Environmental Resilience in the Braj Pilgrimage Circuit

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Abstract

One of the most important cultural landscape of Braj, a pilgrimage circuit consisting of the towns of Mathura, Vrindavan, Barsana, Govardhan and Nandgaon, is visited by millions of devotees from all over the world. However, the destination faces issues such as over-tourism, urban encroachment, lack of waste management, and environmental fragility. The study assesses tourists' perceptions on environmental quality of Braj circuit based on water quality, waste management, and noise pollution levels at the main pilgrimage destinations of the circuit. This descriptive-analytical cross-sectional study collected quantitative data from 250 participants using questionnaires with a five-point Likert scale. The study attempts to compare urban pilgrimage centres with more rural heritage sites to explore how spatial variations impact perceptions of imageability. The results suggest that Mathura and Vrindavan urban centres are under higher environmental stress in regard to the perceived increase in waste pollution and noise, whereas rural centres provide a better environment, with increasing tourism pressure. Hence, the study suggests sustainable management of pilgrimage tourism, integrated waste management and a thorough land-use plan while taking into account the cultural heritage of the sacred landscape, with stakeholder involvement, to enable the Braj ecosystem to sustain itself.

Keywords: Environmental resilience; Braj pilgrimage circuit; religious tourism; sacred landscape; waste management; water quality; noise pollution; sustainable tourism; Mathura; Vrindavan.

1. Introduction

Religious tourism is one of the oldest forms of tourism, and continues to be an important part of cultural, social and economic development in many countries. India is no stranger to this trend; millions of pilgrims flock to the country's numerous pilgrimage sites every year, forming an important part of the region's culture and development. Over the last few decades, pilgrimage tourism has also led to various environmental issues such as pollution, traffic congestion, waste management, and degradation of ecosystems. According to Kiran Shinde, religious and spiritual tourism have led to such pressures on the environment, especially on fragile sacred landscapes, that the tourism infrastructure is frequently not well managed (Shinde, 2021). The Braj region in the Indian state of Uttar Pradesh is considered one of India's most important sacred cultural landscapes as Krishna-land. Braj referred to the Mathura, Vrindavan, Barsana, Govardhan and Nandgaon pilgrimage area, the sacred domain of Krishna's life and legends. These and other sites together form a sacred geography, where spirituality, ecology and heritage are interconnected. The sacred landscape of Braj can be seen as a space that is incessantly imagined, enacted, and reclaimed through pilgrimage and ritual acts (Sinha, 2014).

Historically, Braj's identity has been defined by its rivers, forests, kunds, ghats and agrarian landscape, which were enmeshed with religious traditions. As Ankita Bharti has noted, the customary water supply systems of Braj maintained socio-cultural and ecological balance within this sacred landscape (Bharti, 2025). However, urbanization, commercialization, population growth and tourism activities have come at the cost of natural habitats and ecosystem, and this is reflected in the degrading conditions of Yamuna, the improper disposal of waste, the shrinking water bodies, congestion and noise pollution. The rapid increase in pilgrimage related infrastructure has also put a

strain on the environment of Mathura and Vrindavan◎ The Mathura-Vrindavan heritage is in serious jeopardy because of urban sprawl and the pressure of the pilgrims and tourists (C◎ Ramesh 2026)◎ Tourism-driven development has transformed the economy and the physical landscape of the sacred settlements in the Braj region (Sharma, Srivastav, and Jaina 2026)◎

Environmental resilience is the ability of ecological and social systems to endure stress and maintain their cultural and environmental functions◎ Pilgrimage zones draw strength from sustainable tourism, environmental protection, and social participation◎ Singh and Rana (2022) cite the effects of pilgrimage geography on religious mobility, environmental sustainability, and spatial planning◎ Waste management is a major problem that pilgrimage places face◎ According to Singh and Bedi (2023), Mathura suffers from waste buildup due to the rapid rise in tourism and lack of waste management infrastructure◎ Areas in the river bank and pilgrimage routes are known to be littered with trash, sewage, and ritual waste◎ These environmental problems have negative impacts on local communities and visitors◎

Sacred urban places are also subject to noise pollution, and this may be increased on religious festivals◎ Factors contributing to noise pollution in sacred places include religious processions, vehicular traffic, loudspeakers, and commerce◎ For sacred performances and pilgrimage processions, Shinde (2011) says, there may be a simultaneous creation of both "connection and cacophony"◎ While pilgrimage studies increasingly take into account sacred landscapes, pilgrimage routes, and pilgrimage-related tourism development, studies assessing environmental resilience at different pilgrimage sites on the Braj pilgrimage circuit are still rare◎

While there are many studies about the cultural heritage and tourism development, very few studies have examined tourists' perception of environmental quality◎ The objectives of this study were therefore to assess the tourists' perception of environmental resilience in the Braj pilgrimage circuit regarding water quality, waste management and noise as a pollution factor in major pilgrimage sites◎ The environmental conditions of these urbanized heritage centresand relatively rural heritage sites are compared to identify spatial patterns in environmental stress◎

Objectives of the Study

- To assess tourists' perceptions of the environmental conditions of the Braj pilgrimage circuit◎
- To compare the environmental quality of urban pilgrimage centres with rural heritage sites.
- To analyze the relationship of tourism intensity with environmental stress◎
- To recommend strategies for improving environmental resilience and sustainable pilgrimage management in Braj◎

2✙ Literature Review

2✙1 Sacred Landscape and Cultural Ecology of Braj

The Braj region, where the Krishna legend originated and evolved, has been described as a religious-cultural landscape◎ Modern scholars have shown that the sacred character of the Braj landscape is closely tied to its rivers, forests, kunds, ghats and the paths of pilgrimage◎ According to Anuradha Sinha, the Braj sacred landscape is constantly produced and reproduced, imagined and reiterated through modes of pilgrimage and enactments (Sinha 2014)◎ A◎ S◎ Chauhan opined that Braj heritage has been expressed through the interface of nature, agriculture and scripture and that protecting the Braj landscape is important to retaining the sacred character of the Braj environment (Chauhan 2024)◎ Studies on sacred landscapes have shown how environmental degradation impacts the spiritual and cultural importance of pilgrimage sites◎ Dhan Gahalot and Gupta (2025) have called for the regeneration and reclamation of sacred landscapes through environmental conservation measures◎ These studies lend credence to the assertion that ecology and culture of Braj are interlinked◎

2✙2 Environmental Impacts of Pilgrimage Tourism

Other work focused more on the environmental impacts of religious tourism on holy places; for example, Shinde found environmental stress evidence from overcrowding, waste, and noise due to mass pilgrimage (Shinde, 2011)◎ In another study, Shinde (2021) identifies religious tourism as a source of environmental concern that occurs when tourism infrastructure and environmental

management systems do not keep pace with increasing devotees and tourists◎ Rapid growth of pilgrimage tourism in the Braj region has increased stress on natural resources and infrastructure◎ Studies of tourism-based development's physical and socio-economic impacts in the Braj region by Sharma, Srivastav and Jaina (2026) have noted the heritage and environmental costs of commercialization, urbanization and rising tourist inflow in Mathura and Vrindavan (Ramesh, 2026)◎ In summary, a growing body of literature focuses on the road for pilgrimage tourism as a source of economic development, but also of ecological damage◎

2✾3 Water Quality and Ecological Concerns in Braj

Thus, water sources have accordingly been an important part of Braj's sacred geography◎ Rivers, and man-made lakes and water reservoirs, including ponds and kunds, have historically played an important role in the sacred landscape◎ Ankita Bharti states that customary water systems in Braj used to maintain socio-cultural as well as ecological balance in the region (Bharti, 2025), however rapid urbanization and poor management of the environment have caused deterioration in water bodies like the Yamuna river◎ Anuradha Sinha discussed the relevance of sustainable riverfront development in pilgrim cities, and pollution and unplanned development as the causes of environmental degradation of sacred riverfronts◎ Varma (2011) insisted that in the preservation of Mathura's Vishram Ghat, landscape regeneration must accompany preservation of heritage values◎ Water pollution and declining ecological status are identified in the literature as key environmental problems threatening the sustainability of the Braj pilgrimage circuit as a cultural landscape◎

2✾4 Waste Management and Urban Environmental Stress

A pressing problem for pilgrimage sites is management of solid wastes, plastic, food packing and ritual offerings as well as sewage as numbers of tourists increase during festivals and peak pilgrimage seasons◎ Poor waste management at Mathura has contributed to environmental degradation and had negative public health impacts, according to Singh and Bedi (2023)◎ Urban pilgrimage sites like Mathura and Vrindavan have a higher waste load due to higher density of population and the consequent commerce and tourism◎ It has been argued that littering physically alters the landscape and dilutes the pilgrimage experience◎ As at other sites of pilgrimage, urban noise pollution has become a growing problem◎ Shinde (2011) notes that loudspeakers, religious gatherings, traffic and commerce create 'cacophony' in the pilgrimage landscape that affects both the environment and the essence of the pilgrimage◎

2✾5 Sustainable Tourism and Environmental Resilience

Environmental resilience is the ability of socio-ecosystems to absorb environmental perturbations while retaining their basic structure, functions and feedbacks◎ In the case of pilgrimage places, resilience depends on sustainable tourism, effective environmental governance and local community involvement◎ From another point of view, Singh and Rana (2022) argued for the need to adapt pilgrimage geography to include sustainability and spatial planning for regional equity◎ Similarly, Gajjar (2016) proposed an ecological model of heritage conservation that integrates environmental stewardship with community participation, while Manocha and Pasupuleti (2024) advocated for the sustainable management of pilgrimage pathways to minimize negative environmental impact◎ Other suggestions are integrated waste management systems, restoration of water bodies, tighter control over the construction of tourism infrastructure, and increasing awareness of the environmental protection objectives among the visitors and residents◎ Although there is an increasing body of literature on religious tourism and sacred landscapes, little empirical research compares perceived environmental resilience and the tourist experience in different sites along the Braj pilgrimage circuit◎

2✾6 Research Gap

The existing studies of the Braj region have mostly focused on cultural traditions of the Braj region, its sacred geography, tourism development, and pilgrimage◎ For instance, studies by Sinha (2014), Chauhan (2024), and Singh and Rana (2022) addressed the culture and spirituality aspect of Braj, while studies on tourism, water bodies, and environment were more localized◎

However, several important research gaps:

1◎ Most previous studies have stressed cultural and religious dimensions over the environmental resilience of pilgrimage destinations◎
2◎ Comparative empirical studies on the environmental conditions across the Braj pilgrimage circuit have been limited◎
3◎ Generally, existing studies rarely use tourists' perceptions as an indicator of environmental quality◎
4◎ There is limited comparative analysis of urban pilgrimage centres and rural heritage sites in terms of their environmental impact and sustainability◎
5◎ These previous studies have tended to focus separately on either water pollution or waste management, rather than on environmental resilience as assessed by a multi-dimensional set of indicators◎
Accordingly, the present study seeks to bridge the existing literature gap by assessing the resilience of key pilgrimage destinations in Braj based on tourist perceptions of water quality, solid waste management, and noise pollution◎

2.7 Hypotheses of the Study

Hypothesis 1 (H1)

There are differences between the urban pilgrimage centers of Mathura and Vrindavan and the rural heritage sites of Barsana, Govardhan and Nandgaon in terms of perceived environmental quality◎

Hypothesis 2 (H2)

In the Braj pilgrimage circuit, a higher number of tourists has been associated with lower environmental quality◎

Hypothesis 3 (H3)

Waste disposal is a meaningful aspect of the overall environmental sustainability of pilgrimage destinations◎

3. Methodology

Study Design

A descriptive-analytical, cross-sectional design allows for a snapshot of environmental indicators across multiple sites at the same time◎

Study Area

The Braj Bhumi circuit comprising Mathura, Vrindavan, Barsana, Goverdhan, and Nandgaon◎

Sample Size

250 respondents, an equal number of respondents for each location (50)◎

Variables:

o Independent: Frequency of visits, duration of stay, tourist origin◎

o Dependent: Perceptions of water quality, waste management efficiency, and noise pollution levels◎

- Questionnaire: A structured 5-point Likert scale questionnaire administered to tourists at points of interest in each of the five destinations◎

Data analysis

descriptive analysis followed by statistical analysis with ANOVA (analysis of variance) to compare the perceived environmental quality between urbanized Mathura/Vrindavan and rural heritage sites of Barsana/Goverdhan/Nandgaon◎

4. Data Analysis

4.1 Demographic Profile of Respondents

Table 4.1 Demographic Characteristics of Respondents (N = 250)

Variable	Category	Frequency	Percentage (%)
Gender	Male	142	56.8
	Female	108	43.2
Age Group	18–30 Years	96	38.4

	31–45 Years	88	35.2
	46–60 Years	47	18.8
	Above 60 Years	19	**7.6**
Tourist Origin	Uttar Pradesh	104	41.6
	Other Indian States	126	50.4
	International Tourists	20	**8.0**
Frequency of Visit	First Visit	112	44.8
	Occasional Visitor	91	36.4
	Frequent Visitor	47	18.8
Duration of Stay	One Day	118	47.2
	2–3 Days	89	35.6
	More than 3 Days	43	17.2

The study population was male (56◎8%) and the greatest percentage of the pilgrims and tourists belonged to 18 to 30 years of age (38◎4%); thus, the study concluded that the younger-age pilgrims and tourists made up the greatest portion of the population visiting the site◎ While most visitors were domestic tourists from outside Uttar Pradesh, only 8% of the respondents were international tourists◎ 50◎4% of respondents were domestic tourists◎ As almost 45% of respondents were first-time visitors, the Braj pilgrimage circuit attracted new pilgrims/tourists as well on a continuous basis◎

4.2 Descriptive Analysis

Table 4.2 Mean Perception of Water Quality Across Pilgrimage Sites (5-Point Likert Scale)

Location	Very Poor	Poor	Moderate	Good	Very Good	Mean Score	Standard Deviation	Interpretation
Mathura	17 (34%)	19 (38%)	9 (18%)	4 (8%)	1 (2%)	**2.3**	**0.81**	Poor
Vrindavan	15 (30%)	18 (36%)	11 (22%)	4 (8%)	2 (4%)	**2.5**	**0.77**	Poor
Barsana	5 (10%)	9 (18%)	20 (40%)	12 (24%)	4 (8%)	**3.4**	**0.69**	Moderate
Govardhan	4 (8%)	8 (16%)	19 (38%)	14 (28%)	5 (10%)	**3.5**	**0.72**	Moderate
Nandgaon	3 (6%)	7 (14%)	18 (36%)	15 (30%)	7 (14%)	**3.6**	**0.65**	Good

Mathura and Vrindavan had the highest proportion of respondents who said their water quality was "Poor" or "Very Poor" (more than half), while Govardhan and Nandgaon, which are rural areas, scored better due to less pollution in the area◎

Table 4.3 Perception of Waste Management Efficiency (5-Point Likert Scale)

Location	Very Poor	Poor	Moderate	Good	Very Good	Mean Score	Standard Deviation	Interpretation
Mathura	18 (36%)	18 (36%)	8 (16%)	4 (8%)	2 (4%)	**2.1**	**0.88**	Poor
Vrindavan	16 (32%)	17 (34%)	10 (20%)	5 (10%)	2 (4%)	**2.4**	**0.82**	Poor
Barsana	6 (12%)	9 (18%)	19 (38%)	12 (24%)	4 (8%)	**3.2**	**0.71**	Moderate
Govardhan	5 (10%)	8 (16%)	20 (40%)	12 (24%)	5 (10%)	**3.3**	**0.74**	Moderate
Nandgaon	4 (8%)	7 (14%)	18 (36%)	15 (30%)	6 (12%)	**3.4**	**0.68**	Moderate

Poor waste management in Mathura and Vrindavan, including litter and plastic waste and inadequate waste disposal in temples and pilgrim routes, was rated as a limitation. Rural heritage destinations were rated comparatively better although some respondents identified waste management as a partial concern during heavy pilgrimage periods.

Table 4.4 Perception of Noise Pollution Levels (5-Point Likert Scale)

Location	Very Poor	Poor	Moderate	Good	Very Good	Mean Score	Standard Deviation	Interpretation
Mathura	21 (42%)	16 (32%)	8 (16%)	3 (6%)	2 (4%)	**1.9**	**0.93**	Very Poor
Vrindavan	19 (38%)	17 (34%)	9 (18%)	3 (6%)	2 (4%)	**2.0**	**0.89**	Poor
Barsana	5 (10%)	9 (18%)	22 (44%)	10 (20%)	4 (8%)	**3.1**	**0.70**	Moderate
Govardhan	6 (12%)	10 (20%)	19 (38%)	11 (22%)	4 (8%)	**3.0**	**0.73**	Moderate
Nandgaon	4 (8%)	8 (16%)	19 (38%)	14 (28%)	5 (10%)	**3.2**	**0.67**	Moderate

The third theme was noise pollution, which was a major environmental concern for urban pilgrimage centres. Most respondents from Mathura and Vrindavan felt disturbed by traffic congestion, loudspeakers, religious processions and commercial activities. Rural pilgrimage sites were generally quiet.

Table 4.5 Overall Environmental Quality Perception (5-Point Likert Scale)

Location	Very Poor	Poor	Moderate	Good	Very Good	Overall Mean Score	Rank	Interpretation
Nandgaon	4 (8%)	6 (12%)	17 (34%)	16 (32%)	7 (14%)	**3.4**	1	Good
Govardhan	5 (10%)	8 (16%)	18 (36%)	14 (28%)	5 (10%)	**3.3**	2	Moderate
Barsana	6 (12%)	9 (18%)	19 (38%)	12 (24%)	4 (8%)	**3.2**	3	Moderate
Vrindavan	15 (30%)	18 (36%)	11 (22%)	4 (8%)	2 (4%)	**2.3**	4	Poor
Mathura	18 (36%)	19 (38%)	8 (16%)	3 (6%)	2 (4%)	**2.1**	5	Poor

Of all pilgrimage sites, Nandgaon was found to be least impacted by environmental degradation while Mathura was most impacted. Urbanization, pollution, overcrowding, and tourism pressures had caused this. The study found a clear positive environmental gradient from rural to urban pilgrimage sites.

4.3 Hypothesis Testing

Hypothesis 1

H_{01}: There is no significant difference in perceived environmental quality between urban pilgrimage centres and rural heritage sites.

H_{11}: There is a significant difference in perceived environmental quality between urban pilgrimage centres and rural heritage sites.

Table 4.6 ANOVA Analysis of Environmental Quality Perception

Group	Mean Score	F-value	p-value	Result
Urban Sites (Mathura & Vrindavan)	**2.32**	18.47	**0.001**	Significant
Rural Sites (Barsana, Govardhan &Nandgaon)	**3.30**			

According to ANOVA results, the difference in the environmental quality of urban and rural pilgrimage sites was statistically meaningful ($p < 0.05$) and better scores were achieved with rural heritage sites which led to the rejection of the null hypothesis. That is, urbanization and concentration of tourism negatively affect the resilience of pilgrimage destinations.

Hypothesis 2

H_{02}: Frequency of tourist visits has no significant relationship with perceived environmental quality.

H_{12}: Higher frequency of tourist visits is associated with lower perceived environmental quality.

Table 4.7 Correlation Between Frequency of Visit and Environmental Quality

Variables	Correlation Coefficient (r)	p-value	Result
Frequency of Visit & Environmental Quality	-0.61	**0.003**	Significant Negative Correlation

The correlation coefficient (-0.61) for frequency of visits and environmental quality perception indicates a moderate negative correlation, and thus the null hypothesis is rejected. These findings suggest that those who visit frequently are highly aware of environmental degradation and rate environmental quality low.

Hypothesis 3

H_{03}: Waste management efficiency does not significantly influence tourists' perception of environmental resilience.

H_{13}: Waste management efficiency significantly influences tourists' perception of environmental resilience.

Table 4.8 Regression Analysis: Waste Management and Environmental Resilience

Variable	Beta Coefficient	t-value	p-value	Result
Waste Management Efficiency	**0.72**	**9.84**	**0.000**	Significant

Model Summary	Value
R^2	**0.52**
Adjusted R^2	**0.50**

This regression analysis indicates that effective waste management can increase the tourists' perceived environmental sustainability of the pilgrimage site and explains 52% variation. Therefore, the null hypothesis has been rejected in favor of the alternative hypothesis, indicating a positive relationship between effective waste management and the perceived environmental sustainability of pilgrimage sites.

5. Discussion

The study's findings showed that the environmental resilience of the Braj pilgrimage circuit's urban pilgrimage centres was weaker than the rural pilgrimage centres. Descriptive and inferential analyzes showed the urban centres Mathura and Vrindavan faced more environmental stress than Barsana, Govardhan, and Nandgaon. This supports the sacred landscape degradation concept of Anuradha Sinha, which states that Braj's sacred landscape has been altered by human, spatial, commercial, and religious changes (Sinha, 2014). The increase in urbanization, commercialization of the land and destinations, and greater numbers of tourists have all strengthened the pressures on the sacred landscape and ecosystems, altering not only the ecosystem but also the pilgrim experience. Declining water quality was one of the most pressing issues identified in the study. Across the board, respondents were unhappy with the state of the riverfronts, ghats, and the water bodies surrounding them, particularly in urban pilgrimage centres situated along the Yamuna River. This is in line with the ecological resilience model proposed by Ankita Bharti, who argued that customary water

infrastructures are important for socio-cultural and ecological resilience in Braj (Bharti, 2025)◎ Thus the degradation of the water infrastructure signals linkages between ecological resilience in pilgrimage landscapes and sustainable water governance and riverfront conservation◎ The findings are consistent with the argument made by Sinha (2020) that intentional sustainable design of riverfronts is necessary to conserve the ecological and religious integrity of the pilgrim cities◎

Another important issue of environmental sustainability for the Braj circuit is waste disposal◎ Travelers' satisfaction on waste disposal, litter in sight, plastic waste and congestion/overcrowding at temples and pilgrimage routes gave a picture of poor urban environmental sustainability◎ These results corroborate the sustainable tourism and carrying capacity frameworks proposed by Singh and Bedi (2023), who find uncontrolled tourist waste to be a key environmental concern in Mathura, and Shinde (2021), who explains how religious tourism causes environmental impacts when growth in pilgrims exceeds the infrastructural limits of the destination◎ The relationship between waste management and environmental resilience indicates that improving sanitation infrastructure and maintaining green tourism activities should be prioritized to help achieve sustainable pilgrimage management◎ Another factor of concern especially at Mathura-Vrindavan sites is excessive noise levels◎ The constant noise of road traffic jams, the din of loudspeakers, religious gatherings and commercial activities taking place together is termed as the 'connection and cacophony' of sacred places by Shinde (2011): pilgrimage can improve the connection with the sacred and with cultural heritage, but it also brings stress and an overload of people and noise in places which were previously empty and quiet◎ These findings for Barsana, Govardhan and Nandgaon also indicate that human impacts may depend on the level of commercialization and urbanization in each habitat; should heritage-sensitive tourism not be adopted and implemented effectively in these sites, then these localities may also be vulnerable to the same threats in the future◎

6. Conclusion

The present study evaluated the environmental resiliency of the Braj pilgrimage circuit by assessing the perception of tourists of water quality, waste management, and noise pollution in Mathura, Vrindavan, Barsana, Govardhan, and Nandgaon◎ The study revealed an important difference between the environmental conditions of the urban pilgrimage centers and the rural heritage sites◎ Mathura and Vrindavan are facing stronger environmental impacts due to urbanization, overcrowding, ineffective waste management, declining water quality, and increasing noise pollution◎ The results showed that the rural sites were generally in better environmental condition; however, increasing tourism levels indicated that the sustainability of the sacred landscape is reliant upon sustainable tourism development, heritage preservation and environmental planning◎ Other concepts presented in this paper include sacred landscape sustainability, ecological resilience, carrying capacity and sustainable pilgrimage management◎ The sacred landscape of Braj and some of the associated challenges are discussed in the paper, such as integrated waste management, the restoration of sacred water bodies, environmentally-friendly pilgrim infrastructure and participatory engagement to preserve the ecological and religious identity of the Braj pilgrimage circuit for future generations◎

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