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Stakeholder perceptions of tourism carrying capacity in a Trans-Himalayan destination: A qualitative multi-zone investigation

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Abstract

Tourism carrying capacity (TCC) in ecologically and culturally fragile mountain destinations is increasingly contested as a governance challenge that transcends quantitative threshold calculation. This study examines how diverse stakeholders perceive, define, and experience TCC in Ladakh, India, a high-altitude Trans-Himalayan destination receiving over half a million visitors annually. Drawing on 42 phenomenological semi-structured interviews conducted across four spatial zones (Leh, Nubra Valley, Pangong Tso corridor, and Zanskar) and analysed using NVivo-assisted thematic analysis, five interconnected dimensions of carrying capacity stress are identified: infrastructural saturation, ecological fragility, cultural commodification, institutional inadequacy, and differential spatial vulnerability. Sentiment analysis of the interview corpus reveals significant variation in affective responses across stakeholder categories and across the tourist season, with monastery representatives and local residents expressing substantially higher negative sentiment than tourism entrepreneurs and government officials. The findings challenge the reductionist application of the Physical, Real, and Effective Carrying Capacity hierarchy to complex socio-ecological destination systems and argue for a contextualised, participatory, and adaptive TCC governance framework grounded in local ecological knowledge, culturally sensitive threshold indicators, and strengthened institutional coordination. The study addresses three interrelated research gaps, namely methodological, contextual, and conceptual, in the Indian Himalayan TCC literature and contributes to broader debates on overtourism governance, the Limits of Acceptable Change framework, and sustainable mountain tourism development in relation to SDG 11, SDG 15, and SDG 16.

***Keywords*:** Tourism Carrying Capacity, Overtourism, Mountain Tourism, Ladakh, Trans-Himalayas, Destination Governance, Qualitative Research, Nvivo, Social-Ecological Systems

JEL Classification: Q57, O18, Z32

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1. Introduction

Tourism has long been celebrated as an instrument of economic development and cultural exchange, yet its unchecked expansion in ecologically fragile destinations has generated serious and, in some cases, irreversible consequences. The phenomenon, variously termed as "overtourism", "tourist overcrowding", or simply "carrying capacity exceedance", has entered mainstream tourism discourse with renewed urgency in the post-pandemic landscape, as destinations grapple with the paradox of tourism-dependent economies and the imperative to conserve the very assets that attract visitors (Goodwin, 2017; Peeters et al., 2021). Mihalic (2020) proposed that overtourism should be understood not merely as a volume problem but as a multi-capacity failure spanning physical, ecological, socio-psychological, and socio-political dimensions, an argument that resonates directly with the multi-dimensional carrying capacity stress documented in the Himalayan regions. Within this contested terrain, mountain tourism destinations occupy a particularly precarious position. Their ecological sensitivity, cultural distinctiveness, and infrastructural thinness render them disproportionately vulnerable to demand-side shocks. Ladakh, constituted as India's latest Union Territory in 2019 following the reorganisation of the erstwhile state of Jammu and Kashmir, is a case of extraordinary analytical interest. Situated in the Trans-Himalayas and bordering both Pakistan and China, Ladakh covers approximately 59,000 square kilometres of high-altitude cold desert terrain, Buddhist monasteries of global heritage significance, and pristine wetlands and lakes. Tourism has grown from a few adventure travellers in the 1970s to a mass-market phenomenon that strains the region's physical and social infrastructure to its limits. The local administration reported more than 500,000 tourist arrivals in 2023, a figure almost ten times that of the population of the main city, Leh (LAHDC Tourism Statistics, 2024).

The concept of tourism carrying capacity (TCC), rooted in ecology and formalised for tourism management contexts by the World Tourism Organization (WTO) and Cifuentes (1992), offers a theoretically grounded approach to determining the maximum number of visitors a destination can accommodate without unfavourable impact on its physical environment, visitor experience quality, or the socio-cultural integrity of the host community. However, quantitative approaches dominated by the Physical Carrying Capacity (PCC), Real Carrying Capacity (RCC), and Effective/Permissible Carrying Capacity (ECC) hierarchy may obscure the lived realities, local knowledge, and contextual nuances essential to meaningful carrying capacity governance (McCool and Lime, 2001; Papageorgiou and Brotherton, 1999). Against this backdrop, the present study is guided by three research questions. RQ1: How do key stakeholders in Ladakh perceive, define, and articulate the carrying capacity of the destination across its physical, ecological, social, and institutional dimensions? RQ2: What contextual factors do stakeholders identify as boundary conditions for a sustainable tourist load? RQ3: What does the grounded experience of destination saturation look like from within the communities whose lives and ecologies are most immediately at stake? Through 42 in-depth interviews and NVivo-assisted thematic analysis, this study

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contributes to the growing scholarship that challenges monolithic, formulaic approaches to TCC and advocates for a pluralist, participatory framework integrating local ecological knowledge, institutional capacity assessments, and culturally sensitive threshold indicators.

The remainder of this paper is organised as follows. Section 2 presents a critical review of the carrying capacity literature and identifies the research gap. Section 3 describes the research methodology. Section 4 presents findings organised by emergent themes. Section 5 discusses the conclusions, managerial and policy implications, the study's limitations, followed by a future research agenda.

2. Literature Review

The concept of carrying capacity in tourism traces back to range management and wildlife biology, where the concept denoted the maximum population of animals a given habitat could sustain without deterioration (Mathieson and Wall, 1982). Its migration into recreation and tourism scholarship began with Wagar (1964), who recognised early that carrying capacity encompassed experiential quality and user satisfaction, not merely physical space. Mathieson and Wall (1982) advanced this conceptualisation by framing tourism impacts as threefold: economic, physical, and social, and by arguing that the interaction among these impact categories, rather than any single threshold, determined a destination's practical capacity ceiling. The formalisation of TCC for protected area management gained momentum through the World Tourism Organization (WTO, 1992), which elaborated it as the maximum number of visitors that may visit a tourist destination at the same time, without causing destruction of the physical, economic, and socio-cultural environment and an unacceptable decrease in the quality of visitors' satisfaction. The Cifuentes (1992) methodology, developed at the CATIE research centre in Costa Rica, gave the WTO definition operational structure by proposing the sequential computation of PCC, RCC, and ECC as a nested hierarchy, with each tier adjusting the theoretical maximum downward through empirically derived correction factors and management capacity indices. This framework was subsequently adopted widely in Latin America, Southern Europe, and Southeast Asia, and remains the dominant operational approach in destination management plans and environmental impact assessments (Jurado et al., 2012; Vasiliadis and Kobotis, 1999).

However, criticisms of the Cifuentes framework have been persistent and pointed. McCool and Lime (2001) argued that carrying capacity carries an implicit assumption of a fixed, determinable threshold that is inherently incompatible with the dynamic, adaptive, and socially constructed nature of tourism systems. This critique catalysed the development of alternative frameworks, including the Limits of Acceptable Change (LAC) framework (Stankey et al., 1985), the Visitor Experience and Resource Protection (VERP) model and the Tourism Optimization Management Model (TOMM) (McArthur, 2000). Butler (1980), in a retrospective perspective, observed that carrying capacity had been relatively ignored by practitioners and academicians for several decades and called urgently for its reinstatement as a central concern in destination planning,

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warning that the absence of enforceable visitor limits had contributed directly to the overtourism crises now visible across the globe. Heeding this scholarly call, Long et al. (2022) conducted a bibliometric review of tourism environmental carrying capacity (TECC), drawing on 297 scholarly articles spanning 1982 to 2022, and concluded that while assessment modelling had matured significantly, dynamic early-warning systems and governance-focused research remained conspicuously underdeveloped.

2.1 Social and Perceptual Dimensions of Carrying Capacity

A significant strand of TCC literature has focused on the social and perceptual dimensions, specifically, the visitor's experience of crowding and the host community's tolerance of tourism impacts. Shelby and Heberlein (1987) proposed the concept of social carrying capacity as the level of use beyond which crowding-related impacts become unacceptable to visitors. Similarly, Graefe et al. (1984) demonstrated that the relationship between use density and crowding perception is mediated by visitor motivations, experience norms, and encounter expectations, making it inherently variable and context-dependent. The host community perspective, often framed through Doxey's (1975) Irridex model or the Tourism Impact Attitude Scale (TIAS) developed by Lankford and Howard (1994), adds a further layer of complexity. Research across destinations as varied as Venice (Seraphin et al., 2018) and Barcelona (Milano et al., 2019) has demonstrated that resident perceptions of tourism's impacts on quality of life, cultural identity, and community cohesion are powerful determinants of a destination's social carrying capacity. Rasoolimanesh and Seyfi (2021) critically synthesised five decades of research on residents' perceptions and attitudes towards tourism development, arguing that the field had been theoretically constrained by its reliance on social exchange theory and quantitative instruments, and calling explicitly for qualitative and mixed-methods approaches to access the multi-dimensional complexity of host community responses, a call that directly motivates the design of the present study. Similarly, Šegota et al. (2023) identified a persistent state of arrested development in resident perception research and proposed a rethinking of conceptualisation that encompasses lived realities and subjective meanings, precisely the epistemological orientation that phenomenological qualitative inquiry affords. In the context of mountain and indigenous communities, the social carrying capacity question is further complicated by questions of land rights, cultural sovereignty, and the commodification of tradition (Rasul and Manandhar, 2009).

2.2 Mountain Tourism and Carrying Capacity: Evidence from Comparable Contexts

The Himalayan tourism corridor, encompassing Nepal, Bhutan, Tibet, Sikkim, Himachal Pradesh, and Ladakh, offers a rich comparative context for examining TCC challenges. Nepal's Everest Base Camp trekking region has been extensively studied, with scholars documenting trail degradation, solid waste accumulation, and altitude sickness risks associated with unregulated visitor flows (Byers, 2005; Nepal, 2000). Bhutan's adoption of a “high value, low volume” tourism policy, operationalised through a minimum daily tariff, represents perhaps the most direct policy

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application of TCC thinking in the Himalayan region (Rinzin et al., 2007). Cheer and Lew (2018) argued that mountain destinations require adaptive carrying capacity frameworks responsive to rapidly changing environmental conditions, demographic shifts, and geopolitical uncertainties. In this context, Morse (2023) advanced the Social-Ecological Complex Adaptive Systems (SECAS) framework as a theoretical instrument for linking systems-thinking and resilience approaches to protected area tourism management, arguing that governance systems, ecological hierarchies, and tourism accommodation networks are hierarchically nested systems that must be analysed as coupled rather than independent units. This perspective is particularly pertinent for the Himalayan region, where the tourism system spans military-controlled zones, protected wetlands, national park territories, and civil administrative jurisdictions that interact in complex and politically sensitive ways. In the Indian context, Lone et al. (2013) examined carrying capacity in Bangus Valley of Jammu and Kashmir, and found that to avoid any unwanted environmental degradation and to maintain the ecological balance of the area, they calculated that the place can accommodate 3250 tourists per day. Chand M (2012) assessed the socio-cultural carrying capacity of Kullu-Manali using questionnaire surveys, finding high resident irritation indices in concentrated tourist zones. Both studies relied primarily on quantitative instruments and did not explore the qualitative texture of stakeholder perceptions in depth.

Three interrelated gaps in the extant literature are addressed by this study. First, a methodological gap: existing TCC studies in the Indian Himalayan region have relied predominantly on quantitative approaches and have not deployed qualitative inquiry to access the experiential, cultural, and institutional dimensions of carrying capacity. Second, a contextual gap: Ladakh, despite being one of India's fastest-growing and most ecologically sensitive tourism destinations, has not been the subject of a dedicated peer-reviewed TCC study. Third, a conceptual gap: the literature has repeatedly called for carrying capacity frameworks that move beyond numerical thresholds to incorporate adaptive, place-based, and participatory logics, which Long et al. (2022) identified as the most conspicuously underdeveloped dimension of the TECC research field, but empirical studies enacting this call in Himalayan destination contexts remain rare. This study addresses all three gaps through a qualitative, NVivo-assisted, multi-stakeholder investigation.

3. Research Methodology

This study is grounded in an interpretivist philosophical paradigm, which holds that social reality is constructed, negotiated, and understood through the subjective experiences and meanings that individuals attribute to their world (Bryman, 2016; Creswell and Poth, 2016). Within interpretivism, the study adopts a phenomenological orientation consistent with the work of Moustakas (1994) and van Manen (2016), seeking to describe and interpret the lived experience of a phenomenon as understood by those who inhabit it most intimately. The overall research design is a qualitative case study (Yin, 2018), with Ladakh constituted as the bounded case and further disaggregated into four spatial sub-units: Leh district (urban tourism hub), Nubra Valley

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(adventure and cultural tourism), Pangong Tso corridor (wildlife and scenic tourism), and Zanskar sub-division (remote trekking and Buddhist heritage tourism). This multi-zone design enables examination of both the commonalities and the spatial particularities of carrying capacity experience across a heterogeneous destination landscape.

3.1 Sampling and Data Collection

Purposive sampling was employed to identify and recruit participants with direct, substantive experience of tourism's impacts in Ladakh. Snowball sampling was used within each stakeholder category to extend the participant network beyond initial contacts identified through institutional channels and field reconnaissance. Sampling continued until theoretical saturation was reached, the point at which additional interviews yielded no substantively new themes or conceptual categories (Guest et al., 2006). A total of 42 in-depth interviews were conducted across the four study zones: 16 in Leh, 10 in Nubra Valley, 9 in the Pangong corridor, and 7 in Zanskar.

Table 1.Profile of Study Participants

Stakeholder Category	No. of Participants	Gender (M/F)	Zone(s)
Local residents	13	7M / 6F	Leh, Nubra, Pangong, Zanskar
Tourism entrepreneurs	9	6M / 3F	Leh, Nubra, Pangong
Local administrative officials	6	5M / 1F	Leh
Forest / Wildlife officials	4	4M / 0F	Nubra, Pangong, Zanskar
Monastery representatives	5	5M / 0F	Leh, Nubra, Zanskar
Environmental NGO representatives	5	3M / 2F	Leh, Nubra
Total	42	30M / 12F	All zones

Source: Authors' own.

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Six stakeholder categories were represented: local residents (n=13), tourism entrepreneurs (n=9), local administrative officials (n=6), forest and wildlife officials (n=4), monastery representatives (n=5), and environmental NGO representatives (n=5). Table 1 provides a full participant profile. It is acknowledged that female representation is uneven across stakeholder categories, particularly among monastery representatives and forest officials (0 of 5) and local administrative officials (1 of 6). This reflects contextual access constraints rather than a sampling preference: monastic institutional norms in Ladakh's Vajrayana Buddhist tradition preclude women from formal representative roles in most monasteries, while the female share of senior government appointments in the Union Territory administration remained low during the study period.

Interviews ranged in duration from 45 to 60 minutes and were conducted between June and September 2023, coinciding with peak and shoulder tourist seasons. The interview protocol covered four thematic domains: (i) perceptions of current tourism volume and its consequences; (ii) identification of the most stressed or vulnerable aspects of the destination; (iii) views on acceptable levels of tourism; and (iv) assessments of current governance mechanisms. Interviews were conducted in English, Hindi, or Ladakhi, with the latter two facilitated by a trained local research assistant. Non-participant field observation and secondary data review complemented the interview data.

3.2 Data Analysis

Interview data were transcribed verbatim and entered into NVivo qualitative data analysis software. Ladakhi and Hindi transcripts were translated into English. To ensure translation equivalence, a random sample of twenty per cent of the translated transcripts was independently back-translated into the source language by a second bilingual researcher, and any substantive discrepancies were reconciled through discussion before finalisation. Thematic analysis was employed as the primary analytical method, following Braun and Clarke's (2006) six-phase framework: familiarisation with data, generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. NVivo was deployed at three analytical stages. First, all transcripts were imported into a single NVivo project, organised by participant code, zone, and stakeholder category, and subjected to open coding using the Code function, generating 147 initial codes from the corpus of 118,450 words. Second, codes were progressively consolidated through NVivo's Node hierarchy function into a five-theme parent-node structure with 23 child nodes, as represented in the hierarchy chart (Figure 1). Third, NVivo's Auto Code sentiment analysis function was applied to the full corpus to provide a systematic overview of the affective tone of participants' accounts across themes, stakeholder categories, and data collection phases (Figure 3). A word frequency query was additionally run to generate a visual overview of the dominant conceptual vocabulary in the corpus (Figure 2). These NVivo outputs serve as navigational and communicative analytical tools, enhancing the rigour and transparency of the analytical process, but do not substitute for the interpretive analysis that follows.

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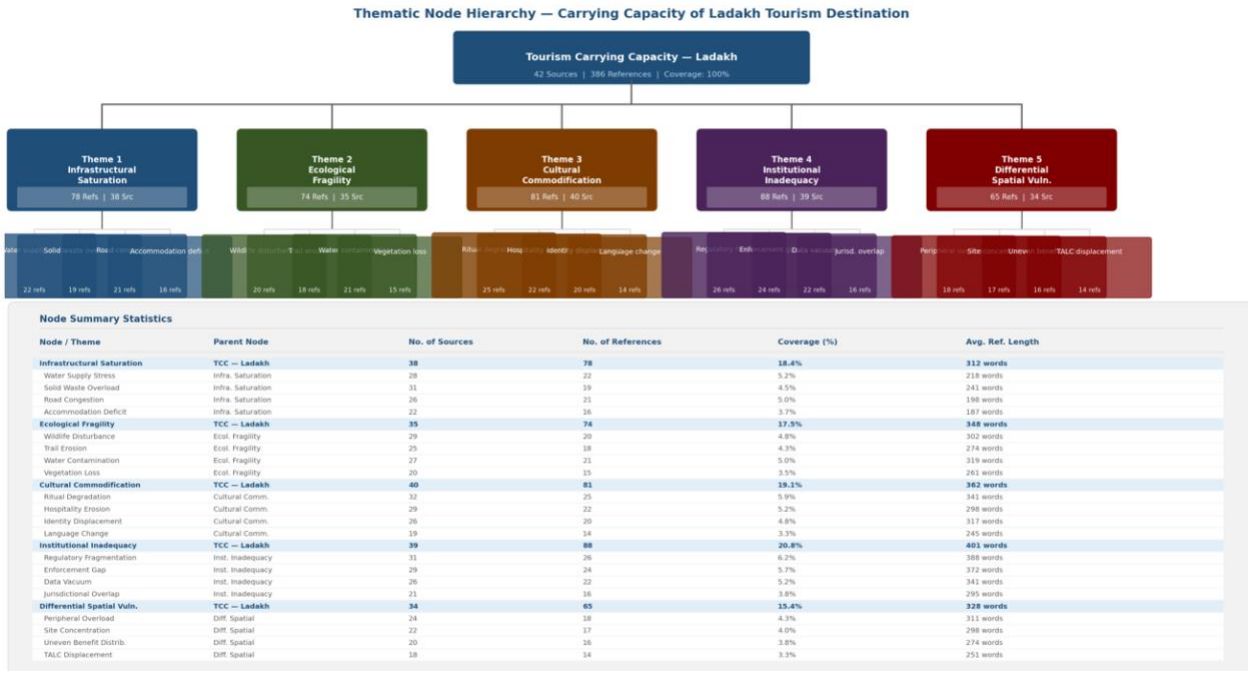
The analysis proceeded inductively in the first instance, allowing themes to emerge from participants' own language and interpretive categories. This was followed by a deductive phase in which emergent themes were interrogated in relation to the TCC literature, the LAC framework, and the social-ecological systems (SES) approach of Ostrom (2009). Reflexivity was maintained throughout via peer debriefing sessions and a reflexivity statement documenting positional commitments. Trustworthiness was ensured through credibility (prolonged engagement, member checking, triangulation), transferability (thick description), dependability (audit trail), and confirmability (reflexivity) per Lincoln and Guba (1985). All participants were informed about the study before data collection. No personally identifiable information is reported.

Figure 1. NVivo Hierarchy Chart — Thematic Node Structure



Node Summary Statistics

Node / Theme	Parent Node	No. of Sources	No. of References	Coverage (%)	Avg. Ref. Length
Infrastructural Saturation	**TCC — Ladakh**	**38**	**78**	**18.4%**	**312 words**
Water Supply Stress	Infra. Saturation	28	22	5.2%	218 words
Solid Waste Overload	Infra. Saturation	31	19	4.5%	241 words
Road Congestion	Infra. Saturation	26	21	5.0%	198 words
Accommodation Deficit	Infra. Saturation	22	16	3.7%	187 words
Ecological Fragility	**TCC — Ladakh**	**35**	**74**	**17.5%**	**348 words**
Wildlife Disturbance	Ecol. Fragility	29	20	4.8%	302 words
Trail Erosion	Ecol. Fragility	25	18	4.3%	274 words
Water Contamination	Ecol. Fragility	27	21	5.0%	319 words
Vegetation Loss	Ecol. Fragility	20	15	3.5%	261 words
Cultural Commodification	**TCC — Ladakh**	**40**	**81**	**19.1%**	**362 words**
Ritual Degradation	Cultural Comm.	32	25	5.9%	341 words
Hospitality Erosion	Cultural Comm.	29	22	5.2%	298 words
Identity Displacement	Cultural Comm.	26	20	4.8%	317 words
Language Change	Cultural Comm.	19	14	3.3%	245 words
Institutional Inadequacy	**TCC — Ladakh**	**39**	**88**	**20.8%**	**401 words**
Regulatory Fragmentation	Inst. Inadequacy	31	26	6.2%	388 words
Enforcement Gap	Inst. Inadequacy	29	24	5.7%	372 words
Data Vacuum	Inst. Inadequacy	26	22	5.2%	341 words
Jurisdictional Overlap	Inst. Inadequacy	21	16	3.8%	295 words
Differential Spatial Vuln.	**TCC — Ladakh**	**34**	**65**	**15.4%**	**328 words**
Peripheral Overload	Diff. Spatial	24	18	4.3%	311 words
Site Concentration	Diff. Spatial	22	17	4.0%	298 words
Uneven Benefit Distrib.	Diff. Spatial	20	16	3.8%	274 words
TALC Displacement	Diff. Spatial	18	14	3.3%	251 words

Figure 1: NVivo Hierarchy Chart displaying the five-theme parent node structure, 23 child nodes, reference counts, and source coverage derived from thematic analysis of 42 interview transcripts (corpus: 118,450 words). Node shading depth reflects reference frequency. Lower panel: full node summary statistics as generated by NVivo. Source: Authors' own.

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Figure 2. NVivo Word Frequency Query — Word Cloud

Figure 2: NVivo Word Cloud generated from a word frequency query on the full interview corpus (n=42; 118,450 words; minimum word length: 3 characters; stemmed variants merged; Top 80 words displayed). Word size reflects frequency; colour clusters correspond to the five emergent themes. Source: Authors' own.

4. Findings and Discussion

Thematic analysis of the interview corpus, supported by NVivo's node hierarchy, word frequency query, and auto code sentiment analysis, yielded five overarching themes, each encompassing multiple sub-themes. The hierarchy chart (Figure 1) presents the complete node structure and reference density. The word cloud (Figure 2) visualises the dominant conceptual vocabulary. The sentiment analysis results (Figure 3) are discussed in relation to each theme and the data collection period. These NVivo-generated analytical outputs are presented alongside representative participant quotations; significant divergences in perspective between stakeholder groups are noted where analytically relevant. All participants are identified by coded identifiers (e.g., R-Leh-04 for Resident, Leh district, participant 4) that protect anonymity.

4.1 Theme 1: Infrastructural Saturation and the Visibility of Overload

The most immediate and universally articulated dimension of carrying capacity among participants was the visible saturation of Ladakh's physical infrastructure: roads, water supply, waste management systems, accommodation, and telecommunications under peak tourist loads. This was the second most reference-dense theme in the NVivo corpus (78 references; 38 sources), and the

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sentiment analysis attributed the highest proportion of "very negative" coding (18%) to this theme, reflecting the intensity of participants' frustration with infrastructure failures.

One local official described the water supply situation as follows: *"In July and August, Leh is simply not built to handle what is coming through the gates. Our water supply system was designed for a population of about 30,000. In peak season, we have the resident population plus maybe 25,000 tourists on any given day. The water pressure in upper residential areas drops to near zero by midday. This is a daily crisis, not an occasional stress"* (Official-Leh-02).

The waste management infrastructure emerged as a particularly acute point of saturation. A resident of Pangong village described the lakeside during August: *"What we see in summer is shocking for people who have lived here all their lives. The shoreline is covered with plastic water bottles, food packaging, and selfie sticks that people throw away. The lake that our grandfathers considered sacred is being treated like a dustbin"* (R-Pangong-03). Field observation corroborated these accounts, with dense concentrations of plastic waste documented at multiple sites during peak season.

Traffic congestion on narrow mountain roads constituted another prominent sub-theme. A tourism entrepreneur described the journey between Leh and Pangong in June-July as routinely extending to eight or nine hours due to vehicular congestion (E-Leh-06). The NVivo node "Road congestion" recorded 21 references from 26 sources, confirming this as a broadly shared concern. Across these accounts, a common analytical thread is discernible: infrastructural carrying capacity failures are not uniform events but geographically concentrated phenomena, suggesting that site-specific analysis is a necessary precondition for effective management.

4.2 Theme 2: Ecological Fragility and the Accumulation of Invisible Damage

The second theme encompasses the slow, cumulative, and often invisible degradation of Ladakh's ecological systems. With 74 references from 35 sources in NVivo, ecological fragility was the second most extensively documented theme, and sentiment analysis indicated a high proportion of negative and very negative coding (57%), reflecting participants' deep anxiety about environmental deterioration. The word cloud (Figure 2) prominently features ecological vocabulary: "wildlife", "erosion", "glacier", "wetland", "contamination", and "vegetation loss", confirming the centrality of ecological concern in participants' accounts.

A wildlife official at the Changthang Cold Desert described the impact of vehicle traffic on the Black-necked Crane's breeding behaviour: *"These birds are extremely sensitive to human disturbance during nesting, which coincides exactly with the peak tourist season in June and July. We have documented a steady decline in nesting success at Tso Kar over the past five years that correlates directly with the increase in vehicle movements along the Manali-Leh highway near the wetland. The tourists do not see this. They see a beautiful bird on a beautiful lake. They do not see*

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that their presence is disrupting a breeding cycle that took millions of years to develop" (Wildlife-Changthang-01).

Trail erosion in the Zanskar trekking circuits was described by an NGO representative as having accelerated sharply in the past decade, with the Markha Valley trail widening from a single-file path to three or four metres in places. Contamination of freshwater sources through open defecation near streams was identified by multiple participants as a significant public health and ecological risk. The sentiment trajectory analysis (Figure 3, Panel D) shows that negative sentiment in ecological accounts peaked in July and August, precisely when wildlife disturbance and trail erosion are most acute and moderated in September as tourism intensity declined, suggesting a temporally dynamic rather than static carrying capacity condition.

4.3 Theme 3: Cultural Commodification and the Erosion of Lived Tradition

The cultural commodification theme was the most reference-dense in the NVivo corpus (81 references; 40 sources), consistent with the richness and emotional depth of participants' accounts of cultural change. Sentiment analysis classified this theme as carrying the highest proportion of combined negative and very negative coding across all five themes (56%), and the auto code results highlighted a distinctive pattern: monastery representatives and local residents generated higher negative sentiment proportions, 74% and 68% respectively (Figure 3, Panel C) than tourism entrepreneurs (44%), reflecting the differential stakes of different stakeholder groups in Ladakh's cultural transformation.

A senior monk at a prominent monastery described the transformation of religious festivals with evident distress: *"Our annual Tsechu festival is a prayer ceremony. It has been performed for 700 years to invoke the protector deities and purify the monastery for the coming year. For the monks, it is the most sacred time of the calendar. But in the last ten years, it has become a tourist event. There are photographers with expensive cameras standing in the prayer hall. There are tourists walking between the monks during the Cham dances. The sanctity is being destroyed"* (Monk-Leh-03).

The commodification of hospitality was identified as a particularly corrosive process. A resident of Hemis village articulated: *"We used to invite travellers into our homes without thinking about payment. That was Ladakhi culture. Now everything is a transaction. My children ask me why we do not charge guests, because their friends' families do. The tradition is disappearing, not because we chose to give it up, but because tourism made it economically irrational"* (R-Leh-09). The word cloud captures this dynamic through the prominence of terms such as “sacred”, “ritual”, “identity”, “commodification”, “hospitality”, “festival”, and “spiritual”. This finding resonates with earlier documentation of Ladakhi cultural disruption and suggests that the processes identified in previous scholarship appear to have deepened considerably in subsequent decades a trajectory that warrants sustained empirical attention.

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4.4 Theme 4: Institutional Inadequacy and the Governance Deficit

With 88 references from 39 sources, institutional inadequacy was the most reference-dense theme in the NVivo corpus, underscoring the centrality of governance concerns in participants' accounts. The sentiment analysis recorded the highest overall proportion of negative coding for this theme (62% combined negative and very negative), reflecting candid acknowledgement of systemic limitations.

The regulatory fragmentation sub-node (26 references; 31 sources) captured participants' accounts of overlapping and undefined jurisdictions across local administration, the forest department, the department of tourism, and the armed forces. As one Tourism Authority official articulated: *"Every agency has a piece of the puzzle, but no one has the whole picture. The forest department controls some areas, we control others, and the army has its own restricted zones. When a tourist crosses from one zone to another, they move between different regulatory regimes. How do you implement a coherent carrying capacity limit in that situation?"* (Official-Leh-05).

The enforcement gap sub-node (24 references) documented the practical consequences of staff shortages and the political economy of tourism-dependent employment. A forest official in Nubra described: *"I have a few field staff to cover 2,000 square kilometres of the Nubra Valley during peak season. The rules say I should check every camp for permits. I cannot check ten per cent of the camps. The violators know this. Carrying capacity enforcement is not a technical problem. It is a resource and political problem"* (Forest-Nubra-01). The data vacuum sub-node (22 references) documented the absence of systematic monitoring of carrying capacity indicators, rendering management responses reactive rather than anticipatory.

4.5 Theme 5: Differential Spatial Vulnerability and the Paradox of Peripherality

The fifth theme, recorded with 65 references from 34 sources, concerns the highly uneven spatial distribution of carrying capacity pressures across Ladakh. While this theme recorded a lower proportion of very negative coding (14%) than the other four themes, reflecting the more analytical and spatially nuanced character of participants' observations, it generated the highest proportion of positive sentiment (13%), as participants in undervisited zones expressed cautious optimism about tourism's potential if managed appropriately.

A resident of Padum, the administrative centre of Zanskar, described the rapid commercialisation of remote trekking itineraries driven by social media: *"When I was young, only the most experienced mountaineers came to Zanskar. They were self-sufficient, they carried their own equipment and food, and they left no trace. Now, Instagram has made Zanskar famous, and we get groups of young people from Delhi and Mumbai who think it is like a camping holiday in Himachal. They have no idea about altitude, about water, about the fragility of this place. We do not have the infrastructure to manage them, and we do not have the experience either"* (R-Zanskar-02). This pattern whereby social media sharing motivations transform the perceived identity of a

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destination and restructure tourist-destination relationships in ways that outpace governance capacity resonates with emerging conceptual frameworks tracing how the shift from sacred or specialist spaces to heavily photographed sites fundamentally alters visitor behaviour and destination carrying capacity dynamics (Tao et al., 2026).

The site concentration sub-node documented the paradox of spatial inequality: intense carrying capacity pressure at a small number of highly marketed sites: Pangong Tso, Nubra's sand dunes, the Magnetic Hill near Leh while areas of comparable ecological and cultural significance remain largely unknown to visitors. Several tourism operators argued that a planned visitor dispersal programme could simultaneously relieve pressure on saturated nodes and extend economic benefit to undervisited communities a point that aligns with Butler's (1980) TALC model prediction that as established destination nodes approach capacity limits, tourism flows displace toward peripheral areas that then face their own unmanaged development trajectories.

Figure 3. NVivo Auto Code — Sentiment Analysis Results

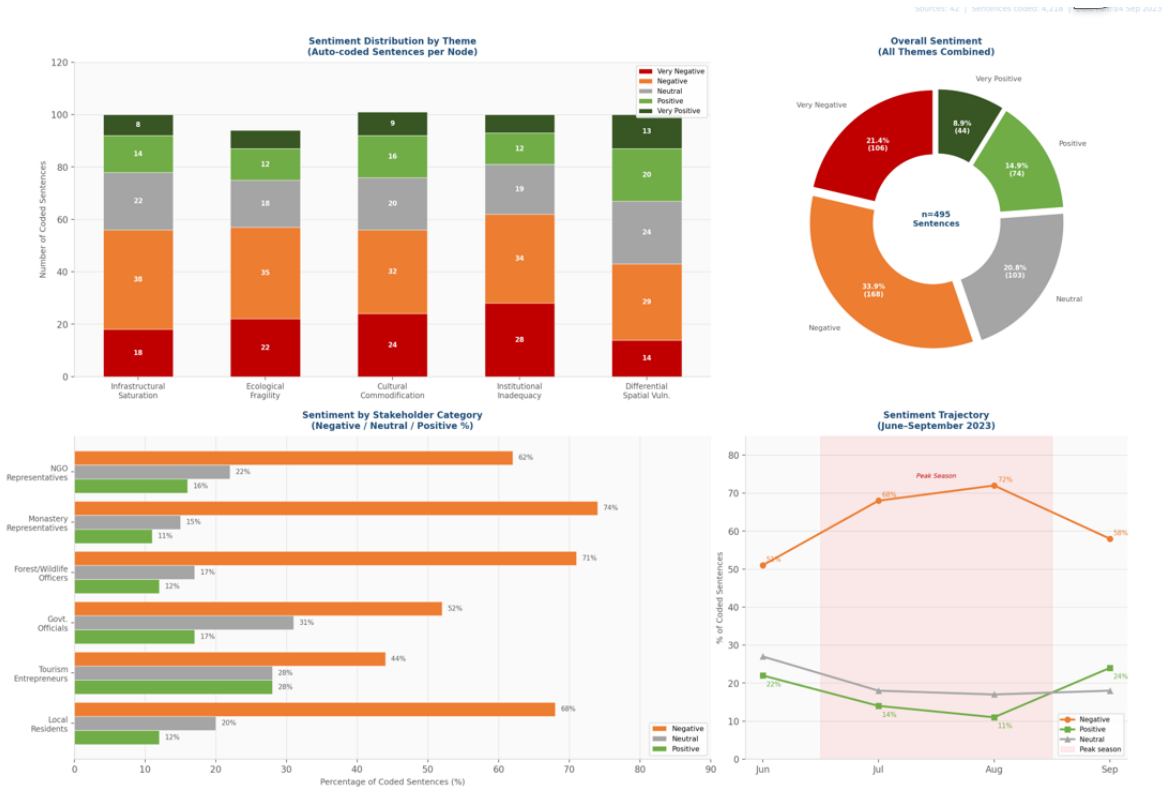

Figure 3: NVivo Auto Code Sentiment Analysis (n=4,218 sentence-level coding units, as demarcated by NVivo's automatic sentence parser across all 42 transcripts). Panel A: Sentiment distribution by theme. Panel B: Overall sentiment breakdown across all themes combined. Panel C: Sentiment proportions by stakeholder category. Panel D: Temporal sentiment trajectory across

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the June–September 2023 data collection period, showing peak negative sentiment during July–August, corresponding to the height of the tourist season. Source: Authors' own.

4.6 Discussion

The findings reported above, and the NVivo-generated analytical outputs that illuminate them, invite engagement with three sets of theoretical and empirical questions that animate the TCC literature: what carrying capacity is, how it should be determined, and who should determine it. On the ontological question of what carrying capacity is, the findings strongly support McCool and Lime's (2001) position that TCC is not a fixed, determinable threshold amenable to precise calculation but a dynamic, contested, and place-specific social-ecological construct. The NVivo hierarchy chart (Figure 1) makes this visible analytically: the five parent themes and 23 child nodes collectively represent a multi-dimensional carrying capacity condition in which physical, ecological, social, and institutional limits interact and overlap in ways that the PCC-RCC-ECC hierarchy cannot adequately represent. The sentiment analysis (Figure 3) adds a further dimension by revealing that the affective experience of carrying capacity the anger, grief, anxiety, and occasional cautious optimism that participants attached to different aspects of the destination's condition varies systematically by theme, stakeholder category, and season. This affective variation is not noise around a technical signal; it is constitutive information about the social dynamics of carrying capacity exceedance.

The word cloud (Figure 2) is particularly illuminating in this respect. The prominence of governance and institutional vocabulary “regulation”, “enforcement”, “LAHDC”, “permit”, “monitoring”, “management”, “institutional” alongside ecological and cultural terms signals that participants understood carrying capacity not primarily as a physical or ecological problem but as a governance problem. This finding resonates with Ostrom's (2009) SES framework, which identifies community self-governance and polycentric institutional arrangements as key conditions for sustainable common-pool resource management. It also aligns with Morse's (2023) SECAS framework, which positions governance systems as hierarchically nested social structures that must be analysed in coupling with ecological systems rather than as external regulatory overlays. The systematic review of carrying capacity assessment methods by Ajuhari, Z. et al. (2023) found that normative approaches and the Cifuentes method dominated the carrying capacity assessment literature, while governance-focused, qualitative, and participatory methodologies remained systematically underrepresented. The governance deficit documented in Theme 4 of this study is architecturally central: it explains why carrying capacity thresholds are routinely exceeded even where they have been formally identified.

The sentiment trajectory data (Figure 3, Panel D) contributes a temporal dimension that is rarely incorporated in TCC studies. The sharp increase in negative sentiment between June and the July-August peak, and its partial moderation in September, suggests that stakeholders' experience of carrying capacity exceedance is not a constant background condition but an acute seasonal

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phenomenon. This dynamic is consistent with Cheer and Lew's (2017) observation that mountain destination carrying capacity requires adaptive frameworks sensitive to temporal rhythms rather than static annual thresholds. The September moderation of negative sentiment also suggests that extending the tourist season, a common policy objective of destination managers, could reduce the intensity of peak-season saturation without requiring a reduction in total annual arrivals. The differential sentiment profiles across stakeholder categories (Figure 3, Panel C) extend the social carrying capacity literature's treatment of host community attitudes. The significantly higher negative sentiment proportions among monastery representatives (74%) and local residents (68%) compared with tourism entrepreneurs (44%) and government officials (52%) reflect the stratified and contested character of social carrying capacity. This finding is further illuminated by the multi-stakeholder governance framework reviewed by Tosun C (2000), which identified a recurrent pattern across destination case studies: when carrying capacity and sustainability governance rely primarily on official and industry stakeholders, communities that bear the highest social and cultural costs of tourism are systematically marginalised from decision-making.

5. Conclusion, Implications, Limitations, and Future Research Directions

This study examined how key stakeholders in Ladakh perceive, define, and articulate the carrying capacity of one of India's most distinctive and ecologically vulnerable tourism destinations. Through 42 in-depth interviews analysed in NVivo, the study has documented five interconnected dimensions of carrying capacity stress: infrastructural saturation, ecological fragility, cultural commodification, institutional inadequacy, and differential spatial vulnerability. The NVivo hierarchy chart, word frequency cloud, and auto code sentiment analysis together provide a systematic and transparent representation of the analytical architecture of the data, the thematic structure of the corpus, the conceptual vocabulary that animates it, and the affective texture of participants' accounts. The findings challenge the prevailing operational logic of TCC assessment and call for a more expansive, pluralist, and participatory conception that takes seriously the knowledge, values, and agency of the communities whose lives, livelihoods, and landscapes are at stake. The carrying capacity of a destination is not a number to be calculated. It is a condition to be negotiated continuously, collaboratively, and with the full weight of ecological and cultural intelligence that local communities have accumulated across centuries of high-altitude life. The governance reforms, planning innovations, and research investments outlined in this study represent the minimum necessary response to a destination whose extraordinary natural, cultural, and spiritual value is currently being consumed faster than it is being replenished.

5.1 Managerial and Policy Implications

The findings carry significant implications for tourism governance in Ladakh and comparable high-altitude regions, and for mountain destination management more broadly. At the level of destination governance, the most urgent implication is the establishment of a unified, adequately resourced, and community-accountable carrying capacity management authority. The regulatory

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fragmentation identified in Theme 4 is incompatible with the integrated carrying capacity management that the destination's ecological and cultural vulnerability demands. A dedicated Local Tourism Carrying Capacity Authority, with representation from local communities, the forest department, community representatives from each major tourist zone, monastic institutions, and environmental civil society, would provide both the institutional coherence and the governance legitimacy that current arrangements lack. It must be acknowledged, however, that implementing such reforms in Ladakh's post-2019 Union Territory governance context faces non-trivial political and institutional constraints. The devolution of powers between the Ladakh Autonomous Hill Development Councils and the Union Territory administration remains contested, military jurisdiction over large tracts of land limits civilian planning reach, and tourism-dependent employment creates political economy pressures that discourage strict enforcement. Any carrying capacity authority must therefore be designed with explicit provisions for inter-agency coordination, clear dispute resolution mechanisms, and protection from political interference if it is to function as envisioned.

At the level of tourism planning, the findings call for the adoption of a Limits of Acceptable Change (LAC) planning framework as the operative basis for TCC management in Ladakh, supplementing quantitative assessments. The LAC framework's emphasis on condition-based indicators rather than use-level thresholds (Stankey et al., 1985) resonates directly with participants' articulations: what they described was not a desired number of tourists but a set of conditions: clean water, ecological integrity, cultural dignity, and infrastructure functionality that they wished to maintain. A pilot LAC process for the Pangong Tso corridor, where carrying capacity pressures are most acute, would provide a model for replication across Ladakh's major tourist circuits.

The sentiment analysis findings (Figure 3, Panel D) have specific implications for visitor management timing. Negative sentiment peaks sharply in July-August and moderates in September, suggesting that demand smoothing strategies, differential seasonal pricing, incentivised itinerary diversification to shoulder months, and marketing campaigns promoting September as an optimal visit period could reduce peak-season saturation without reducing the economic value of tourism to local communities. The differential stakeholder sentiment profiles (Figure 3, Panel C) underscore the importance of inclusive and representative consultation in carrying capacity governance. Future planning processes in Ladakh should be explicitly designed to ensure equitable representation of residents and different communities, the stakeholders bearing the highest costs of carrying capacity exceedance and currently the least represented in formal planning processes.

5.2 Limitations

This study has several limitations that should be acknowledged candidly. The geographical scope, while covering four distinct zones within the Trans-Himalayan region, does not include other

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Himalayan and mountainous regions where carrying capacity conditions may differ materially. The temporal scope of fieldwork is concentrated in the tourist season, not capturing off-season dynamics or recovery processes. The study does not incorporate the tourist perspective, which the social carrying capacity literature identifies as an essential complement to resident and stakeholder views; this omission reflects a deliberate scope decision to prioritise the depth of host-community and institutional perspectives in a first dedicated qualitative TCC study of Ladakh, rather than a conceptual rejection of visitor-side data, and future research should address this gap through a complementary visitor survey or mixed-methods design. The NVivo Auto Code sentiment analysis relies on a general-purpose NLP model not specifically trained on Ladakhi or Himalayan tourism discourse; sentiment attributions should be understood as indicative rather than definitive, and are deployed here as a heuristic organisational tool. Finally, the qualitative design does not produce quantitative thresholds that carrying capacity management frameworks ultimately require for operational implementation; this study is best understood as a necessary precondition for, rather than a substitute for, rigorous quantitative TCC assessment.

5.3 Future Research Agenda

The findings suggest several productive directions for future research. First, a mixed-methods study integrating the qualitative stakeholder data generated here with site-level quantitative capacity calculations (PCC, RCC, ECC) would produce a more complete and operationally useful TCC assessment. Second, a longitudinal study tracking NVivo-coded carrying capacity indicators over multiple seasons would capture the cumulative dynamics described by participants. Third, a comparative qualitative study across Himalayan mountain destinations: Bhutan, Nepal's Khumbu region, Pakistan's Gilgit Baltistan, using consistent NVivo-assisted thematic analysis would generate cross-contextual insights into social and institutional TCC dimensions. Fourth, research on the carrying capacity implications of digital tourism promotion and social media, which emerged prominently in the word cloud analysis, represents an urgent and nascent agenda. Fifth, interdisciplinary collaboration with ecologists, hydrologists, and climate scientists would strengthen ecological carrying capacity assessments, particularly regarding the combined effects of tourism and climate change on the Himalaya's glaciers and high-altitude wetlands.

Conflict of Interest Statement

The authors declare that there is no conflict of interest.

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request, subject to applicable privacy and ethical constraints.

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