a dynamic and visually striking landscape. These landforms not only shape the physical terrain but also create specialized ecological niches that support unique habitat types and microclimates.

Lake-Wetland Ecosystem
The region's lake and wetland systems, fed by subterranean karst hydrology, play a vital role in regional water regulation and are recognized as a biodiversity hotspot. The mosaic of shallow lakes, marshes, and underground rivers supports a wide variety of aquatic species and serves as a critical ecological buffer in the regional landscape.

Unique Biological Resources
The karst wetlands of Puzhehei host distinct and often endemic species, particularly freshwater fish, amphibians, and wetland flora. These include rare and vulnerable species adapted to the fluctuating hydrological conditions and nutrient-poor environments typical of karst wetlands, highlighting the area's ecological sensitivity and conservation value.

Multi-Ethnic Settlements
Puzhehei is home to a diverse range of ethnic minority communities, including the Yi, Zhuang, Miao, and Bai peoples. These communities maintain rich cultural traditions, vernacular architectures, and agricultural practices that are deeply integrated with the local karst environment. However, tourism development has led to spatial transformations, such as changes in land use, building styles, and cultural expressions—raising important questions about cultural resilience and authenticity.

Together, these characteristics make Puzhehei not only a microcosm of the challenges facing karst regions globally, but also a living laboratory for testing integrated approaches to ecological security, sustainable tourism, and cultural preservation.

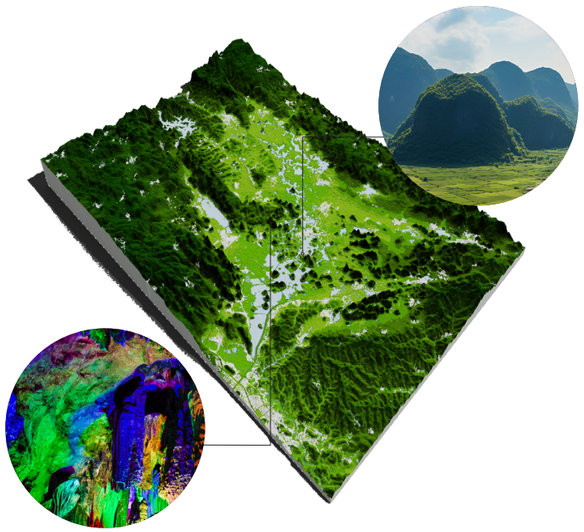


Figure 35- Peak-Cluster and Cave Ecosystem

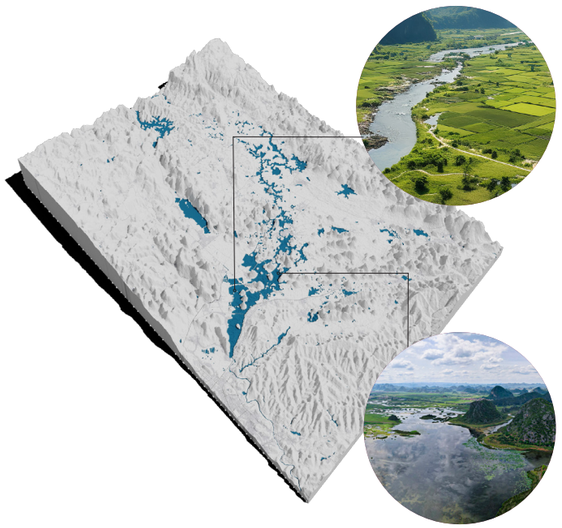


Figure 36- Lake-Wetland Ecosystem

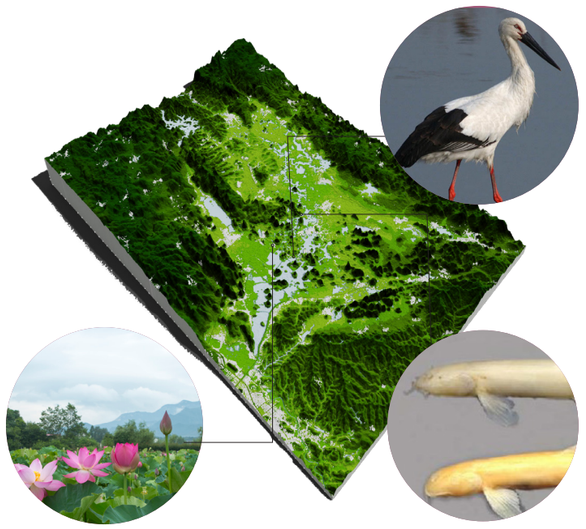


Figure 37- Unique Biological Resources

Figure 38- Multi-Ethnic Settlements

4.3 GEOGRAPHIC CONDITION

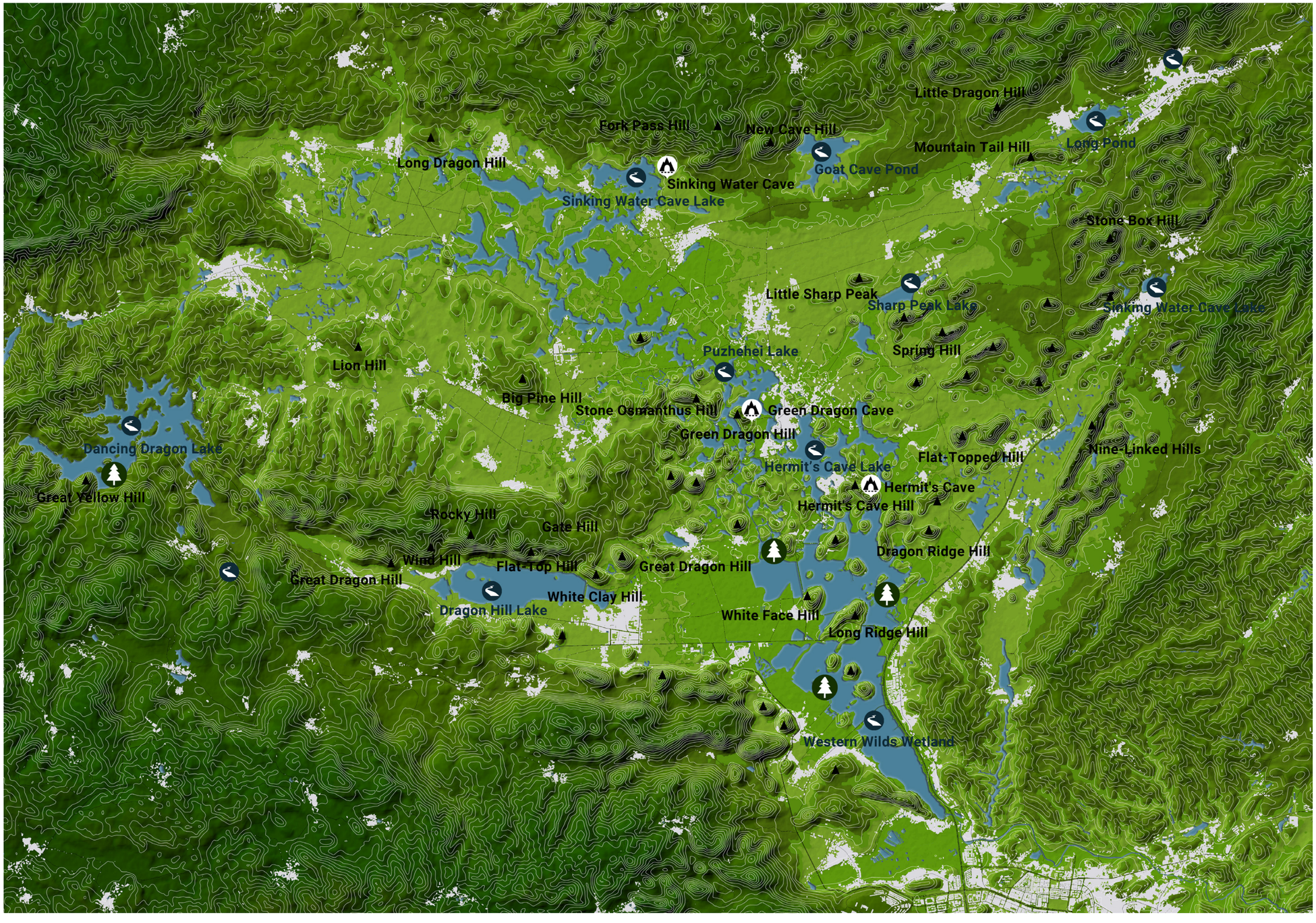


Figure 39- Topographic Features of the Puzhehei Area

Puzhehei exhibits the typical characteristics of karst landforms, including isolated peaks, peak clusters, sinkholes, and lakes that form a picturesque landscape. As shown in the figure, the area is located on a plateau with relatively high elevation, ranging from approximately 1,450 meters at the lowest point to 1,825 meters at the highest.

The overall terrain can be described as "high on all sides and low in the center." Most of the scenic area is relatively flat, except for the surrounding mountain ranges. Only Longshan forms a large-scale landmass, while the rest are distributed in the form of isolated hills and clustered peaks.

4.4 ECO-CULTURAL CHARACTERISTICS

1.Peak-Cluster and Cave Ecosystem
Unique Karst Geomorphology

2.Lake-Wetland Ecosystem
Hydrological Significance and Biodiversity Hotspot

3.Unique Biological Resources
Distinctive Karst Wetland Biodiversity

4.Multi-Ethnic Settlements
Cultural Diversity and Spatial Transformations

Figure 40- Distribution of Multi-ethnic Villages

This map illustrates the spatial distribution and ethnic composition of key villages in the Puzhehei Karst Region. It highlights the coexistence and interweaving of diverse ethnic groups such as the Yi, Zhuang, Miao, and Han. Different colors indicate different ethnic groups, while photographs showcase representative traditional clothing, and cultural features.

4.5 KEY STAKEHOLDER SECTORS

private sector includes online travel agencies, tourism companies, and local businesses that drive the region's tourism economy. Their focus is on profit and development, but this can sometimes lead to overuse of natural resources, making sustainable practices important for balance.

The **public sector** comprises local and national government bodies, such as ministries of tourism, natural resources, and environment, who manage regulations, infrastructure, and policies. Their role is to promote economic growth while protecting the environment and local cultures.

Civil society includes NGOs, environmental groups, local universities, and ethnic minorities. These groups advocate for sustainable development, environmental protection, and cultural preservation. The local ethnic communities, such as the Yi, Zhuang, and Miao, are integral in maintaining traditional practices and being involved in decision-making.

Nonhuman resources refer to Puzhehei's natural assets like rivers, lakes, karst caves, and wildlife. These resources are central to tourism and require careful protection to preserve the area's ecological balance and cultural heritage.

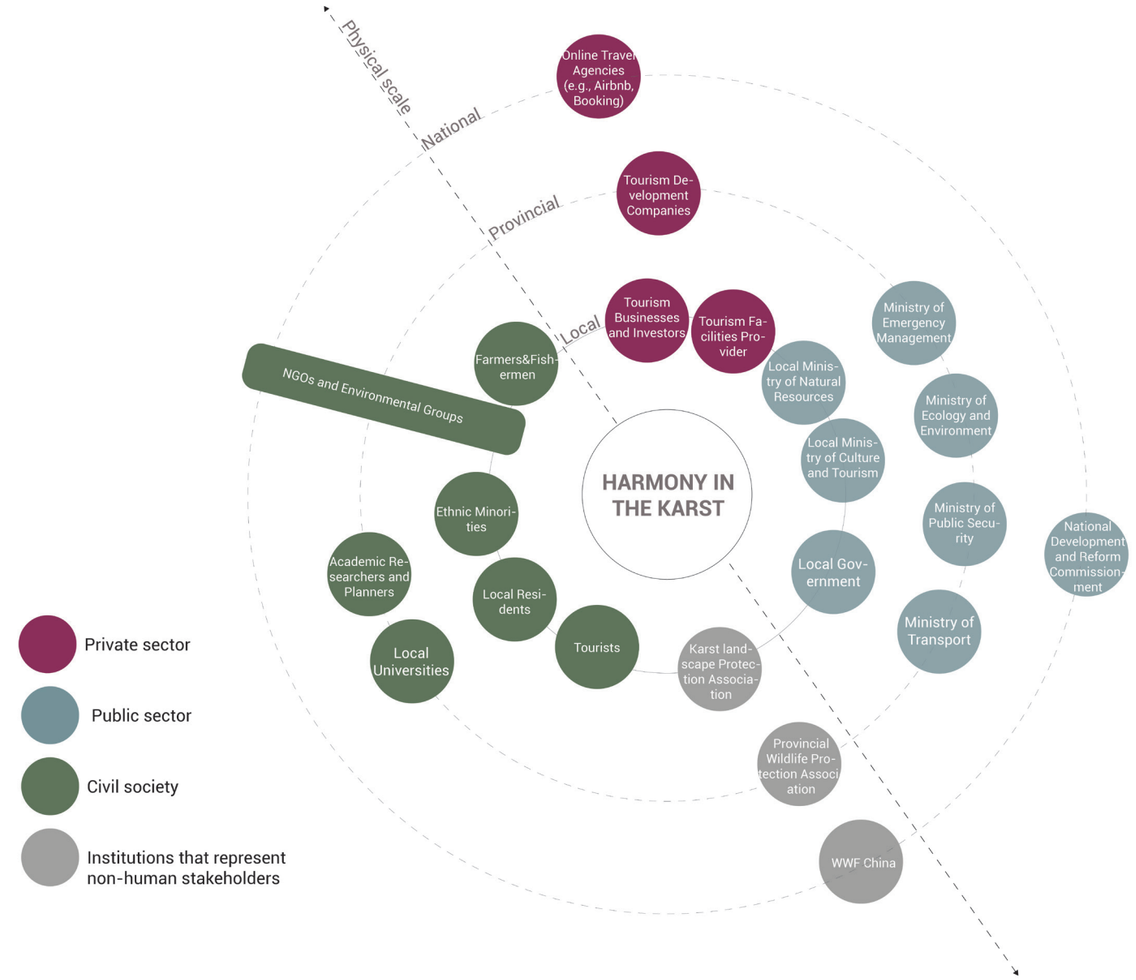


Figure 41- Key Stakeholder Sectors

4.6 STAKEHOLDER POWER & INTEREST

Many different stakeholders are connected with the karst landscape region. To identify the most influential and important actors in the development of a harmonious karst landscape, a stakeholder analysis was conducted. The actors have been identified and presented in several diagrams.

In this project, the actors are categorized as stakeholders from civil society, the public sector, the private sector, nonhuman resources, and various physical scales.

Power-Interest Grid

The power-interest grid provides insight into the role or position of each actor in the process of creating a harmonious karst landscape. Each quadrant represents a 'function' based on the actor's level of power and interest in the project.

Spectators

Actors with the least amount of power and interest are important to understand. These parties may be engaged later in the project but are not key players in achieving a harmonious karst landscape.

Interested Parties

Actors who show interest but lack power need to be kept informed. Although they are not as powerful as others, they can support the project. They should be regularly updated on the project's progress to maintain their interest.

Influencers

Actors with significant power but limited interest need to be kept satisfied to ensure their continued support.

Key Figures

Key figures are crucial to the success of the harmonious karst landscape and must collaborate to achieve this goal. Most of these parties are governmental institutions responsible for developing policies to realize the harmonious landscape system.

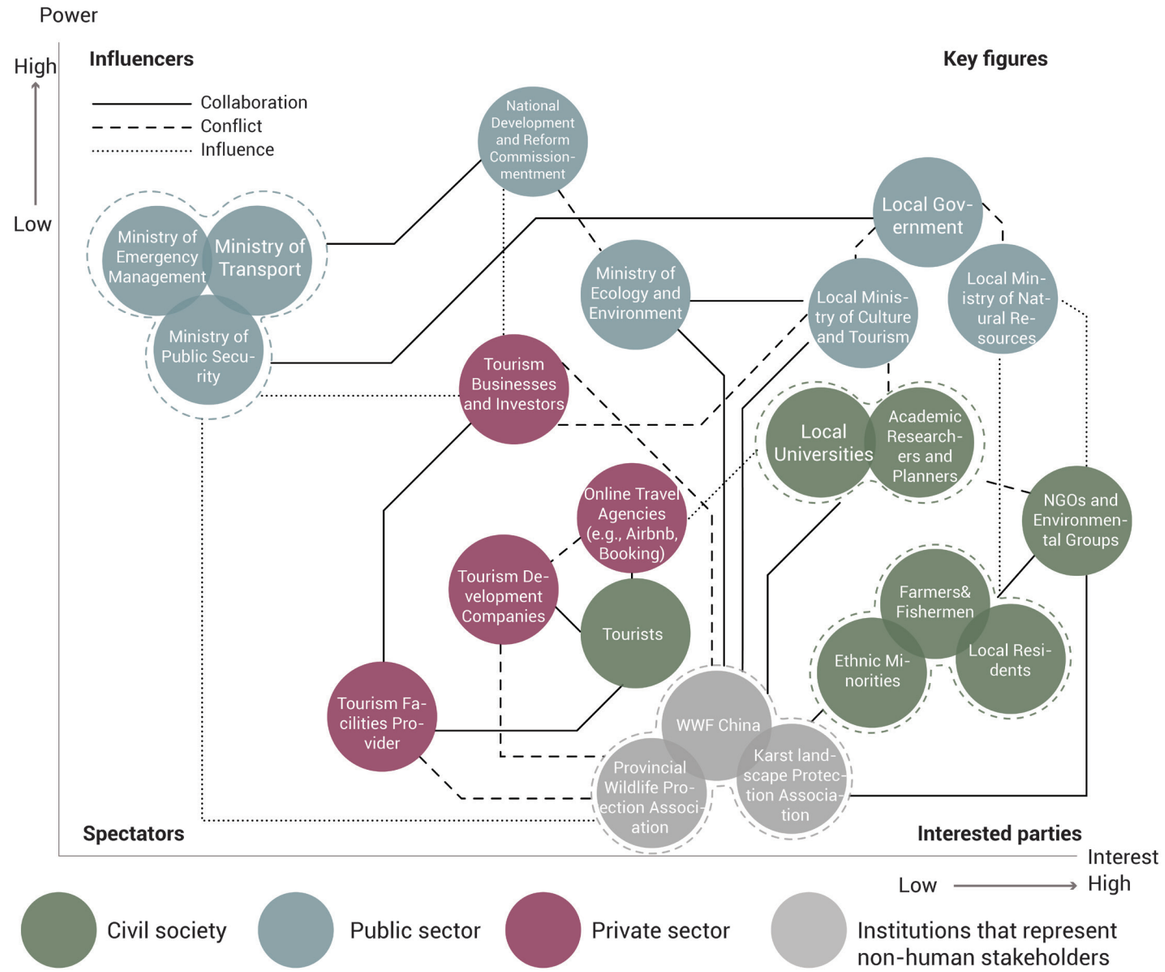


Figure 42- Stakeholder Power & Interest

4.7 SPATIAL CONFLICTS WITHIN STAKEHOLDERS

A detailed analysis of the conflicts between different stakeholders in the Puzhehei karst landscape focuses on the tensions between tourism development, local governments, natural resources, and the local population. The diagram highlights several key areas of conflict

1. Conflicts Among Government Bodies:
Local Ministry of Natural Resources vs. Local Government vs. Local Ministry of Culture and Tourism:
Value Conflicts:
The Ministry of Natural Resources prioritizes ecological protection and sustainability, while the Local Government focuses on economic growth through development. The Ministry of Culture and Tourism seeks to balance tourism promotion with commercialization, which often overlooks ecological concerns.
Management Conflicts:
The Ministry of Natural Resources enforces strict protections, creating tension with the Local Government, which favors flexible planning for quicker development approvals. The Ministry of Culture and Tourism supports rapid infrastructure development to enhance tourism.
Spatial Conflicts:
Development within protected areas often clashes with environmental preservation efforts, while the government's long-term focus on economic or cultural preservation competes with immediate ecological concerns.
2. Conflicts Between Local Residents and Government/Tourism Developers:
Local Residents vs. Government/Tourism Developers:
The government tends to prioritize tourism and economic growth, often overlooking the cultural and ecological needs of local residents. This causes frustration among residents who feel their needs are sidelined for the benefit of tourism.
3. Conflicts Involving Tourists and Various Stakeholders:
Tourists vs. Local Ministry of Natural Resources:
Overtourism damages the karst landscape, harms habitats and water systems, and threatens rare plant and animal species.
Tourists vs. Ethnic Minorities:
The influx of tourists dilutes local traditions, turning cultural sites into attractions, which can erode the authenticity of ethnic customs and lifestyles.
Tourists vs. Local Residents:
Tourism disrupts the daily lives of local residents by overlapping tourist zones with residential areas, causing tension in community spaces.
Tourists vs. Farmers/Fishermen:
Tourism facilities often encroach on land traditionally used for farming and fishing, impacting local livelihoods.
4. Conflict Areas (A, B, C, D):
These conflict areas represent zones within the landscape where different types of land use and ecological systems are in tension with tourism development:
Conflict Area A:
A sensitive area with shrubwood, coniferous forest, and mingled forest that faces pressure from tourism-related activities.
Conflict Area B:
An area with economic forests that is a major tourist destination, leading to ecological stress.
Conflict Area C:
A region with karst caves, and traditional villages, where tourism and local customs clash.
Conflict Area D:
An area of paddy fields, farmlands, and traditional villages where tourism developments threaten the local agricultural economy.

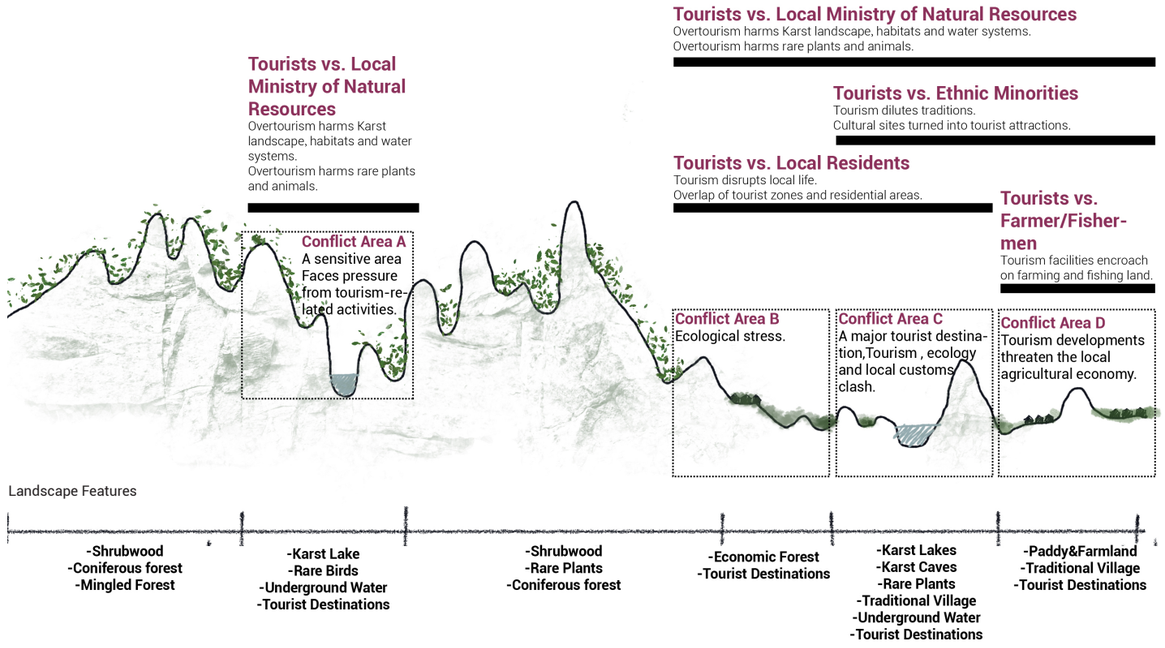


Figure 43- Spatial Conflicts within Stakeholders

CHAPTER 5: IMPACTS OF TOURISM DEVELOPMENT

5.1 PHYSICAL AND ECOLOGICAL IMPACTS

Transformation of Puzhehei: From Fishing Villages to National Attraction
The timeline illustrates the historical evolution of Puzhehei from a cluster of traditional fishing villages into a nationally recognized tourist destination, highlighting key milestones in tourism development and ecological designation.

1985: Puzhehei was still a cluster of small, largely self-sufficient fishing villages with minimal external contact. The natural karst wetlands and rural cultural landscapes remained largely untouched by large-scale development.

1993: Marked the beginning of tourism development, as the scenic value of the karst landscape began to attract attention. Basic tourism infrastructure and promotional efforts were initiated.

2004: The area was designated as a National Scenic and Historic Area, signaling formal governmental recognition of its aesthetic, ecological, and cultural value. This milestone initiated stronger regulatory oversight and tourism-oriented planning.

2011: Puzhehei was selected as a pilot National Wetland Park, reflecting its ecological importance—particularly its wetland biodiversity and karst hydrology. This status brought ecological protection to the forefront of planning agendas.

2020: The site was rated as an AAAAA National Tourist Attraction, the highest classification for tourism destinations in China. This reflects both its national-level branding and its maturity in tourism services, but also introduces increased tourism pressure on local ecosystems and communities.

From Fishing Villages to National Attraction

1985
A cluster of small fishing villages before tourism began

1990
Beginning of tourism development

2004
Designated as a National Scenic and Historic Area

2011
Selected as a pilot National Wetland Park

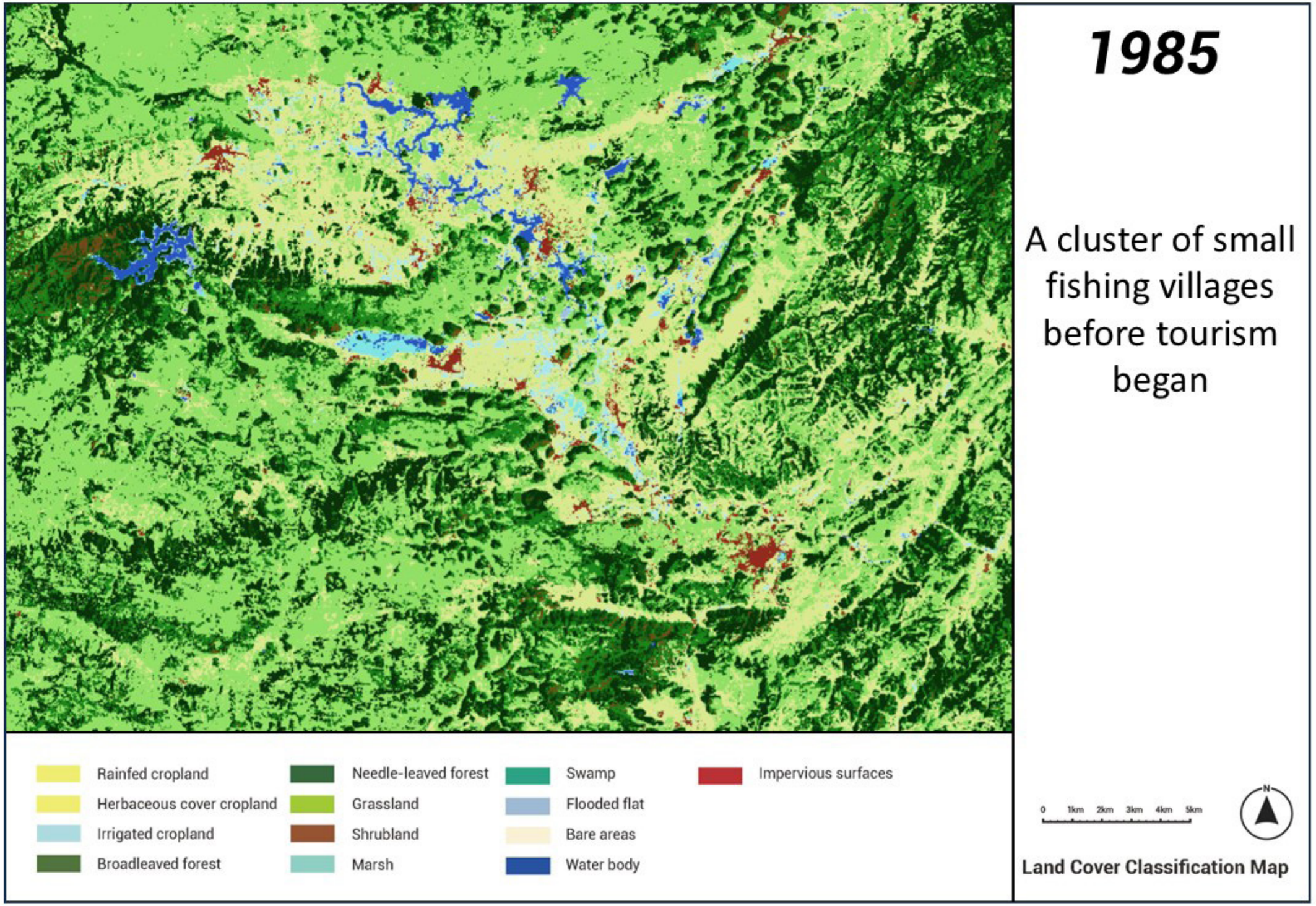
2020
Rated as a AAAAA National Tourist Attraction

2050
What if ?

Figure 44- Development History

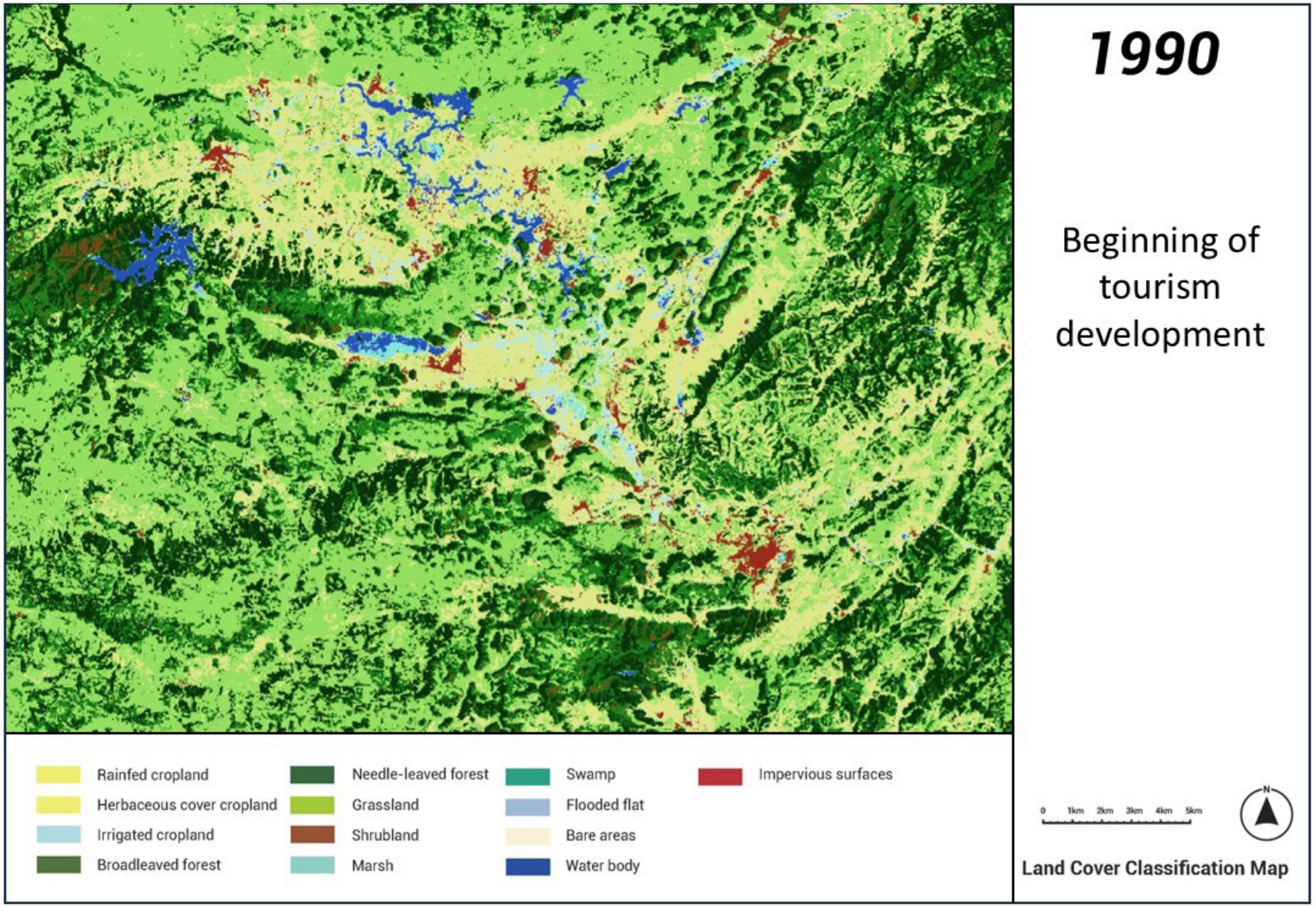
5.1.1 SPATIAL CHANGES IN LANDCOVER

Figure 45- Land Cover Classifcation Map in 1985



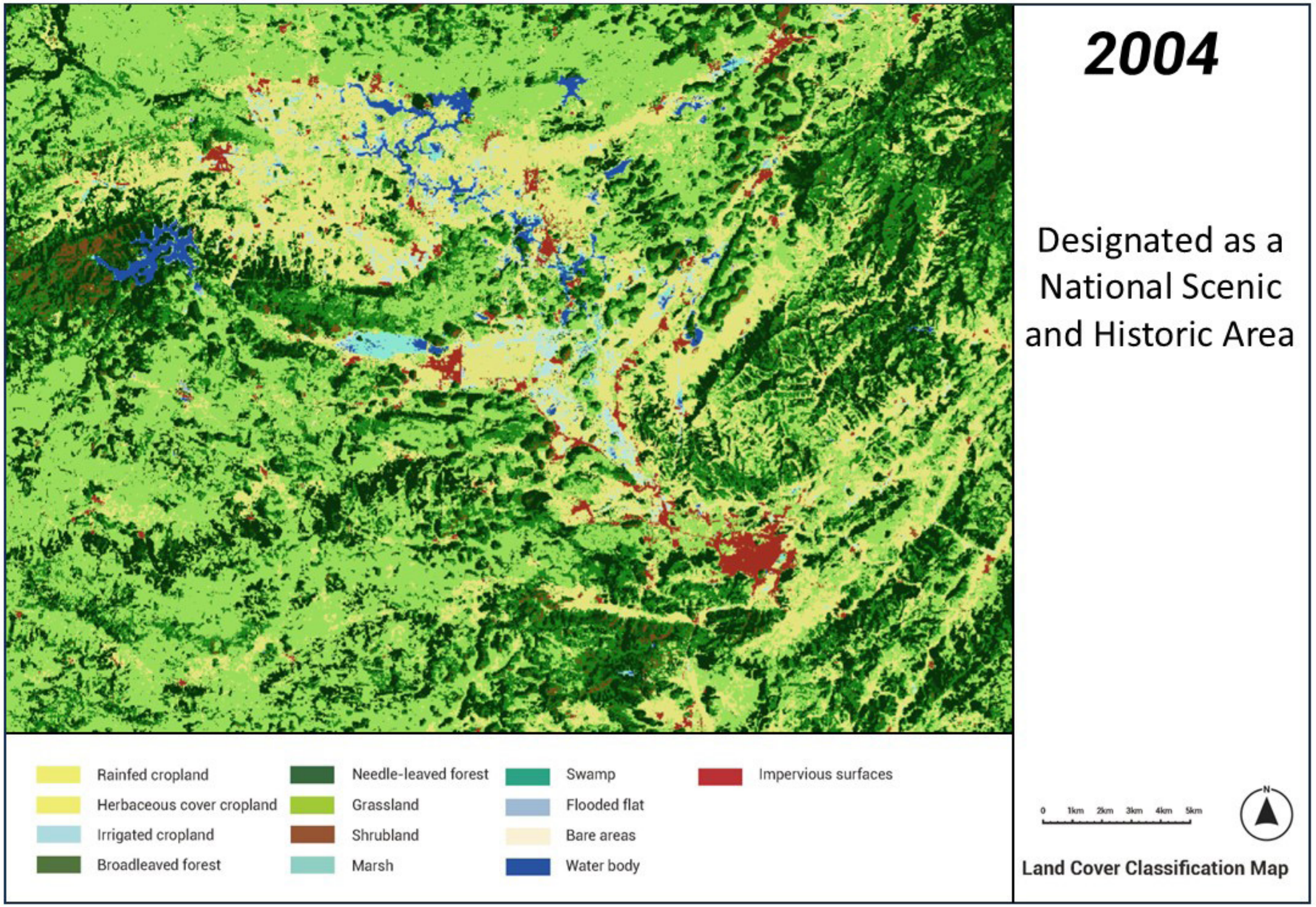
5.1.1 SPATIAL CHANGES IN LANDCOVER

Figure 46- Land Cover Classifcation Map in 1990



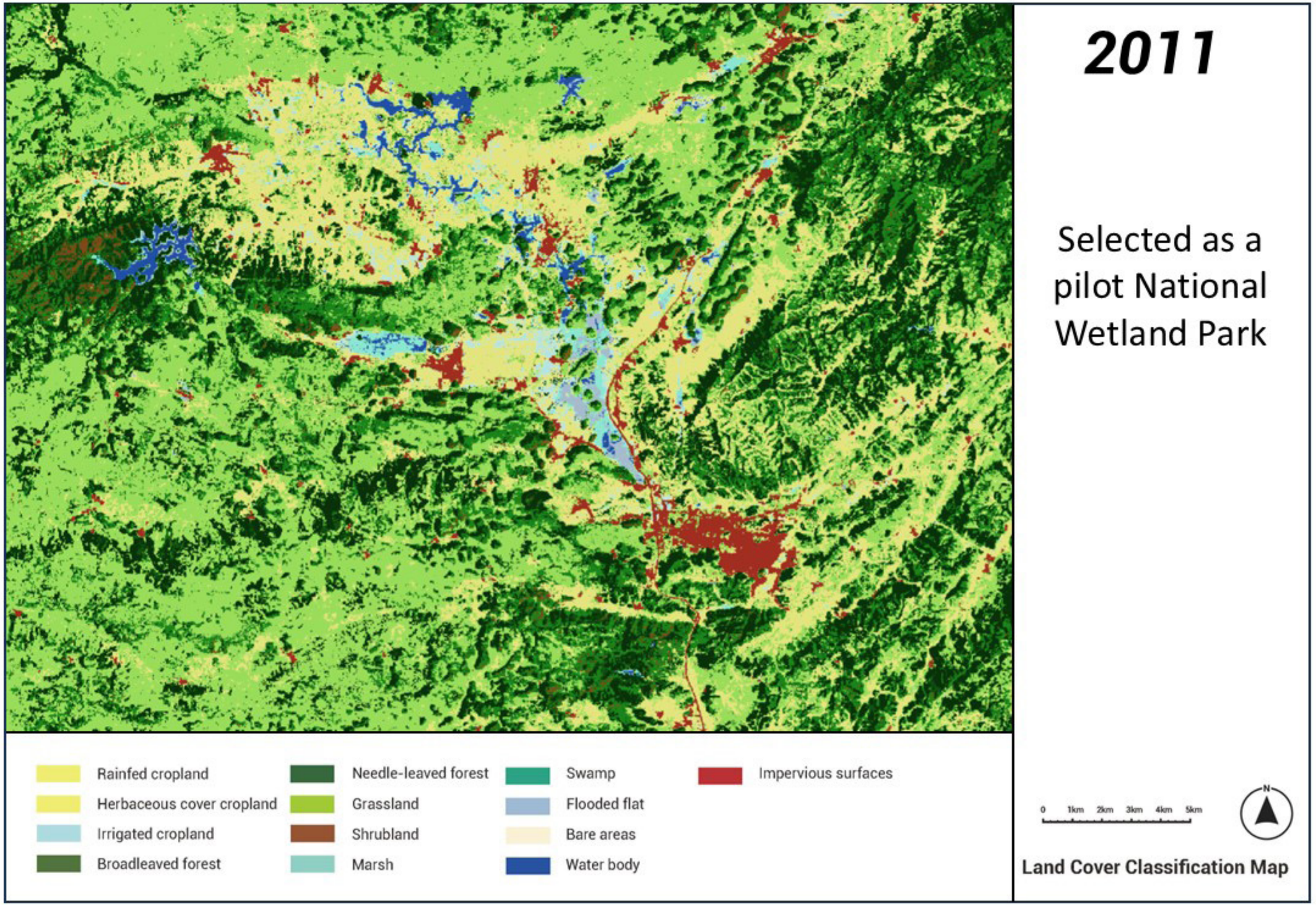
5.1.1 SPATIAL CHANGES IN LANDCOVER

Figure 47- Land Cover Classifcation Map in 2004



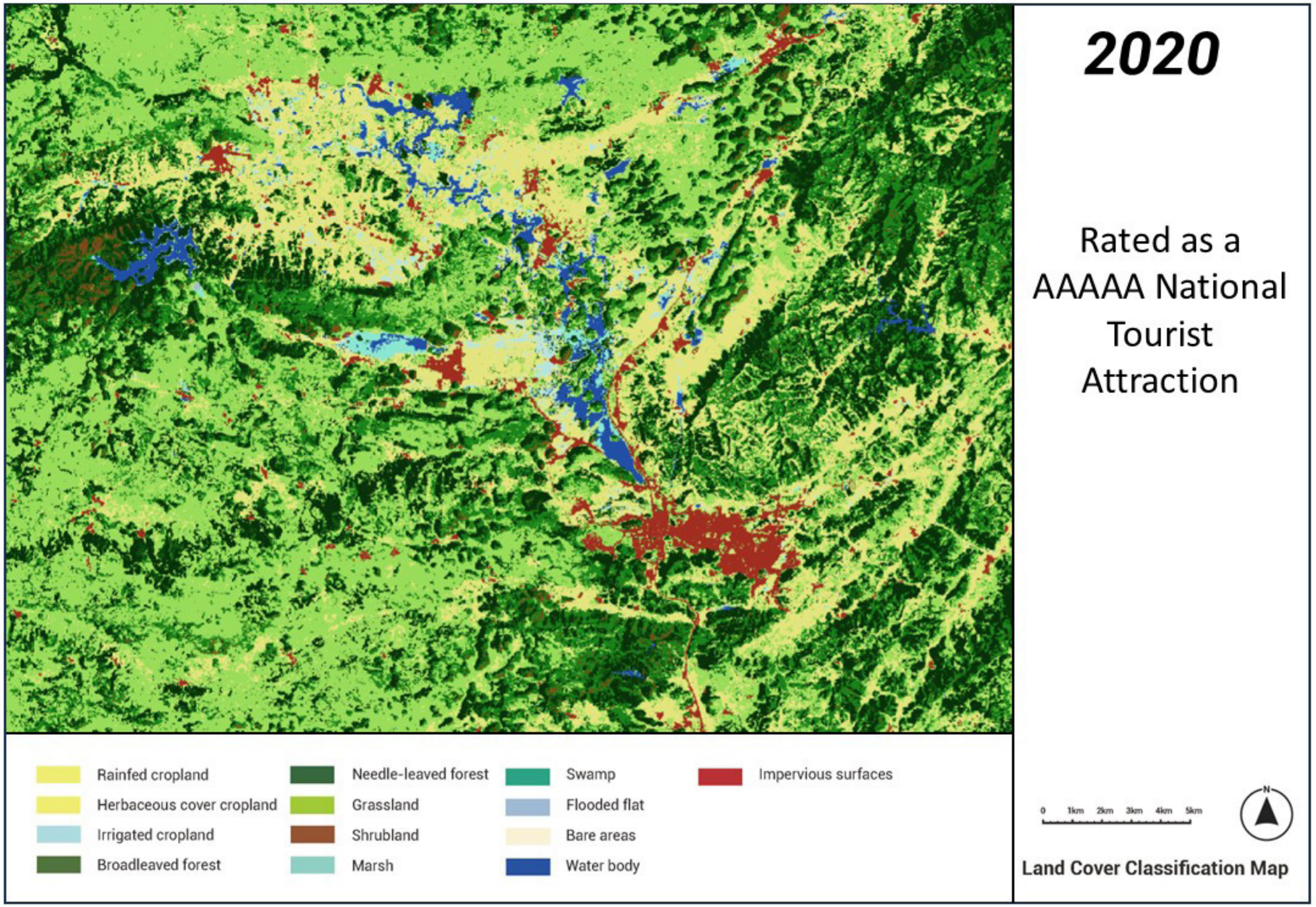
5.1.1 SPATIAL CHANGES IN LANDCOVER

Figure 48- Land Cover Classifcation Map in 2011



5.1.1 SPATIAL CHANGES IN LANDCOVER

Figure 49- Land Cover Classifcation Map in 2020



5.1.2 SPATIAL CHANGES IN FOREST AREAS (1985VS2022)

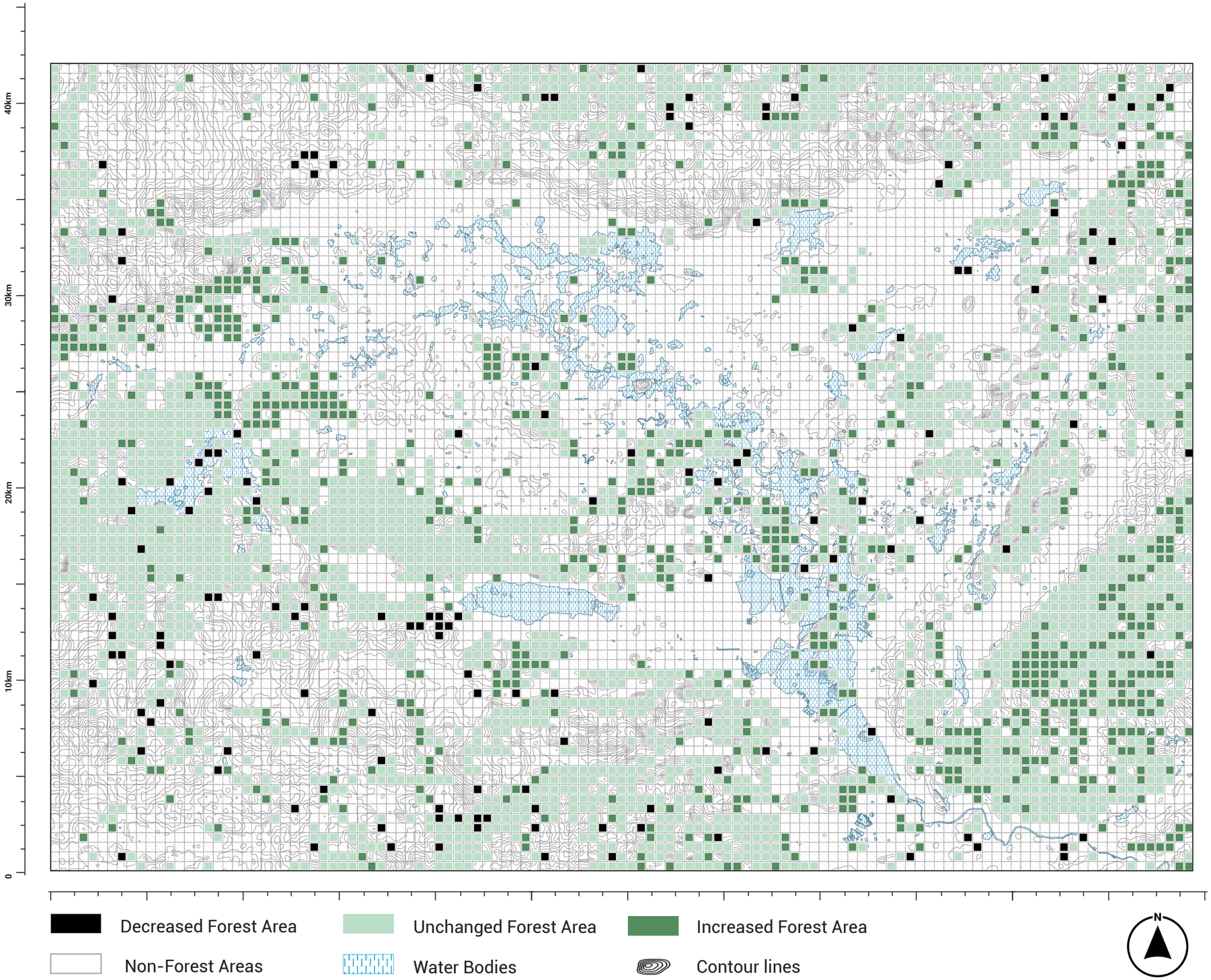


Figure 50- Forest Area Changes (1985VS2022)

1985: Forests primarily existed in mountainous or inaccessible zones, serving ecological functions but not prioritized in local development.

1990s–2000s: Moderate deforestation occurred due to expanding cropland and village growth. However, tourism promotion also began to value scenic forest landscapes.

2010s–2022: With the implementation of reforestation programs (e.g., "Grain for Green") and ecological zoning, forest coverage gradually increased, especially in non-arable slopes and buffer areas of scenic zones.

Trend: Net increase in forest area, particularly in higher elevation and conservation-designated regions.

5.1.3 SPATIAL CHANGES IN CROPLAND AREAS (1985VS2022)

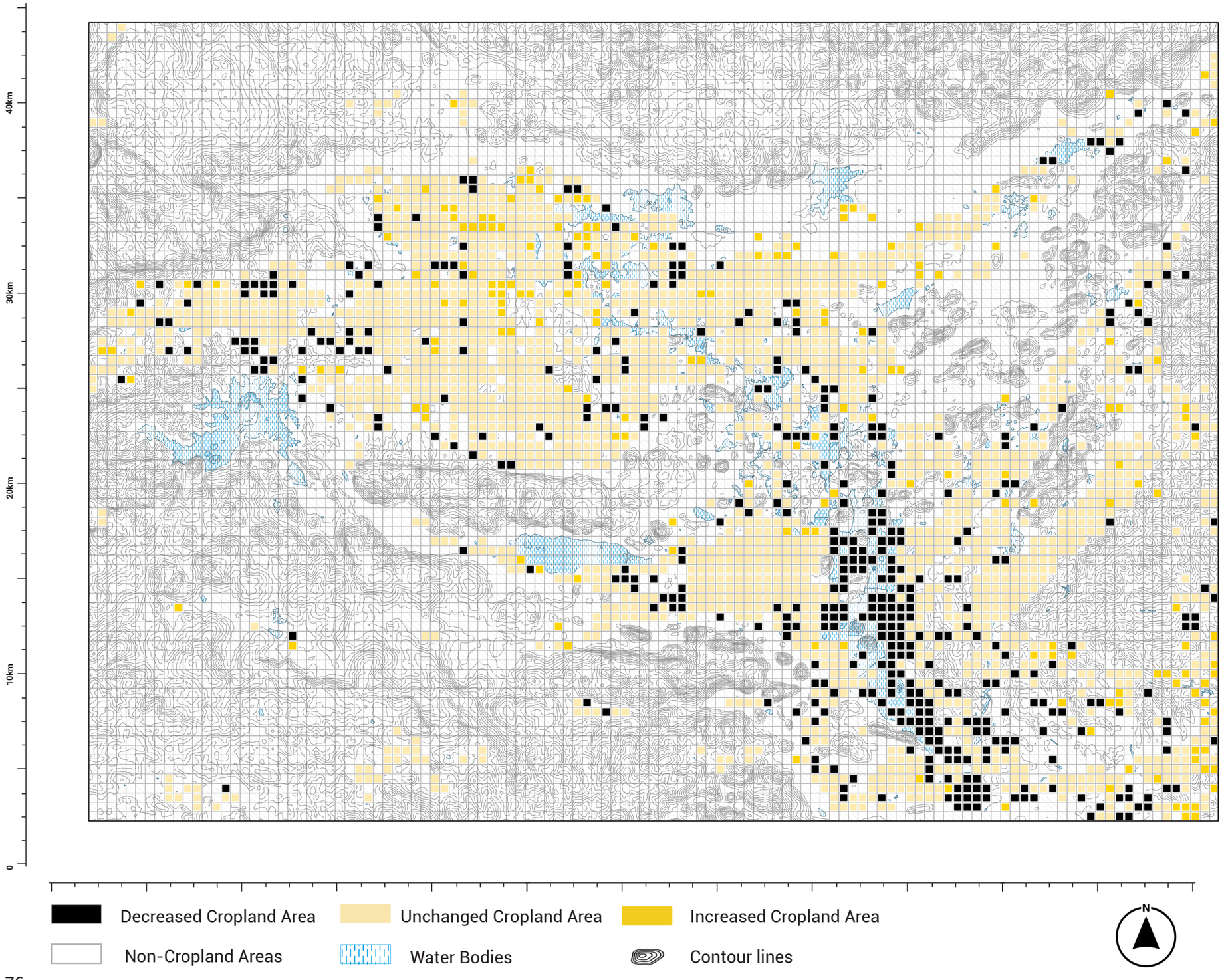


Figure 51 - Cropland Area Changes (1985VS2022)

1985: Cropland dominated the valleys and basins, centered around rice-based agriculture, which is deeply tied to local ethnic traditions.

1990s–2010s: Agricultural land began to decline in core scenic areas due to land conversion for tourism infrastructure, homestays, and roads.

2022: Some cropland remains in peripheral areas or is converted to eco-agriculture (e.g., tourism farms), but overall cropland area has decreased, especially near lakes and transport corridors.

Trend: Decrease in cropland area, with fragmented and multifunctional land use replacing traditional continuous fields.

5.1.4 SPATIAL CHANGES IN WATERBODY AREAS (1985VS2022)

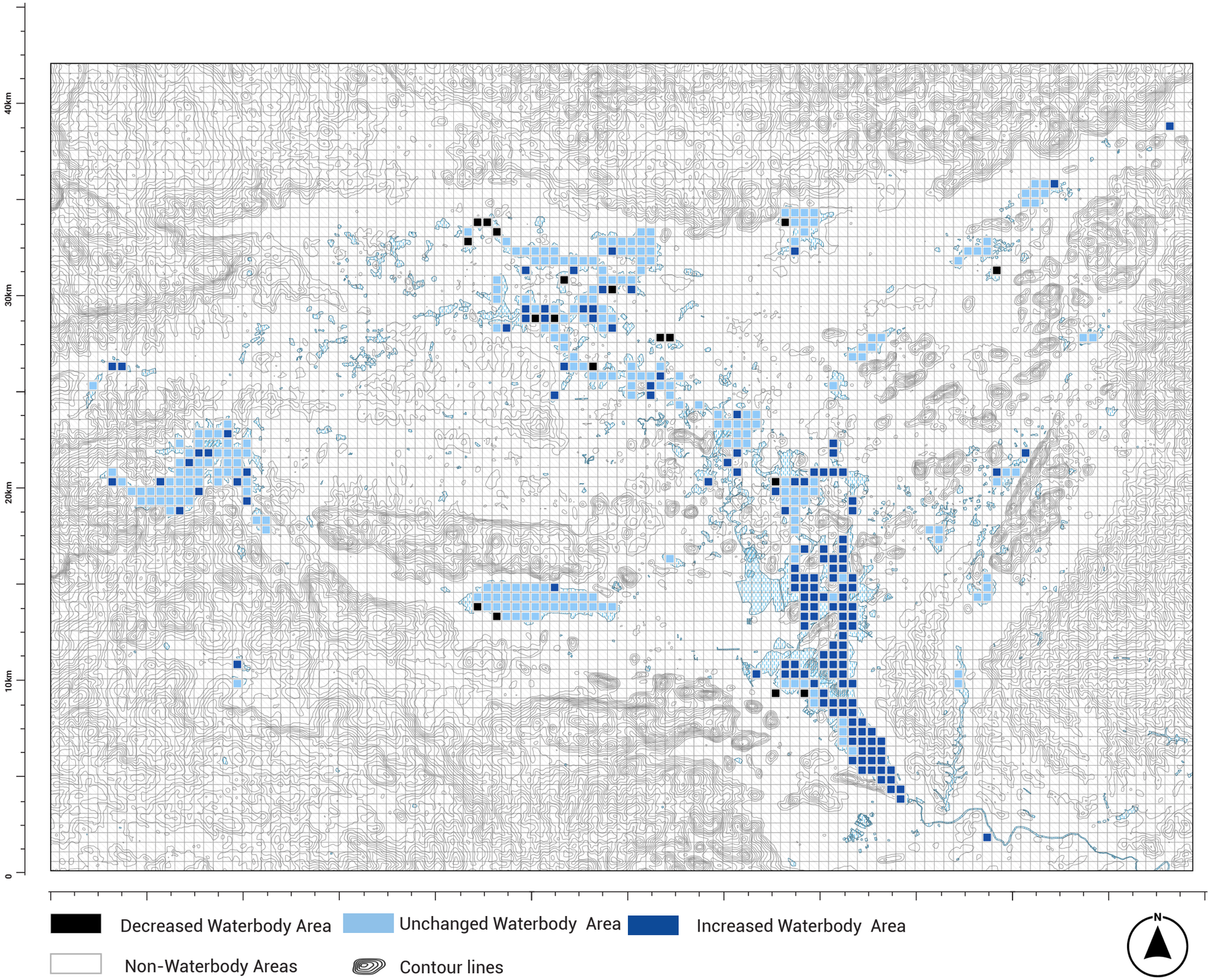


Figure 52- Waterbody Area Changes (1985VS2022)

1985: Natural lakes and wetlands formed an interconnected hydrological network, largely unaffected and seasonally dynamic.

1993–2010s: Water bodies were increasingly utilized for recreational purposes—boating, photography, performances—which prompted partial modification of natural edges.

2010s–2022: Designation as a wetland park led to protection and even wetland restoration, although water quality has faced challenges due to tourism and nearby land use changes.

Trend: Fluctuating but relatively stable; some expansion through wetland recovery, but ecological integrity faces pressure.

5.1.5 SPATIAL CHANGES IN BUILT-UP AREAS (1985VS2022)

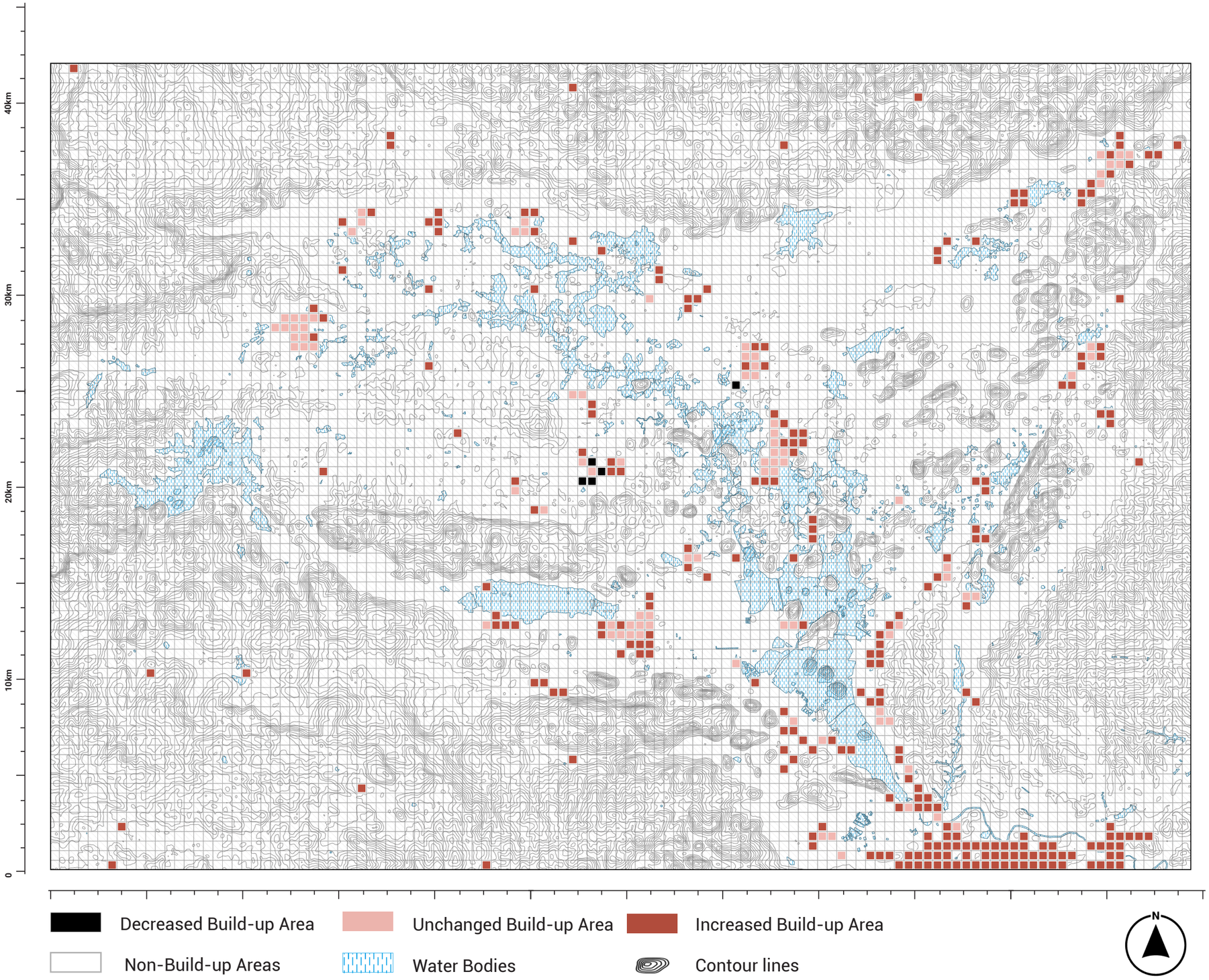


Figure 53- Build-up Area Changes (1985VS2022)

1985: Built-up areas were limited to scattered fishing villages with basic rural infrastructure.

1993–2011: Significant growth of built-up area, including guesthouses, roads, tourism facilities, and commercial spaces, particularly around core scenic nodes.

2022: Urban-style development expanded, leading to dense clusters of built-up land within and near wetland and karst areas, raising concerns about landscape fragmentation and visual impact.

Trend: Rapid increase in built-up area, now a major factor influencing ecological security and cultural landscape transformation.

Puzhehei's land use change reflects a classic pattern in karst tourism zones: cropland and open land decrease, built-up and forest land increase, and water systems are preserved but under stress. These transitions reveal the tensions between ecological protection, tourism economy, and cultural continuity, providing a crucial foundation for future spatial planning and zoning based on ecological security patterns.

5.2 STAKEHOLDER PERCEPTIONS

Guiding Question:
How does tourism impact Puzhehei's karst landscape and local culture, and what should be done to balance development and preservation?

Residents (Han and Ethnic Groups)——Cultural Identity

"Tourism brings income, but it is changing our way of life. Traditional villages are being commercialized, and some customs are becoming performances for tourists rather than real traditions. We need respectful tourism that benefits locals while preserving our heritage."

Tourists——Experience & Convenience

"Puzhehei is beautiful, and we want to experience its unique landscapes and ethnic culture. However, some areas feel overcrowded, and excessive development reduces authenticity. More sustainable tourism options, such as eco-tours and cultural immersion programs, would improve our experience."

Local Government——Economic Growth

"Tourism is essential for local economic development, but we recognize the risks of over-commercialization and environmental degradation. We aim to promote sustainable tourism by investing in eco-friendly infrastructure, heritage conservation projects, and better visitor management strategies."

NGOs and Grassroots Organizations——Conservation

"The karst landscape is fragile and cannot withstand uncontrolled tourism. Increased foot traffic, infrastructure expansion, and pollution threaten caves, wetlands, and biodiversity. We need stricter regulations, eco-tourism initiatives, and cultural education programs to protect Puzhehei's natural and cultural assets."

Research Institutions——Sustainable Planning

"Scientific research shows that Puzhehei's karst landscape is highly sensitive to human activity. Unregulated tourism accelerates soil erosion, water pollution, and biodiversity loss. More interdisciplinary collaboration is needed to develop long-term strategies for sustainable tourism, cultural preservation, and ecological resilience."

5.2 STAKEHOLDER PERCEPTIONS

Interview 1

Artisan

Perspective: Artisans highlighted challenges in passing down traditional crafts due to low interest among younger generations, making skill inheritance difficult. However, they believe tourism can create new markets and opportunities for cultural transmission.

Support: “We use cotton and hemp threads to create hand-woven fabrics using simple tools and traditional techniques. While visitors show great interest, the niche market deters young people from pursuing this craft.” Artisans suggested adding weaving experiences and selling handmade fabrics in tourism projects to attract attention and generate economic benefits.

Interview 2

Tourists

Perspective: Tourists are impressed by the economic transformation through homestay operations and cultural experiences but believe that tourism reception capacity, particularly in infrastructure and cultural promotion, needs improvement.

Support: “The ethnic charm of Xianrendong Village is remarkable, but there is a lack of off-season activities, and some homestays require better maintenance and cleanliness.” Tourists proposed developing more off-season tourism projects, such as craft experiences and traditional festival activities, to diversify offerings.

Interview 3

Village Head

Perspective: The village head emphasized controlling village aesthetics and cultural preservation. Buildings must follow strict planning guidelines, and unauthorized renovations are prohibited to maintain ethnic characteristics. He also stressed that cultural preservation is the cornerstone of tourism development.

Support: “In village planning, we collaborated with the Kunming Paddyfield Design Team to integrate ecology and culture. However, government support remains mostly policy-based, with scarce resources, forcing villagers to self-fund aesthetic improvements.” He also noted, “By preserving Yi festivals like the Flower Picking Festival and Yi weddings, we attract more tourists while enhancing villagers' cultural identity.”

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CHAPTER 6: STAKEHOLDER VOICES AND INSIGHTS

6.1 VIRTUAL ROUNDTABLE

In china, we like to sit around a big round table for dinner. Weplace our dishes on a big spinning disk in the center of the tableso that we can all reach the food, Everyone, whether or not hehas anything to say,and every discussion, whether it isimportant or not, has an equal place around the table.

We hope to have such a dinner and to invite to our table those who don't usually come together in real life to share theirexperiences, opinions, and observations. Their concerns arereally also our concerns.
——Yansong Bai, MAD

Figure 54-Virtual Roundtable

6.2 ROUNDTABLE1: HUMAN-NATURE / ENVIRONMENT

Guiding Question:
How do human activities (e.g., tourism, agriculture, urban expansion) impact the environment in Puzhehei?

Residents (Han and Ethnic Groups)——Livelihoods

“Tourism and agriculture provide us with income, but we see increasing environmental damage—waste from tourists, overcrowding in peak seasons, and water pollution affecting fishing and farming. We need solutions that allow us to earn a living without harming the land and water that sustain us.”

Local Government ——Development

“Economic growth is essential, and tourism is a major driver of local prosperity. However, rapid urban expansion, increased tourism facilities, and excessive resource extraction put pressure on the ecosystem. We must implement stricter land use planning, green infrastructure, and eco-tourism policies to ensure long-term sustainability.”

NGOs and Grassroots Organizations——Sustainability

“Puzhehei's environment is under stress due to uncontrolled tourism, land conversion, and inadequate waste management. If these issues continue, the very resources attracting visitors will be lost. We need stricter environmental policies, community participation in conservation, and education on sustainable tourism practices.”

Non-Human (Nature's Perspective)——Balance

“I have provided clean water, fertile land, and beautiful landscapes for centuries, but human activities are disrupting my balance. Overcrowding is eroding my karst formations, pollution is degrading my lakes, and habitat destruction is displacing my wildlife. If humans do not take responsibility, my ecosystems may not recover.”

6.2 ROUNDTABLE1: HUMAN-NATURE / ENVIRONMENT

Interview1

Local Resident 1

Perspective: Ecological changes have impacted traditional lifestyles. For example, villages transitioning from agriculture and animal husbandry to tourism economies have reduced traditional farming practices. While villagers recognize that excessive tourism development may harm the environment, they worry about losing income sources.

Support: Villagers noted, “The lotus lake and wetlands face pollution due to the surge in tourists, and the cleanliness of the village environment has declined, requiring urgent protection.” They also suggested promoting local culture and festivals to engage tourists in environmental protection initiatives.

Local Resident 2

Perspective: Ecological changes have impacted traditional lifestyles. For example, villages transitioning from agriculture and animal husbandry to tourism economies have reduced traditional farming practices. While villagers recognize that excessive tourism development may harm the environment, they worry about losing income sources.

Support: Villagers noted, “The lotus lake and wetlands face pollution due to the surge in tourists, and the cleanliness of the village environment has declined, requiring urgent protection.” They also suggested promoting local culture and festivals to engage tourists in environmental protection initiatives.

Local Resident 3 (Homestay Operator)

Perspective: Residents emphasize the close relationship between natural environments and tourism income while pointing out insufficient ecological protection as a threat to long-term development. For example, lakes and wetlands suffer from garbage accumulation and declining water quality during peak tourist seasons.

Support:Resident stated, “During peak seasons, there are too many tourists at the lotus lake, and garbage is everywhere, making the water less clear than before.” He proposed creating environmental patrol teams involving villagers and tourists to maintain cleanliness.

Interview 2

Tourists

Perspective: Tourists praise Puzhehei’s natural environment but highlight the conflict between ecological conservation and tourism development. Wetlands and lakes are key attractions but are degraded by excessive visitor traffic during peak seasons.

Support: Tourists mentioned, “The natural scenery of the lakes and wetlands is stunning, but some areas lack proper waste management and visitor guidelines.” They suggested limiting daily visitor numbers during peak seasons and increasing wetland protection awareness campaigns.

6.3 ROUNDTABLE2: ENGAGEMENT

Guiding Question:
How can different stakeholders actively participate in shaping the future of Puzhehei to ensure sustainable development and environmental protection?

Residents (Han and Ethnic Groups)——Community Involvement

“We want to be heard in decision-making processes. Local traditions and ecological knowledge should be valued when planning tourism and conservation efforts. Community-led initiatives and economic opportunities that respect our way of life are essential.”

Local Government——Policy & Implementation

“We are responsible for balancing development with sustainability. Policies that encourage eco-tourism, regulate land use, and protect cultural heritage need enforcement. Collaboration with researchers and community groups will help create practical solutions.”

NGOs and Grassroots Organizations——Advocacy & Education

“Public awareness is key to sustainable development. We engage with locals and tourists through workshops, conservation projects, and policy advocacy. Stronger partnerships between civil society, businesses, and government are needed to drive real change.”

Tourists——Responsible Tourism

“As visitors, we should respect local customs and minimize our environmental footprint. Clearer eco-friendly guidelines, authentic cultural experiences, and sustainable travel options would help us engage in a more meaningful and responsible way.”

Research Institutions——Data-Driven Solutions

“Scientific research can guide better policies. Long-term monitoring of environmental changes, social impact assessments, and sustainable planning models can help Puzhehei grow without harming its natural and cultural assets.”

6.3 ROUNDTABLE2: ENGAGEMENT

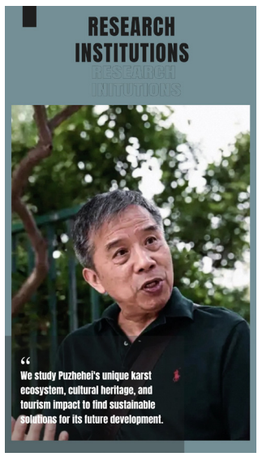
Interview 1

NGO Representative

Perspective: The organization promotes community economic development and cultural preservation by integrating agriculture and tourism. For instance, they established a seed bank while promoting natural education and cultural storytelling.

Support: "Under the Yunnan model, we work with small-scale farmers to promote heirloom seeds, combining traditional cuisine and local culture education to drive economic development." They also collaborate with women's groups, offering homestay training and handicraft courses to boost income and social participation.

Interview 2



Professor on Public Participation

Perspective: The professor highlighted institutional and practical challenges in achieving public participation in China. For example, collective land ownership and limited freedom of expression lead residents to prioritize short-term gains over long-term public values.

Support: "The significance of public participation lies in building consensus through diverse demands, such as the 'Market Art Gallery' project, where vendors transitioned from distrust to active involvement, resulting in artistic space transformation and commercial value enhancement." He criticized rapid "empowerment" projects, stating, "Such projects often impose external perspectives, neglecting local residents' agency and exacerbating cultural alienation."

Interview 3

Resident —Women's Cooperative Member

Perspective: Residents believe women play a crucial role in community development and tourism reception but need further skill development and social participation.

Support: "We became homestay managers through training, but some women are still hesitant to host tourists and lack confidence in expressing themselves." She suggested offering more vocational training and language courses to empower women in tourism activities.

Interview 4

Tourists

Perspective: Tourists believe local participation in tourism development should be enhanced, with a focus on cultural activity involvement and public space management.
Support: "The homestay I stayed at offered good service, but villagers were less engaged in cultural interpretation and interaction. I hope villages can provide more guided tours to help tourists understand local culture."

Perspective: Tourists see public participation as key to sustainable tourism development in Puzhehei. Strengthening interaction between villagers and tourists through cultural activities and co-creation projects can bridge the gap.
Support: "The village has fascinating folk culture, but there is little interaction between tourists and villagers. Co-creation activities, such as crafting or participating in traditional festivals, can enhance this connection."

6.4 ROUNDTABLE3: NON-HUMAN

Guiding Question:
How do human activities (e.g., tourism, agriculture, urban expansion) affect Puzhehei's natural ecosystems, and what is needed for their protection?

Water (Lake, Wetland)——Pollution & Degradation

"I provide life to Puzhehei, sustaining people, animals, and plants. But unchecked tourism, agricultural runoff, and wastewater discharge are poisoning me. Without better water management, stricter pollution controls, and ecosystem restoration, I may no longer be able to support life."

Karst Landscape (Karst Caves, Karst Towers)——Erosion & Overuse

"I have stood for millions of years, shaped by time and nature. But excessive tourism, infrastructure development, and deforestation are wearing me down. Sustainable tourism policies, visitor limits, and conservation programs are necessary to prevent irreversible damage."

Animals (Birds, Fish)——Habitat Loss & Disruption

"We have lived here for centuries, but human activities are making survival harder. Noise, pollution, and habitat destruction are driving some of us away. We need protected areas, reduced disturbances, and a balanced approach that respects biodiversity."

Plants (Lotus, Rapeseed, Peach)——Ecosystem Health & Biodiversity

"We bring beauty to Puzhehei and support its ecological balance. But soil degradation, water pollution, and monoculture farming threaten our growth. A more sustainable agricultural approach and habitat protection are crucial to maintaining our role in this landscape."

6.5 COGNITIVE MAPPING

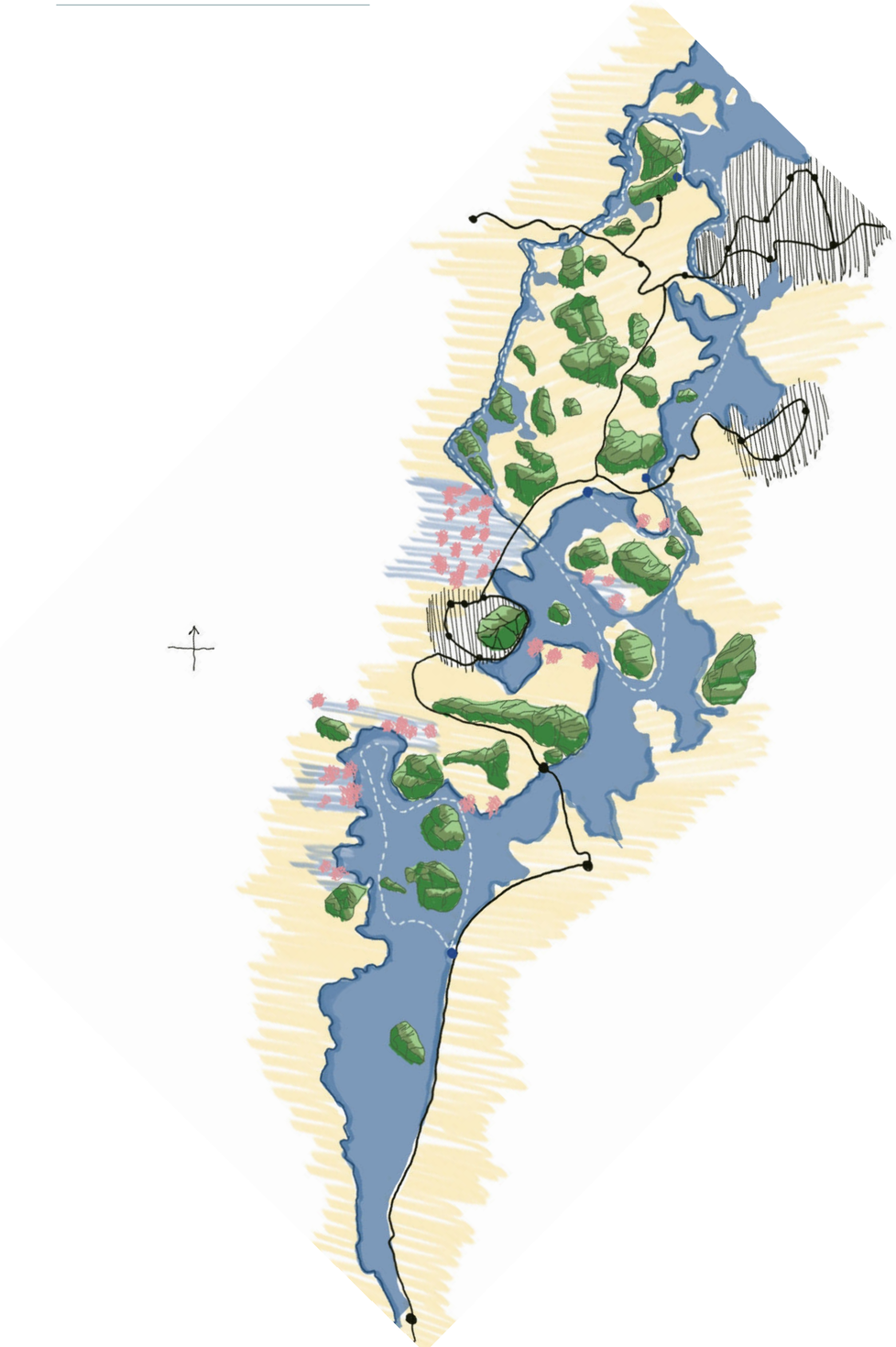


Figure 55 - L (Overall Scenic Area Scale)

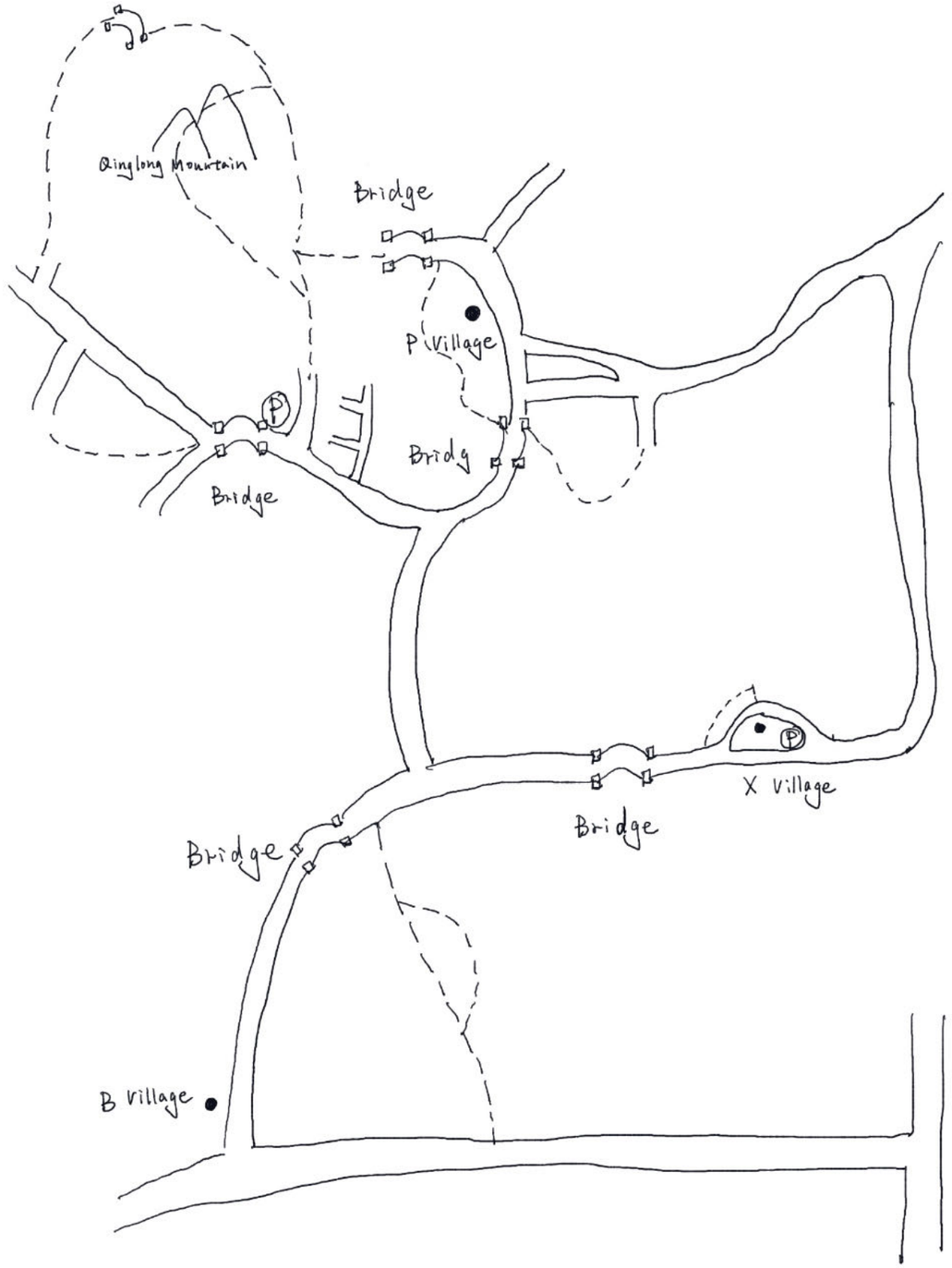


Figure 56 - X (Core Scenic Area Scale)

6.5 COGNITIVE MAPPING

Cognitive mapping provides insights into how different stakeholders perceive and interact with the landscape at various spatial scales. In this analysis, three scales are considered:

S (Village Scale) – Examines individual ethnic villages and their relationship with local resources, livelihoods, and tourism.

X (Core Scenic Area Scale) – Focuses on the main tourist attractions within Puzhehei, where tourism activities are most concentrated.

L (Overall Scenic Area Scale) – Encompasses the entire Puzhehei Scenic Area, analyzing broader ecological, economic, and socio-cultural dynamics.

Figure 57 - Main Village Scale)

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CHAPTER 7: TOURISM SUITABILITY ASSESSMENT

7.1 ECOLOGICAL SECURITY PATTERNS

This diagram presents a tourism suitability analysis system based on the construction of the Ecological Security Pattern in the Puzhehei region. It categorizes the factors influencing tourism development into three main dimensions: **ecological restrictive factors, resource attractiveness, and accessibility.** By identifying ecologically sensitive areas—such as flood regulation zones, water source protection areas, rare species habitats, and zones with high soil erosion risk—and combining them with assessments of ecological and cultural attraction density, transportation connectivity, and infrastructure availability, the region is evaluated for its tourism suitability. The color coding indicates different levels of development restriction: dark purple represents high restriction/unsuitable for tourism, light purple indicates moderate restriction/tourism can be developed with caution, and green signifies low restriction/suitable for tourism. This evaluation provides an comprehensive understanding of the ecological conditions for tourism development.

Ecology Security Pattern/ Restrictive Factors	***Flood Regulation***	High Flood-risk Zones Moderate Flood-riskZones Low Flood-risk Zones ✓
	Water Source Protection	Core Water Source Zones Buffer Protection Zones Eco-tourism-friendly Zones ✓
	Rare Species Distribution	Endangered Species Habitats Buffer Zones Non-critical Ecological Zones ✓
	Soil Erosion Risk	High Erosion-risk Zones Moderate Erosion-risk Zones Low Erosion-risk Zones ✓
Goverment Planning Perception Attractive Resources	***Attractions***	High-Density Attractions ✓ Moderate-Density Attractions Low-Density Resources
Accessibility	***Infrastructure***	Accommodation ✓ Emergency Services Signage

High Restriction/Unsuitable For Tourism

Moderate Restriction/Tourism Can Be Developed With Restrictions

✓ Low Restriction/Suitable For Tourism

Figure 58 - ESP Factors

7.1.1 FLOOD REGULATION

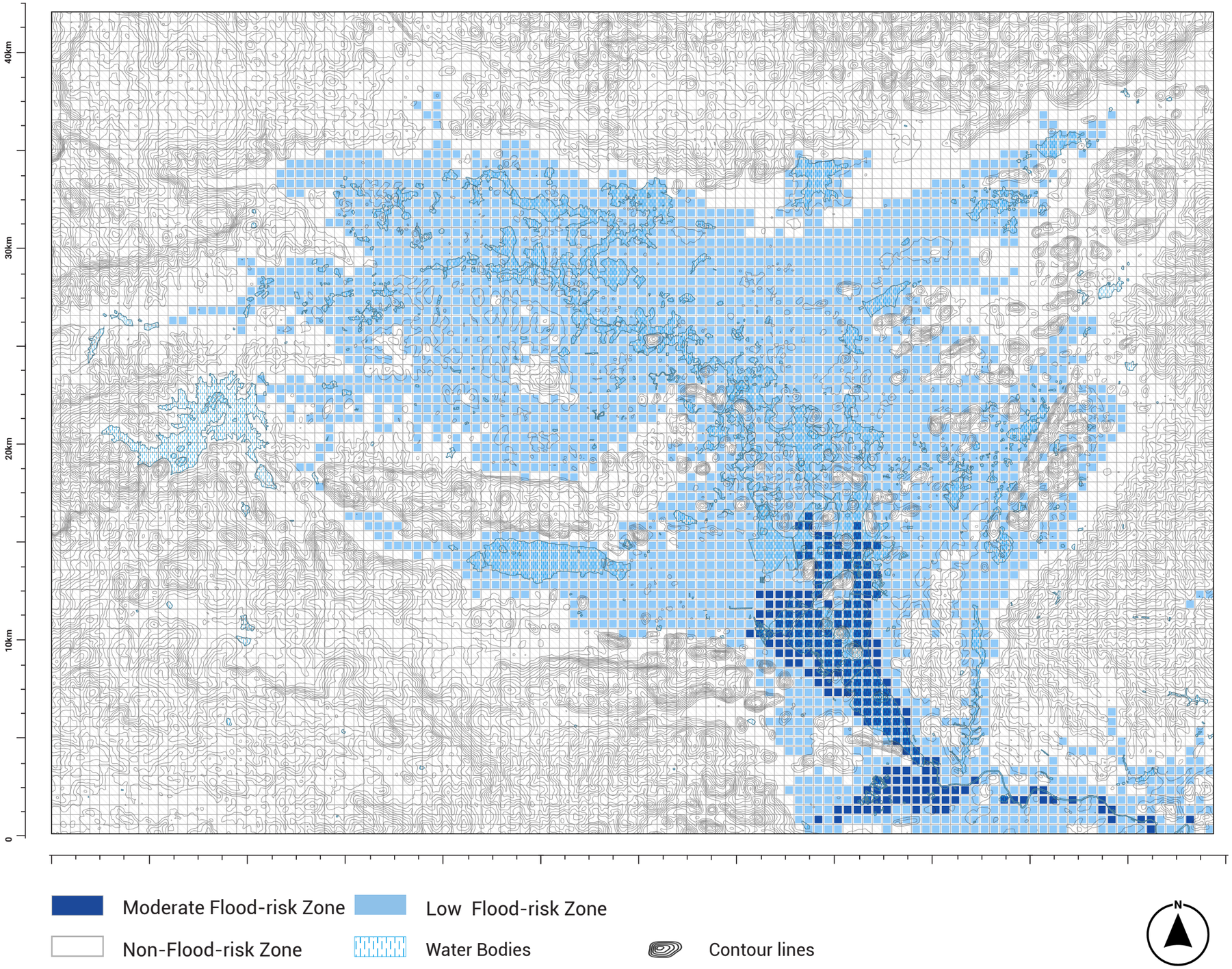


Figure 59- Flood Risk Classification

This map illustrates a spatial assessment of flood risk levels in the Puzhehei region, based on terrain elevation, hydrological flow accumulation, and historical precipitation data. Grid-based classification was used to identify zones of varying vulnerability: Moderate Flood-risk Zones are located primarily along lowland valleys and lake edges with high water retention, while Low Flood-risk Zones extend further into the basin where slopes are gentle and water dispersal is more feasible.

Non-Flood-risk Zones are typically situated on elevated terrain or in areas with rapid drainage. This analysis supports land use planning and tourism development by identifying areas requiring protection, infrastructure reinforcement, or water management interventions.

Moderate Flood-risk Zones (1446–1470m) lie in low-lying areas near lakes and valleys. Flat terrain and poor drainage make them prone to seasonal flooding.

Low Flood-risk Zones (1470–1490m) have better elevation and drainage—suitable for infrastructure, housing, and emergency services.

Non-Flood-risk Zones (>1490m) are higher, drier, and more stable.

7.1.2 WATER RESOURCES PROTECTION

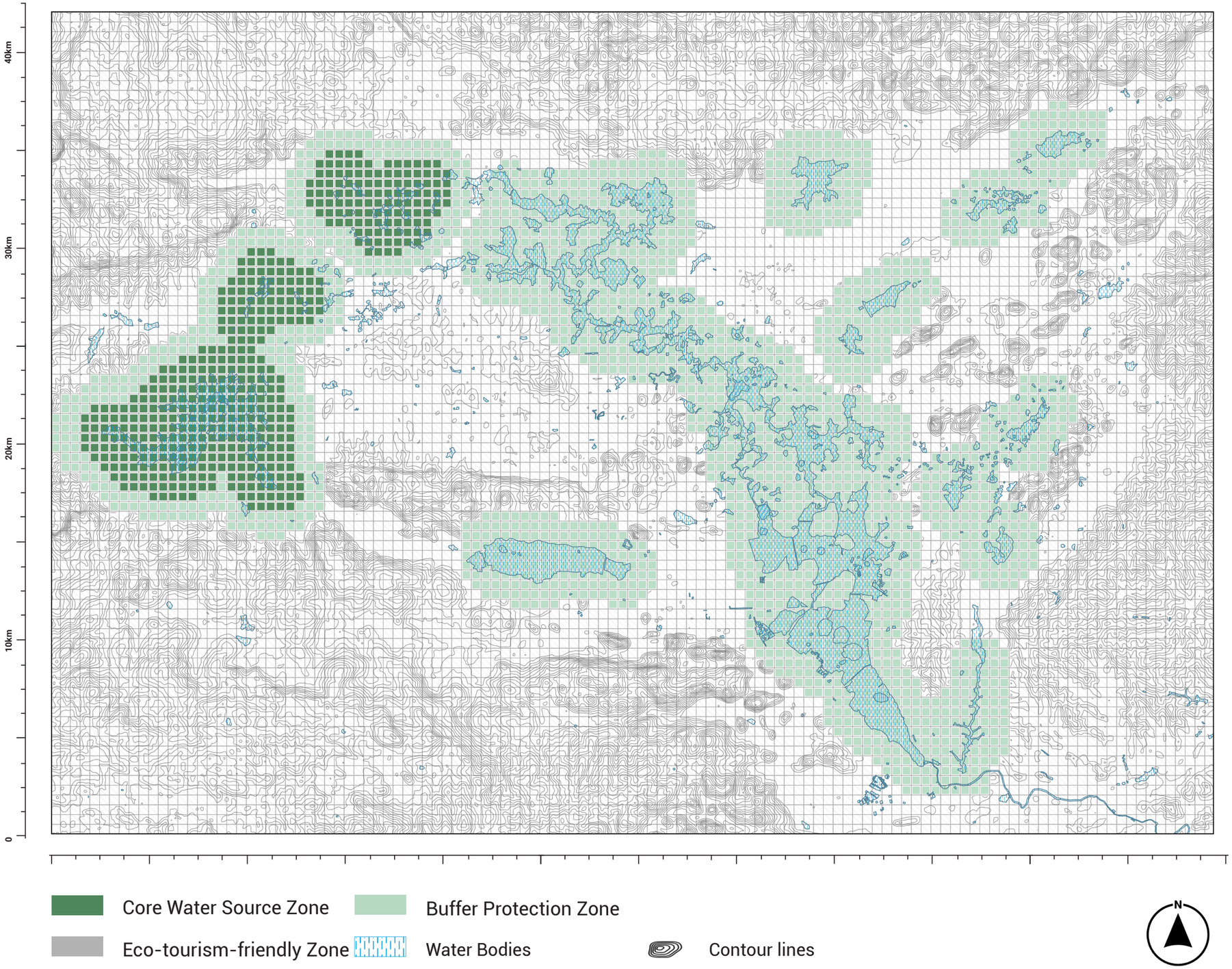


Figure 60- Water Source Protection Zoning

This map illustrates water source protection zones in the Puzhehei region, classified by proximity to core water bodies.

Core Water Source Zones are located within 0–500 meters of key lakes, reservoirs, and springs. These areas are highly sensitive to pollution and should be strictly conserved.

Buffer Protection Zones extend from 500 to 1000 meters. They serve as transitional belts that mitigate external disturbances and support ecological resilience.

Eco-tourism-friendly Zones lie beyond 1000 meters and are conditionally suitable for low-impact tourism activities with proper water management.

These zones provide a spatial framework for balancing watershed protection with tourism planning.

7.1.3 RARE SPECIES DISTRIBUTION

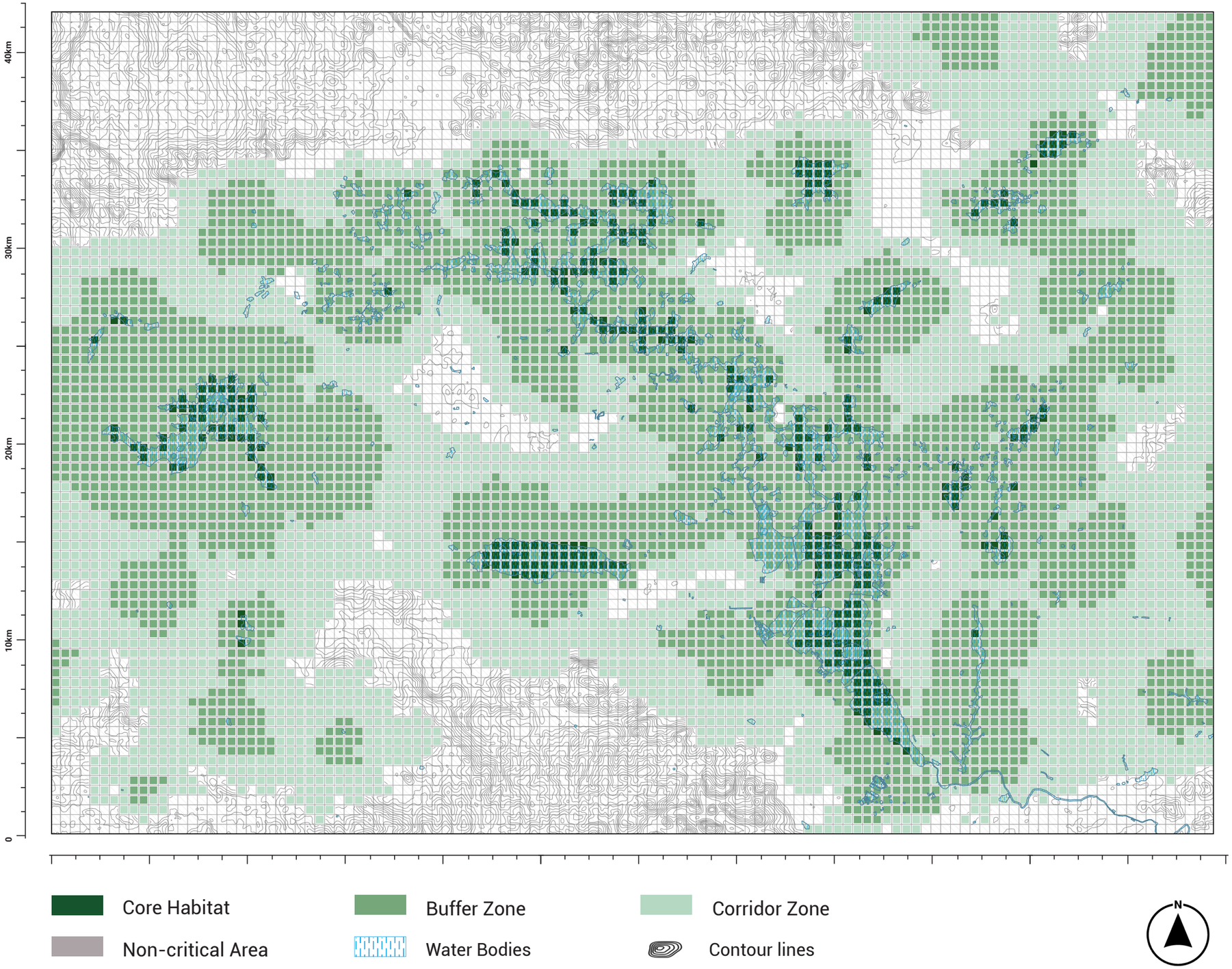


Figure 61-Habitat Suitability Assessment for Oriental stork

This habitat suitability map is particularly relevant for species such as the Oriental stork, a solitary apex predator that inhabits wetland ecosystems.
The stork favors marshes, pond edges, and shallow water zones, especially during its breeding season. Its diet includes fish, frogs, insects, reptiles, small birds, and rodents—making it highly dependent on intact wetland food chains.
This map presents the spatial classification of habitat suitability for rare and endangered species in the Puzhehei region.
Based on a weighted overlay of five key ecological and anthropogenic indicators—including land cover, proximity to water, settlements, high-grade roads, and medium-grade roads—the region is divided into four management zones:

Core Habitat: High ecological integrity, ideal for species protection and biodiversity conservation.

Buffer Zone: Transitional areas that surround core habitats and help reduce external disturbance.

Corridor Zone: Ecological passageways that support species migration and connectivity.

Non-critical Areas: Low ecological value and/or high disturbance, where conservation priority is minimal.

7.1.4 SOIL EROSION SENSITIVITY

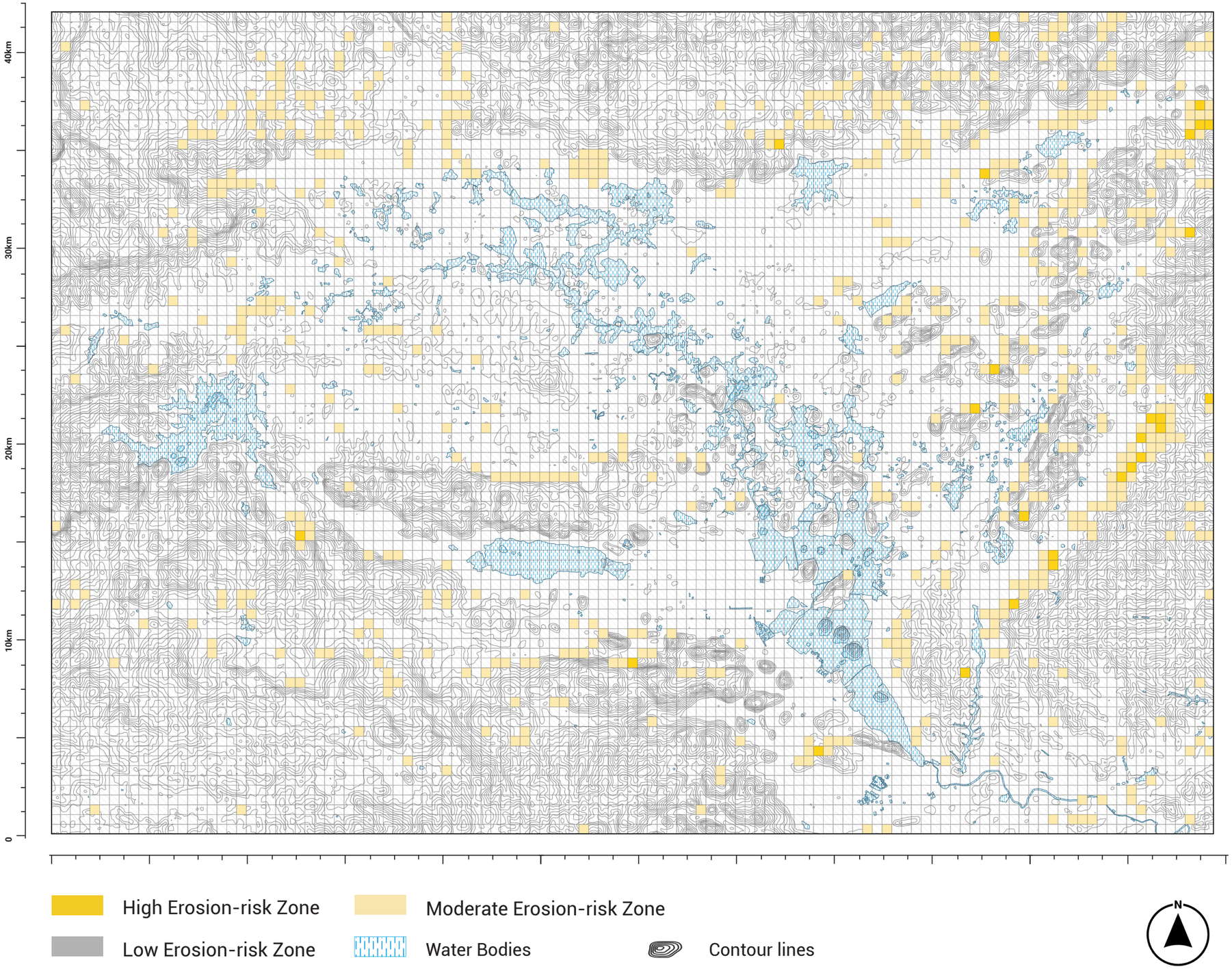


Figure 62- Soil Erosion Risk Assessment

This map presents a spatial analysis of soil erosion risk levels in the Puzhehei basin, derived from topographic slope, land cover types, and hydrological flow patterns. Areas with steep slopes, sparse vegetation, and disturbed surfaces are classified as High Erosion-risk Zones, concentrated mainly in hilly edges and outer ridges. Moderate-risk Zones include gentle slopes and agricultural mosaics, where erosion is conditional and seasonal. Low-risk Zones lie in lowlands, wetlands, and areas with stable vegetative cover, where soil displacement is minimal. This classification helps guide ecological protection, erosion control, and sustainable land use planning.

7.1.5 KEY ATTRACTIONS

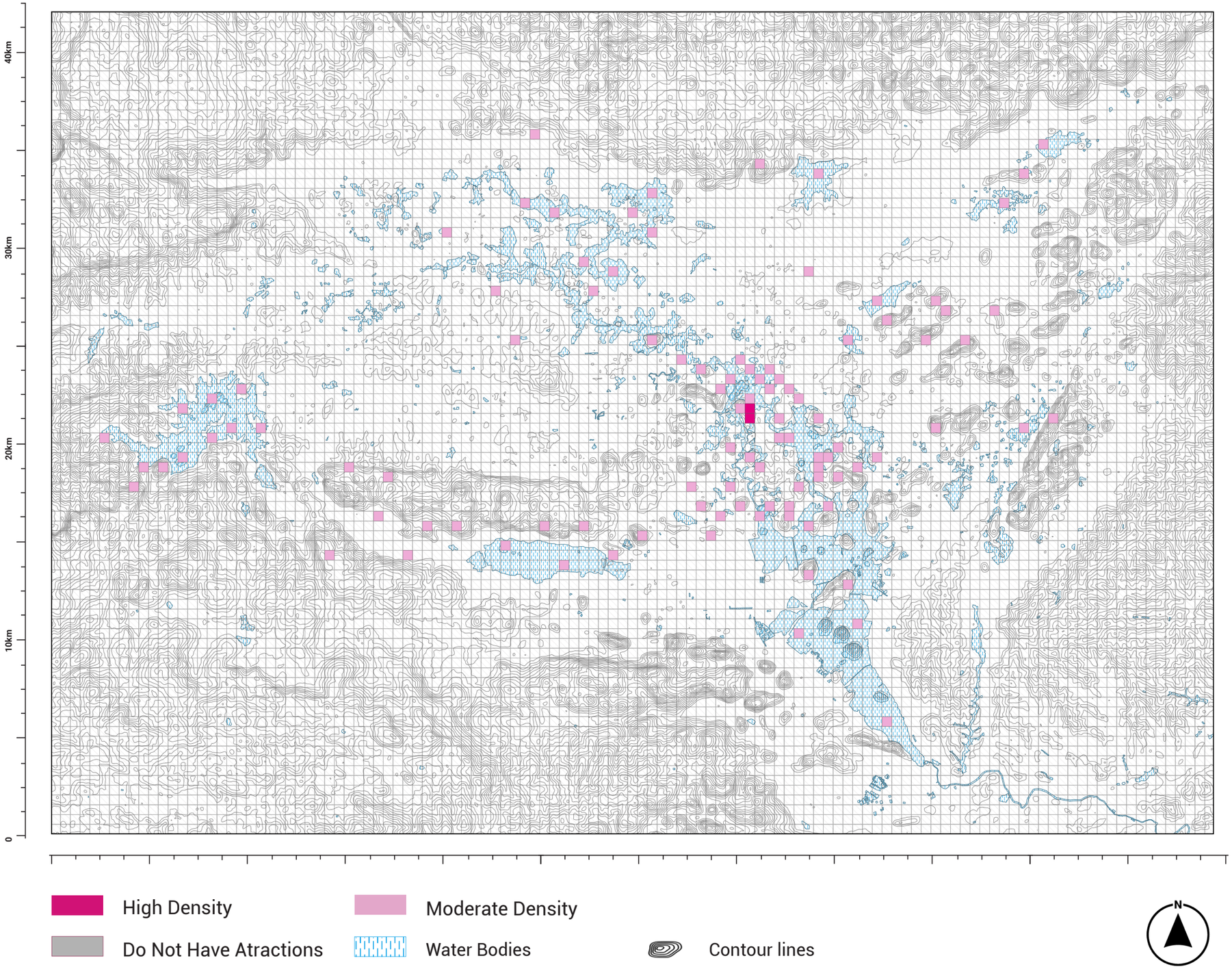


Figure 63- Tourism Attraction Density Analysis

This map illustrates the spatial distribution of tourism attraction density within the Puzhehei region. The classification is based on the presence and clustering of points of interest (POIs), including scenic spots, cultural landmarks, recreational facilities, and ecological highlights.

High-Density Zones are primarily concentrated in the central basin, where tourism infrastructure and iconic sites are clustered.

Moderate-Density Zones form a transitional belt, often close to water bodies or accessible from main roads.

Non-Attraction Zones represent areas with few or no known tourism features, typically at ecological peripheries or agricultural land.

This analysis provides a foundational layer for zoning tourism development priorities and integrating attraction density with ecological suitability.

7.2 SYNTHESIS MAPPING

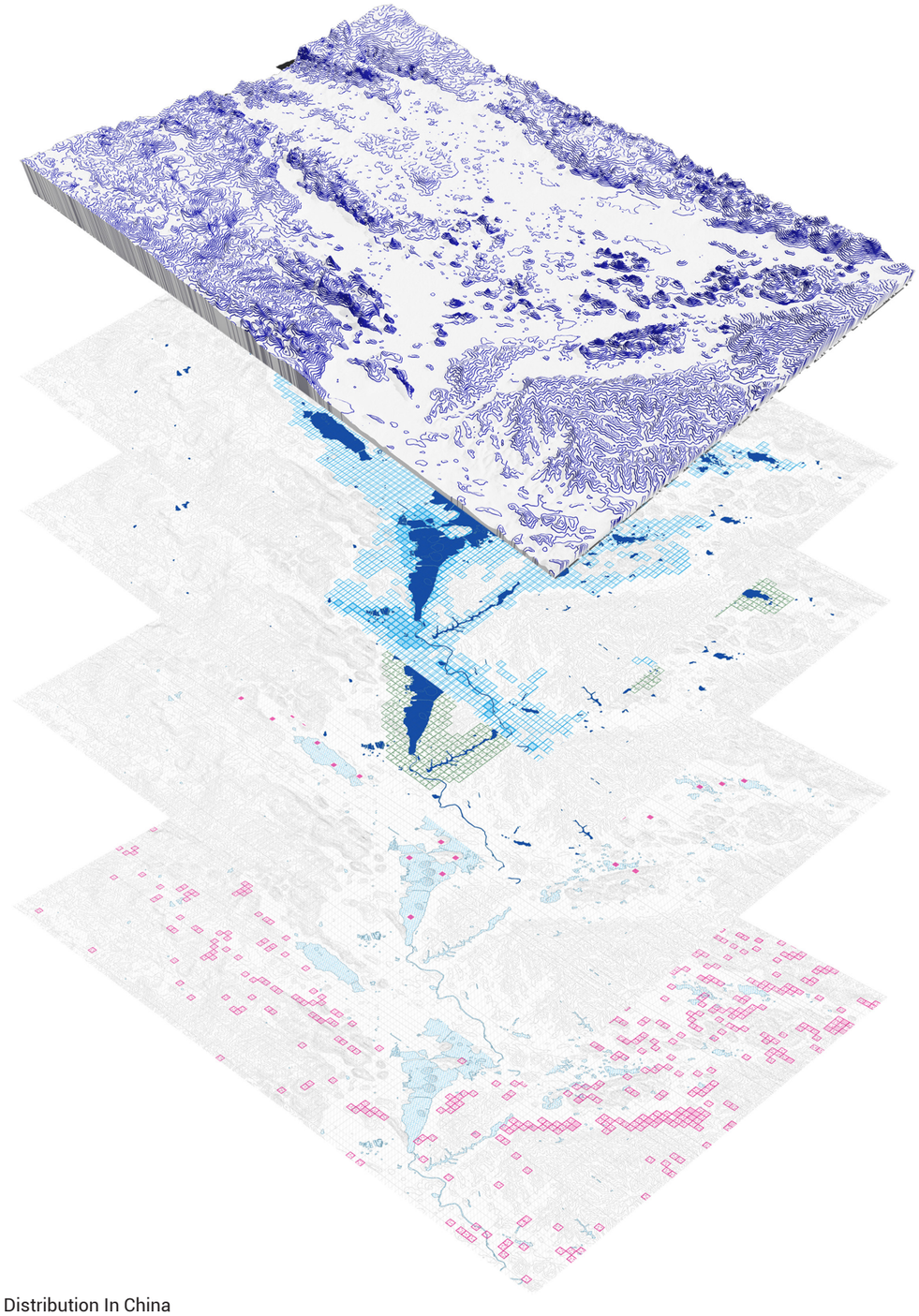


Figure 29- Karst Distribution In China

To identify spatial zones suitable for tourism development in the karst landscape of Puzhehei, this study constructs an Ecological Security Pattern (ESP) by integrating three key dimensions: ecological constraints, landscape attractiveness, and accessibility conditions. Guided by a multi-criteria evaluation framework and implemented through GIS-based spatial overlay analysis, this method ensures that spatial planning decisions are both environmentally grounded and context-sensitive.

The indicator system for ESP construction comprises three categories. First, restrictive ecological factors reflect ecological vulnerability and the critical functions of ecosystem services. Indicators include flood regulation capacity (categorized into high-, moderate-, and low-risk zones), water source protection zones (core, buffer, and eco-tourism-friendly), rare species distribution (endangered species habitats and buffer zones), and soil erosion risk (high to low levels). Each of these zones is assigned a restriction level—high, moderate, or low—based on its ecological sensitivity and development suitability.

Second, attractive resource potential is incorporated to reflect the spatial tourism value as perceived in government planning. This includes the density and distribution of ecological attractions (e.g., wetlands, biodiversity hotspots) and cultural attractions (e.g., local heritage, ethnic traditions, and scenic villages). Third, accessibility and infrastructure are evaluated to determine the practical feasibility of tourism activation, based on transportation connectivity (well-connected, moderately accessible, remote) and supporting infrastructure (accommodation, emergency services, signage).

Based on these indicators, each spatial unit is assessed through weighted overlay analysis in GIS. The results are presented in a suitability matrix, where the X-axis represents ecological restriction (from high to low), and the Y-axis represents tourism potential (based on resource attractiveness and accessibility). This intersection produces a classification into four types of zones.

This framework provides a spatial basis for strategic tourism zoning and development control, supporting a planning approach that aligns tourism activities with ecological resilience and long-term sustainability goals in karst regions.

	Evaluation Factor	Classification	Score	Weight
Restrictive Factors	**Flood Regulation**	High Flood-risk Zones	0	0.1
		Moderate Flood-risk Zones	8	
		Low Flood-risk Zones	10	
	Water Source	Core Water Source Zones	0	0.2
		Buffer Protection Zones	5	
		Eco-tourism-friendly Zones	10	
	Rare Species Distribution	Endangered Species Habitats	0	0.2
		Buffer Zones	5	
		Non-critical Ecological Zones	10	
	Soil Erosion Risk	High Erosion-risk Zones	0	0.2
		Moderate Erosion-risk Zones	5	
		Low Erosion-risk Zones	10	
Attractive Factors	**Attractions**	High-Density Attractions	10	0.2
		Moderate-Density	7	
		Low-Density Resources	5	
	Infrastructure	Accommodation	10	0.1
		Emergency Services	6	
		Signage	0	

Figure 64- Evaluation Factor

7.2 SYNTHESIS MAPPING

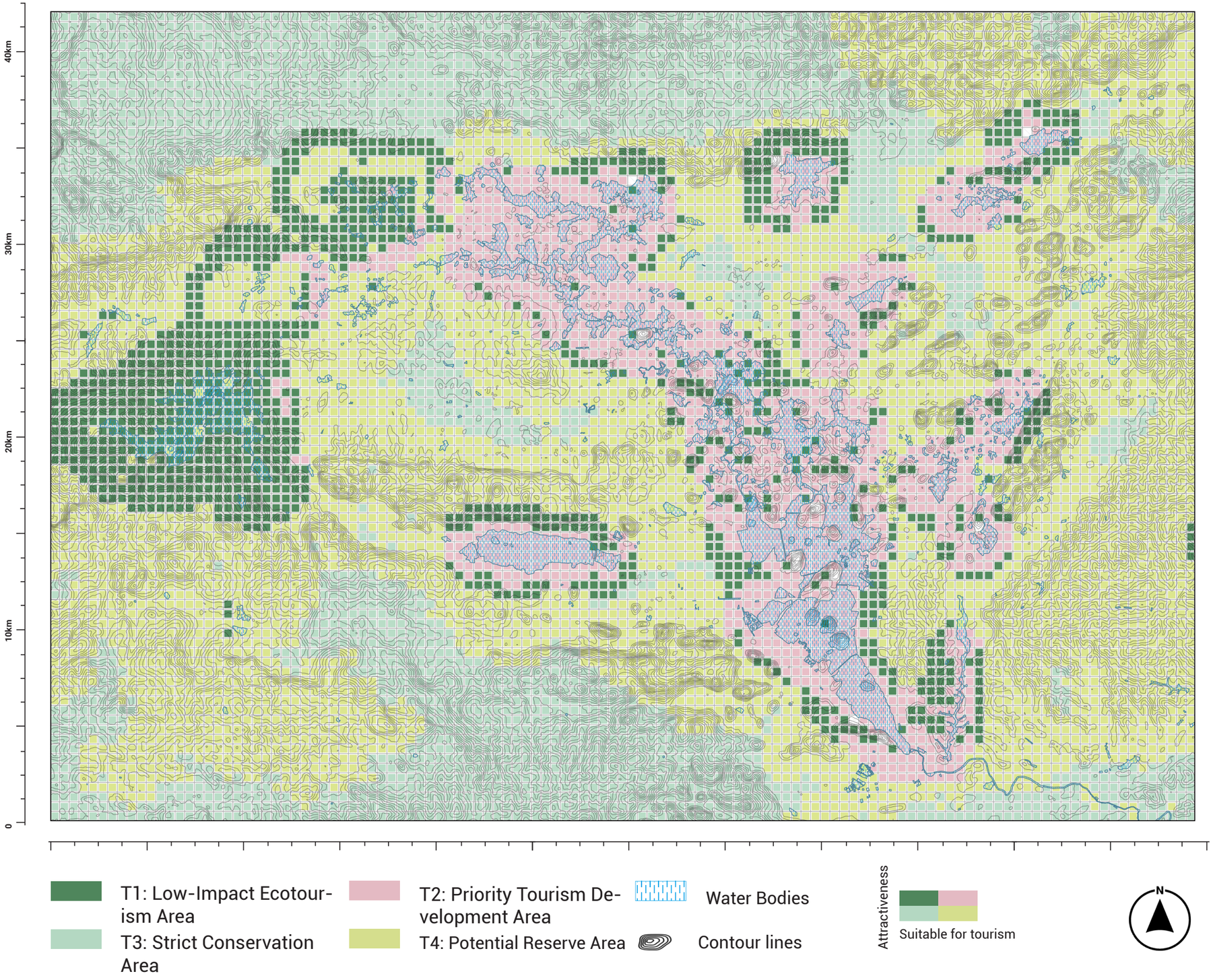
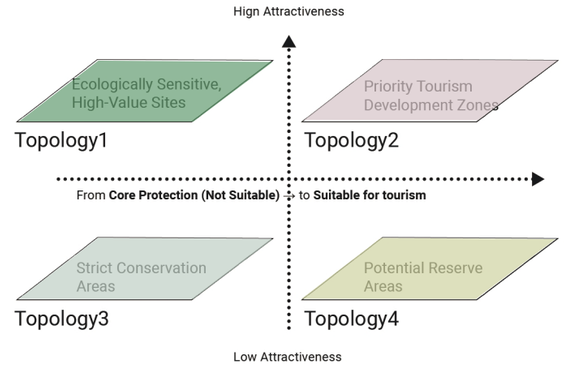


Figure 65- Tourism Attraction Density Analysis

Typological analysis



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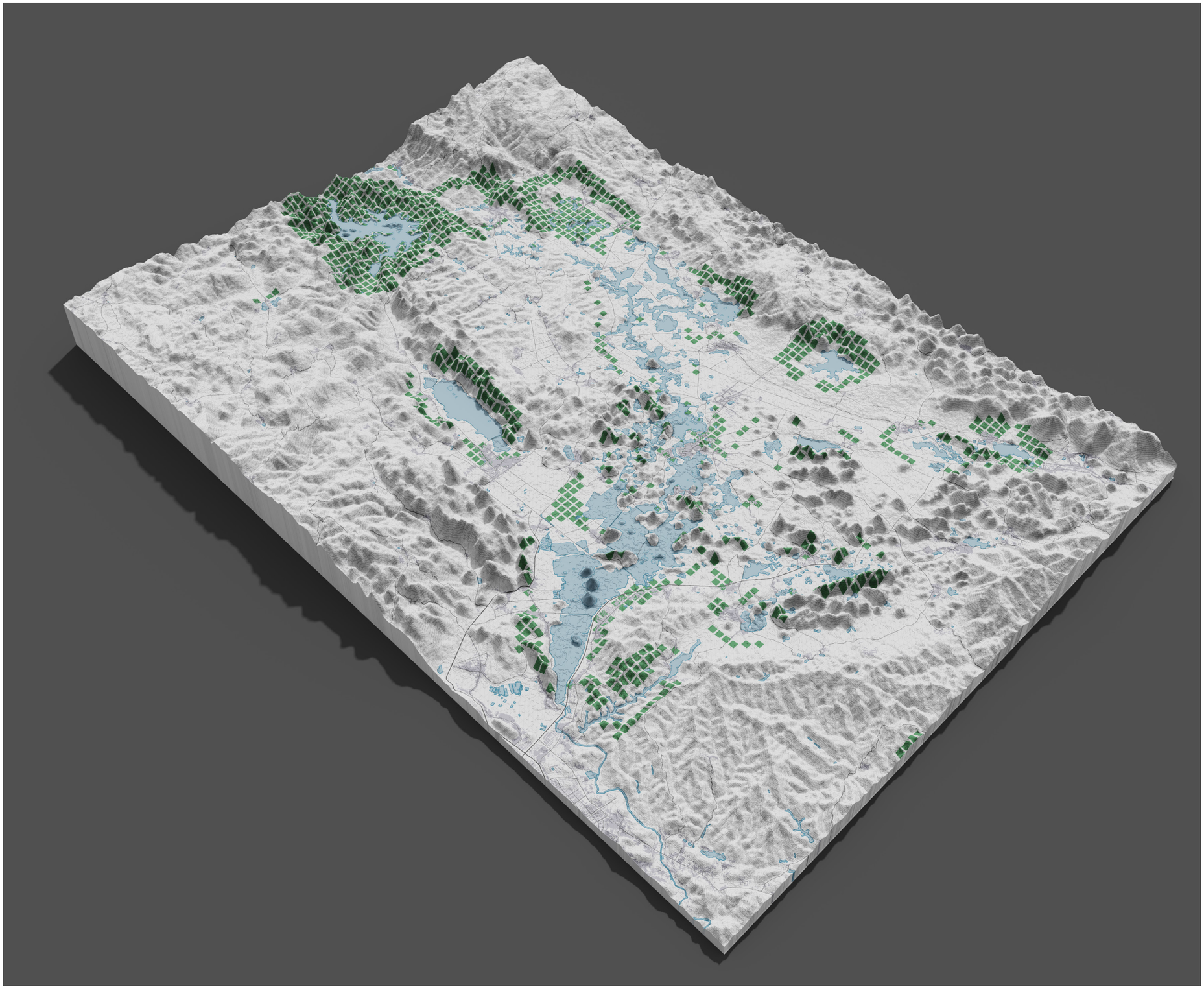
7.3 TOPOLOGICAL MAPPING



Typological analysis

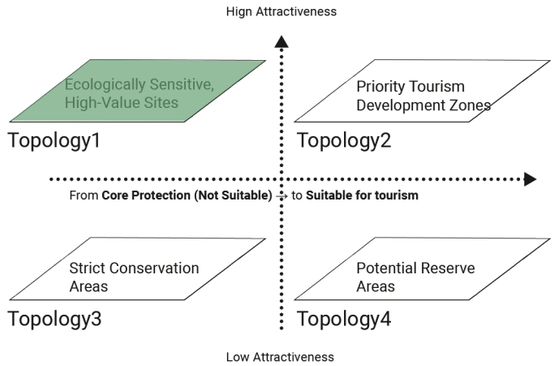
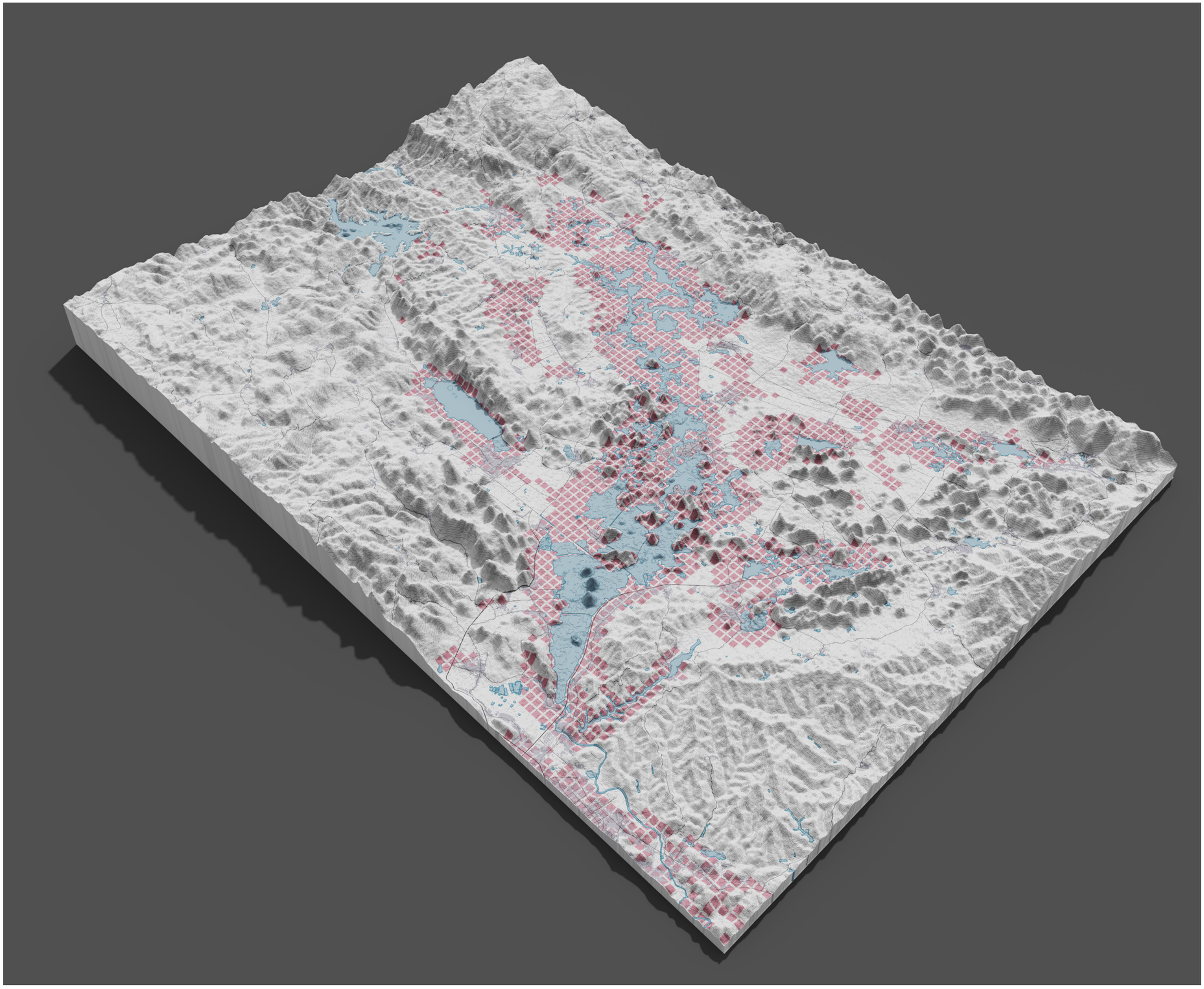


Figure 66- Low-Impact Ecotourism Area

This typology includes areas with both high ecological value and strong tourism appeal, such as wetlands, heritage zones, and fragile karst landscapes. These places often host rich biodiversity or hold cultural significance, making them attractive but vulnerable. As a result, they require strict protection and controlled accessibility. Strategies for these zones should prioritize ecological restoration, the use of non-intrusive tourism methods (such as elevated walkways or observation points), and the restriction of large-scale development. The main goal is to maintain the ecological balance while allowing limited, respectful visitor experiences.

7.3 TOPOLOGICAL MAPPING



Typological analysis

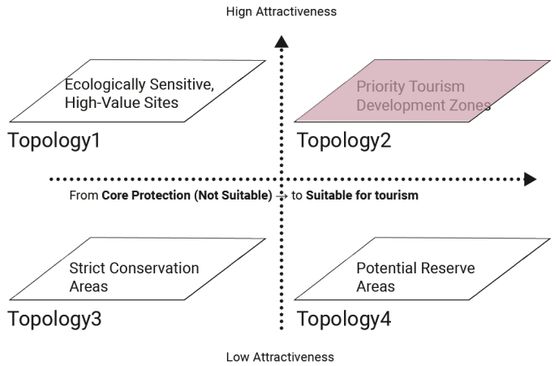
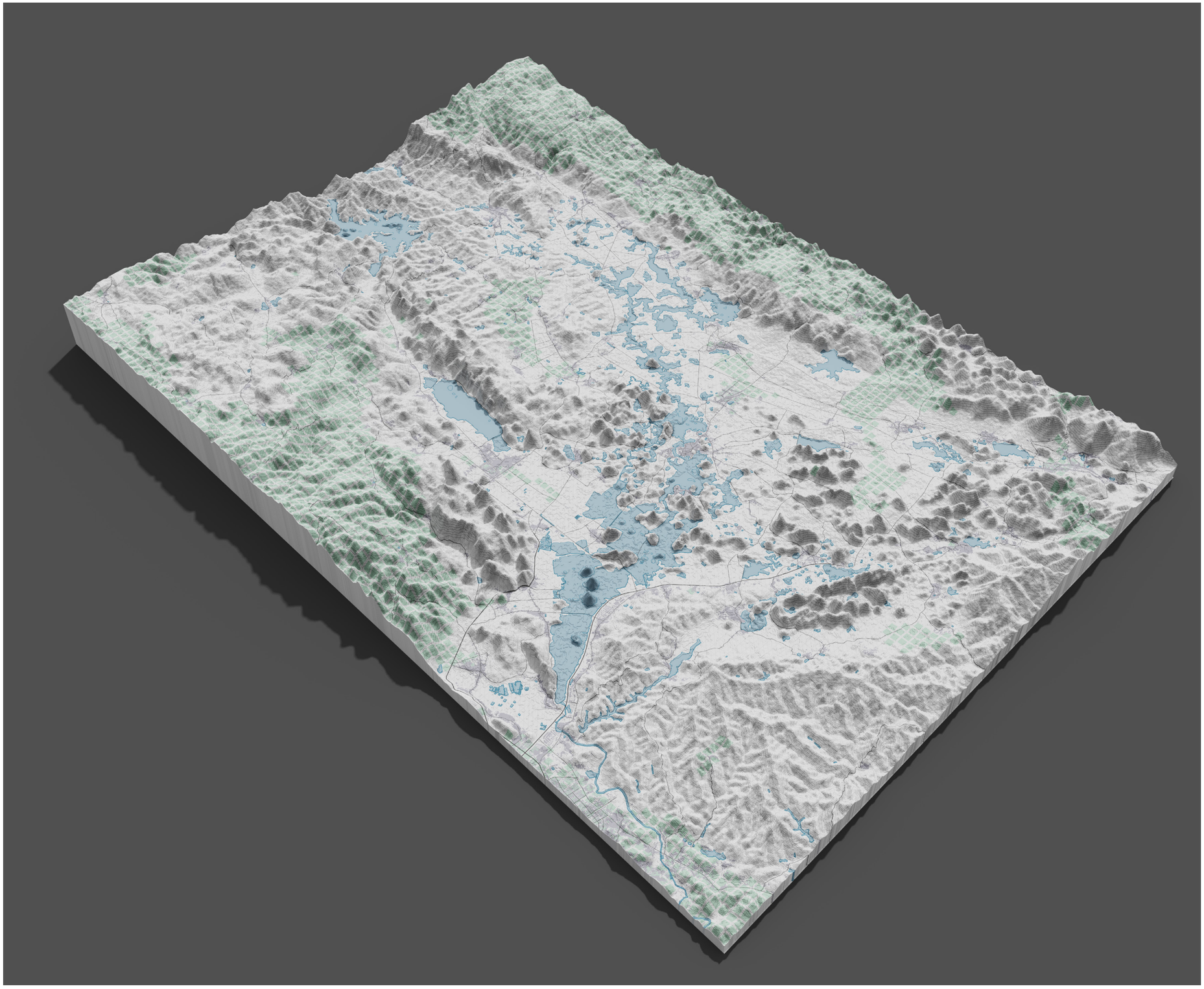


Figure 67- Priority Tourism Development Zone

This typology refers to areas where both tourism value and ecological resilience are relatively high. These zones are suitable for moderate development and cultural activation. They can accommodate tourism-related infrastructure such as visitor centers, marketplaces, and cultural exhibition spaces. Strategies in T2 zones should promote balanced tourism growth that enhances local economic vitality while respecting environmental boundaries. This includes cultural events, community-led tourism, and improved accessibility. With careful planning and stakeholder engagement, these areas can become models for sustainable tourism that supports both conservation and local livelihoods.

7.3 TOPOLOGICAL MAPPING



Typological analysis

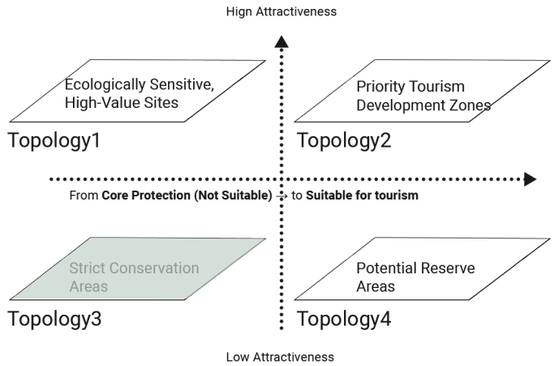
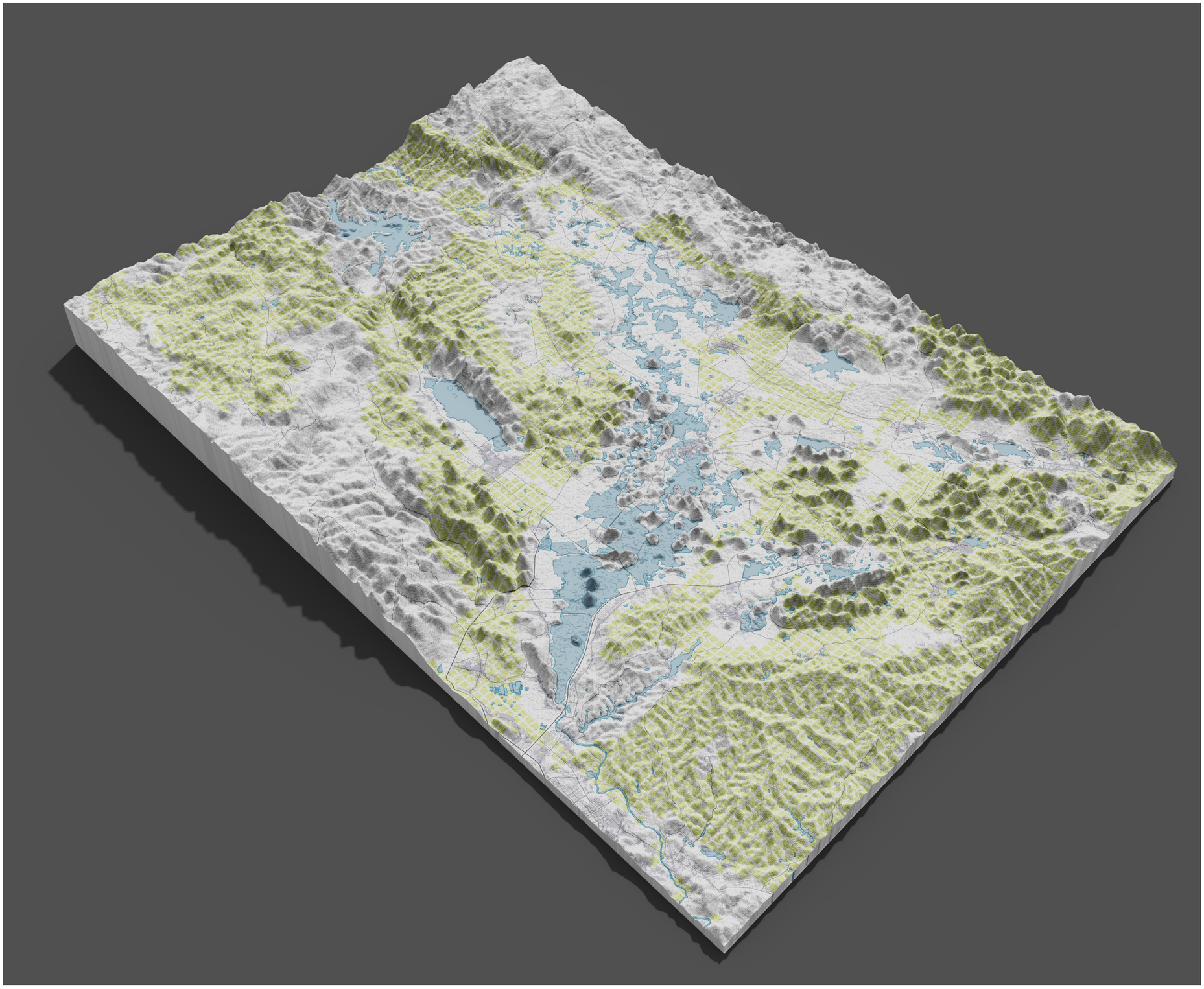


Figure 68- Strict Conservation Area

These zones have limited appeal to visitors but possess very high ecological significance. Examples include core habitats, watersheds, or ecologically degraded zones in need of recovery. Because of their low tourism suitability and high ecological sensitivity, such areas should be designated as conservation-only zones. Any form of tourism or infrastructure development should be prohibited. Conservation efforts should focus on habitat restoration, biodiversity monitoring, and long-term ecological protection. These areas serve as ecological anchors for the entire region, helping to stabilize natural systems and buffer the impacts of nearby tourism activity.

7.3 TOPOLOGICAL MAPPING



Typological analysis

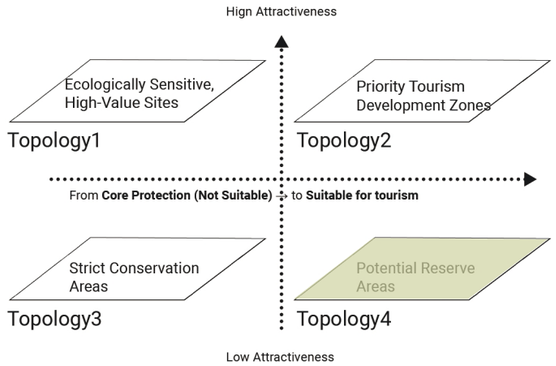


Figure 69- Potential Reserve Area

These are currently underutilized areas with moderate ecological or cultural value. While they may not attract much tourism at present, they have the potential to be improved through restoration, cultural storytelling, or community engagement. Strategies in these zones should emphasize low-impact activation—such as cultural trails, native planting, and seasonal activities—to gradually build tourism capacity. These areas offer flexibility for future planning and can serve as testing grounds for innovative, community-based models of sustainable development. With careful attention, T4 zones may eventually evolve into new cultural or ecological hotspots.

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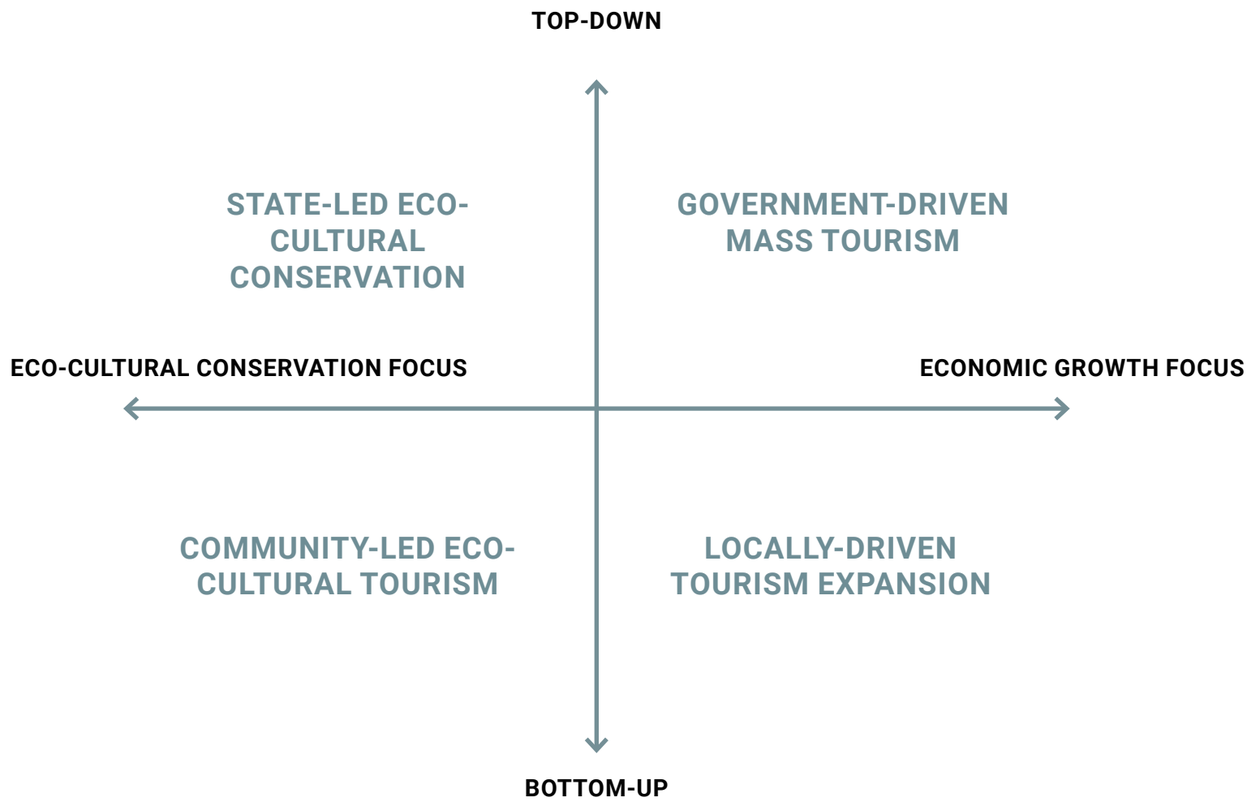
CHAPTER 8: VISION 2050: BALANCING TOURISM AND CONSERVATION

8.1 SCENARIO PLANNING: STRATEGIES FOR BALANCE



X: TOURISM DEVELOPMENT FOCUS

Y: GOVERNANCE MODEL

Figure 70-Scenario Planning

8.1 SCENARIO PLANNING: STRATEGIES FOR BALANCE

X-Axis (Horizontal): Governance Model
Left: Bottom-Up-Led by local communities, NGOs, academic institutions, and grassroots organizations, emphasizing participatory governance and local engagement.
Right: Top-Down-Led by governments, policymakers, and national or provincial planning authorities, emphasizing macro-level regulation and policy control.

Y-Axis (Vertical): Tourism Development Focus
Top: Eco-Cultural Conservation Focus-
Prioritizing ecological and cultural heritage protection, controlling tourism scale, and emphasizing sustainability.
Bottom: Economic Growth Focus-
Prioritizing economic growth, expanding tourism industries, and maximizing financial benefits.Quadrant Analysis

Community-Led Eco-Cultural Tourism (Bottom-Up + Eco-Cultural Conservation)
Characteristics:
Led by local communities, environmental organizations, and academic institutions.
Promotes low-impact tourism, such as small-scale eco-tourism, cultural experience tourism, and environmental education.
Advantages:
Environmentally friendly, strong community participation, and preservation of cultural heritage.
Ensures tourism activities are integrated with local culture.
Challenges:
Economic benefits may be slow to materialize.
Hard to compete with large-scale tourism industries.
May rely on external support for funding and expertise.

State-Led Eco-Cultural Conservation (Top-Down + Eco-Cultural Conservation)
Characteristics:
The government strictly regulates tourism development to minimize environmental impact.
Implements measures such as visitor caps, ecological compensation policies, and cultural heritage restoration programs.
Advantages:
Strong environmental and cultural protection.
Rapid recovery of ecosystems.
Long-term sustainability of the tourism sector.
Challenges:
May limit local economic opportunities.
Communities might not fully benefit from tourism revenues.
Policies may lack flexibility for localized needs.

Locally-Driven Tourism Expansion (Bottom-Up + Economic Growth)
Characteristics:
Tourism-driven economic growth is led by local communities, rural cooperatives, and small businesses.
Focuses on local tourism enterprises, such as farm stays, homestays, and specialty products.
Advantages:
Enhances the local economy and increases community income.
Stronger local engagement and participation.
Challenges:
May lack environmental and cultural oversight.
Unregulated expansion could lead to overuse of resources and cultural commercialization.

Government-Driven Mass Tourism (Top-Down + Economic Growth)
Characteristics:
The government plays a leading role in tourism industry development.
Invests in large-scale infrastructure, such as resorts, commercial tourism zones, and high-end hotels.
Advantages:
Rapid short-term economic growth.
Attracts a large number of tourists, boosting regional development.
Challenges:
High ecological risks due to overdevelopment.
Cultural heritage might be commercialized.
Local communities may lack decision-making power in tourism planning.

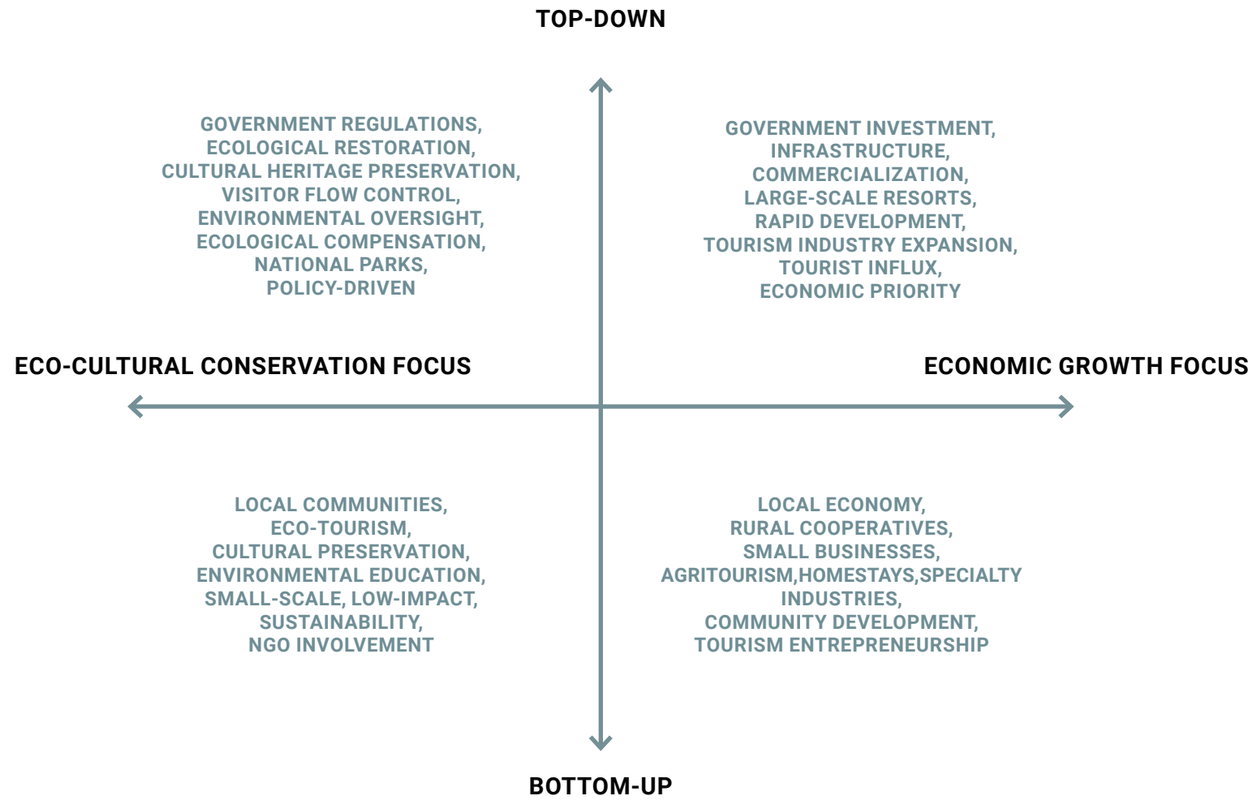


Figure 71-Scenario Planning:Governance vs. Development Focus

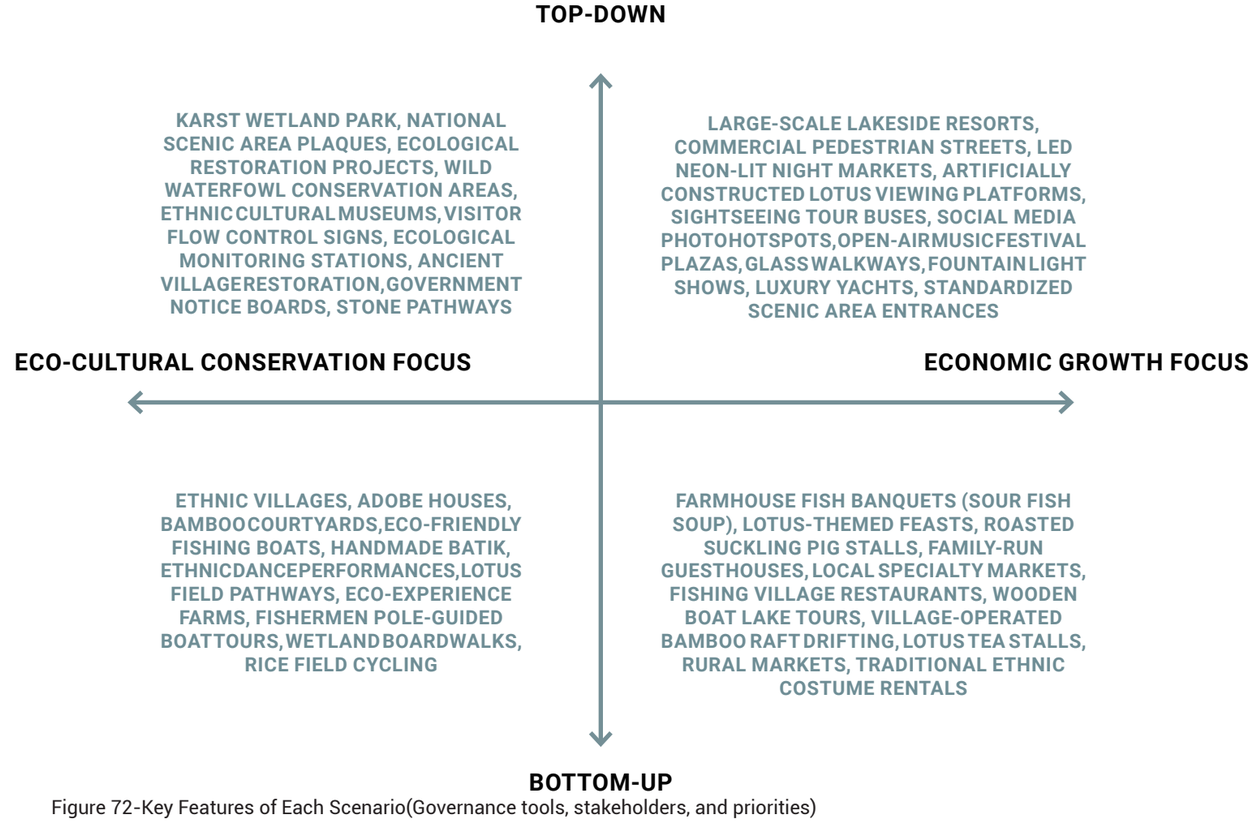
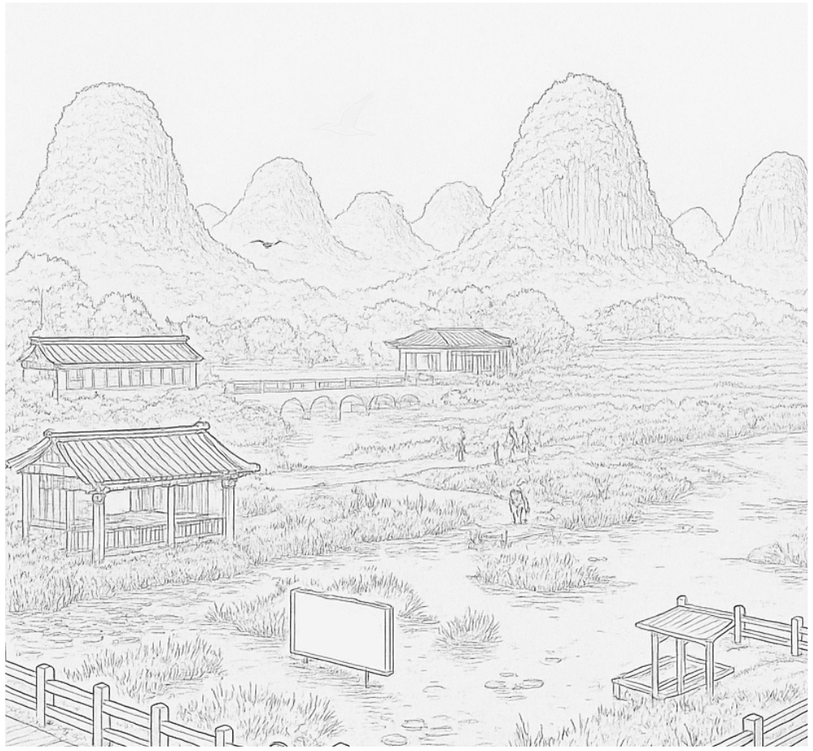
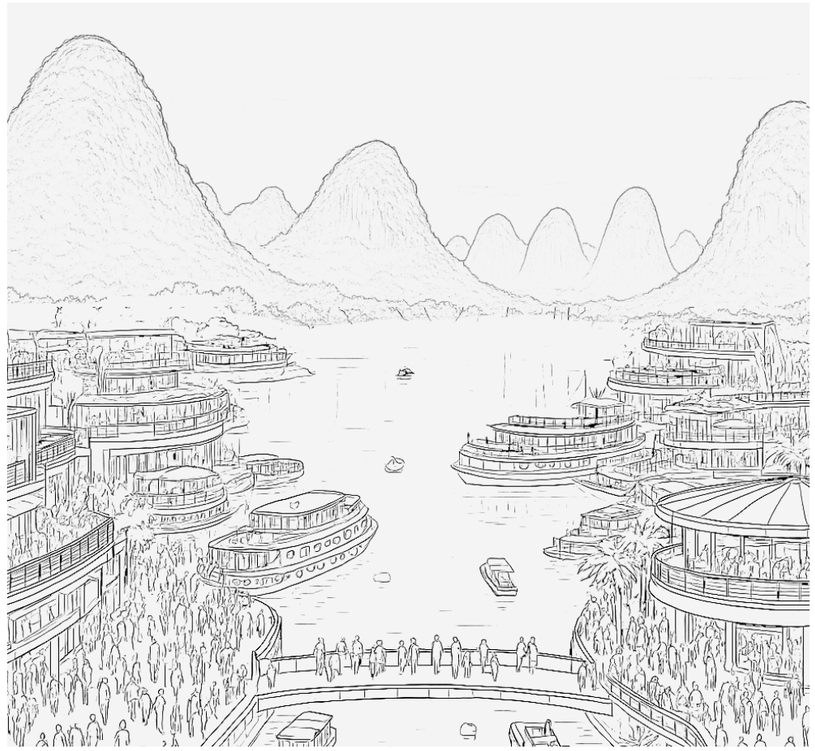


Figure 72-Key Features of Each Scenario(Governance tools, stakeholders, and priorities)

8.1 SCENARIO PLANNING: STRATEGIES FOR BALANCE





STATE-LED ECO-CULTURAL CONSERVATION

GOVERNMENT-DRIVEN MASS TOURISM

COMMUNITY-LED ECO-CULTURAL TOURISM

LOCALLY-DRIVEN TOURISM EXPANSION

Figure 73-Spatial Expressions of Scenarios
(Representative landscape and tourism elements under each model)

8.2 A VISION FOR 2050: HARMONY IN THE KARST

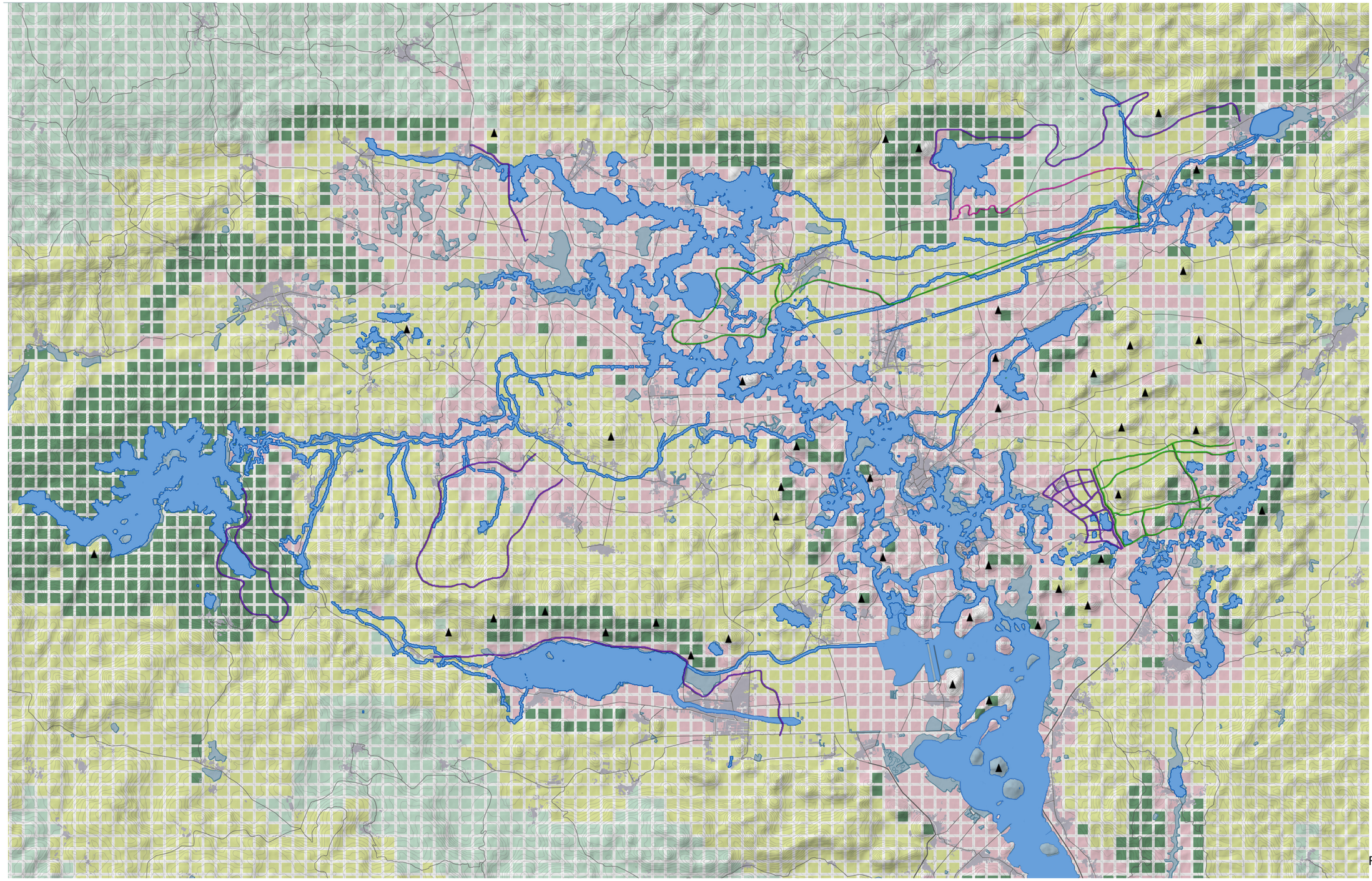


Figure 74- Vision Map

This vision map outlines a future spatial framework for sustainable tourism and ecological protection in the karst landscape by 2050.
The vision integrates cycling and pedestrian networks, water bodies, and karst peaks to enhance connectivity and experience. Routes such as horse-drawn carriage tours and green corridors support low-carbon access. This spatial proposal serves as a guiding blueprint for balancing protection, development, and cultural continuity in Puzhehei.

8.3 COMPREHENSIVE ENGAGEMENT STRATEGIES

Human

Residents——Community-Based Tourism & Sustainable Livelihoods

Challenges:

Economic dependence on tourism with seasonal fluctuations.
Environmental degradation impacting traditional livelihoods (fishing, farming).
Rising living costs due to tourist-driven inflation.

Recommendations:

Community-Based Tourism: Encourage local ownership of eco-friendly homestays, cultural tours, and handicrafts.
Sustainable Business Practices: Incentivize waste reduction, biodegradable packaging, and local sourcing.
Skill Development: Train locals in sustainable tourism management, language skills, and eco-tourism guiding.

Local Government——Sustainable Policy & Infrastructure Development

Challenges:

Balancing economic growth with environmental sustainability.
Ineffective enforcement of conservation regulations.
Limited funding for sustainable tourism infrastructure.

Recommendations:

Tourism Zoning & Carrying Capacity Limits: Designate protected areas with restricted visitor access and set seasonal tourism quotas.
Green Infrastructure Investments: Expand eco-friendly transportation, waste management, and water treatment facilities.
Incentives for Sustainable Businesses: Offer tax benefits for eco-certified hotels, restaurants, and tour operators.
Community Co-Management: Involve residents and local businesses in tourism decision-making through advisory councils.

NGOs and Grassroots Organizations——Advocacy, Conservation, & Community Engagement

Challenges:

Limited funding for conservation and community programs.
Lack of enforcement power despite advocacy efforts.

Recommendations:

Eco-Volunteering & Citizen Science: Engage tourists and locals in biodiversity tracking, wetland restoration, and clean-up initiatives.
Partnerships with Businesses: Work with tourism operators to develop sustainability commitments and eco-tourism programs.
Community Education Initiatives: Organize workshops on sustainable farming, fishing, and entrepreneurship in green tourism.

Tourists——Eco-Friendly Travel & Responsible Behavior

Challenges:

Overcrowding leading to strain on local infrastructure.
Unregulated waste disposal and environmental damage.
Unintentional disruption of wildlife and traditional ways of life.

Recommendations:

Eco-Friendly Travel Incentives: Discounts for visitors who use green transport, stay in eco-certified lodgings, and participate in conservation efforts.
Responsible Behavior Campaigns: Educate tourists on proper waste disposal, respect for wildlife, and cultural sensitivity.
Controlled Access & Permits: Implement visitor quotas and require permits for sensitive ecological areas.
Low-Impact Tourism Activities: Promote guided kayaking, cycling, and nature walks over high-impact activities.

Research Institutions——Long-Term Environmental & Socioeconomic Impact Studies

Challenges:

Lack of comprehensive data on tourism's long-term impact on biodiversity and local culture.
Limited collaboration between researchers and policymakers.

Recommendations:

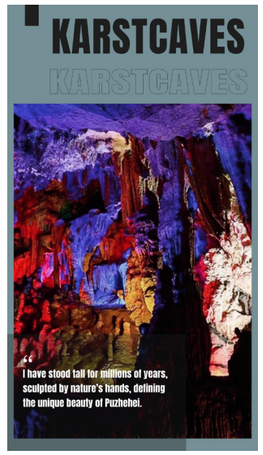
Longitudinal Impact Studies: Conduct ecosystem health assessments and social-economic impact studies.
Biodiversity Monitoring Programs: Work with local guides to track changes in bird and fish populations.
Policy-Oriented Research: Provide actionable recommendations to the government on carrying capacity, conservation zoning, and sustainable tourism models.

8.3 COMPREHENSIVE ENGAGEMENT STRATEGIES

Non—Human

Water (Lake, Wetland)——Pollution Control & Sustainable Water Management

Challenges:
Pollution from plastic waste, untreated sewage, and agricultural runoff.
Over-extraction of water resources for tourism and farming.
Disruption of aquatic ecosystems due to motorized boats and excessive human activity.
Recommendations:
Strict Waste Management Regulations: Enforce bans on single-use plastics and promote waste collection systems.
Sustainable Water Use Policies: Implement controlled irrigation systems and water recycling programs.
Eco-Friendly Transportation: Replace motorized boats with non-invasive alternatives like solar-powered or paddle boats.
Wetland Buffer Zones: Restrict construction and farming near sensitive wetland areas to protect biodiversity.



Karst Landscape (Karst Caves, Karst Towers)——Conservation & Controlled Access
Challenges:
Structural damage from climbing, graffiti, and unauthorized entry.
Pollution and erosion due to uncontrolled foot traffic.
Recommendations:
Controlled Access & Guided Tours: Implement permits and restrict visitor numbers in sensitive geological sites.
Eco-Friendly Trails & Infrastructure: Construct boardwalks and designated viewing areas to prevent erosion.
Conservation Fund: Allocate a portion of tourism revenue to restoration and monitoring of karst formations.
Strict Climbing & Exploration Rules: Prohibit unauthorized climbing and caving activities.

Animals (Birds, Fish)——Wildlife Protection & Eco-Tourism Guidelines
Challenges:
Habitat destruction due to unregulated tourism development.
Disruption of breeding and feeding patterns due to excessive human activity.
Illegal fishing and over-extraction of aquatic resources.
Recommendations:
Wildlife Protection Zones: Designate no-tourism zones during breeding seasons.
Eco-Tourism Guidelines: Train guides to enforce safe wildlife viewing distances and prohibit feeding wild animals.
Sustainable Fishing Regulations: Introduce quotas and community-based fisheries management.
Educational Campaigns: Promote awareness of local species and their role in the ecosystem.

Plants (Lotus, Rapeseed, Peach)——Tourism Route Management & Sustainable Agriculture
Challenges:
Damage from tourists trampling and unauthorized picking.
Over-commercialization leading to monoculture and loss of biodiversity.
Pollution affecting plant health, especially in water bodies.
Recommendations:
Tourism Route Management: Establish designated pathways to minimize damage.
Seasonal Visitor Quotas: Limit access during peak flowering seasons to prevent over-tourism.
Sustainable Agriculture Practices: Promote crop rotation and organic farming methods to preserve soil health.
Educational Eco-Tours: Offer guided experiences that teach visitors about native flora and their ecological significance.

8.3 COMPREHENSIVE ENGAGEMENT STRATEGIES

Scientific relevance

This research contributes to the theoretical development of overtourism management by integrating multi-scalar analysis, CES evaluation, and stakeholder collaborative governance. Through data-driven spatial planning and management methods, the study enriches the field of sustainable tourism. By incorporating VR/AR technologies, the research also introduces innovative tourism management approaches that minimize direct environmental impacts while enhancing the interaction between cultural and natural resources. Moreover, by comparing global karst destinations, the research deepens the understanding of karst ecosystem management and provides valuable lessons for other ecologically vulnerable areas worldwide.

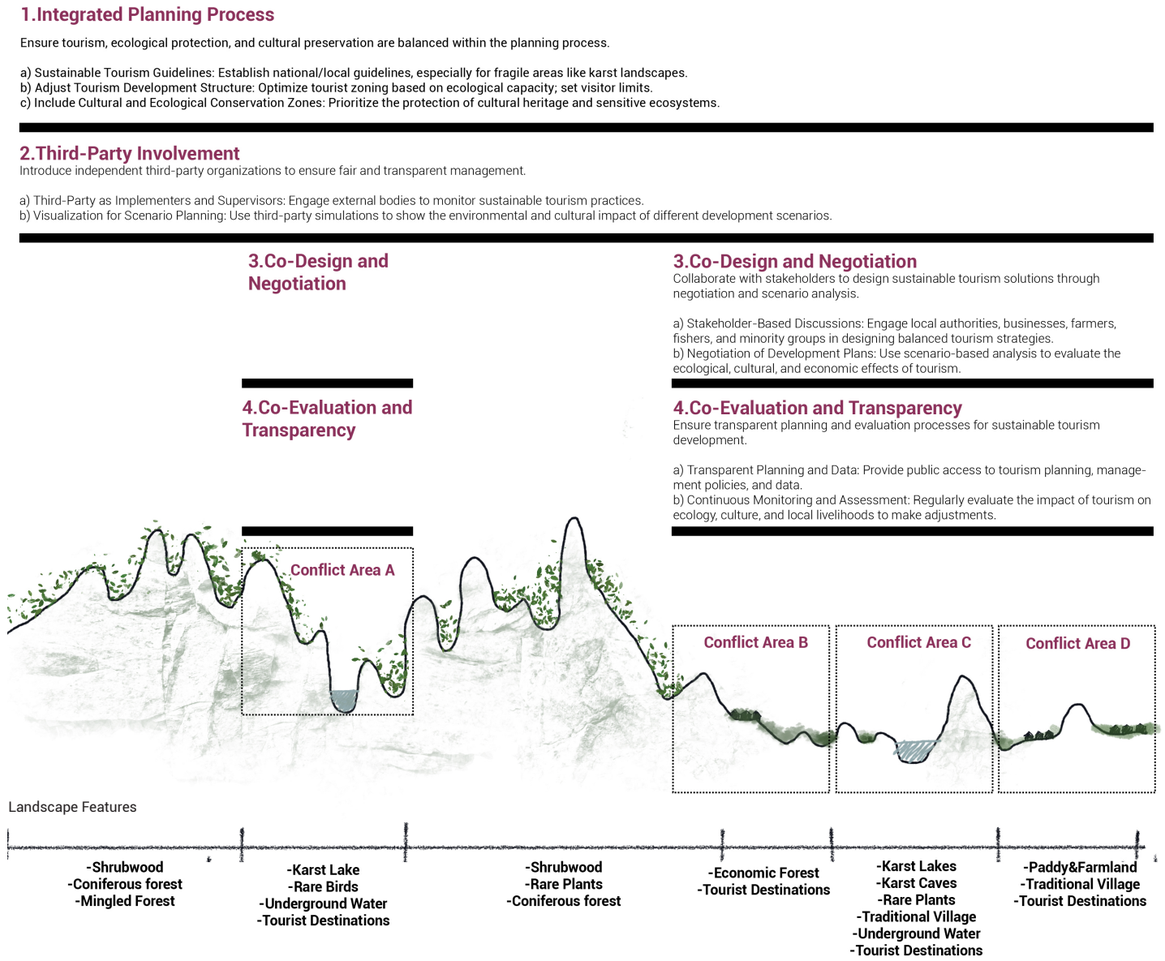


Figure 75- Spatial Conflicts within Stakeholders

8.3 COMPREHENSIVE ENGAGEMENT STRATEGIES

Scientific relevance

This research contributes to the theoretical development of overtourism management by integrating multi-scalar analysis, CES evaluation, and stakeholder collaborative governance. Through data-driven spatial planning and management methods, the study enriches the field of sustainable tourism. By incorporating VR/AR technologies, the research also introduces innovative tourism management approaches that minimize direct environmental impacts while enhancing the interaction between cultural and natural resources. Moreover, by comparing global karst destinations, the research deepens the understanding of karst ecosystem management and provides valuable lessons for other ecologically vulnerable areas worldwide.

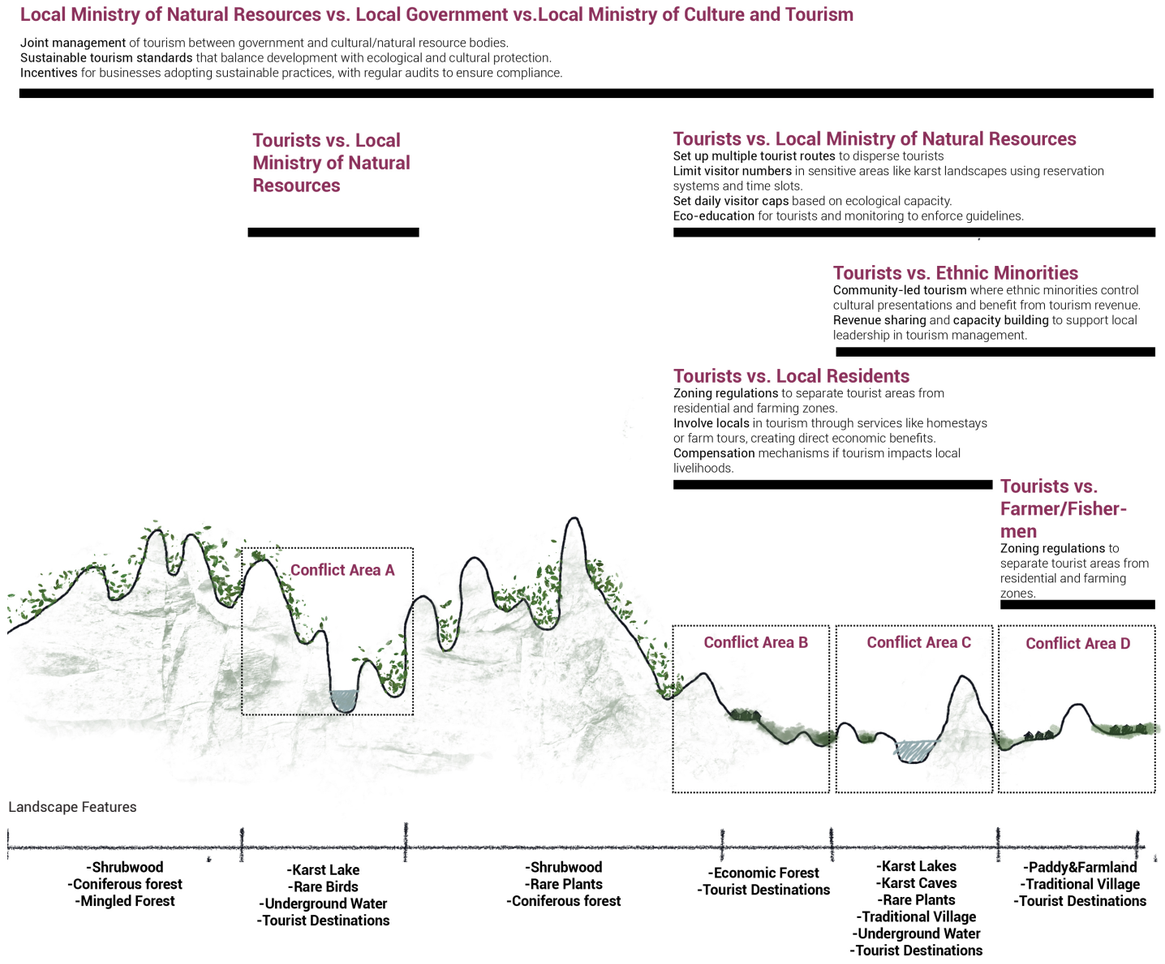


Figure 76- Spatial Conflicts within Stakeholders

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CHAPTER 9: STRATEGIC RECOMMENDATIONS

The design toolkit is selectively matched with the four typological zones based on ecological sensitivity and tourism suitability. Ecological Restoration and Oral History Paths are prioritized in Topology 1 and 3 to protect sensitive ecosystems while offering non-intrusive experiences. Market Activity and Cultural Edges are introduced in Topology 2 where tourism development is encouraged. Topology 4 focuses on landscape and cultural activation tools like Restoration Edges and Living Interfaces, supporting long-term improvement.

9.1 DESIGN TOOLKIT

I. Typology and Strategy Logic

Topology	Key Features	Recommended Strategy Logic
T1: Ecologically Sensitive + Highly Attractive	High ecological value and tourism appeal; requires strict access control and protection	✔ Ecological restoration ✔ Non-intrusive interactions ✔ Limited accessibility
T2: Priority Tourism Development Zone	High tourism value with acceptable ecological resilience	✔ Market activities ✔ Cultural experiences ✔ Infrastructure enhancement
T3: Strict Conservation Area	Low visitor appeal but high ecological importance	✔ Full conservation ✔ No development ✔ Ecological monitoring
T4: Potential Reserve Area	Moderate ecological and tourism potential	✔ Landscape restoration ✔ Cultural integration ✔ Community participation

II. Design Toolkit vs. Typology Zones

Strategy/Tool	T1	T2	T3	T4	Notes:
1.Ecological Restoration Edge	✅		✅	✅	Boundary restoration / wetlands / buffers
2.Scenic Interaction Edge	⚠️	✅			Low-impact landscape interface
3.Cultural Living Edge		✅		✅	Cultural activation along village edges
4.Interactive Installations	⚠️	✅			Non-intrusive, better suited for T1
5.Market Activity Edge		✅	❌	⚠️	T4 requires careful planning
6.Oral History Path	✅	⚠️		✅	Low-impact cultural storytelling routes

1: ECOLOGICAL RESTORATION EDGE

Figure 77- Ecological Restoration Edge

Ecological Restoration
This strategy involves systematic efforts to restore ecological functions, including wetland hydrology, native vegetation, aquatic habitat, and pollinator networks. Restoration may target degraded agricultural lands, polluted water edges, or previously drained wetlands. Interpretive areas with signage or observation decks allow the public to learn about succession, biodiversity, and human impact mitigation.

2: SCENIC INTERACTION EDGE

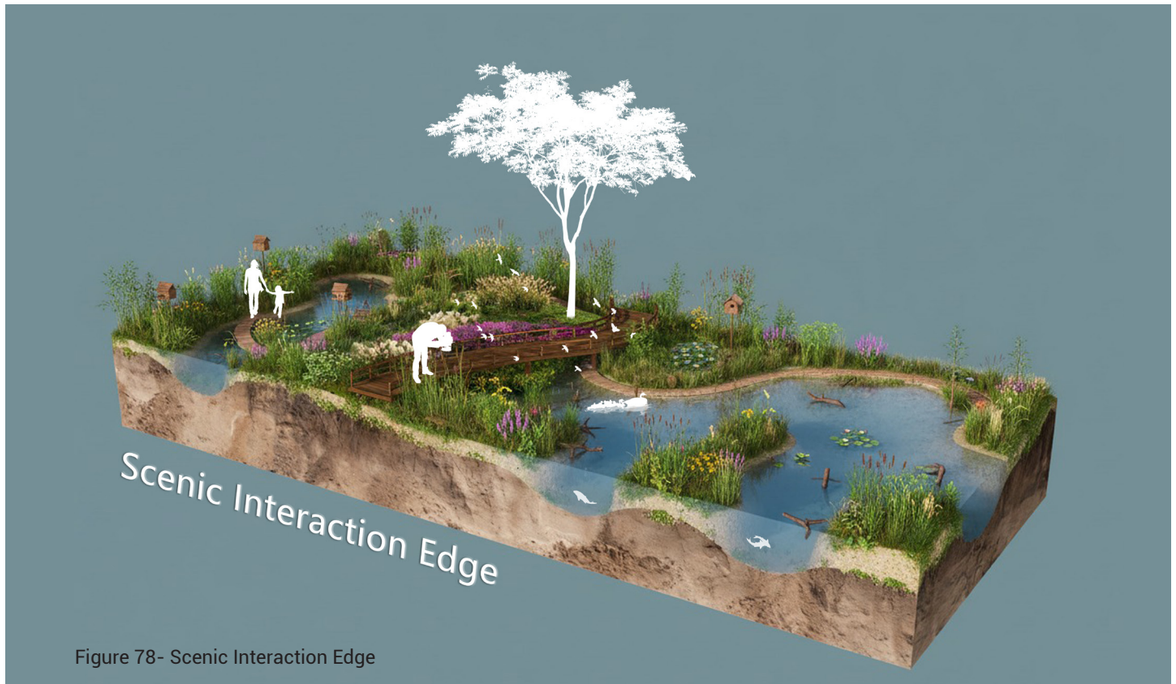
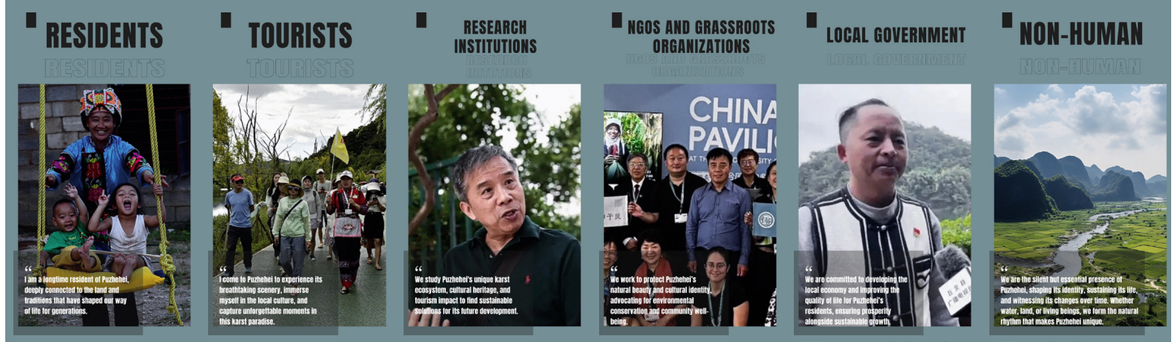


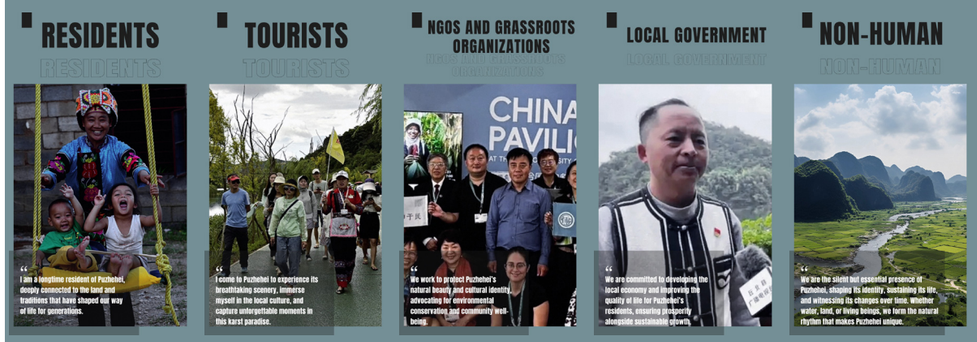
Figure 78- Scenic Interaction Edge



Scenic Interaction
These are sensitively designed scenic points along trails, wetlands, and viewing decks that allow visitors to approach nature without disrupting it. They may include bird hides, floating walkways, shaded platforms, and suspended decks. Visual and auditory immersion is encouraged, while physical contact is controlled. These structures must balance accessibility, aesthetics, and ecological sensitivity.

3: CULTURAL LIVING EDGE

Figure 79- Cultural Living Edge



Core actors who define openness and use

Observe respectfully and appreciate local rhythms

Promote respect for everyday cultural practices

Manage public safety and cultural landscape preservation

Designs must balance daily human activity with nearby natural systems

Cultural Living Spaces
These are semi-public areas within or near villages where traditional daily practices still take place, such as laundry, food drying, boat docking, or gathering spaces. Rather than staging culture for tourists, these spaces preserve authenticity and invite silent observation. Signage may explain usage, but the atmosphere is intimate and slow-paced.

4: MARKET ACTIVITY EDGE

Figure 80- Market Activity Edge

Main participants and beneficiaries (as vendors)

Engage through consumption and social exchange

Study local economic and tourism dynamics

Support local entrepreneurship and creative industries

Regulate and maintain market operations

Market design must include proper waste disposal and noise control

Market Activity
Open-air or semi-permanent markets located near village entrances or along scenic corridors. These markets feature local produce, handmade crafts, indigenous foods, and seasonal goods. They foster cultural exchange and support local economies. Infrastructure includes modular stalls, shade structures, water access, and waste management stations.

5: INTERACTIVE INSTALLATIONS

Figure 81- Interactive Installations

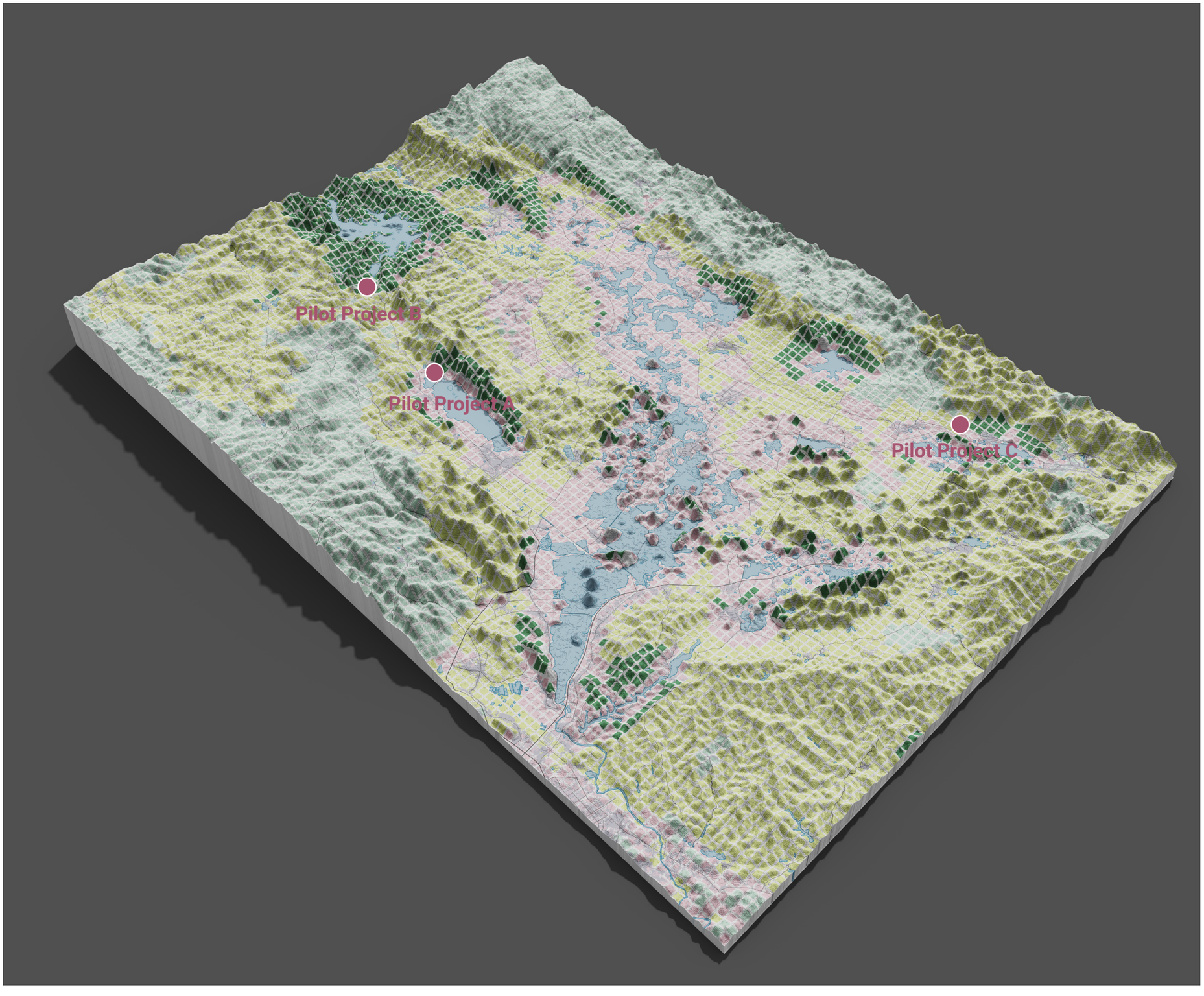
Interactive Installations
These are spatial and artistic installations integrated into key locations such as plazas, trail intersections, or entrances. They may include kinetic sculptures, water-triggered sound devices, species recognition screens, or co-creation walls where visitors can leave marks or stories. The goal is to spark emotional engagement with place through sensory interaction, storytelling, and participatory creation.

6: ORAL HISTORY PATH

Figure 82- Oral History Path

Oral History Path
This is a curated narrative trail weaving through the cultural landscape of villages, incorporating storytelling stations, audio recordings, visual memory walls, and digital QR codes. It frames the landscape as a living archive, where locals' lived experiences, migration histories, and traditional knowledge are spatialized and publicly interpreted. Visitors walk through stories while remaining respectful observers.

9.2 PILOT PROJECT LOCATION



Typological analysis

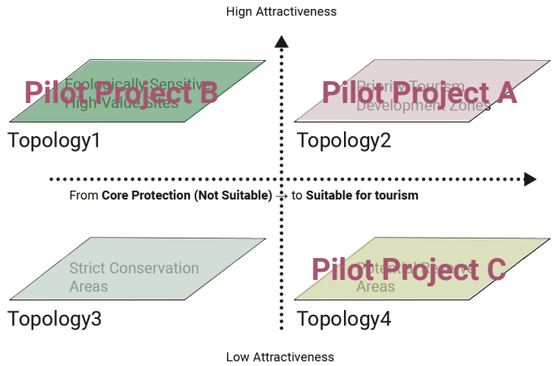


Figure 83- Pilot Project Location

This diagram illustrates a typological zoning framework based on tourism attractiveness and ecological suitability.
Each quadrant represents a distinct planning strategy, with three pilot projects positioned accordingly:

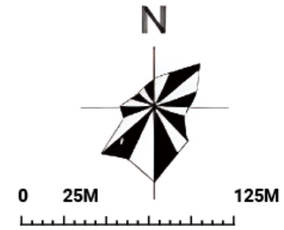
Pilot Project A (Topology 2): Located in a high-attractiveness and tourism-suitable area, ideal for cultural tourism, infrastructure, and economic development.

Pilot Project B (Topology 1): Situated in an ecologically sensitive yet attractive area, requiring non-intrusive strategies like ecological restoration and interpretive design.

Pilot Project C (Topology 4): Found in low-attractiveness areas with development potential, focusing on long-term activation through restoration and local engagement.

No project is assigned in Topology 3, which represents strict conservation zones where tourism is not suitable.

9.3 PILOT PROJECT A



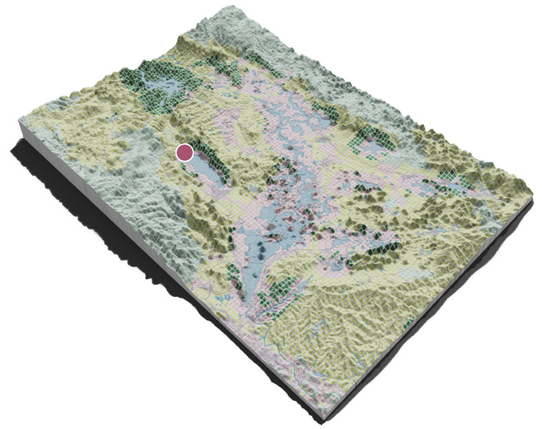
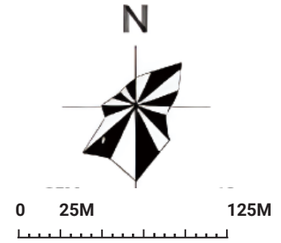


Figure 84- Pilot Project A Master Plan

The master plan presents an integrated pilot spatial design plan oriented toward ecological and cultural tourism, aiming to achieve sustainable development in the karst region through ecological restoration, cultural revitalization, and tourism management. The design is organized around a traditional village core and adapts to the natural topography and water systems, forming a multi-node, multifunctional tourism experience network. The spatial layout incorporates ecological infrastructure (such as ecological forests, wetland purification systems, and vegetation restoration), cultural exhibition and interaction spaces (including traditional architecture showcases, waterwheels, corn buildings, and local food experience zones), as well as tourism service facilities (such as a tourist center, museum, and parking areas). Features like dragon boat racing and the dragon-bone water lift highlight local water culture and enhance visitor engagement. The design emphasizes ecological sensitivity and cultural continuity, ensuring that tourism infrastructure coexists harmoniously with the local living environment. It reflects a planning philosophy where landscape functions as infrastructure and culture serves as attraction, supporting an immersive and sustainable eco-tourism model.

9.3 PILOT PROJECT B



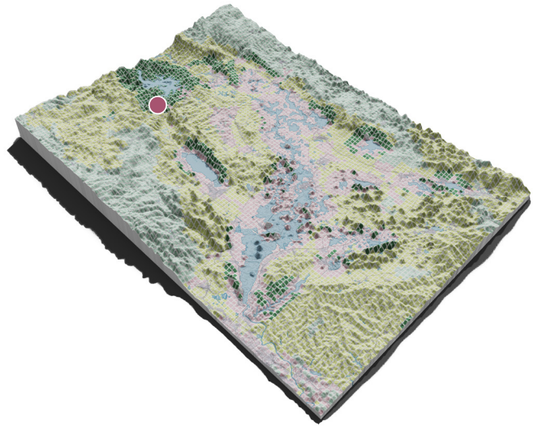
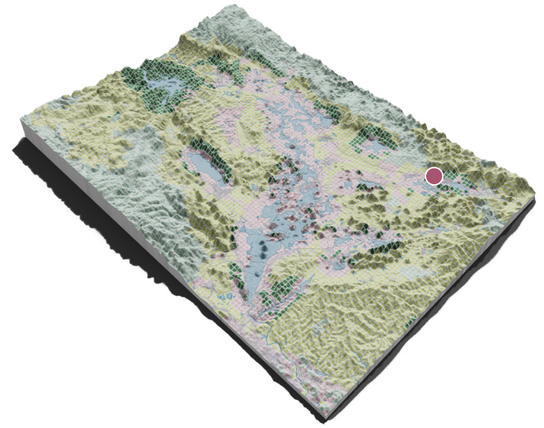


Figure 85- Pilot Project B Master Plan

This Pilot area is located on the southeast side of Bailong Lake. Bordered by water to the north and surrounded by hills on the east and west, the site is a relatively flat open space. It forms part of the overall masterplan for the Firefly Eco Wetland Park, serving as a key zone that integrates landscape, ecology, and visitor experience.

This image illustrates a detailed design plan for the Firefly Eco Wetland Park, located southeast of Bailong Lake. The site is bordered by water to the north and enclosed by hills to the east and west, forming a flat and open space ideal for ecological and recreational development. The layout centers around a flowing water system, with key features such as the Eco Island, Starlight Path, and Wishing Plaza woven into a network of boardwalks and themed zones. Spaces like the Zen Garden, Cherry Grove, and shaded retreats offer quiet reflection, while the Nature Exhibit and Light Sky Path enhance interaction and learning. Together, the design integrates ecological restoration, cultural expression, and visitor experience into a harmonious landscape.

9.3 PILOT PROJECT C



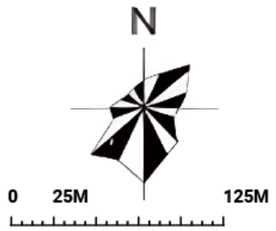


Figure 86- Pilot Project C Master Plan

The master plan is structured on three ascending terraces—earth, human, and sky—collectively known as the "three platforms." At the heart of the second terrace, the visitor center plaza features a monumental ancestor totem pillar, symbolizing the reverence and honor of ancestral heritage. At its base lies the "source" spring, representing the origin of wisdom and the pioneering spirit of the ancestors.

The overall design fosters a joyful, open, and nature-oriented atmosphere. While preserving the site's original topography and water features, carefully integrated architectural elements and spatial interventions celebrate Yi ethnic culture. Elements such as festive rituals, totem worship, and the solar calendar are embedded into the landscape, reflecting a design philosophy of "three points, one line, one ring," where time overlaps with space, and earth, humanity, and heaven harmoniously coexist.

Two elevated points remain within the site, strategically aligned with the central ancestral axis. Together, they reinforce a spatial structure that is both inwardly cohesive and outwardly expansive, guiding visual flows and enhancing the site's ceremonial and symbolic depth.

CHAPTER 10: CONCLUSION

KEY FINDINGS

In response to the overarching research question—how to balance tourism development with ecological and cultural sustainability in the karst region of Puzhehei—this study addressed three sub-questions through a mixed-methods approach combining spatial analysis, stakeholder engagement, and theoretical synthesis. The findings are summarized as follows:

Sub-Question 1: What are the economic, ecological, and cultural impacts of tourism development in Puzhehei?

Tourism development has generated both opportunities and challenges. Economically, it has contributed to the expansion of infrastructure and created employment, particularly through homestay operations and cultural tourism. However, its sustainability is undermined by seasonal fluctuations and overreliance on natural and cultural capital. Ecologically, the karst landscape has experienced significant pressure, including wetland degradation, water pollution, habitat fragmentation, and loss of biodiversity. Land use analysis from 1985 to 2022 reveals a marked increase in built-up areas and a reduction in cropland, reflecting the transition toward a tourism-dominated economy. Culturally, the commercialization of ethnic traditions has led to the transformation of authentic practices into performative spectacles. Local communities express concern over the dilution of cultural identity, calling for more respectful, community-centered tourism models.

Sub-Question 2: Which areas in Puzhehei are most suitable for tourism development based on an ecological security pattern (ESP)?

Using ecological security pattern (ESP) modeling and GIS-based multi-criteria analysis, four typologies of tourism suitability were identified:

Priority Tourism Development Zones – Areas with relatively high ecological resilience where eco-tourism can be moderately developed.

Strict Conservation Areas – Ecologically fragile zones such as wetland cores and water source protection areas, where development should be prohibited.
Ecological Restoration Zones – Sites requiring urgent intervention to restore degraded habitats.
Potential Reserve Areas – Currently unsuitable for development, but may serve as future eco-tourism zones with appropriate safeguards.

These classifications were based on indicators including biodiversity value, soil erosion risk, flood regulation, landscape attractiveness, and infrastructural readiness.

Sub-Question 3: What spatial planning strategies can be developed to achieve economic, ecological, and cultural balance in Puzhehei?

An integrated planning framework is proposed, emphasizing three strategic dimensions:

Ecological Dimension: Define ecological redlines, enhance landscape connectivity, and implement a multi-scalar protection system based on ESP outcomes.

Cultural Dimension: Support the living heritage of local ethnic communities through participatory conservation, festival revitalization, and culturally sensitive tourism programs.

Economic Dimension: Promote small-scale, low-density tourism development, such as eco-agriculture, artisan workshops, and sustainable accommodation.

Implementation strategies include:

A Design Toolkit offering tailored spatial interventions;
Pilot Projects that demonstrate feasible models of eco-cultural integration;
Phased Implementation balancing short-term actions with long-term governance innovation

Stakeholder collaboration is identified as a critical enabler of sustainable transformation, requiring institutional mechanisms that integrate local knowledge, cross-sector governance, and ecological compensation policies.

11 REFLECTION

This chapter reflects on the research process and findings by critically examining the methodological choices, design strategies, and broader implications for sustainable tourism governance in ecologically and culturally sensitive regions such as Puzhehei. It highlights the tension between technical tools and lived realities, explores the transformative potential of design interventions, and proposes governance pathways grounded in interdisciplinary understanding.

10.2.1 Methodological Reflection:
Integrating Data with Lived Experience
Guiding Question: How can data-driven analysis be meaningfully integrated with local, lived knowledge?

While geospatial tools such as GIS and remote sensing were essential in modeling land use changes and constructing the Ecological Security Pattern (ESP), they alone were insufficient for capturing the full complexity of tourism-induced transformation in Puzhehei. Quantitative data revealed spatial shifts and ecological risks, but did not fully explain the social dynamics behind those changes.

To bridge this gap, the research incorporated fieldwork, including stakeholder interviews and policy reviews, which uncovered deeper concerns such as inequitable resource access, limited livelihood transitions, and the commodification of cultural space. These insights reaffirm Flyvbjerg's (2001) argument that social science must engage with context-dependent, value-laden knowledge. This dialectical approach—connecting "data facts" with "experiential truths"—enhanced the analytical depth and social relevance of the research.

10.2.2 Design and Planning Reflection:
Evaluating Spatial Tools and Participatory Gaps
Guiding Question: What are the strengths and limitations of the planning and design methods applied in this study?

The integration of ESP modeling with a tourism suitability matrix enabled the identification of zones where development could occur with minimal ecological disruption. The four-quadrant zoning framework provided a flexible planning tool to spatially balance ecological constraints and tourism potential.

However, limitations emerged in both data availability and stakeholder access. Some ecological datasets lacked sufficient resolution for site-specific decisions, while time constraints restricted deeper engagement with local residents. Future studies should consider multi-season ecological monitoring and long-term participatory planning processes to enhance context sensitivity.

Despite these constraints, the pilot design interventions illustrated the role of architecture and landscape strategies as mediators between ecology and culture. Rather than imposing a generic eco-tourism model, the study embraced place-based planning, aligning spatial form with local narratives, practices, and aspirations.

10.2.3 Rethinking Rural Tourism Paradigms

Guiding Question: What kind of development paradigm is needed for ecologically and culturally sensitive regions like Puzhehei?

The findings suggest a necessary shift from extractive tourism models—focused on resource consumption and economic maximization—toward a regenerative paradigm grounded in stewardship, cultural continuity, and ecological care. In Puzhehei, tourism must not be treated as a stand-alone economic driver, but as part of an interdependent system that supports local identity, biodiversity, and social resilience.

Design, in this context, becomes a tool not just for spatial ordering, but for cultural affirmation and ecological repair. By centering local knowledge and practice, planning can resist homogenization and foster inclusive development rooted in place.

10.2.4 Policy Implications: Toward Multi-Level and Adaptive Governance

Guiding Question: What governance mechanisms are necessary to support sustainable tourism in fragile karst areas?

This research generates several policy recommendations:

First, the Ecological Security Pattern (ESP) should be formally adopted into regional planning frameworks to guide land-use zoning and limit tourism encroachment in sensitive areas.

Second, tourism policies must include carrying capacity assessments and ecosystem service valuation as prerequisites for infrastructure investment and development approval.

Third, cultural preservation must go beyond heritage documentation to be embedded in planning standards and tourism regulations. Ethnic minority communities should be regarded as co-creators of tourism content, not just passive subjects of observation.

Finally, governance structures must be multi-level, cross-sectoral, and adaptive, enabling coordination among environmental agencies, tourism authorities, local governments, and community stakeholders. Only through integrated governance can ecological resilience and cultural sustainability be jointly achieved.

10.2.5 Summary

In sum, this chapter has reflected on the interplay between spatial modeling, field-based insights, and policy design. It emphasizes that contextual sensitivity, interdisciplinary integration, and community participation are not optional add-ons but foundational to planning tourism in ecologically and culturally vulnerable landscapes like Puzhehei.

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RESIDENT QUESTIONNAIRE

1. Person information
1.1 What is your age group?
18-25 years
26-40 years
41-60 years
61 years and above
1.2 What is your ethnicity?
(Please specify)
1.3 Are you a permanent or temporary resident?
Permanent resident
Temporary resident
If temporary, what brought you to this area? (e.g., work, tourism, study, other)

2. Tourism Impact: Evaluating both positive (e.g., income) and negative (e.g., commercialization) effects on the community.
2.1 What is your main source of income?
Tourism
If tourism, please specify (e.g., accommodation, guiding, other)
Farming
A combination of tourism and farming
Other (please specify)
2.2 Has tourism brought economic benefits to your community?
Yes
If yes, in what ways? (e.g., job opportunities, higher income, other)
No
2.3 How has tourism affected your community?
(Please describe briefly)
2.4 Do you feel that tourism has impacted your daily life?
Yes
No
2.5 If yes, what specific impacts of tourism have you experienced? (Select all that apply)
Environmental changes (positive or negative)
Changes in cultural traditions (positive or negative)
Changes in living space
Changes in privacy levels
Other (please specify)
2.6 What are visitors' attitudes toward your culture?
Very respectful
Somewhat respectful
Neutral
Somewhat disrespectful
Very disrespectful
2.7 Are there misunderstandings or biases about your culture among visitors?
Yes (Please specify)
No
2.8 Have you participated in the development of the tourist area?
Yes
No
2.9 In your opinion, should the number of tourists be managed or regulated?
Yes
No
Not sure

3. Cultural Identity: How communities preserve and promote their cultural values through tourism, focusing on traditions, festivals, and crafts.
3.1 What cultural traditions do you think tourists should learn about?
(Please list or describe briefly)
3.2 How do you feel about tourists participating in local cultural festivals or events?
Very open
Somewhat open
Neutral
Somewhat opposed
Very opposed

4. Community Infrastructure and Housing
4.1 How satisfied are you with the following in your village?
a. Transport services
Very satisfied
Satisfied
Neutral
Dissatisfied
Very dissatisfied
b. Shopping facilities meeting your daily needs
Very satisfied
Satisfied
Neutral
Dissatisfied
Very dissatisfied
4.2 How would you rate the quality of your housing compared to ten years ago?
Improved
No change
Declined

5. Sustainability: Exploring how economic growth can align with cultural and environmental preservation.
5.1 How can tourism be made more sustainable in your community?
(Please share your suggestions)

TOURIST QUESTIONNAIRE— M-GAM MODEL VALUE-TOURISTIC VALUE

Source：Antić, A., Marković, S. B., Marković, R. S., Cai, B., Nešić, D., Tomić, N., ... & Hao, Q. (2022). Towards sustainable karst-based geotourism of the mount Kalafat in southeastern Serbia. Geoheritage, 14(1), 16.

1.What is your age group?
18-25 years
26-40 years
41-60 years
61 years and above
2.Promotion
How did you learn about Puzhehei?
Social media
Recommendation from friends
Travel agencies
Official tourism website
Others: _____
How would you rate the effectiveness of Puzhehei's tourism promotion? (1-5, where 1 = very poor and 5 = excellent)

3. Organized Visits
Did you join a group tour organized by a travel agency or guide?
Yes
No
If yes, how satisfied are you with the organization of the tour? (1-5)

4. Vicinity of Visitor Centers
Did you visit the Puzhehei visitor center?
Yes
No
How would you rate the convenience of the visitor center's location? (1-5)

5. Interpretative Panels
Did you notice the interpretative panels within the scenic area?
Yes
No
Are the interpretative panels clear and educational? (1-5)

6. Number of Visitors
Do you think the current number of visitors has impacted your experience?
Significantly impacted
Somewhat impacted
Not impacted

7. Tourism Infrastructure
How would you rate the quality of the following facilities? (1-5)
Parking lots
Public restrooms
Scenic area pathways

8. Tour Guide Service
Did you use the tour guide service provided in the scenic area?
Yes
No
How would you rate the professionalism and attitude of the tour guide service? (1-5)

9. Hostelry Service
Did you stay at any accommodation facilities in Puzhehei?
Yes
No
How satisfied are you with the accommodation? (1-5)
What type of accommodation do you prefer?
Homestays
Hotels
Youth hostels

10. Restaurant Service
Did you dine at restaurants in Puzhehei?
Yes
No
How would you rate the following aspects of the restaurant service? (1-5)
Food taste
Service quality
Hygiene standards

11.Culture and Entertainment
What cultural activities did you participate in during your visit?
(Please list the activities, e.g., scenic boat tours, fishing, cultural festivals, visiting local villages, attending performances, etc.)

What aspects of the local culture impressed you the most?
(e.g., traditional music, ethnic clothing, local customs, food culture, historical sites, etc.)

How would you rate your experience of the local culture? (1-5)
Very satisfied\Satisfied\Neutral\Dissatisfied\Very dissatisfied

What specific elements of the cultural experience did you enjoy or find lacking?

Do you have any suggestions for improving cultural experiences for future visitors?

INTERVIEW GUIDING QUESTION

Government Interview

Impact of Rising Prices

How have rising prices (e.g., housing, food, services) due to tourism affected local residents?

Are residents relocating because of these price increases? How does this impact the community?

Tourism Facilities During Off-Peak Seasons

What are your thoughts on the unused tourism facilities during the low season?

How could these facilities be better utilized during off-peak times?

Community Engagement

How can local communities participate in decisions about tourism development in karst areas?

Sustainability Monitoring

What measures could ensure tourism operators follow sustainable practices?

NGOs Interview

I. Organizational Background & Personal Role

What is your role in the Farmer Seed Network? What are your primary responsibilities?

Can you briefly introduce the background and mission of the Farmer Seed Network?

II. NGO's Role & Positioning

How does the Farmer Seed Network position itself in the protection of agricultural biodiversity?

In your opinion, what is the most important function of an NGO—service, advocacy, or education?

Are there any successful cases of advocacy campaigns, demonstration projects, or collaborations with the government?

III. Collaboration & Multi-Stakeholder Coordination

How does the Farmer Seed Network connect with local farmers and enhance their awareness and techniques for seed preservation?

How does the network collaborate with the government and research institutions? Have there been any challenges in such collaborations, and how were they addressed?

Does the network collaborate with other NGOs or international organizations? What insights or resources have these partnerships provided?

IV. Public Engagement & Educational Outreach

How does the Farmer Seed Network promote public participation in agricultural biodiversity conservation?

Are there any public-facing activities or projects, such as education programs, awareness campaigns, or volunteer initiatives?

How does the network attract urban residents or young people to participate in traditional agricultural conservation? Does it use social media or digital resources for outreach?

V. Function & Value Contribution

What is the most significant contribution of the Farmer Seed Network to local communities? What achievements have been made?

What are the biggest challenges encountered in seed conservation and promotion? What additional roles could the network play?

VI. Recommendations for the Puzhehei Karst Region

Do you have any understanding of the ecological environment and agricultural development in the Puzhehei Karst region?

Could the experiences of the Farmer Seed Network be applied to the Puzhehei region?

Regarding ecological conservation and cultural heritage preservation, what are your recommendations? How can tourism and agricultural development be balanced?

INTERVIEW AUDIO TRANSCRIPT SUMMARY

Interview Record 1—NGO Organizations and Public Participation

The interview focuses on tourism, cultural preservation, and ecological balance in Puzhehei. The interviewee represents an NGO dedicated to agricultural biodiversity, particularly heirloom seed conservation. The organization, established in 2013 and officially registered in 2018, operates in Beijing, Lijiang, Nanning, and Suzhou. It collaborates with research institutions and government bodies to integrate agriculture, ecology, and cultural preservation.

Key Initiatives

The NGO promotes heirloom seeds through different regional models, integrating market-driven approaches and community involvement. In the north, it partners with ecological farms; in Yunnan, it works with small farmers; in Guangxi, it explores market expansion; and in Jiangsu, it connects with organic farms. Additionally, it supports women's employment through hospitality and handicrafts, establishes community seed banks, and collaborates with village leaders.

Public Engagement

The NGO raises awareness via farmers' markets, photography exhibitions, reading clubs, and digital platforms like WeChat, Bilibili, and YouTube. It also submits policy briefs advocating local biodiversity and ecological protection.

Challenges and Solutions

Tourism in Puzhehei heavily depends on a single industry, leading to economic stagnation. Drawing from Lijiang's success, small-scale community tourism integrating agriculture is recommended. Government support varies—stronger in the north but limited in Yunnan, requiring NGOs to invest time in building trust. Cultural conservation, such as the Dongba tradition, highlights the potential for harmonious ecological protection.

Impact and Future Directions

The NGO enhances community confidence, promotes sustainable development, and serves as a model for other regions. However, financial constraints, limited government support, and cross-cultural barriers remain challenges. Adapting Lijiang's model to Puzhehei can foster diversified, community-led tourism while maintaining ecological and cultural integrity.

INTERVIEW AUDIO TRANSCRIPT SUMMARY

Interview Record 2—Government & Former Village Chief

Background & Themes

The interview took place in Xianrendong Village, Puzhehei, Yunnan, focusing on tourism development, planning practices, and cultural and ecological protection. The village, predominantly inhabited by the Yi ethnic group, relies on tourism as its primary economic source. Its overall architectural planning maintains a unified ethnic style, reflecting cultural heritage and regional characteristics.

Village Tourism Development

Xianrendong Village gradually transitioned from a traditional fishing and farming economy to a tourism-based model starting in 2006. By 2014, architectural planning was strictly regulated to enhance the village's appeal, attracting more visitors. The peak season from May to October brings up to 20,000 visitors daily. Tourism activities include locally owned homestays, Yi cultural experiences such as the Flower-Picking Festival, traditional weddings, and seasonal summer activities like water fights. However, winter sees a drop in visitors, highlighting the need for additional off-season attractions. While tourism generates significant income, numbers have declined since 2019 due to economic shifts and the pandemic, reducing the utilization of tourism facilities.

Village Planning & Aesthetic Management

Xianrendong Village follows strict planning practices, with all new buildings required to adhere to predefined architectural styles emphasizing cultural and ecological preservation. Kunming Ricefield Design Team led the planning to maintain a cohesive ethnic aesthetic. Compared to neighboring villages, Xianrendong successfully preserves its cultural identity, whereas other villages suffer from unregulated construction, excessive external investments, and abandoned buildings. To sustain tourism quality, villagers require ongoing training in service skills and cultural integration. Village leaders play a crucial role in educating residents on balancing economic interests with long-term cultural sustainability.

Cultural Preservation & Ecological Sustainability

Traditional festivals such as the Flower-Picking Festival, Yi weddings, and community feasts serve as cultural highlights attracting visitors. Additionally, intangible cultural heritage elements like folk singing, instrument crafting, and traditional dance offer untapped tourism potential. However, challenges include the increasing presence of external tenants diluting local traditions and a decline in local participation in cultural activities. Solutions include developing long-term tourism initiatives that integrate traditional practices, such as transforming fishing and farming into interactive tourist experiences. Encouraging local participation can also strengthen cultural confidence and sustainability.

External Factors & Governance Issues

Government support for Xianrendong Village's development has been limited, with inconsistent policies and frequent leadership changes affecting planning continuity. Strengthening local government planning capabilities is crucial to ensuring sustainable growth while preserving cultural identity. A comparative analysis of similar villages highlights potential risks: Dali's Shuanglang Village struggles with excessive external investments and cultural erosion, while Shaxi Village maintains better aesthetic control but sees reduced local participation. Xianrendong's integrated approach to architecture and ethnic culture positions it as a model for sustainable tourism in Yunnan.

Former Village Chief's Experience & Views

The former village chief played a pivotal role in Xianrendong's transformation. Since 2006, he has led tourism development, formalizing architectural regulations and guiding villagers toward a sustainable tourism economy. Serving as village chief from 2012 to 2022, he emphasized the importance of aesthetic consistency and cultural preservation in tourism planning. He believes frequent leadership changes disrupt long-term initiatives and advocates for improved governance mechanisms to maintain planning consistency.

Conclusion & Recommendations

Xianrendong Village excels in tourism development, architectural management, and cultural preservation but faces challenges related to seasonal economic fluctuations and external investment pressures. Key recommendations include enhancing local cultural involvement to prevent commercialization, expanding winter tourism events to reduce seasonal economic instability, ensuring consistent government support for long-term planning, and promoting Xianrendong's success as a model for nearby villages.

INTERVIEW AUDIO TRANSCRIPT SUMMARY

INTERVIEW AUDIO TRANSCRIPT SUMMARY

Interview Record 3—Local Villager & Homestay Operator A

Village Background & History

Xianrendong Village, located in Qiubei County, Wenshan Prefecture, Yunnan Province, is part of the Wenshan Zhuang and Miao Autonomous Prefecture. Traditionally, the village's economy relied on agriculture and animal husbandry, with fishing and farming being the primary livelihoods. Since 2006, the village has gradually shifted towards tourism, and by 2014, a unified planning strategy was implemented. The village maintains a strong ethnic identity, with architecture featuring white walls and gray tiles, reflecting Yi ethnic characteristics.

Village Planning & Management

Aesthetic Preservation

All new constructions must strictly follow the approved architectural plans, with unauthorized modifications prohibited. Livestock farming is restricted to designated areas outside the village to minimize pollution. Scenic spots, particularly Lotus Lake, receive special protection, with a strong emphasis on maintaining cleanliness and ecological balance.

Planning Outcomes

Compared to neighboring villages, Xianrendong's planning and preservation efforts are more advanced. Other villages suffer from issues such as abandoned buildings and excessive external investment due to weak management. Visitors appreciate Xianrendong for its lotus scenery, Yi culture, and peaceful environment, making it a popular stop for tourists.

Economic & Social Development

Impact of Tourism

Tourism has significantly improved villagers' incomes, with homestays, restaurants, and cultural experiences being the main revenue sources. Most families have renovated their homes into modern homestays or ethnic-style guesthouses. The peak tourist season lasts from May to October, with self-driving tourists being the majority, while winter sees a significant decline in visitors, requiring new events to attract off-season tourists.

Changes in Lifestyle

Some villagers leave to work in urban areas, often saving money to return and build homes. Elderly villagers remain to care for children, while younger generations aspire to improve their economic status and provide better education for their children. Ethnic customs, such as Yi and Miao wedding traditions, are still practiced, though Miao marriages often occur at a young age (16-18 years old).

Ethnic & Population Structure

The majority of the population is Yi, with a smaller presence of Miao and Han residents. The influx of external investors and Han settlers poses challenges to cultural preservation. Family planning policies have had little impact on the village, and birth rates remain high among ethnic minority families. However, younger generations, facing economic pressures, are increasingly choosing to have fewer children.

Cultural Preservation & Tourism Development

Cultural Resources

Ethnic clothing, traditional festivals (e.g., Killing Pig Feast, Flower-Picking Festival), folk songs, dances, and handicrafts serve as key cultural attractions. However, modern education and economic development pose challenges to cultural heritage preservation. Recognizing the economic value of culture, villagers have begun integrating traditional elements into tourism experiences.

external investment and weak cultural identity, leading to less sustainable tourism. Regional economic imbalances remain, with market-driven economies gradually replacing traditional agricultural practices in minority communities.

INTERVIEW AUDIO TRANSCRIPT SUMMARY

improvements have been made, ongoing maintenance is necessary to sustain visitor satisfaction. Future opportunities include expanding off-season activities, introducing hands-on cultural experiences like fishing, ethnic handicrafts, and wedding performances. Strengthening online promotion via social media and collaborating with influencers can also boost visitor engagement.

Key Discussion Points

Economic Disparities

Compared to neighboring villages, Xianrendong benefits from better tourism management and economic returns. Poorly managed villages suffer from excessive external investment and weak cultural identity, leading to less sustainable tourism. Regional economic imbalances remain, with market-driven economies gradually replacing traditional agricultural practices in minority communities.

Villagers' Aspirations

Residents aim to further improve their income, housing, and education quality through tourism. They emphasize the need for continued government planning support, financial investment, and better education resources. Many villagers recognize the importance of preserving ethnic identity, believing that cultural heritage is essential for sustainable tourism.

Challenges & Recommendations

Existing Issues

Seasonal Economic Fluctuations: Tourist numbers vary greatly between peak and off-seasons, leaving some facilities underutilized.

Impact of External Investment: The increasing presence of outside investors could dilute local culture.

Infrastructure Maintenance: The costs of maintaining tourism infrastructure are high, creating financial pressure for villagers.

Recommendations

Expand Winter Tourism Activities: Introduce seasonal festivals and interactive experiences to attract visitors year-round.

Strengthen Cultural Education: Enhance the promotion and preservation of ethnic traditions to boost local cultural pride.

Enhance Government Support: Define a clear tourism strategy, ensure long-term investment, and support regional economic balance.

Promote Environmental Sustainability: Maintain ecological integrity by implementing effective waste management and conservation measures.

Conclusion

Xianrendong Village serves as a model for regional tourism development, balancing planning, ethnic culture, and economic growth. However, it faces challenges related to seasonality, cultural preservation, and financial sustainability. By improving management, diversifying tourism products, and securing stronger government support, Xianrendong can further enhance its long-term development potential.