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When Communities Become Infrastructure: A Human-Centered Perspective on Resilient Tourism Development

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Abstract

The dominant discourse on tourism resilience has traditionally emphasized physical infrastructure, environmental management, and technological solutions as key mechanisms for adapting destinations to climate change and socio-economic disruptions. While these dimensions remain essential, growing evidence suggests that the long-term sustainability of tourism destinations, particularly in remote and vulnerable regions, depends equally on less visible but equally essential community capacities. This paper introduces the concept of human infrastructure as a complementary perspective for understanding resilience in tourism development. Human infrastructure encompasses social relationships, local leadership, collective efficacy, cultural identity, community participation, intergenerational knowledge transfer, and educational capacity, which enable communities to adapt, recover, and innovate under conditions of uncertainty. Drawing upon an integrative conceptual review of the literature on tourism studies, community psychology, rural development, resilience theory, and sustainable development, this conceptual paper proposes a human-centered framework explaining how communities themselves function as adaptive infrastructures. The article argues that resilient tourism destinations emerge not only from investments in roads, visitor centers, and digital technologies, but also from investments in social cohesion, local knowledge systems, community empowerment, and cultural continuity. The paper concludes by discussing policy implications for sustainable tourism planning and proposing future research directions for operationalizing and measuring human infrastructure in tourism contexts.

Keywords: tourism resilience; community resilience; human infrastructure; sustainable tourism; climate change adaptation; vulnerable regions; social capital; community development; cultural sustainability



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1. Introduction

Tourism has long been recognized as one of the world’s most dynamic economic sectors, generating employment opportunities, supporting local livelihoods, and contributing significantly to regional development. For many rural, peripheral, and environmentally sensitive areas, tourism represents not only an economic activity but also a pathway toward social revitalization, cultural preservation, and territorial cohesion. However, the sustainability of tourism development is increasingly challenged by a rapidly changing climate. Across continents, destinations are experiencing unprecedented environmental

transformations that affect ecosystems, landscapes, infrastructure, visitor behavior, and community wellbeing. As climate-related disruptions become more frequent and severe, resilience has emerged as a central concern for scholars, policymakers, and practitioners seeking to ensure the long-term viability of tourism destinations.

The concept of resilience has gained substantial attention within tourism research, particularly as destinations face growing exposure to environmental uncertainty and socio-economic vulnerabilities. Most existing discussions have focused on the adaptive capacity of infrastructure, ecosystems, and governance systems. While these dimensions remain essential, an emerging body of evidence suggests that the ability of destinations to respond effectively to change depends equally on the capacities embedded within local communities. In many remote and vulnerable regions, the strength of social networks, local knowledge, collective action, cultural identity, and community participation often determines whether a destination merely survives external shocks or successfully transforms them into opportunities for sustainable development.

This paper argues that although contemporary tourism resilience research has increasingly acknowledged the importance of community capacities, these capacities are generally examined within separate theoretical traditions, including social capital, community resilience, adaptive capacity, participatory governance, and place identity. As a result, tourism resilience research still lacks an integrative conceptual framework capable of explaining how these complementary community resources interact as a coherent adaptive system. Building upon this observation, the present paper proposes the human infrastructure perspective as a higher-order conceptual framework that organizes these dispersed concepts within a unified explanation of tourism resilience.

1.1. Climate Change and the Future of Tourism

Climate change has evolved from being a distant environmental concern to becoming one of the most significant forces shaping the future of global tourism. Unlike many previous challenges faced by the tourism sector, climate change affects both the supply and demand dimensions of tourism simultaneously. It alters environmental conditions, transforms destination attractiveness, modifies travel behavior, influences seasonal patterns, and increases uncertainty for tourism-dependent communities. As a result, understanding tourism resilience today requires acknowledging climate change not as an external disturbance but as a structural force that is redefining the conditions under which tourism develops and operates.

Early research highlighted the profound implications of global climate change for tourism flows and destination seasonality. Changes in temperature regimes, precipitation patterns, and weather variability have the potential to redistribute tourist movements across regions and seasons, altering the comparative advantages of many destinations [1]. Destinations historically dependent on predictable climatic conditions increasingly face uncertainty regarding visitor demand, while other regions may experience temporary opportunities resulting from shifting environmental preferences.

The relationship between tourism and climate change is particularly complex because tourism is both affected by climate change and contributes to it. International tourism relies heavily on transportation systems associated with greenhouse gas emissions, creating a reciprocal relationship between tourism development and environmental change [2]. This dual role has generated growing interest in understanding how tourism can simultaneously adapt to climate impacts while contributing to broader climate mitigation efforts. Research examining tourism mobility patterns suggests that future climate mitigation policies may significantly influence travel behavior, destination accessibility, and tourism competitiveness [3].

As the consequences of climate change become increasingly visible, adaptation has emerged as a key theme within tourism scholarship. In [4], the authors argue that adaptation is no longer optional but represents a necessary component of tourism planning and destination management. Their review demonstrates that tourism systems are highly sensitive to climatic variability and that destinations differ substantially in their adaptive capacities. Such differences are particularly evident in geographically remote and socio-economically vulnerable regions, where limited resources often constrain adaptation efforts.

Some tourism sectors are already experiencing substantial impacts. European ski tourism, for example, faces growing challenges associated with declining snow reliability, changing water availability, and increasing energy demands for artificial snow production. The studies in [5–8] demonstrate that climate change is exacerbating snow-water-energy trade-offs, raising important questions regarding the long-term sustainability of winter tourism destinations across Europe. Such examples illustrate how climate change affects not only environmental conditions but also the economic and operational foundations of tourism systems.

Similarly, nature-based tourism and outdoor recreation are becoming increasingly influenced by tourists' perceptions of weather, climate variability, and environmental change. A recent systematic review [9] reveals that both actual climatic conditions and subjective perceptions of climate-related risks influence recreation choices, destination preferences, and visitor experiences. This finding highlights the importance of understanding tourism resilience not only as an environmental or infrastructural challenge but also as a psychological and social phenomenon shaped by perceptions, expectations, and adaptive behaviors.

1.2. The Resilience Imperative

Few concepts have gained as much prominence in tourism scholarship over the past decade as resilience. Initially borrowed from ecology and systems theory, resilience has evolved into a central framework for understanding how tourism destinations respond to crises, uncertainty, and rapid environmental and social change. The succession of global disruptions experienced in recent years, including climate-related disasters, economic instability, geopolitical tensions, and, most notably, the COVID-19 pandemic, has reinforced the realization that tourism systems operate in increasingly volatile environments where the ability to anticipate, absorb, adapt to, and recover from shocks is becoming a defining condition for long-term sustainability.

The growing popularity of resilience within tourism research reflects a broader shift in perspective. Instead of focusing exclusively on growth, competitiveness, and destination attractiveness, scholars have increasingly turned their attention toward the capacities that enable tourism systems to endure and transform under conditions of disruption. As a result, resilience has become one of the most frequently discussed concepts in contemporary tourism studies, although its rapid diffusion has also generated concerns regarding conceptual ambiguity and inconsistent applications across disciplines. In [10], the authors note that resilience research has often suffered from conceptual overlap and definitional inconsistencies, creating what he describes as “jingle and jangle” fallacies, whereby different phenomena are described using similar terminology or similar phenomena are labeled differently. Nevertheless, despite these conceptual challenges, resilience remains a valuable lens for understanding how tourism destinations navigate uncertainty.

Recent reviews suggest that resilience has evolved into a multidisciplinary concept encompassing individual, organizational, community, destination, and socio-ecological dimensions [11]. This broadening of scope reflects the recognition that tourism resilience

cannot be reduced to a single level of analysis. Destinations are complex systems composed of interconnected actors, institutions, infrastructures, ecosystems, and communities whose adaptive capacities influence one another. Consequently, resilience has become increasingly associated with the ability of tourism systems not merely to return to previous states after disruption but to learn, innovate, and transform in response to changing circumstances.

Research examining governance responses in disaster-affected destinations highlights the importance of coordinated planning, stakeholder collaboration, and adaptive management strategies in facilitating recovery and long-term resilience [12,13]. Such findings reinforce the idea that resilience is not solely determined by material resources but also by the quality of relationships, institutions, and collective decision-making processes operating within destinations.

The expansion of resilience research has also brought greater attention to human wellbeing and psychological dimensions. A growing body of literature demonstrates that resilience extends beyond physical recovery and economic performance, encompassing psychological wellbeing, social cohesion, and collective capacities to cope with adversity [14]. This perspective has become particularly relevant in tourism contexts, where the wellbeing of residents, workers, entrepreneurs, and visitors directly influences the sustainability of tourism systems.

Bibliometric analyses reveal a substantial increase in tourism resilience research following the pandemic, reflecting a growing recognition of resilience as a fundamental principle for sustainable tourism development [15,16]. However, these analyses also reveal a tendency for resilience studies to concentrate on crisis management, organizational adaptation, infrastructure planning, and governance mechanisms, often overlooking deeper social and community-level processes that shape adaptive capacity. Indeed, much of the current resilience discourse remains heavily influenced by infrastructural and engineering perspectives. Within this view, resilience is frequently associated with the capacity of physical systems to withstand shocks, maintain functionality, and recover after disruption. As a result, tourism resilience strategies often prioritize investments in transportation networks, visitor facilities, protective structures, environmental monitoring systems, climate adaptation technologies, and risk-management frameworks. Environmental adaptation measures, nature-based solutions, and socio-ecological planning approaches have similarly become central components of contemporary resilience agendas.

While these approaches are undoubtedly important, they often imply that resilience can be engineered primarily through physical interventions and technological solutions. Yet, evidence increasingly suggests that destinations possessing comparable infrastructures may experience markedly different recovery trajectories following crises. Some communities demonstrate remarkable adaptive capacities despite limited material resources, whereas others struggle to recover despite substantial investments in infrastructure and institutional support.

Recent developments in tourism resilience research increasingly acknowledge this complexity. In [17], the authors argue that tourism destinations should be understood as social-ecological systems characterized by dynamic interactions among environmental, economic, institutional, and social dimensions. Their framework highlights the importance of moving beyond narrow infrastructural understandings of resilience toward more integrated perspectives capable of capturing the adaptive capacities embedded within communities themselves.

Furthermore, studies of tourism entrepreneurship emphasize the importance of psychological and social capital as critical resources for resilience. Entrepreneurs operating in tourism and hospitality sectors rely not only on financial and material assets but also on optimism, self-efficacy, social support, trust, and community relationships to navi-

gate uncertainty and sustain their activities [18]. These findings suggest that resilience is fundamentally a human phenomenon before it becomes an infrastructural one.

Contemporary tourism scholarship demonstrates that resilience is no longer a peripheral concept but a central organizing principle for understanding sustainable tourism development in an era of uncertainty. However, despite significant advances, an important question remains insufficiently explored. If resilience depends on much more than physical infrastructure, why do some communities recover, adapt, and thrive despite limited resources, while others struggle despite substantial investments in infrastructure and technological solutions?

1.3. The Missing Question

The literature on tourism resilience has generated substantial knowledge regarding crisis management, destination governance, environmental adaptation, social capital, community resilience, and organizational recovery. These studies demonstrate that community-based resources play a central role in destination adaptation. Nevertheless, these resources have generally been examined as separate theoretical constructs rather than as interacting components of a single adaptive system.

Hence, an important conceptual question remains insufficiently addressed: how do these different community capacities together generate tourism resilience? While previous research has convincingly demonstrated their individual importance, a comprehensive framework explaining their interaction remains largely theoretically disconnected from tourism resilience scholarship.

Instead of identifying new community factors, the present paper argues that existing community capacities, including social cohesion, local leadership, community participation, cultural identity, trust, collective efficacy, intergenerational knowledge, and educational resources, should be understood as interacting components of a common adaptive infrastructure.

In many remote and vulnerable tourism regions, resilience emerges not simply because infrastructure exists, but because communities possess the capacity to mobilize available resources, coordinate collective action, preserve local knowledge, and maintain a shared vision for the future. Such capacities cannot be fully explained through infrastructural or environmental variables alone. They point toward the existence of a deeper layer of resilience embedded within the social fabric of communities.

Recognizing this gap requires a shift in perspective, from viewing communities as beneficiaries of resilience interventions to understanding them as active infrastructures of resilience themselves.

1.4. Aim of the Paper

Building upon this premise, the aim of the present paper is to develop a human-centered perspective on tourism resilience by introducing the concept of human infrastructure. The paper argues that resilience in tourism destinations should not be understood solely through physical infrastructure, environmental adaptation measures, or governance mechanisms. Instead, resilience also emerges from the capacities embedded within communities themselves, including social relationships, local leadership, cultural continuity, collective efficacy, educational resources, and participatory processes.

By conceptualizing communities as a form of infrastructure, the article seeks to broaden current understandings of tourism resilience and provide a complementary framework capable of explaining why some destinations demonstrate remarkable adaptive capacities despite limited material resources. Based on an integrative conceptual review,

the paper proposes human infrastructure as a foundational yet often insufficiently integrated dimension of resilient tourism development.

Ultimately, the article aims to contribute to ongoing debates concerning climate adaptation, sustainable tourism, and regional resilience by highlighting the central role that people, relationships, and community capacities play in shaping the future of tourism in remote and vulnerable regions.

1.5. Theoretical Positioning and Contribution of the Human Infrastructure Perspective

The growing body of research on tourism resilience has substantially expanded our understanding of how destinations prepare for, respond to, and recover from environmental, economic, and social disturbances. Over the past two decades, scholars have developed a rich array of concepts—including social capital, adaptive capacity, community resilience, participatory governance, place identity, and community capacity building—to explain why some destinations are better equipped than others to cope with uncertainty. These perspectives have significantly advanced resilience research by demonstrating that resilience depends not only on material assets but also on the social, institutional, and cultural characteristics of communities.

At the same time, the diversity of these conceptual traditions has created a fragmented theoretical landscape. Each construct emphasizes a specific aspect of community functioning, yet they differ in their disciplinary origins, analytical focus, and explanatory purpose. Social capital primarily explains the relational resources that facilitate cooperation and trust; adaptive capacity refers to the ability of systems or communities to adjust to changing conditions; community resilience describes the capacity to absorb disturbances while maintaining essential functions; participatory governance focuses on collaborative decision-making processes; and place identity emphasizes emotional and cultural attachment to local environments. Although each concept contributes valuable insights, they are rarely integrated into a single framework capable of explaining how these diverse community resources generate tourism resilience.

The present paper does not replace these well-established concepts; rather, it integrates them within a common explanatory framework. Indeed, the existing literature has convincingly demonstrated that social relationships, local knowledge, community participation, leadership, and cultural identity play fundamental roles in adaptation and recovery. However, these factors have largely been examined within separate theoretical traditions and are typically treated as independent explanatory variables rather than as interconnected elements of a broader adaptive system.

Viewed in this way, the concept of human infrastructure is proposed not as an additional resilience construct, but as a higher-order conceptual framework that integrates these complementary community-based resources into a coherent explanatory model. The central argument of the present paper is that tourism resilience is generated through the interaction of multiple forms of social and cultural capital that function as an adaptive infrastructure supporting destination sustainability. Instead of asking which single community characteristic contributes most strongly to resilience, the human infrastructure perspective shifts attention toward the dynamic relationships among these characteristics and their combined capacity to sustain adaptation over time.

This integrative perspective also addresses an important analytical gap within tourism resilience research. Existing concepts frequently operate at different levels of analysis. Social capital is generally conceptualized as a property of social relationships; adaptive capacity is often considered a system outcome or capability; community resilience is commonly understood as the observable ability to withstand and recover from disturbances; and participatory governance refers to institutional decision-making processes. Because these

concepts describe different analytical dimensions, direct comparisons among them are often difficult. Human infrastructure does not collapse these distinctions but instead organizes them within a common conceptual architecture, where each represents a complementary component of a broader adaptive system.

Accordingly, the unit of analysis proposed in this paper is neither the individual nor any single community attribute. Instead, human infrastructure conceptualizes the community itself as an integrated adaptive infrastructure composed of interconnected social, cultural, educational, and participatory resources. Within this framework, resilience emerges not from isolated variables but from the interaction among multiple community capacities that reinforce one another through continuous processes of cooperation, learning, leadership, cultural continuity, and collective action.

Equally important, human infrastructure complements rather than substitutes physical infrastructure, public investment, and institutional capacity. Its contribution lies in explaining why destinations possessing comparable material resources frequently demonstrate different adaptive outcomes under similar environmental and socio-economic conditions.

The framework proposed in this paper therefore explains how multiple community capacities jointly contribute to tourism resilience, but it does not attempt to explain every determinant of resilience. External factors such as macroeconomic conditions, government policies, financial resources, environmental hazards, institutional quality, and technological development continue to influence destination resilience in important ways. Human infrastructure represents only one—albeit fundamental—dimension within this broader resilience system. Recognizing these boundaries is essential to avoid conceptual overextension and to position the framework appropriately within existing resilience scholarship.

The principal theoretical contribution of this study therefore lies in reframing dispersed community-based capacities as components of an integrated adaptive infrastructure. This perspective enables tourism resilience research to move beyond examining isolated community variables toward understanding the systemic interactions through which community resources generate adaptive capacity and long-term sustainability.

The distinctive explanatory value of the human infrastructure perspective therefore lies not in identifying additional determinants of tourism resilience, but in explaining how existing community capacities operate as an integrated adaptive system. Whereas established constructs typically account for individual dimensions of community functioning, the proposed framework explains why destinations characterized by similar levels of social capital, adaptive capacity, or participatory governance may nevertheless exhibit different resilience trajectories. It argues that resilience depends not only on the presence of these capacities but also on the way they interact, reinforce one another, and become organized into a coherent adaptive infrastructure. In this sense, human infrastructure provides an explanation for the emergent properties of community resilience that cannot be fully captured when existing constructs are examined independently.

Three propositions summarize the theoretical positioning advanced in this paper:

First, existing concepts successfully explain important components of tourism resilience, including social capital, adaptive capacity, community resilience, participatory governance, and place identity. However, these constructs originate from different theoretical traditions, operate at different analytical levels, and rarely provide an integrated explanation of how multiple community resources jointly function as a resilience-generating system.

Second, the human infrastructure perspective does not replace these concepts. Rather, it provides a higher-order organizing framework that conceptualizes these community resources as interdependent elements of a single adaptive infrastructure.

Third, the theoretical contribution of this paper lies not in proposing an additional resilience variable, but in reframing dispersed community-based capacities as an integrated infrastructure that can be developed, strengthened, maintained, degraded, and ultimately operationalized within tourism resilience research.

This article adopts an integrative conceptual review approach, drawing upon literature from tourism studies, resilience research, community psychology, rural development, and sustainable development. Relevant studies were identified through iterative searches in Web of Science, Scopus, and Google Scholar using combinations of keywords including tourism resilience, community resilience, social capital, adaptive capacity, participatory governance, place identity, and community leadership, following established methodological recommendations for integrative and conceptual literature reviews [19–21]. The six dimensions of human infrastructure emerged through a comparative synthesis of recurring themes identified across these complementary theoretical traditions. Studies were selected based on their theoretical relevance to tourism resilience, community adaptation, and sustainable development rather than through a formal systematic review protocol. Hence, the objective was not to produce an exhaustive synthesis of evidence but to identify recurring conceptual patterns capable of supporting theory development and conceptual integration.

2. The Evolution of Resilience Thinking in Tourism

The growing prominence of resilience within tourism research reflects broader transformations in how destinations, communities, and policymakers understand development under conditions of uncertainty. Historically, tourism planning was largely guided by assumptions of stability, growth, and predictability. Destinations were expected to expand through investments in infrastructure, marketing, and service development, while external disturbances were often treated as temporary interruptions rather than permanent features of the operating environment. However, the increasing frequency of environmental disasters, economic crises, public health emergencies, and climate-related disruptions has challenged these assumptions, prompting scholars to reconsider the foundations of tourism sustainability.

Over time, resilience has evolved from a relatively narrow concept focused on recovery and resistance into a multidimensional framework encompassing environmental, economic, social, cultural, and institutional dimensions. This evolution reflects an important shift in thinking, from asking how destinations can return to normal after disruption to exploring how tourism systems can adapt, learn, and transform in response to continuous change [11]. Understanding this intellectual trajectory is essential because it reveals both the strengths and limitations of existing resilience frameworks and helps identify the conceptual space within which a more human-centered perspective can emerge.

2.1. Engineering Resilience

The earliest resilience perspectives applied to tourism were heavily influenced by engineering and infrastructure-based approaches. Within this tradition, resilience was primarily understood as the capacity of a system to resist disturbance and rapidly return to a pre-existing state following disruption. The central concern was stability, and success was often measured by the speed and effectiveness of recovery.

In tourism contexts, engineering resilience has typically focused on the robustness of physical infrastructure and destination systems. Transportation networks, accommodation facilities, communication systems, energy supply, and protective structures were viewed as essential components determining a destination's ability to withstand shocks and maintain functionality. Recovery planning frequently emphasized restoring operational capacity as quickly as possible after disasters, economic downturns, or other disruptions.

This perspective remains highly influential in contemporary tourism planning. Studies examining regional tourism resilience often evaluate indicators such as economic performance, infrastructure functionality, visitor recovery rates, and destination competitiveness following crises [22,23]. Similarly, research investigating tourism economies frequently conceptualizes resilience through dimensions such as resistance, recoverability, and economic stability [24].

Recent developments in technology have further strengthened infrastructure-centered approaches. The emergence of smart tourism systems, digital monitoring platforms, Internet of Things (IoT) technologies, and big data analytics has expanded the range of tools available for managing destination risks and enhancing operational resilience. For example, digital infrastructures are increasingly used to optimize transportation systems, monitor environmental conditions, and improve crisis response mechanisms [25]. Such innovations undoubtedly contribute to destination resilience by improving efficiency, coordination, and adaptive decision-making.

2.2. Ecological Resilience

Recognizing the limitations of equilibrium-based perspectives, tourism researchers increasingly adopted concepts derived from ecological resilience theory. Unlike engineering resilience, ecological resilience does not focus primarily on resistance or rapid recovery. Instead, it emphasizes the capacity of systems to absorb disturbances while maintaining essential functions, structures, and identities.

This perspective proved particularly relevant for tourism because many destinations depend directly on environmental resources and ecosystem services. Coastal areas, mountain regions, protected natural areas, forests, wetlands, and island destinations are all deeply interconnected with ecological processes. Consequently, environmental degradation and climate change pose direct threats to tourism sustainability.

Within ecological resilience frameworks, attention shifted toward ecosystem adaptation, biodiversity conservation, environmental management, and nature-based solutions. Researchers increasingly examined how ecological systems respond to environmental stressors and how tourism development influences ecosystem resilience [26]. Similarly, studies have explored the spatial and temporal evolution of tourism ecological resilience, highlighting the importance of maintaining environmental integrity as a foundation for sustainable destination development [27].

Nature-based solutions have become particularly prominent within this paradigm. Ecosystem restoration, habitat conservation, green infrastructure, landscape regeneration, and biodiversity protection are increasingly viewed as mechanisms capable of simultaneously supporting environmental sustainability and tourism resilience. Such approaches recognize that healthy ecosystems often provide natural protection against climate-related hazards while enhancing destination attractiveness and visitor experiences.

Research conducted in environmentally sensitive and border regions further illustrates the importance of ecological resilience. Ref. [28], for example, demonstrates how mismatches between ecological resilience and tourism development can generate vulnerabilities that undermine long-term sustainability. The authors' findings highlight the need for greater integration between environmental management and tourism planning.

Nevertheless, ecological resilience frameworks often prioritize ecosystem processes while paying less attention to the social and cultural dimensions through which communities experience environmental change. Although humans are acknowledged as part of ecological systems, community dynamics frequently remain secondary to environmental considerations.

2.3. Socio-Ecological Resilience

The growing recognition that environmental and social systems are inseparable led to the emergence of socio-ecological resilience perspectives. This approach represents one of the most significant developments in contemporary resilience research because it explicitly acknowledges the dynamic interactions between people, institutions, economies, cultures, and ecosystems.

Within tourism studies, socio-ecological resilience conceptualizes destinations as complex adaptive systems in which environmental and human processes continuously influence one another. Instead of treating communities and ecosystems as separate entities, this perspective emphasizes their mutual dependence and co-evolution [29].

Socio-ecological resilience has broadened the focus of tourism research by incorporating governance, participation, local knowledge, social capital, and community adaptation into resilience discussions. Research increasingly demonstrates that environmental sustainability cannot be achieved without considering the social capacities that enable communities to manage resources, respond to crises, and participate in decision-making processes.

Recent studies provide compelling evidence for this perspective. Investigations into ecotourism and co-management arrangements reveal that collaborative governance structures can strengthen both ecological sustainability and community resilience simultaneously [30]. Similarly, investments in tourism and conservation initiatives have been shown to enhance adaptive capacity and resilience when they actively engage local communities and support collective action [31].

Research on ethnic rural tourism further illustrates how resilience emerges through networks of actors, relationships, institutions, and local knowledge systems rather than through physical infrastructure alone [17]. Such findings suggest that adaptive capacity is deeply embedded within social structures and community interactions.

The importance of human-environment relationships has become increasingly evident in studies examining environmental identity, pro-environmental behavior, and human-nature interactions. For example, ref. [32] demonstrates that residents' environmental behaviors are influenced not only by ecological conditions but also by identity processes, perceptions of human-nature symbiosis, and community climates that support environmental responsibility. Similarly, broader reviews of human-environment interactions emphasize that sustainability outcomes emerge from the continuous interplay between ecological constraints and human capacities [33].

Cultural dimensions have also gained greater attention within socio-ecological perspectives. Tourism destinations are not merely ecological spaces; they are lived environments shaped by memories, identities, traditions, and social meanings. In [34], the authors argue that tourism increasingly transforms living heritage into forms of collective memory, illustrating how cultural resilience becomes intertwined with environmental and social adaptation.

In many ways, socio-ecological resilience represents the most comprehensive resilience framework currently available within tourism research because it recognizes the interconnected nature of environmental and human systems. Yet, even this perspective leaves an important conceptual issue unresolved.

2.4. Remaining Gaps

Current tourism resilience research increasingly recognizes communities as essential actors in adaptation and recovery processes. Social capital, participatory governance, community resilience, place identity, local knowledge, and collective action have all received substantial scholarly attention. However, these concepts are typically examined within different theoretical traditions and analytical frameworks. As a result, the literature pro-

vides valuable insights into individual community capacities but offers relatively limited explanation of how these capacities interact as components of a unified adaptive system.

The conceptual contribution proposed in this paper therefore does not arise from introducing new community factors. Instead, it lies in integrating these well-established concepts into a common explanatory framework that conceptualizes communities themselves as adaptive infrastructures capable of generating resilience through the interaction of multiple social, cultural, educational, and participatory resources.

This distinction is more than semantic. It reflects a deeper assumption about where resilience originates. Engineering resilience locates resilience primarily in physical systems. Ecological resilience locates it within ecosystems. Socio-ecological resilience recognizes interactions between environmental and social processes but often stops short of treating social capacities themselves as infrastructures.

Yet evidence from diverse contexts suggests that communities frequently determine whether resilience strategies succeed or fail. Following environmental disasters, economic crises, or tourism disruptions, recovery is often driven by local leadership, social cohesion, collective efficacy, informal support networks, cultural continuity, and community participation. In many cases, these capacities compensate for limited financial resources and inadequate infrastructure. Conversely, destinations possessing substantial material resources may struggle when social fragmentation, declining trust, weak participation, or demographic decline undermine collective adaptive capacity.

Examples from beyond tourism further support this observation. Ref. [35] provides an examination of post-Katrina community rebuilding demonstrates how local knowledge, collective action, and social relationships contributed to resilience in ways that exceeded the influence of physical reconstruction alone. Such findings suggest that resilience may be sustained by forms of infrastructure that are social rather than material.

This observation forms the foundation of the present article. If resilience repeatedly emerges through relationships, identities, leadership, participation, knowledge transfer, and collective action, perhaps these capacities should no longer be viewed merely as supporting factors. Perhaps they constitute a distinct form of infrastructure altogether.

The following section develops this argument by introducing the concept of human infrastructure, a framework that places communities themselves at the center of resilient tourism development.

3. Beyond Physical Infrastructure: The Concept of Human Infrastructure

The preceding discussion highlighted an important evolution in resilience thinking, from engineering approaches focused on physical systems to socio-ecological frameworks that recognize the interconnectedness of environmental and human dimensions. Despite these advances, a persistent tendency remains within tourism research to associate resilience primarily with tangible assets: transportation networks, visitor facilities, environmental protection systems, digital technologies, and governance structures. While these elements undoubtedly contribute to destination sustainability, they do not fully explain why some tourism communities demonstrate remarkable adaptive capacities under adverse conditions whereas others struggle despite possessing comparable material resources.

A growing body of research suggests that resilience emerges not solely from what destinations have, but from what communities are capable of achieving collectively. Studies examining tourism governance, community adaptation, social-ecological systems, and regional recovery increasingly point toward the importance of social relationships, local knowledge, collective action, cultural continuity, and community participation as critical determinants of adaptive capacity [11,29,32]. Yet these factors are often treated as supple-

mentary variables rather than as foundational resources that enable tourism systems to function and evolve.

This section introduces the concept of human infrastructure as a framework for understanding the social foundations of tourism resilience. Instead of viewing communities as passive recipients of resilience interventions, the concept positions them as active infrastructures that sustain adaptation, innovation, and long-term development.

3.1. Defining Human Infrastructure

The concept of human infrastructure is grounded in the recognition that communities possess capacities that function in ways remarkably similar to conventional infrastructures. Just as roads facilitate mobility, communication systems facilitate information exchange, and environmental infrastructures provide ecological services, social and cultural resources facilitate adaptation, cooperation, and collective problem-solving.

For the purpose of this paper, human infrastructure is defined as the network of social relationships, cultural resources, local knowledge, collective capacities, and participatory processes that enable communities to sustain, adapt, and transform tourism systems under conditions of environmental and social change. Equally important, the human infrastructure perspective should not be interpreted as suggesting that previous resilience scholarship insufficiently integrated community factors. Rather, it builds upon the extensive literature on social capital, community resilience, participatory governance, adaptive capacity, place identity, and community capacity building by proposing an integrative conceptual framework capable of explaining how these complementary resources jointly function as an adaptive infrastructure supporting tourism resilience. In this sense, human infrastructure represents a higher-order conceptual perspective that connects existing theoretical constructs instead of replacing them. Its contribution lies in explaining how these community capacities interact, reinforce one another, and generate adaptive capacity under conditions of environmental uncertainty and socio-economic change.

This definition reflects an understanding of resilience as a fundamentally relational process. Communities are not merely collections of individuals occupying a shared geographical space. They are dynamic systems composed of social connections, shared meanings, institutions, memories, practices, and values that shape collective responses to uncertainty.

Recent developments in tourism resilience research indirectly support such an interpretation. Socio-ecological resilience frameworks emphasize that adaptation emerges through interactions between human and environmental systems rather than through environmental management alone [29]. Similarly, studies of tourism recovery demonstrate that destinations possessing strong social cohesion and collaborative governance structures often recover more effectively from crises than those relying exclusively on material resources [13,22].

Human infrastructure therefore extends existing resilience perspectives by proposing that communities themselves constitute a critical adaptive system, communities becoming infrastructure.

The importance of human infrastructure becomes particularly visible when comparing it to traditional forms of tourism infrastructure.

Physical infrastructure addresses practical and operational questions. It determines how tourists access destinations, how transportation systems function, how accommodation is provided, and how services are delivered. Investments in roads, airports, visitor centers, communication systems, environmental monitoring technologies, and smart tourism platforms are essential components of destination development and resilience planning [25,36].

However, physical infrastructure alone cannot explain how destinations respond to disruption. Infrastructure can facilitate recovery, but it does not automatically generate adaptive capacity. Behind every resilience strategy lies a human dimension that determines whether available resources are effectively mobilized and sustained over time.

Human infrastructure addresses a different set of questions:

- Who maintains resilience when external conditions change?
- Who generates adaptive responses to emerging challenges?
- Who innovates when established models become ineffective?
- Who preserves and transmits local knowledge across generations?
- Who mobilizes collective action during periods of crisis?

The answers invariably point toward communities.

Research on tourism entrepreneurship highlights how psychological resources, social capital, and interpersonal relationships often become decisive factors in navigating uncertainty [18]. Similarly, investigations of tourism recovery repeatedly demonstrate that destinations recover not simply because infrastructure survives, but because people collaborate, adapt, and reorganize in response to changing circumstances [12,37].

This distinction becomes particularly important in remote and vulnerable regions. Such destinations frequently operate under conditions of limited financial resources, geographical isolation, demographic decline, or environmental exposure. In these contexts, resilience often depends less on the quantity of available infrastructure and more on the capacity of communities to mobilize existing resources creatively and collectively.

The experience of many small island destinations illustrates this reality. Despite facing considerable environmental and economic vulnerabilities, some communities demonstrate remarkable adaptive capacities through local cooperation, social solidarity, and collective problem-solving [38]. These examples suggest that resilience frequently emerges from social capacities that remain largely invisible within conventional infrastructure-centered frameworks. At the same time, human infrastructure should not be regarded as inherently beneficial. Like other community-based resources, its effects depend on how it is organized and governed. Strong social capital may unintentionally reinforce exclusionary networks or reduce openness toward newcomers. Community leadership may become concentrated within local elites, limiting participation and innovation. Likewise, strong cultural identity may, under certain circumstances, discourage external ideas or slow adaptation to changing tourism contexts. Hence, the resilience-generating potential of human infrastructure depends not only on the presence of community capacities but also on inclusive governance, openness to learning, and the ability to balance social cohesion with innovation.

These considerations also highlight that the effectiveness of human infrastructure depends on governance arrangements that encourage broad stakeholder engagement and continuous learning. Inclusive decision-making processes, openness to external knowledge and innovation, and balanced participation across community groups help prevent the concentration of power, reduce exclusionary dynamics, and maintain the adaptive flexibility required for long-term tourism resilience. Consequently, human infrastructure contributes most effectively to resilience when strong community ties are accompanied by transparent governance, social inclusion, and an ongoing capacity for learning and adaptation.

3.2. Human Infrastructure as a Hidden Resource

One reason human infrastructure has received limited attention within tourism research is that its most important components are often difficult to observe, quantify, or measure directly. Unlike roads, visitor centers, protective barriers, or digital platforms, social relationships and cultural resources leave few visible traces within conventional

development indicators. Yet these invisible assets frequently determine how communities respond to crises and opportunities.

One such resource is community memory. Communities accumulate knowledge through lived experiences, previous crises, environmental change, and historical adaptation processes. This collective memory often informs future responses by providing locally grounded understandings of risks, opportunities, and effective coping strategies. The capacity to remember and learn from previous disruptions contributes significantly to long-term adaptive capacity.

A second dimension involves informal social networks. While resilience policies often focus on formal institutions and governance structures, communities frequently rely on informal relationships during periods of uncertainty. Family ties, friendships, neighborhood support systems, volunteer groups, and local associations create channels through which information, resources, and assistance can circulate rapidly. Research examining community resilience consistently identifies such networks as critical mechanisms facilitating adaptation and recovery [31].

Equally important is local identity. Tourism destinations are not merely physical locations; they are places imbued with meaning, belonging, and cultural significance. Local identity strengthens emotional attachment to place and motivates individuals to invest in the preservation and future development of their communities. Studies examining heritage tourism increasingly demonstrate that cultural narratives, memories, and identities influence how communities engage with tourism development and environmental stewardship [34].

Closely related are shared values, which provide the normative foundations for collective action. Communities characterized by trust, reciprocity, environmental responsibility, and mutual support often demonstrate stronger capacities for cooperation and adaptation. Shared values influence decisions regarding resource management, conservation practices, participation in tourism planning, and responses to external pressures. Recent research examining pro-environmental behavior among destination residents highlights the importance of identity, social norms, and human–nature relationships in shaping sustainable adaptation processes [32].

Together, community memory, informal networks, local identity, and shared values form a largely invisible but highly influential layer of resilience. They cannot be easily replicated through external investments, imported technologies, or standardized development programs. Instead, they emerge gradually through social interaction, cultural continuity, and collective experience.

Viewed through this lens, human infrastructure represents a hidden resource that underpins many of the adaptive capacities commonly attributed to successful tourism destinations. It is the social foundation upon which environmental, economic, and institutional resilience ultimately depend. Recognizing this hidden infrastructure offers a new perspective on tourism development, one that places people, relationships, and collective capacities at the center of resilience rather than at its margins.

3.3. Human Infrastructure and Related Concepts: A Conceptual Distinction

The concept of human infrastructure shares certain characteristics with established constructs such as social capital, community resilience, adaptive capacity, and community capacity building. However, it is not intended to replace these concepts. Rather, it seeks to integrate them within a broader explanatory framework capable of clarifying the social foundations of tourism resilience.

The comparison presented in Table 1 clarifies that human infrastructure should not be interpreted as an alternative to existing resilience constructs but rather as an integrative

conceptual framework operating at a different analytical level. Unlike previous constructs that primarily explain individual dimensions of community functioning, human infrastructure focuses on their systemic integration and reciprocal interactions. While established concepts such as social capital, adaptive capacity, community resilience, participatory governance, and place identity each explain specific dimensions of community functioning, they originate from different disciplinary traditions and address distinct theoretical questions. Therefore, they often appear in tourism resilience research as parallel explanatory variables rather than as components of a coherent adaptive system.

Table 1. Conceptual positioning of human infrastructure in relation to established resilience constructs.

Concept	Unit of Analysis	Primary Focus	Main Limitation for Tourism Resilience Research	Contribution of the Human Infrastructure Perspective
Social capital	Social relationships and networks	Trust, reciprocity, cooperation, social ties	Focuses primarily on relational resources and does not explain how these interact with other community capacities	Human infrastructure conceptualizes social capital as one interconnected component of a broader adaptive system that also includes leadership, culture, education, participation, and youth engagement.
Adaptive capacity	Individuals, organizations, or communities	Ability to adjust and respond to disturbances	Represents an outcome or capability rather than the underlying resources that generate adaptation	Human infrastructure explains the social, cultural, and educational resources that produce adaptive capacity rather than adaptive capacity itself.
Community resilience	Community	Ability to absorb, recover, and adapt after disturbances	Describes resilience outcomes but provides limited explanation of the interacting community resources that generate those outcomes	Human infrastructure conceptualizes community resilience as the manifestation of an underlying adaptive infrastructure composed of multiple interacting dimensions.
Community capacity building	Community development processes	Strengthening community skills and resources	Primarily focuses on intervention processes rather than the existing community resource system	Human infrastructure represents the resource base that capacity-building initiatives seek to strengthen and sustain.
Participatory governance	Institutions and stakeholders	Collaborative decision-making and stakeholder engagement	Focuses mainly on governance arrangements without fully incorporating broader social and cultural capacities	Human infrastructure positions participatory governance as one enabling mechanism operating within a wider community-based adaptive infrastructure.
Place identity	Individuals and communities	Emotional attachment, belonging, cultural meaning	Explains attachment to place but does not account for the broader organizational and relational capacities supporting resilience	Human infrastructure integrates place identity with leadership, knowledge transfer, participation, and social capital within a unified resilience framework.
Human infrastructure (proposed framework)	Community as an integrated adaptive system	Interaction among social capital, leadership, cultural identity, education, participation, and youth engagement	Integrative conceptual framework requiring future empirical operationalization	Reframes dispersed community capacities as a single adaptive infrastructure that can be strengthened, maintained, degraded, measured, and incorporated into tourism resilience research.

The human infrastructure perspective seeks to overcome this conceptual fragmentation by repositioning these community capacities within a common explanatory architecture. In this framework, social capital provides the relational foundation that facilitates cooperation and trust; community leadership mobilizes collective action and strategic coordination; cultural identity strengthens place attachment and long-term stewardship; education and knowledge transfer sustain learning and adaptive innovation; community participation promotes collaborative governance and collective ownership; and youth engagement ensures intergenerational continuity and future adaptive potential. These dimensions do not operate independently but continuously reinforce one another through reciprocal interactions.

Hence, tourism resilience is conceptualized not as the direct consequence of any single community attribute but as the emergent property of an integrated adaptive infrastructure embedded within local communities. This systems-oriented perspective shifts the analytical focus from identifying isolated resilience factors toward understanding the dynamic interactions among multiple community resources. By emphasizing these interdependencies, human infrastructure offers a more comprehensive explanation of why communities possessing comparable physical resources may nevertheless display markedly different adaptive trajectories following environmental, economic, or social disturbances.

This conceptual repositioning also provides a foundation for future empirical research by enabling human infrastructure to be operationalized as a multidimensional construct composed of interacting community capacities.

3.4. Conceptual Architecture and Causal Mechanisms of Human Infrastructure

Human infrastructure should not be understood as a simple aggregation of community characteristics. Rather, it represents a dynamic adaptive system in which multiple social, cultural, educational, and participatory resources continuously interact to generate adaptive capacity and ultimately strengthen tourism resilience. The explanatory value of the proposed framework therefore lies not only in identifying its constituent dimensions but also in clarifying the mechanisms through which these dimensions reinforce one another.

Within this perspective, the six dimensions of human infrastructure operate as an interconnected network rather than as independent variables. Social capital provides the relational foundation that facilitates trust, reciprocity, and cooperation among community members. These social relationships create favorable conditions for the emergence of effective community leadership, which coordinates collective action, mobilizes local resources, and facilitates strategic responses during periods of uncertainty. Leadership, in turn, strengthens opportunities for community participation by encouraging collaboration, shared decision-making, and collective responsibility for tourism development.

Simultaneously, cultural identity contributes to community cohesion by reinforcing place attachment, shared values, and long-term commitment to local development. Strong cultural identity also facilitates intergenerational knowledge transfer, allowing communities to preserve traditional ecological knowledge, tourism practices, and locally developed adaptive strategies. Educational processes further expand these capacities by supporting environmental literacy, innovation, professional competencies, and continuous learning, thereby increasing the community's ability to respond to emerging challenges.

Youth engagement represents a particularly important reinforcing mechanism within the proposed framework. Younger generations contribute not only through demographic renewal but also by introducing technological innovation, entrepreneurial initiatives, environmental awareness, and new forms of social participation. Their interaction with older generations creates reciprocal learning processes that sustain both cultural continuity and adaptive innovation.

The interaction among these six dimensions generates adaptive capacity, understood as the collective ability of communities to anticipate change, mobilize available resources, reorganize institutional arrangements, learn from previous experiences, and develop innovative responses to environmental and socio-economic disturbances. Adaptive capacity should therefore be interpreted as the immediate outcome of human infrastructure rather than as one of its constitutive dimensions.

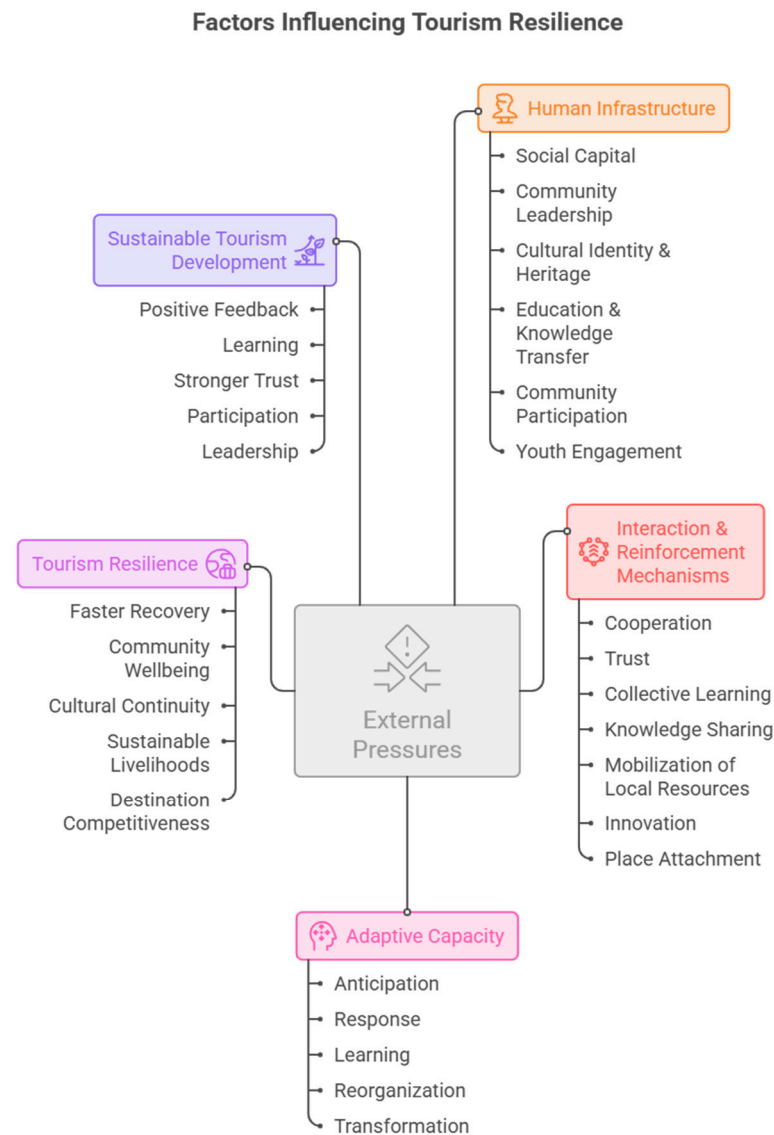
Adaptive capacity subsequently contributes to tourism resilience by enabling destinations to absorb disturbances, recover more efficiently, reorganize tourism activities, preserve community wellbeing, maintain cultural continuity, and support long-term sustainable development. Equally important, these relationships are not strictly linear. Successful adaptive responses further strengthen social trust, reinforce community participation, stimulate leadership development, and encourage knowledge sharing, creating positive feedback loops that continuously reinforce human infrastructure over time.

Instead of functioning as isolated resilience factors, these dimensions generate emergent properties that cannot be fully explained by examining each component independently. This systems perspective provides a more comprehensive explanation of why tourism destinations possessing comparable physical resources frequently display markedly different resilience trajectories when confronted with similar environmental or socio-economic challenges.

Figure 1 summarizes the conceptual architecture proposed in this paper. The framework illustrates how external pressures, including climate change, economic crises, demographic change, environmental uncertainty, and natural hazards, activate the adaptive functions of human infrastructure. The six interdependent dimensions foster cooperation, trust, collective learning, innovation, knowledge sharing, place attachment, and the mobilization of local resources. These interaction mechanisms generate adaptive capacity, which subsequently enhances tourism resilience and contributes to sustainable tourism development. The framework also incorporates a positive feedback mechanism, whereby successful adaptive outcomes reinforce human infrastructure itself by strengthening social cohesion, leadership, participation, and collective learning. This recursive relationship emphasizes that human infrastructure is not a static community asset but a dynamic adaptive resource that evolves continuously through social interaction, shared experience, and institutional learning.

AI-assisted visualization statement. The conceptual diagram presented in Figure 1 was created using the AI-assisted visualization platform Napkin AI (<https://www.napkin.ai/>). The platform was used exclusively to transform an author-developed conceptual framework into a graphical representation by assisting with the arrangement of visual elements, layout, and design. All scientific concepts, theoretical relationships, structure of the framework, labels, textual content, and interpretation were conceived, developed, verified, and finalized by the authors. The authors critically reviewed and edited the final figure to ensure that it accurately reflected the conceptual model described in the manuscript.

The conceptual model presented in Figure 1 also provides a foundation for future empirical operationalization of human infrastructure. Rather than measuring social capital, leadership, participation, or cultural identity independently, future research may conceptualize human infrastructure as a multidimensional latent construct composed of these interacting dimensions. Such an approach offers a theoretically grounded basis for developing composite indicators capable of assessing the strength, quality, and evolution of human infrastructure across different tourism destinations and examining its contribution to adaptive capacity, resilience, and sustainable tourism outcomes.



Made with Napkin

Figure 1. Conceptual mechanism linking human infrastructure to tourism resilience.

Although human infrastructure is introduced here as a conceptual framework, it also offers clear opportunities for future empirical operationalization. The six dimensions discussed in this paper may be conceptualized as a multidimensional latent construct measured through indicators reflecting social trust, leadership capacity, cultural attachment, knowledge sharing, community participation, and youth engagement. Likewise, tourism resilience may be operationalized through outcomes such as adaptive capacity, recovery processes, community well-being, destination continuity, and sustainable tourism performance. Developing and validating such measurement models represents an important direction for future research.

4. Components of Human Infrastructure in Tourism Communities

Human infrastructure is to be understood as a foundational dimension of tourism resilience, it becomes necessary to identify the elements that constitute it. Unlike physical infrastructure, which can be observed through tangible assets such as roads, transportation systems, visitor facilities, or communication networks, human infrastructure is embedded within relationships, identities, values, knowledge systems, and collective capacities. These

elements are often less visible, yet they profoundly influence how communities respond to environmental uncertainty, economic disruptions, demographic change, and tourism-related pressures.

The literature reviewed throughout this paper suggests that human infrastructure is not a single attribute but a multidimensional system composed of interconnected social and cultural resources. While the relative importance of each component may vary across destinations, several recurring dimensions consistently emerge as critical for resilience: social capital, community leadership, cultural identity, education and knowledge transfer, community participation, and youth engagement. These dimensions shape the adaptive capacity of tourism communities and provide the social foundations upon which sustainable development can be built.

4.1. Social Capital

Among all components of human infrastructure, social capital is perhaps the most frequently associated with resilience. Although definitions vary, social capital generally refers to the networks, relationships, trust, reciprocity, and norms of cooperation that facilitate collective action and mutual support within communities.

The importance of social capital becomes particularly evident during periods of crisis. Communities characterized by strong interpersonal relationships and high levels of trust are often better equipped to mobilize resources, share information, coordinate responses, and support vulnerable members. A recent systematic review by [39] concluded that social capital represents one of the most important determinants of community disaster resilience, influencing preparedness, response, recovery, and long-term adaptation capacities.

Similarly, ref. [40] emphasizes that individual social capital contributes significantly to crisis response processes by strengthening cooperation, reducing uncertainty, and facilitating access to support networks. These mechanisms are especially relevant in tourism-dependent regions where economic and environmental disruptions often require rapid collective adaptation.

Within tourism contexts, social capital supports resilience not only during crises but also in everyday destination management. Research examining rural hospitality businesses in China demonstrated that social networks and network interactions significantly enhance organizational resilience by facilitating information exchange, collaboration, and mutual support among tourism actors [29]. Likewise, ref. [41] describes social capital as a “seed of resilience,” capable of cultivating community strength and adaptive capacity during environmental crises. For tourism destinations, social capital functions as an invisible yet highly effective resource.

4.2. Community Leadership

While social capital provides the relational foundation of resilience, leadership often determines how collective capacities are mobilized and directed. Resilient communities rarely emerge spontaneously. They are frequently guided by individuals and groups capable of articulating shared goals, facilitating cooperation, and coordinating adaptive responses.

Community leadership extends beyond formal governance structures. Although elected officials and institutional representatives play important roles, resilience is equally shaped by informal leaders, local entrepreneurs, educators, cultural custodians, environmental activists, and respected community members. These actors often function as bridges connecting diverse groups and facilitating collective action.

Research examining disaster recovery governance highlights the central role of leadership in strengthening social capital and coordinating recovery efforts [39]. Similarly, studies

of collective leadership suggest that resilience frequently emerges through processes of negotiation, collaboration, and distributed decision-making rather than through hierarchical authority alone [42].

In rural contexts, community leadership has also been shown to contribute significantly to environmental governance and local sustainability initiatives. Ref. [43] found that effective leadership enhances community participation, strengthens institutional trust, and improves collective capacities to address environmental challenges.

For tourism destinations facing climate-related risks and socio-economic uncertainties, leadership serves as a catalyst that transforms social resources into adaptive action. Infrastructure may provide opportunities, but leadership often determines whether communities are able to capitalize on them.

4.3. Cultural Identity and Heritage

Tourism destinations are not merely physical spaces; they are places imbued with meaning. Cultural identity and heritage provide communities with a sense of continuity, belonging, and purpose that becomes particularly important during periods of change and uncertainty.

A growing body of research suggests that resilience is closely linked to place-based identities and cultural attachments. Communities that maintain strong connections to local traditions, narratives, and cultural heritage often demonstrate greater capacities for adaptation because these resources provide psychological stability and collective motivation.

Studies examining heritage revitalization projects indicate that cultural heritage contributes to place attachment and strengthens cultural identity among local residents [44]. Similarly, ref. [45] argues that authenticity and cultural preservation play a fundamental role in shaping community identity and supporting long-term sustainability.

The relationship between identity and resilience has been demonstrated across diverse contexts. Ref. [46] found that place identity significantly contributes to community resilience by enhancing social cohesion, collective efficacy, and commitment to local development. Likewise, ref. [47] demonstrates that place attachment influences how communities respond to disasters and environmental disruptions, often strengthening adaptive capacities and recovery efforts.

Within tourism destinations, cultural identity performs multiple functions simultaneously. It contributes to destination attractiveness, supports heritage preservation, fosters community pride, and encourages long-term stewardship of local resources. Heritage is therefore not simply a tourism asset; it is an integral component of human infrastructure.

4.4. Education and Knowledge Transfer

Resilience is fundamentally a learning process. Communities adapt because they acquire knowledge, interpret experiences, and transfer lessons across generations. Consequently, education and knowledge transmission constitute essential components of human infrastructure.

In tourism contexts, environmental literacy, sustainability education, and tourism-related competencies enhance the ability of communities to respond effectively to environmental and socio-economic challenges. Educational initiatives support informed decision-making, encourage environmental stewardship, and strengthen local capacities for adaptation.

Particularly important is the intergenerational transfer of knowledge. Traditional ecological knowledge, cultural practices, local histories, and community experiences often provide valuable insights for managing environmental uncertainty and sustaining tourism development. Ref. [48] highlights the importance of informal educational processes in

transmitting traditional knowledge across generations, emphasizing their role in sustaining cultural continuity and community resilience.

Recent research also demonstrates that knowledge transfer is increasingly multidirectional. Ref. [36] describes processes of reverse socialization in which younger generations contribute to the environmental literacy of older community members, illustrating the dynamic nature of contemporary learning systems.

Within rural tourism communities, intergenerational learning can serve as a mechanism for preserving local knowledge while simultaneously fostering innovation. Ref. [49] identify intergenerational learning as a catalyst for sustainable tourism development, while [50] emphasizes its importance for strengthening environmental literacy and sustainability-oriented behaviors. Similarly, ref. [51] highlights the role of intergenerational knowledge transfer in cultivating future environmental leadership.

Viewed through the lens of human infrastructure, education is not merely a service delivered to communities, but a resilience-generating process that enables communities to adapt, innovate, and sustain themselves over time.

4.5. Community Participation

Resilience cannot be imposed externally. Sustainable adaptation requires active engagement from those who are directly affected by decisions and policies. Community participation therefore represents one of the most important dimensions of human infrastructure.

Contemporary governance research increasingly emphasizes participatory approaches that involve residents in decision-making processes related to planning, resource management, and local development. Such approaches strengthen legitimacy, improve decision quality, and foster collective ownership of outcomes [52].

Within tourism development, participation allows local communities to influence decisions that shape their environments, livelihoods, and cultural heritage. Ref. [53] demonstrates that public participation enhances planning processes by incorporating local knowledge and increasing stakeholder commitment to implementation efforts.

Participation also contributes to resilience by strengthening social cohesion and collective efficacy. Studies of informal settlements and vulnerable communities reveal that collective strategies of resistance and adaptation often emerge through participatory processes that mobilize local knowledge and community capacities [54]. Similar dynamics can be observed in tourism destinations, where community involvement often determines the success of sustainability initiatives and adaptation strategies.

Hence, participatory governance should be viewed not merely as a democratic ideal but as an essential resilience mechanism that strengthens human infrastructure.

4.6. Youth Engagement

Among all components of human infrastructure, youth engagement may be one of the most partially integrated yet strategically important dimensions. Discussions of tourism resilience frequently focus on environmental management, economic development, and governance systems while paying relatively little attention to demographic sustainability. However, communities cannot remain resilient if younger generations leave permanently.

Many remote, rural, peripheral, and environmentally vulnerable regions face significant challenges associated with youth outmigration, aging populations, and declining demographic vitality. Even destinations possessing valuable natural resources and strong tourism potential may struggle to sustain long-term development if they are unable to retain or attract younger generations.

At the same time, young people increasingly demonstrate strong awareness of environmental and climate-related issues. Ref. [55] found that climate change represents a significant source of concern among youth, but also a catalyst for resilience-oriented thinking and environmental engagement. Such findings suggest that young people may become important agents of adaptation and sustainability within tourism destinations.

Youth involvement contributes not only to workforce renewal but also to innovation, entrepreneurship, digital transformation, and environmental stewardship. Younger generations frequently serve as bridges between traditional knowledge systems and emerging technologies, facilitating adaptation in rapidly changing contexts.

The importance of youth engagement also aligns with broader discussions concerning rural resilience and community sustainability. Ref. [56] argues that resilient communities depend on institutions and social structures capable of fostering belonging, participation, and future-oriented development. Without opportunities for meaningful engagement, younger residents may seek alternatives elsewhere, weakening the very social foundations upon which resilience depends. For this reason, youth engagement should be considered a core component of human infrastructure rather than a peripheral demographic issue. The future resilience of tourism destinations depends not only on preserving landscapes and heritage but also on ensuring that future generations remain connected to the communities that sustain them.

Thus, social capital, leadership, cultural identity, education, participation, and youth engagement constitute the primary pillars of human infrastructure. Although each dimension contributes differently to resilience, their combined effects create the social conditions that enable communities to adapt, recover, and thrive in the face of uncertainty.

5. Human Infrastructure in Remote and Vulnerable Regions

The importance of human infrastructure becomes particularly visible in regions where material resources are limited and exposure to environmental, economic, and demographic pressures is high. While physical infrastructure remains important, remote and vulnerable destinations often lack the financial, institutional, and technological capacities available to major tourism centers. Consequently, resilience frequently depends on the ability of communities to mobilize social resources, maintain cultural continuity, preserve local knowledge, and adapt to changing conditions.

Climate change, demographic decline, economic restructuring, and environmental pressures are not experienced uniformly across territories. Mountain communities, rural tourism destinations, protected natural areas, and peripheral border regions face distinct challenges that require context-specific forms of adaptation. Yet despite these differences, a common pattern emerges: communities characterized by strong human infrastructure tend to demonstrate greater adaptive capacity than those relying primarily on external investments and physical assets.

5.1. Mountain Communities

Mountain regions represent some of the most environmentally sensitive tourism destinations in the world. Their attractiveness is closely linked to unique landscapes, biodiversity, outdoor recreation opportunities, and seasonal tourism activities [57]. At the same time, these regions often face structural vulnerabilities associated with geographical isolation, limited accessibility, demographic decline, and climate-sensitive economic activities.

Climate change has intensified many of these challenges. Mountain tourism economies, particularly those dependent on winter sports, are increasingly affected by changing snow conditions, altered hydrological systems, and rising environmental uncertainty. Recent

evidence from European ski destinations demonstrates that climate change is exacerbating snow-water-energy challenges, raising important concerns regarding the long-term sustainability of tourism models heavily dependent on predictable climatic conditions [8].

Beyond environmental pressures, many mountain communities struggle with depopulation and youth outmigration. The migration of younger generations toward urban centers often weakens local labor markets, reduces entrepreneurial capacity, and disrupts the intergenerational transmission of knowledge that supports tourism and environmental stewardship. In such contexts, human infrastructure becomes particularly important. Community networks, local leadership, cultural identity, and place attachment frequently compensate for structural disadvantages by sustaining collective action and encouraging local engagement [58–60].

Research on community resilience consistently suggests that social capital and local participation become increasingly important in geographically isolated areas where formal support systems may be limited [36,38]. Thus, the resilience of mountain tourism destinations depends not only on environmental adaptation measures but also on the capacity of local communities to maintain social cohesion and mobilize collective resources. For example, Alpine destinations have demonstrated that communities characterized by strong local leadership, cooperation among tourism stakeholders, and diversified community initiatives have generally shown greater adaptive capacity when responding to declining snow reliability and climate-related pressures than destinations relying primarily on technical adaptation measures [61–63].

5.2. Rural Tourism Destinations

Rural tourism destinations face a different but equally significant set of vulnerabilities. Many rural regions experience long-term demographic decline, aging populations, limited public services, and reduced economic diversification. While tourism often provides valuable opportunities for local development, its benefits can be unevenly distributed and may not fully compensate for broader structural challenges. Comparable dynamics have been reported in several European rural destinations, where community-led heritage initiatives, local entrepreneurship, and collective participation have contributed to tourism diversification and strengthened long-term destination resilience.

Aging populations represent one of the most significant concerns for rural resilience. As younger residents migrate toward urban areas seeking educational and employment opportunities, communities may experience declining workforce availability, reduced entrepreneurial dynamism, and weakened capacities for innovation. This demographic imbalance can affect the sustainability of tourism businesses, local governance structures, and community-based initiatives.

Research increasingly demonstrates that rural resilience depends on more than economic growth alone. Ref. [56] emphasizes the role of local institutions and community anchors in sustaining social cohesion and supporting adaptive capacities in rural settings. Similarly, ref. [31] found that investments in tourism and conservation contribute most effectively to resilience when they strengthen local capacities instead of simply generating economic returns.

Tourism can play an important role in addressing some of these challenges by creating employment opportunities, supporting local entrepreneurship, and encouraging community participation. However, sustainable outcomes depend heavily on human infrastructure. Communities characterized by strong social networks, effective leadership, and active participation are often better positioned to leverage tourism as a development tool while avoiding excessive dependence on external actors.

Moreover, recent research highlights that tourism influences community wellbeing in complex ways. The benefits of tourism are often mediated by social relationships, perceptions of fairness, community engagement, and local participation in decision-making processes [64]. Consequently, human infrastructure becomes a critical factor determining whether tourism contributes to long-term resilience or merely provides temporary economic gains.

5.3. Protected Natural Areas

Protected natural areas occupy a unique position within tourism systems. They are often among the most attractive destinations for nature-based tourism and ecotourism while simultaneously serving as critical sites for biodiversity conservation and environmental protection. This dual function creates a fundamental challenge: balancing tourism development with ecological integrity. Similarly, experiences from protected natural areas indicate that conservation outcomes and tourism resilience are generally stronger where local communities actively participate in governance and resource management.

The increasing popularity of nature-based tourism has generated both opportunities and risks. On the one hand, tourism can provide financial resources, public support, and incentives for conservation. On the other hand, excessive visitation may contribute to habitat degradation, resource depletion, and environmental pressures that undermine the very ecosystems upon which tourism depends.

This tension has led researchers to emphasize the importance of sustainable ecotourism frameworks capable of integrating environmental conservation with community wellbeing and economic development [65]. Such approaches recognize that conservation objectives are more likely to succeed when local communities actively participate in environmental governance and benefit from tourism-related opportunities.

Recent studies examining co-management arrangements demonstrate that socio-ecological resilience is strengthened when communities are involved in decision-making processes concerning natural resource management [30]. Local knowledge, environmental stewardship, and community engagement contribute to more adaptive and sustainable management practices while enhancing local support for conservation initiatives.

Human infrastructure is therefore particularly relevant in protected natural areas because environmental sustainability ultimately depends on human behavior. Trust, cooperation, environmental literacy, and shared stewardship values often determine whether conservation goals can coexist successfully with tourism development. Protected areas may possess exceptional ecological assets, but without resilient communities capable of supporting and managing these resources, long-term sustainability remains uncertain.

5.4. Peripheral and Border Regions

Peripheral and border regions frequently experience some of the most complex combinations of environmental, economic, and demographic vulnerabilities. Geographic distance from major economic centers often contributes to limited investment opportunities, lower accessibility, weaker institutional capacities, and increased dependence on a narrow range of economic activities. Likewise, several peripheral border destinations illustrate that strong local identity, community cooperation, and cross-border partnerships can partially compensate for structural geographical disadvantages and limited public investment.

Many border regions also experience persistent migration dynamics. Outmigration, particularly among younger and highly educated individuals, can reduce local capacities for innovation, entrepreneurship, and community development. At the same time, changing geopolitical conditions, economic restructuring, and environmental pressures create additional layers of uncertainty.

Recent research examining tourism development in border regions reveals significant spatial mismatches between ecological resilience and tourism growth, suggesting that development trajectories are often shaped by broader structural inequalities rather than local environmental conditions alone [28]. Such findings highlight the importance of considering social and territorial factors when assessing resilience.

The challenges faced by peripheral regions are further complicated by accessibility constraints. Studies focusing on indigenous communities and remote territories demonstrate that transportation limitations significantly influence tourism opportunities, economic diversification, and community development prospects [66]. While improvements in infrastructure can enhance connectivity, physical accessibility alone does not guarantee resilience.

Instead, resilience often depends on the ability of communities to maintain strong social ties, preserve local identity, and mobilize collective resources despite structural disadvantages. Research examining community adaptation in vulnerable settlements shows that local knowledge, informal networks, and collective strategies frequently compensate for institutional and economic limitations [67].

Consequently, human infrastructure becomes especially important in peripheral and border regions because it provides a mechanism through which communities can respond to challenges that extend beyond their direct control. Social cohesion, leadership, cultural continuity, and participation create adaptive capacities that enable communities to navigate uncertainty while preserving their social and territorial vitality.

Across mountain communities, rural destinations, protected natural areas, and peripheral regions, a consistent lesson emerges: resilience is not solely a function of environmental conditions, economic resources, or physical infrastructure. Rather, it is deeply embedded in the capacities of people to cooperate, learn, lead, preserve, and adapt. Human infrastructure therefore represents not a supplementary dimension of resilience but a central mechanism through which vulnerable tourism destinations confront the challenges of an increasingly uncertain future.

6. Towards a Human-Centered Framework of Resilient Tourism Development

The previous sections argued that resilience cannot be fully understood through physical infrastructure, environmental protection measures, or technological solutions alone. Although roads, transportation systems, digital platforms, environmental monitoring technologies, and conservation initiatives remain essential components of sustainable tourism development, they do not independently generate adaptive capacity. Rather, resilience emerges through the interaction between material resources and the human systems that mobilize, maintain, and transform them.

The conceptual developments presented throughout this paper culminate in what may be termed the human infrastructure theory of tourism resilience (HITR). The theory is founded on the premise that resilience in tourism destinations is not determined solely by the availability of physical infrastructure, environmental resources, or technological capacities. Rather, resilience emerges through the interaction between external pressures and the social resources embedded within communities.

The central proposition of the theory is that human infrastructure constitutes the primary mechanism through which tourism destinations generate adaptive capacity under conditions of environmental and social uncertainty. While physical infrastructure facilitates movement, service delivery, and operational continuity, human infrastructure enables communities to interpret challenges, mobilize collective action, preserve local knowledge, coordinate adaptive responses, and sustain long-term development trajectories.

The theory further proposes that the relative importance of human infrastructure increases as uncertainty intensifies. Under stable conditions, the contribution of social and cultural resources may remain partially invisible because physical infrastructure and institutional systems operate effectively. However, during periods of disruption, such as climate-related events, economic crises, demographic decline, environmental degradation, or sudden tourism shocks, the adaptive capacities embedded within communities become increasingly important determinants of resilience outcomes.

According to the human infrastructure theory of tourism resilience, destinations exposed to similar environmental pressures may experience substantially different developmental trajectories because of differences in the quality, density, and interconnectedness of their human infrastructure. Consequently, resilience should be understood not merely as a function of environmental conditions or infrastructural investment, but as the product of interactions between external pressures and community-based adaptive resources.

This perspective extends existing engineering, ecological, and socio-ecological approaches by positioning communities not only as participants in resilience processes but also as infrastructures of resilience themselves. In this way, the theory offers a complementary explanation for why some destinations successfully adapt and transform despite limited material resources, while others remain vulnerable despite substantial investments in physical infrastructure.

Across diverse contexts, from mountain communities and rural destinations to protected natural areas and peripheral regions, a recurring pattern becomes evident. Communities characterized by strong social relationships, active participation, effective leadership, cultural continuity, and knowledge-sharing capacities consistently demonstrate greater abilities to adapt to environmental and socio-economic change. These observations suggest that resilience is fundamentally a human process before it becomes an infrastructural or technological one.

Building on this insight, this paper proposes a human infrastructure model of tourism resilience. The model does not seek to replace existing engineering, ecological, or socio-ecological perspectives. Instead, it complements them by highlighting the social foundations that allow resilience mechanisms to operate effectively. It offers a framework through which resilience can be understood as a dynamic outcome emerging from community capacities that enable adaptation, collective action, and sustainable development under conditions of uncertainty.

6.1. The Human Infrastructure Model

The human infrastructure model conceptualizes resilience as a developmental process linking external pressures, community capacities, adaptive responses, and long-term sustainability outcomes.

At the beginning of this process are the multiple pressures affecting contemporary tourism destinations. Climate change, environmental degradation, biodiversity loss, demographic decline, migration, economic instability, natural disasters, and changing visitor expectations create a context of continuous uncertainty for tourism-dependent communities [5,11]. These pressures are particularly acute in remote and vulnerable regions where adaptive resources are often limited.

However, external pressures do not automatically determine outcomes. Communities respond differently depending on the quality and strength of their human infrastructure.

The model identifies six interconnected dimensions of human infrastructure:

- Social capital;
- Community leadership;
- Cultural identity and heritage;

- Education and knowledge transfer;
- Community participation;
- Youth engagement.

These dimensions operate as adaptive resources embedded within communities. Social capital facilitates cooperation and trust during periods of uncertainty [39,41]. Leadership mobilizes collective action and coordinates responses to emerging challenges [42,68]. Cultural identity strengthens place attachment and motivates stewardship of local resources [46,47]. Education and intergenerational learning enhance environmental literacy and adaptive knowledge [50–52]. Participation increases legitimacy and local ownership of development processes [55], while youth engagement contributes innovation, demographic continuity, and future-oriented capacities [62].

Together, these dimensions shape what may be described as a community's adaptive capacity, the ability to anticipate, absorb, respond to, and learn from disturbances. Adaptive capacity represents the mechanism through which human infrastructure translates into resilience outcomes. Communities possessing strong adaptive capacities are more capable of responding to climate-related challenges, economic disruptions, demographic changes, and environmental pressures without losing their essential social, cultural, and economic functions.

Tourism resilience emerges as a consequence of this adaptive capacity. Instead of being understood solely as recovery after disruption, resilience is conceptualized here as the ability of destinations to maintain functionality, learn from change, and pursue sustainable transformation under uncertain conditions [10,17].

Ultimately, resilient tourism systems contribute to broader processes of sustainable community development. Economic opportunities generated by tourism become more sustainable when supported by strong social networks, active participation, environmental stewardship, and cultural continuity. In this sense, human infrastructure functions as a bridge connecting resilience with long-term sustainability.

Figure 2 operationalizes the human infrastructure theory of tourism resilience by illustrating the causal pathway through which human infrastructure contributes to adaptive capacity, tourism resilience, and sustainable community development. Figure 2 summarizes the evolution of resilience thinking within tourism research, illustrating the progressive transition from engineering and ecological perspectives toward community-oriented and adaptive approaches. This overview provides the conceptual foundation for introducing human infrastructure as an integrative perspective.

As illustrated in Figure 2, resilience research has progressively expanded beyond physical infrastructure and hazard management toward broader social and governance dimensions. This evolution creates the theoretical context within which human infrastructure is proposed. The conceptual arguments developed throughout this paper converge toward what may be termed the human infrastructure theory of tourism resilience. The theory is based on the premise that resilience in tourism destinations cannot be fully explained through physical infrastructure, ecological resources, or governance arrangements alone. Rather, resilience emerges through the interaction between external pressures and the social capacities embedded within communities. The central assumption is that human infrastructure constitutes the foundational mechanism through which tourism destinations generate adaptive capacity under conditions of uncertainty. While physical infrastructure facilitates mobility, service delivery, connectivity, and operational continuity, human infrastructure enables communities to interpret change, mobilize collective action, preserve local knowledge, coordinate responses, and sustain long-term development trajectories.

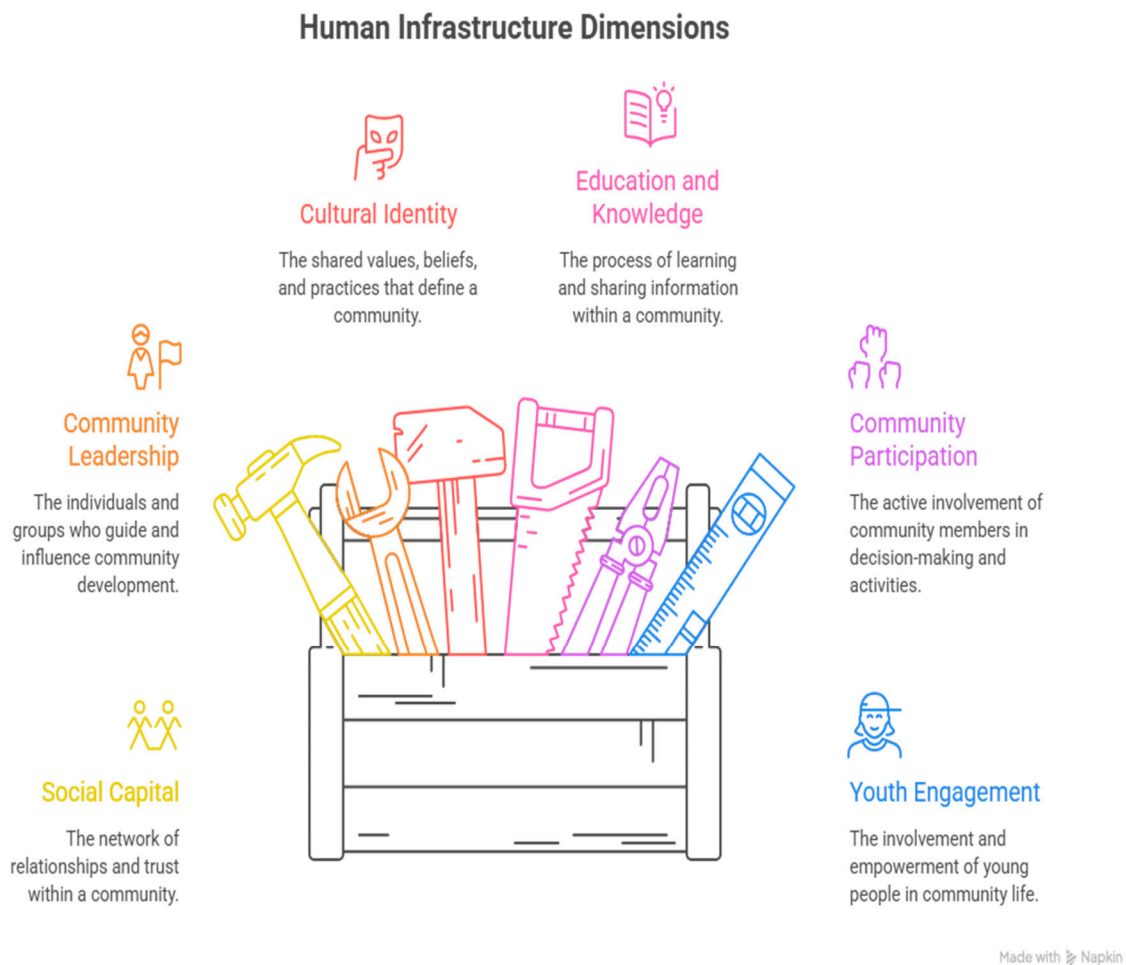


Figure 2. Human infrastructure theory of tourism resilience.

According to the proposed framework, tourism destinations exposed to similar environmental, economic, or social pressures may experience substantially different resilience outcomes because they possess different levels of human infrastructure. Communities characterized by strong social relationships, effective leadership, cultural continuity, participatory governance, educational resources, and active youth engagement are expected to demonstrate greater adaptive capacity than communities where these resources are weak or fragmented [13,17,29,31].

The theory further proposes that the importance of human infrastructure increases as uncertainty intensifies. During periods of relative stability, the contribution of social and cultural resources may remain partially invisible because physical systems function effectively. However, during periods of disruption, including climate-related events, environmental degradation, demographic decline, economic crises, or tourism shocks, human infrastructure becomes a primary determinant of resilience outcomes.

Consequently, human infrastructure theory of tourism resilience extends existing engineering, ecological, and socio-ecological approaches by positioning communities not only as participants in resilience processes but also as infrastructures of resilience themselves. From this perspective, resilient tourism development emerges not solely from what destinations possess, but from what communities are capable of mobilizing, preserving, and transforming as a whole.

Although the human infrastructure theory of tourism resilience provides a complementary explanation for adaptive capacity and destination resilience, it should not be interpreted as suggesting that human infrastructure alone can guarantee successful adap-

tation under all circumstances. Like any theoretical framework, its explanatory power is subject to important contextual limitations.

First, severe social fragmentation may substantially weaken the functioning of human infrastructure. Communities characterized by persistent conflict, low interpersonal trust, polarization, or weak collective identities may struggle to mobilize the social resources necessary for coordinated adaptation. In such contexts, social networks and participatory processes may be insufficient to generate collective responses to environmental and economic challenges.

Second, institutional dysfunction may limit the effectiveness of human infrastructure. Even highly cohesive communities may face significant constraints when operating within governance systems characterized by corruption, political instability, limited transparency, or weak institutional capacity. Human infrastructure can facilitate adaptation, but it cannot fully compensate for the absence of basic governance conditions.

Third, demographic decline represents a major challenge for the long-term sustainability of human infrastructure. Extreme depopulation, persistent outmigration, and the erosion of younger generations may reduce the capacity of communities to maintain leadership structures, transfer knowledge, and sustain collective action over time.

Fourth, the theory may have limited explanatory power in contexts where communities have experienced severe disruption, including large-scale disasters, forced displacement, armed conflict, or prolonged socio-economic collapse. Under such conditions, the social foundations upon which human infrastructure depends may become substantially weakened or temporarily unavailable.

Finally, human infrastructure should be understood as complementary instead of substitutive. Strong social capacities cannot entirely replace the need for transportation systems, communication networks, environmental protection measures, healthcare services, or other forms of physical infrastructure. Sustainable resilience emerges from the interaction between material resources and community capacities rather than from either dimension in isolation.

Recognizing these boundary conditions strengthens the theoretical robustness of HITR by clarifying the contexts in which human infrastructure is most likely to contribute to tourism resilience and the circumstances under which its influence may be constrained.

6.2. Key Propositions

Building upon the human infrastructure model proposed in this paper, five theoretical propositions are advanced to guide future empirical investigations. Instead of treating resilience as a direct outcome of infrastructural investments or environmental conditions alone, these propositions position human infrastructure as a foundational mechanism through which tourism destinations develop adaptive capacity and long-term sustainability.

Proposition 1 (P1). *Human infrastructure functions as a latent resilience resource whose influence becomes increasingly visible under conditions of environmental and socio-economic uncertainty.*

Many dimensions of human infrastructure remain largely invisible during periods of stability. Trust, social cohesion, local leadership, cultural continuity, and collective efficacy often operate in the background of everyday community life [13,29,39]. However, when destinations are confronted with climate-related disruptions, economic crises, demographic pressures, or environmental change, these resources become critical determinants of adaptive responses [13,29]. Therefore, the resilience of tourism destinations may depend not only on the resources they possess but also on the latent social capacities that communities are able to activate when facing uncertainty [29,39].

Proposition 2 (P2). *The adaptive capacity of tourism destinations is positively associated with the density, diversity, and quality of human infrastructure components.*

Adaptive capacity does not emerge spontaneously. It develops through the accumulation and interaction of social capital, leadership structures, knowledge-sharing systems, participatory processes, cultural resources, and intergenerational connections. Destinations characterized by stronger and more interconnected human infrastructure are expected to demonstrate greater flexibility, learning capacity, innovation potential, and responsiveness when confronted with environmental and social challenges. In this perspective, human infrastructure constitutes the social foundation upon which adaptive capacity is built.

Proposition 3 (P3). *Human infrastructure mediates the relationship between climate-related pressures and tourism resilience outcomes.*

Climate change affects destinations through multiple pathways, including environmental degradation, extreme weather events, changing visitor patterns, and increased uncertainty. However, similar environmental pressures frequently produce different outcomes across destinations. This framework proposes that human infrastructure acts as a mediating mechanism explaining these differences. Communities endowed with stronger social networks, leadership capacities, participatory governance processes, and cultural cohesion are expected to transform external pressures into adaptive responses more effectively than communities where such resources are fragmented or weakened.

Proposition 4 (P4). *Human infrastructure partially compensates for infrastructural and resource deficits in remote and vulnerable tourism regions.*

Remote destinations often face structural disadvantages associated with geographical isolation, limited financial resources, demographic decline, and restricted access to services. Nevertheless, numerous communities demonstrate remarkable resilience despite these constraints. The present framework suggests that human infrastructure may function as a compensatory mechanism that enables communities to mobilize available resources more effectively, coordinate collective action, preserve local knowledge, and generate context-specific solutions. While human infrastructure cannot replace physical infrastructure entirely, it may significantly enhance the capacity of communities to adapt under conditions of scarcity.

Proposition 5 (P5). *Youth engagement operates as a long-term sustainability mechanism within human infrastructure systems.*

The resilience of tourism destinations depends not only on present adaptive capacities but also on their ability to reproduce and renew these capacities across generations. Youth engagement contributes to this process by supporting demographic continuity, innovation, entrepreneurship, environmental stewardship, digital competence, and future leadership development. Communities that successfully integrate younger generations into local development processes are expected to maintain stronger human infrastructure over time, thereby increasing their long-term resilience and sustainability potential.

Figure 3 synthesizes the principal dimensions of human infrastructure identified through the conceptual review. Instead of functioning independently, these dimensions represent complementary community resources that together contribute to adaptive capacity.



Figure 3. Human infrastructure as the foundation of destination resilience.

The relationships illustrated in Figure 2 provide the conceptual basis for the interaction mechanisms developed in Figure 3, where the causal pathways linking human infrastructure, adaptive capacity, and tourism resilience are explicitly presented. Thus, Figure 3 illustrates the proposed human infrastructure model and highlights the key social dimensions that support tourism resilience in remote and vulnerable destinations. The metaphor of the keyring emphasizes that destination resilience is not generated by a single factor but emerges from the interaction of multiple community-based resources. Human infrastructure is conceptualized as a combination of social capital, community participation, cultural identity, education and knowledge transfer, and youth engagement, each functioning as a critical mechanism that strengthens adaptive capacity. Together, these interconnected components enable communities to respond to environmental pressures, climate-related challenges, demographic changes, and socio-economic disruptions, ultimately supporting sustainable community development and long-term tourism resilience.

7. Policy and Practical Implications

The framework proposed in this paper has implications for how tourism resilience is conceptualized, planned, and supported in remote and vulnerable regions. Current policy responses to climate change and tourism development often prioritize visible and measurable investments, including transportation networks, visitor facilities, environmental monitoring systems, and destination infrastructure. While such investments remain essential, the present analysis suggests that they represent only part of the resilience equation.

The five theoretical propositions developed in this study extend beyond conceptual clarification by providing a foundation for future tourism policy and governance. They suggest that strengthening community capacities should become a strategic policy objective alongside investments in physical infrastructure. Existing tourism policies continue to prioritize economic and infrastructural indicators, whereas comparatively limited attention has been given to the systematic development of social, educational, cultural, and participatory capacities. The proposed framework therefore identifies an important gap in current tourism resilience policy and provides a conceptual basis for future empirical assessment and policy design.

The findings of this conceptual review indicate that the effectiveness of physical and environmental interventions is frequently mediated by community capacities. Social cohesion, local leadership, cultural continuity, educational resources, and opportunities for participation influence how communities interpret risks, mobilize resources, and respond to change. Therefore, resilience policies that overlook these dimensions may underestimate the social foundations upon which adaptation ultimately depends.

For policymakers, this implies the need for a more balanced approach to resilience planning. Investments in infrastructure should be accompanied by investments in community development processes that strengthen local capacities over the long term. Educational initiatives that promote environmental literacy, programs supporting local leadership, mechanisms encouraging community participation, and strategies aimed at retaining and engaging younger generations may contribute as much to destination resilience as conventional infrastructure projects. Particularly in remote regions facing demographic decline and economic vulnerability, strengthening human infrastructure may represent a cost-effective and sustainable complement to physical adaptation measures.

For tourism practitioners, the framework highlights the importance of fostering meaningful local involvement in tourism development. Resilience is more likely to emerge when tourism initiatives build upon existing community strengths rather than operate independently from them. Supporting local entrepreneurship, encouraging collaboration among stakeholders, preserving cultural heritage, and creating opportunities for residents to participate in tourism planning can strengthen both destination competitiveness and adaptive capacity. Such approaches may also enhance community wellbeing, which is increasingly recognized as an important outcome of sustainable tourism development [64].

The framework also carries implications for destination governance. Participatory approaches should not be viewed solely as mechanisms for consultation but as resilience-building processes that strengthen trust, collective efficacy, and local ownership. As climate-related uncertainties continue to intensify, destinations that cultivate these social capacities may be better positioned to adapt to changing environmental and socio-economic conditions. The concept of human infrastructure invites researchers and policymakers to reconsider how resilience is measured. Existing assessments frequently focus on economic indicators, environmental conditions, or infrastructural capacities. While these measures remain valuable, they may provide only a partial understanding of resilience if community-based resources are excluded. Integrating social and cultural dimensions into resilience assessments could provide a more comprehensive understanding of destination vulnerability and adaptive potential.

Consequently, the resilience-generating potential of human infrastructure depends not only on the existence of community capacities but also on the institutional and social conditions under which they operate. Inclusive governance, openness to external knowledge and continuous learning, together with balanced participation among diverse community stakeholders, help prevent exclusionary dynamics, reduce the concentration

of decision-making power, and maintain the adaptive flexibility necessary for long-term tourism resilience.

The concept of human infrastructure is proposed here as a theoretical framework intended to stimulate further discussion and empirical investigation. Although the present paper has identified several dimensions that appear central to human infrastructure, significant opportunities remain for refining, testing, and operationalizing the concept across different tourism contexts.

A first priority concerns measurement. Future studies could develop and validate instruments capable of assessing human infrastructure at the destination level. Such efforts would allow researchers to examine the relative contribution of social capital, leadership, cultural identity, education, participation, and youth engagement to resilience outcomes. The development of a human infrastructure scale would also facilitate comparative analyses across destinations and regions.

Comparative studies represent a second important avenue for research. The role of human infrastructure is likely to vary according to geographical, cultural, and institutional contexts. Investigating how the framework operates in mountain communities, island destinations, rural regions, protected natural areas, and border territories could provide valuable insights into the contextual factors shaping resilience processes.

Longitudinal research is equally important. Resilience is inherently dynamic, yet most studies rely on cross-sectional data. Following communities over time would make it possible to examine how human infrastructure evolves in response to environmental change, demographic transitions, economic disruptions, and tourism development trajectories.

Future research may also explore the relationship between human infrastructure and digital transformation. Emerging technologies are increasingly influencing tourism planning, visitor experiences, and destination management. Understanding how digital tourism initiatives, smart destination strategies, and community-based digital participation interact with human infrastructure may help identify new pathways toward adaptive capacity and sustainable development.

Finally, empirical investigations should examine the relationship between human infrastructure and climate adaptation outcomes. While the present framework assumes that stronger human infrastructure contributes to adaptive capacity, systematic evidence remains limited. Future studies may explore whether destinations characterized by stronger social cohesion, higher participation levels, stronger cultural identity, and more effective knowledge transfer demonstrate greater resilience to climate-related pressures.

Adopting the human infrastructure perspective would also imply a shift in tourism policy evaluation. Beyond monitoring investments in physical infrastructure, visitor numbers, or economic performance, policymakers should increasingly assess community capacities, including leadership development, social cohesion, knowledge transfer, participatory governance, and intergenerational engagement. Incorporating such indicators into tourism planning would allow decision-makers to evaluate not only the resources available within destinations but also their long-term adaptive potential. Policies aimed at strengthening human infrastructure should therefore promote not only community cohesion but also inclusiveness, transparency, shared leadership, and openness to innovation in order to minimize potential unintended effects associated with strong internal community structures.

8. Conclusions

This paper has argued that contemporary discussions of tourism resilience remain strongly influenced by infrastructural, environmental, and technological perspectives, often emphasizing the physical systems that support tourism development while paying comparatively less attention to the communities that sustain those systems over time. Although

significant advances have been made through engineering, ecological, and socio-ecological approaches, an important conceptual gap persists regarding the role of community capacities as foundational drivers of adaptation and long-term sustainability.

To address this gap, the paper introduced the concept of human infrastructure, defined as the network of social relationships, cultural resources, local knowledge, collective capacities, and participatory processes that enable communities to sustain, adapt, and transform tourism systems under conditions of environmental and social change. Building upon insights from tourism resilience, community resilience, environmental governance, and sustainable development research, the article proposed a human-centered framework in which social capital, community leadership, cultural identity, education and knowledge transfer, participation, and youth engagement function as interconnected dimensions of adaptive capacity.

The analysis suggests that resilience is not solely determined by the availability of physical infrastructure or environmental resources. Rather, it is shaped by the ability of communities to mobilize knowledge, maintain social cohesion, preserve cultural continuity, engage in collective action, and respond creatively to emerging challenges. This perspective is particularly relevant for mountain regions, rural destinations, protected natural areas, and peripheral territories, where environmental vulnerability is often compounded by demographic pressures, economic constraints, and geographical isolation.

The concept of human infrastructure does not diminish the importance of transportation systems, visitor facilities, environmental protection measures, or digital technologies. Instead, it highlights the social foundations that enable these investments to generate meaningful and lasting outcomes. Infrastructure can facilitate adaptation, but communities ultimately determine how adaptation occurs, how resources are used, and how destinations navigate uncertainty.

As climate change continues to reshape tourism systems worldwide, resilience may increasingly depend on capacities that are less visible than roads, visitor centers, or technological innovations. Trust, participation, leadership, local knowledge, cultural identity, and intergenerational continuity are difficult to quantify, yet they frequently determine whether destinations merely recover from disruption or successfully adapt to changing conditions. Understanding communities not only as beneficiaries of development but also as infrastructures of resilience offers a complementary perspective for tourism research and practice.

Ultimately, the future of resilient tourism development may depend less on the infrastructure that communities build and more on the communities that sustain infrastructure. Recognizing human infrastructure as a core component of resilience provides a broader foundation for designing tourism systems capable of adapting to uncertainty while simultaneously supporting environmental sustainability, social wellbeing, and long-term community development.

From a practical perspective, the proposed human infrastructure framework has implications for multiple stakeholder groups. For researchers, it provides a conceptual foundation for developing operational definitions, measurement instruments, and empirical models capable of assessing human infrastructure across different tourism contexts. For policymakers, the framework highlights the importance of complementing investments in physical infrastructure with policies that strengthen community participation, local leadership, cultural continuity, and social cohesion. For tourism practitioners and destination management organizations, the findings emphasize that long-term resilience depends not only on technological or infrastructural improvements but also on fostering collaboration, knowledge sharing, community engagement, and inclusive governance among local stakeholders.

Beyond its theoretical contribution, the proposed human infrastructure framework also offers a new perspective for supporting sustainable tourism development through community-based adaptive capacity. By emphasizing cooperation, local leadership, knowledge transfer, cultural identity, and participatory governance, the framework provides conceptual support for the development of community-based tourism, ecotourism, rural tourism, cultural tourism, and other associative forms of sustainable tourism. These findings suggest that long-term tourism resilience depends not only on investments in physical infrastructure but also on strengthening the social infrastructures that enable communities to adapt, innovate, and sustain destination development over time.

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