



Adaptive sustainability strategies for old Najaf city: integrating heritage and urban development

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Abstract

The Old City of Najaf stands out for its unique urban fabric and rich historical heritage, serving as a key destination for religious tourism while hosting worship facilities and housing for seminary students. As both a vibrant religious center and a cultural landmark, it presents a complex urban context that demands a careful balance between residents' and visitors' needs. This raises the question of how to adapt sustainability standards to align with the city's environmental, historical, and cultural dimensions. Using descriptive and analytical methods, including field observations, literature reviews, and expert consultations in urban planning and heritage preservation, the study examines challenges like uncontrolled urban growth, strained infrastructure, and land-use conflicts. Initial findings suggest these issues significantly hinder sustainable development, particularly with growing demand for heritage tourism and Najaf's role as a hub for religious studies. The study proposes practical strategies to preserve Najaf's cultural identity, improve residents' quality of life, and enhance its status as a sustainable heritage tourism destination, boosting its long-term appeal and sustainability.

Keywords: *Heritage, Preservation, Urban Sustainability, Historic Center, Najaf.*

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1. Introduction

Historic urban cores must balance cultural and architectural conservation with current needs for infrastructure, services, and mobility. Upgrading infrastructure without undermining heritage value is a central challenge. Within this context, two priorities emerge: a mobility priority focused on improving public transport and walkability, and a socioeconomic priority that addresses community and economic determinants of sustainability [1]. Practical actions include supporting local firms, artisans, and cultural organizations to maintain Najaf's distinct cultural identity. Integrating heritage preservation with sustainability practices is essential, and stronger local institutions and knowledge-sharing can raise standards and implementation capacity [2].

Based on this context, the study examines Najaf as a representative historic center and explores its specific sustainability challenges. Adaptive sustainability in this case refers to aligning preservation and development with the local context, institutions, and stakeholders. This perspective connects the heritage track with urban development streams and guides the following analysis. Najaf's historic fabric is centered around the Shrine of Imam Ali, within a compact urban area with a walking radius of approximately 400 meters. The area is partially bounded by Al-Sur Street. It is currently facing pressures

from unregulated growth, strained infrastructure, land-use conflicts, and significant religious tourism [3]. These dynamics highlight the role of planning and heritage management in sustaining Najaf's urban identity.

Accordingly, this paper examines how sustainability standards can be adapted to Najaf's environmental, historical, and social context. It uses a descriptive and analytical design that combines literature review, field observation, expert interviews, and a structured questionnaire to identify key threats and propose operational strategies that connect heritage conservation with urban development. The paper also outlines measurable strategy-indicator pairs tailored to Najaf to support planning and monitoring.

2. Methodology

The study uses a descriptive and analytical design. A focused literature review set the theoretical baseline and shortlisted candidate strategies. Fieldwork included systematic site observations and structured interviews with residents and municipal officials. An expert questionnaire, derived from literature and field insights, covered infrastructure, heritage conservation, environmental management, social participation, and policy frameworks, using Likert-type items. Responses were mapped to preliminary indicators for cross-domain comparison. Qualitative data were thematically

coded and survey data were summarized using descriptive statistics. Internal consistency and basic validity checks informed the final set of indicators. Cross-references to Results and Appendix A specify indicator construction.

3. Najaf: A Living Heritage of History, Culture, and Spirituality

Najaf is a religious, cultural, and social center, and one of the oldest continuously inhabited cities in Iraq and the Islamic world [3]. The idea of focusing on urban renewal of the traditional urban fabric in Najaf came about because of the historical dimension. [4], and because it is a popular and attractive area and a place for tourism, attracting investments and profits, etc. on the other hand [5]. However, the city's historic fabric is under increasing pressure from unregulated urban development, insufficient infrastructure, and a lack of integrated sustainability strategies [6]. Despite its historic and religious stature, the literature reveals a gap in strategic frameworks to address Najaf's unique context in urban-heritage preservation [7]. Previous studies mainly focus on general sustainability in historic cities but often fail to incorporate site-specific solutions that consider cultural identity, local governance, and socio-economic dynamics [8]. In response to the identified challenges, this study proposes a context-sensitive strategy tailored to Najaf's unique socio-cultural and urban fabric. The approach aims to harmonize sustainable development objectives with the preservation of the city's rich heritage, ensuring that future planning efforts remain rooted in local identity and community values.

Integrating sustainability strategies with heritage preservation in Najaf is essential to protect its historic character while responding to contemporary urban needs. Adaptive approaches allow the city to manage growth without losing its cultural soul, especially in areas with deep-rooted religious and social significance. By aligning development with local values and identities, Najaf can achieve balanced progress that respects both people and place. Such integration is not only about physical renewal, but about sustaining memory, identity, and meaning over time. Fig.1 illustrates the location of the Old City in relation to Iraq and the Najaf governorate.

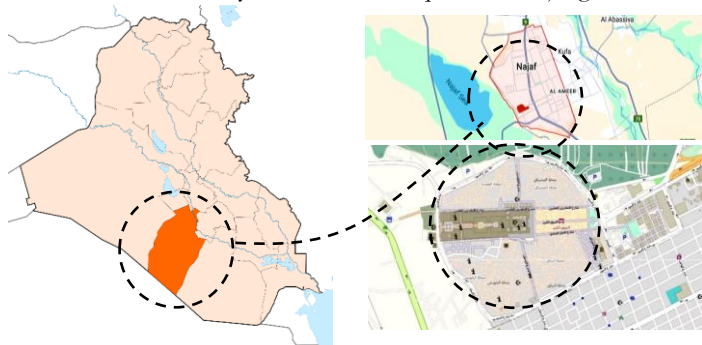


Figure 1. Location of the old city in relation to the city of Najaf. [29] ,[30]

3.1. Preserving the historical centers of cities is not only about protecting monuments or celebrating heritage in general.

It also plays a role in developing sustainable local communities and fostering regional coherence. To effectively integrate urban heritage

into city planning, strategies should be institutional, interdisciplinary, and based on strong engagement with local communities. A bottom-up or cross-cutting approach is essential to ensure long-term impact. A key challenge lies in balancing historic value with modern sustainability goals. The question remains whether one universal model can work across all historic centers, or whether tailored solutions are needed based on each city's specific conditions and characteristics. While historical wealth may explain some of the resilience seen in these areas, other contributing factors are likely involved. Municipal planning in historic cities must respond to the tension between preserving cultural heritage and delivering modern infrastructure that enables integration and sustainability [9]. Supporting the conservation of ancient city centers requires comprehensive, well-grounded strategies that can guide their sustainable development into the future.

Fig.2 shows a comparison between Trinity Church in Boston, renovated using sustainable preservation methods, and Al-Khorana Prep School near the Old City of Najaf, highlighting the importance of preserving architectural heritage in different contexts.

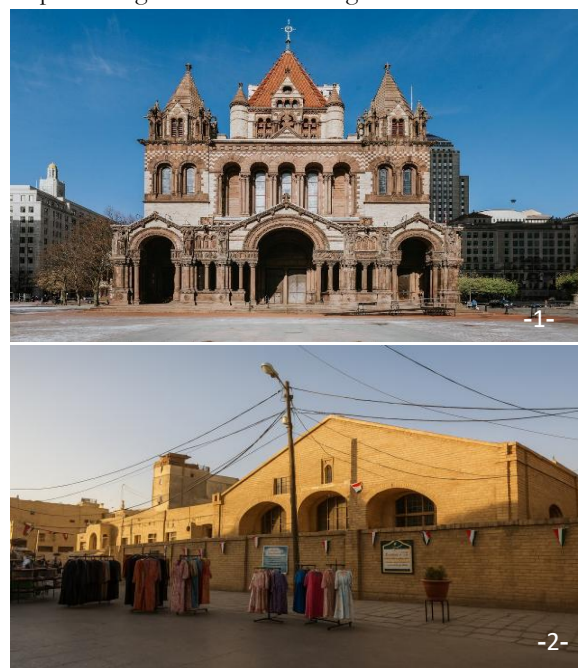


Figure 2. 1. Trinity Church, Boston (1877), renovated using green and preservation methods in 2005. [31]

2. Al-Khorang Prep School, near old Najaf, 2024, documented by the researcher.

The real challenge in Najaf is to preserve the unique character of its narrow streets and historic buildings while meeting the daily needs of residents, the expectations of visitors, and the goals of local businesses. Any effective strategy for these historic quarters must be capable of protecting both their environmental and cultural significance, ensuring their continuity for future generations. These areas demonstrate that historical identity and contemporary urban life can coexist. They serve as practical examples of how heritage preservation and sustainable innovation can progress together.

3.2. Unique characteristics of the city:

As older city centers come under renewed attention, there is a growing need for sustainability models that improve quality of life without erasing what already exists. Compared with modern urban

areas, the historic centers usually have less space for new infrastructure because of existing street layouts and building patterns [10]

However, balancing modernization and preservation is delicate in historic city centers, amid varied planning terms. Renewable energy and green space must be integrated carefully to avoid harming their historical significance [11]. The centers should be considered individually in urban planning, with respect for cultural sensitivities. A sustainability initiative must therefore address the needs and expectations of a broad cross-section of individuals, ranging from longer-term residents to visiting tourists [12]. To succeed, these standards need to be both theoretical and practical, targeting environmental problems such as traffic congestion, air pollution, and the upgrading of antiquated infrastructure [13]. Yet, these heritage buildings offer significant scope for sustainable innovation. While preserving their architectural heritage (which can be adapted to support modern sustainability ambitions), the cultural importance of these structures also provides an opportunity to educate and raise awareness regarding conservation efforts. Strengthening local pride, public engagement, and appreciation of resident history can promote further developments rooted in place in historic urban areas.

4. Sustainability of the old city of Najaf

The old city of Najaf, renowned for its rich cultural and historical heritage, faces numerous sustainability challenges. This research identifies these challenges and proposes strategies to enhance the city's sustainability [14]. Using a descriptive-analytical design with fieldwork and a focused review, this study develops recommendations to safeguard Najaf's heritage. Prior work emphasizes the importance of adapting sustainability standards to the specific historical, cultural, and social contexts of each location. Based on this foundation, the strategies presented in this study are informed by expert input (Appendix A) and focus on areas including adaptive reuse, mobility and walkability, public-space shading and greening, digital documentation, compatible infrastructure, and governance.

To preserve the unique features of historic districts, it is essential to link sustainability standards with heritage preservation and active community participation [15]. These areas, often characterized by dense street networks and aging infrastructure, present physical challenges that require innovative solutions beyond traditional planning methods [16]. Given their deep historical roots and cultural richness, such cities provide an opportunity to apply sustainability approaches that respect their distinctive context. However, implementing these standards in old urban centers calls for tailored measures that respond to the specific form, density, and heritage of each area, that shown in Fig.4.

We present the discussion through strategy clusters that connect heritage conservation needs with urban development goals, offering clear and measurable directions for implementation in the historic core of Najaf. The old city requires an environmentally responsive approach that respects its past while supporting future progress. This involves giving new life to heritage buildings through adaptive reuse, supporting conservation efforts that preserve local craftsmanship, and engaging the community to keep cultural values at the heart of

decision-making. Tourism, while valuable, should be approached with care to avoid exhausting the city's limited natural resources. Upgrading infrastructure must follow thoughtful, sustainable planning and strengthen essential services such as waste management and water conservation [17].

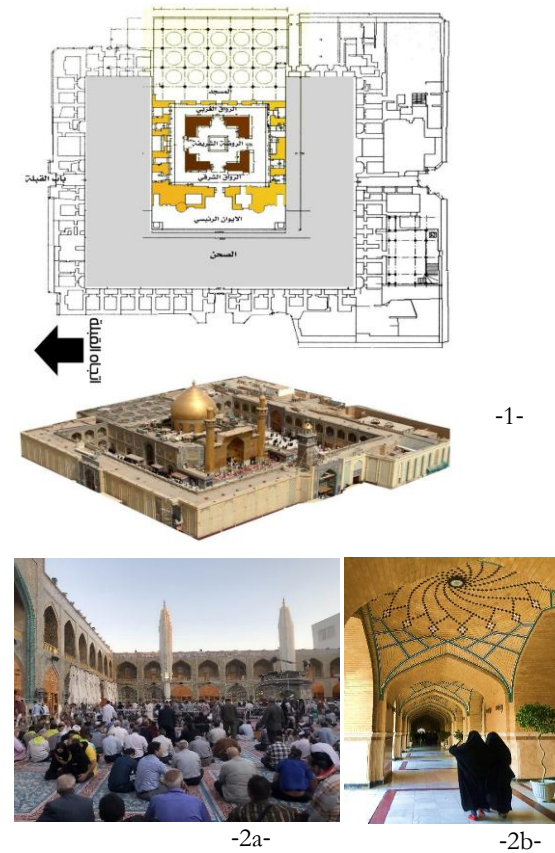


Figure 4. 1. The diagram shows the courtyard of Imam Ali along with a 3D model of the shrine. [28]

2. a,b. The courtyard is shown from the inside, and the surrounding corridors are visible from the outside. Source: by the researcher.

Initiatives should focus on strengthening the local economy by creating stable jobs and generating income that supports long-term community well-being. Instead of relying on development models that favor outside interests, strategies should reflect the realities of the local context and respond to the needs of people on the ground. Protecting heritage sites through clear legal frameworks is also crucial. In the absence of these protections, efforts to preserve cultural identity and to implement citywide sustainability are likely to remain limited and fragmented.

4.1. The Old City of Najaf faces a central challenge: preserving its cultural and historical identity.

Ongoing urbanization and modernization are putting growing pressure on Najaf's built heritage, community ties, and cultural identity [18]. As a result, historic buildings and traditional structures are at risk of deterioration or replacement. Najaf also struggles with critical infrastructure gaps, such as inadequate waste management, unreliable water and sanitation access, and disconnected transport networks. These shortcomings have disrupted efforts to protect and conserve the historic core. Relevant indicators include infrastructure service hours and waste collection frequency, as listed in Table 1.

4.2. Resilient Urban Planning

A holistic urban design based on the conservation of historical sites and traditional architecture was introduced as a countermeasure to address these challenges [19]. This may include requiring zoning and building regulations that favor preservation. Investment in infrastructure, such as better waste management systems and public transit, is key to making the city more sustainable. Planning-related governance indicators are referenced in Table 1.

4.3. Protection of Cultural and Historical Heritage

This is a main aspect that guarantees sustainability for Najaf, where protecting the city’s heritage is essential [20]. Operations should be launched to support and renovate historical sites. Crucial to this engagement is providing a sense of ownership and pride in Najaf’s cultural identity and value to local communities and stakeholders. Additionally, promoting cultural tourism leads to economic development and preserves the city’s historical heritage. Heritage actions are tracked through approved plans and completed maintenance, as shown in Table 1.

4.4. Therefore, any move toward sustainability in the Old City of Najaf can be expected to improve quality of life for residents and also attract tourism [21]. This aligns with the city’s rich cultural heritage and ongoing infrastructure upgrades to offer a better standard of living. Clean water, sanitation, and improved public spaces enhance livability. Promoting tourism in the Old City boosts the economy, supports local businesses, and advances sustainability, with participation and mobility serving as key indicators.

Najaf, among the world’s oldest cities and a cradle of civilization, is a heritage crossroads [22]. In compact cities, green spaces and urban greening are recognized for advancing social, economic, and environmental well-being [23]. This integration reinforces place identity while supporting sustainable development in historically dense settings [24]. Such efforts are essential in compact historical cities like Najaf, where the lack of vegetation and structured green networks underscores the urgency of adopting sustainable greening strategies [25].

Najaf’s historic core can reconcile preservation and progress when actions are calibrated to its compact urban fabric and institutional realities. Priority actions are adaptive reuse, craft-based conservation, carefully managed eco-tourism, and targeted upgrades to water, waste, and mobility systems, paired with modest greening where space permits. The aim is not to display projects but durable local benefit: rules that guide investment, community participation that aligns options with local values, and monitoring that tracks impacts. We therefore frame Adaptive Sustainability Strategies as three coordinated tracks: Heritage (phased conservation and maintenance), Urban Development (basic services and human-scale mobility), and Integrative Tools (governance, permitting, digital documentation, participation). This directly supports the paper’s title and is operationalized in Table 1 via concise indicators that guide sequencing and review.

Urban design, when informed by human-centered principles and supported by smart technology, can help transform the city into a living monument that reflects identity and sustainability alike [26]. However, challenges such as infrastructure degradation, visual

distortion, and the uncontrolled growth of informal structures continue to threaten the spatial and cultural coherence of the historic city [27].

These are not merely interventions in the city’s aesthetic and cultural landscape, but also vital steps for economic vitality through tourism. The significance of these initiatives is profound, serves as a bulwark protecting the city’s historical edifices against the tide of rapid urbanization that risks eroding Najaf’s identity. It is equally important that authorities in Najaf maintain a delicate balance between modernization and the city’s ancient heritage, thus ensuring that the spirit of this venerable city endures for future generations. Adaptive Sustainability Strategies: We define adaptive sustainability as a practical set of actions that align heritage preservation with urban-development needs, measured through concise indicators and revised iteratively as conditions and feedback evolve. We organize the strategy set for Historic Najaf into three tracks: Heritage, Urban Development, and Integrative Tools, which connect both and consolidate Sections Table 1 summarizes the adaptive strategy-indicator pairs, using the fixed columns: Track, Strategy, Indicator, and Planning use.

Table1. Adaptive strategy–indicator matrix for Historic Najaf

	Track	Strategy	Indicator	Planning use
1	Heritage	Heritage conservation program	Plans per year; percent maintenance done	Phase works; design control
2	Urban development	Infrastructure adequacy	Water hours; percent sewered blocks; waste pickups per week	Target upgrades; schedule services
3	Urban development	Mobility near the shrine	Peak pedestrians; average bus access time	Phase calming; last mile
4	Integrative	Community participation	Workshops per quarter; percent actions with input	Align projects with local priorities
5	Integrative	Governance and policy	Updated guides or permits; median permit time	Track capacity and predictability

These indicators provide the measurement framework; baseline values and qualitative evidence are reported in Results.

5. Expert Questionnaire

To support the analysis of sustainability challenges in the historic center of Najaf, a structured questionnaire was developed and distributed to a selected group of professionals. These included urban planners, architects, heritage conservationists, environmental engineers, and municipal officials. The questionnaire was designed based on the key themes identified in the literature review and aimed to validate theoretical insights through practical expert input. It covered major domains such as infrastructure adequacy, heritage preservation, environmental management, social participation, and policy frameworks. The selection of participants was based on their experience in dealing with heritage-related urban projects or sustainability planning in Iraqi cities. The responses were analyzed qualitatively to extract recurring themes and critical priorities, which informed the strategic recommendations proposed in this study.

6. Results

Professionals from a range of disciplines, including urban planners, architects, historians, ecologists, community organizers, and government officials, were invited to contribute through an expert questionnaire. Their responses revealed a variety of challenges that pose a threat to sustainability in the Old City of Najaf. The results identified key themes such as governance issues, infrastructure stress, and the need for stronger community engagement. These areas were highlighted as critical to ensuring the long-term viability of the historic core. Table 2 presents the expert responses using four columns: Track, Strategy, Indicator, and Planning Use. This structure demonstrates how the survey findings align with and support the proposed integrated strategy framework. as shown in Table 2.

Table 2. Expert evidence mapped to the adaptive tracks.

	Track	Strategy	Indicator (short)	Planning use
1	Integrative	Governance and policy support	76% flagged as critical; policy effectiveness skewed low (31.3% = 1; 28.1% = 2)	Issue concise guidelines, simplify permits, run periodic reviews
2	Heritage	Heritage conservation program	65% cited conservation as a major difficulty	Prioritize plans and maintenance for priority assets
3	Urban development	Infrastructure adequacy	63% identified environmental threats (waste, water, heat)	Coordinate upgrades and service scheduling
4	Integrative	Digital documentation for conservation	87.5% agree digital data and 3D help; 9.4% not sure	Establish baseline digital records and training
5	Integrative	Community participation	Experts favored formal coordination and regular workshops	Institutionalize resident/shopkeeper workshops and feedback

Evidence supports the research hypothesis: adaptive sustainability in historic Najaf can be integrated through heritage-related actions with urban service improvements, enabled by integrative tools (participation, governance, and digital workflows).

6.1. Insufficient Infrastructure

A lot of professionals claimed that obsolete infrastructure as well as insufficient public solutions are a few of the huge trouble helped you by the professional. Major challenges impeding the sustainability of the region have been identified as limited access to clean water, poor sewerage systems, and congested transportation networks, See Figure (6).

6.2. Heritage Preservation

The preservation of historic building and archaeological sites was identified as a major challenge. The experts demanded full-proof protection strategy, adaptive reuse of historical structures and comprehensive heritage management plans to save the cultural identity of the ancient town, See Figure (6).

6.3. Pollution Abatement

This focuses on environmental pollution, recalling concerns about pollution, the loss of green spaces, and the continued creation of office parks, whose energy sources are finite. This is critical for

reducing the environmental footprint and improving the quality of the living environment within the Old City; see Figure 6.

6.4. Community Empowerment

As per the Recommendations involving local residents in decision-making processes and community-led social development initiatives were highlighted as key to the Old City’s sustainability. The community has to own a project and be able to influence how things are done before the long-term viability of an initiative can be ensured, See Figure (6).

6.5. According to expert input

The essential requirement is to achieve a balance between modern development and the preservation of cultural heritage. Meeting the needs of today without compromising the immutable old city was seen as a difficult but crucial task, See Figure (6).

Findings from the expert questionnaire are used to construct comprehensive strategies in response to the main challenges identified in Old City of Najaf. Local city authorities, urban planners, heritage conservationists, environmental experts, community stakeholders and other relevant parties will need to come together to develop sustainable solutions for the preservation of its local heritage.

Responses to the questionnaire identifying principal sustainability challenges to the Old City of Najaf were sought from experts across various sectors including but not limited to, urban planning, heritage management, architecture design and sustainable built environment, environmental sciences as well as cultural heritage. The experts shared their perspectives about the sustainability problems this city has, and how to address them.

Nearly 72% of experts identified Infrastructure and Urban Development as the biggest challenge, highlighting inadequate transportation, sewage, and waste management systems and the need for infrastructure modernization while preserving Najaf’s historic image.

About 65% of experts identified conserving the Old City’s architectural legacy as a major challenge. They called for consistent, long-term maintenance of key structures, especially bridges, and raised concerns about the poor condition of historic buildings. Several also noted that recent developments often conflict with Najaf’s traditional architectural identity. Accordingly, integrated rehabilitation and renovation were seen as essential to preserving the city’s distinctive form. At the same time, 63% of participants flagged environmental threats as the most urgent risks, including pollution, water scarcity, extreme weather, and climate change. To counter these, specialists stressed adopting sustainable environmental practices that safeguard both the natural and cultural landscape of the Old City.

Key Economic Activities That Support the Balance Between Development and Heritage (n = 32)

- 1.Sustainable tourism paired with rigorous heritage protection.
- 2.Support for locally rooted handicrafts and traditional industries.
- 3.Cultural and artistic events that strengthen community identity.
- 4.Local trade promotion and small-business empowerment.
- 5.Projects that preserve and elevate the area’s heritage value.

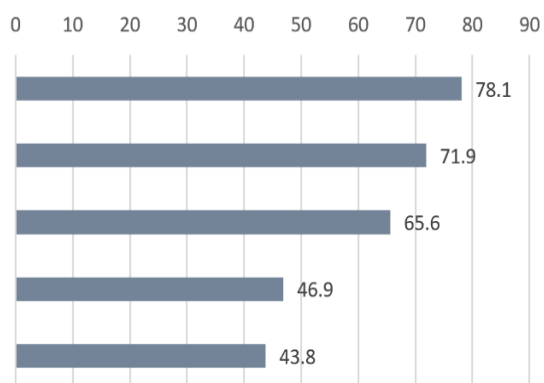


Figure 5. Strategic Economic Activities Identified by Experts to Harmonize Development and Heritage in Najaf.

Fifty-five percent of experts viewed social and cultural factors as essential to sustaining the Old City. They expressed concern that rising population, urban expansion, and weakening social ties could erode Najaf's cultural fabric. In response, they emphasized the need for deeper community involvement and socially responsive development.

Meanwhile, 76% identified governance and policy gaps as major barriers. Weak planning, limited heritage protection, and the lack of inclusive decision-making highlight the urgent need for citywide frameworks that center both sustainability and cultural preservation. The findings point to a web of interconnected challenges across infrastructure, architecture, environment, and governance. Experts stressed that meaningful solutions require sustained and collaborative efforts, rather than isolated fixes. Preserving Najaf's identity, while enabling thoughtful progress, depends on strong partnerships between local authorities, communities, and international actors. With its deep historical roots, Najaf needs a sustainability model that ties heritage to everyday life. This means respecting traditional architecture and reusing historic buildings to meet evolving community needs. To serve residents, visitors, and others, the model should encourage multifunctional spaces that reflect local rhythms and daily use.

Expert insights offer a clear path for sustainable planning. Long-term success will rely on collaboration across sectors. Through shared responsibility and continued partnership, Najaf can protect its historic core while building a more inclusive and resilient future.

The proposed sustainability model for Najaf draws on the city's own heritage and historical foundations to address its unique challenges. In line with this, the design emphasizes preserving traditional architecture and historic features and applies adaptive reuse to treat historic buildings as assets for a sustainable future. Serving residents, pilgrims, tourists, scholars, and merchants, the model prioritizes local needs while balancing visitor demands, shaping spaces where social life attuned to Najaf's urban rhythms can move away from one-size-fits-all approaches.

1. Infrastructure & urban development
2. Heritage preservation
3. Environmental challenges
4. Social & cultural challenges
5. Governance & policies

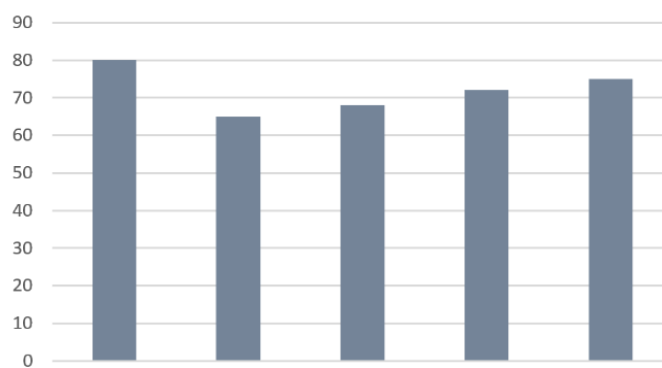


Figure 6. Attribution of key challenges to sustainability, by the researcher.

Najaf, an ancient city, is grappling with sustainability issues in the environmental, economic, social, political and infrastructural realms. It's very dry climate and weak water supply demand careful resource management, and pollution signals the need to upgrade waste treatment. However, financial constraints and economic volatility hinder the release of funds for critical sustainability projects.

Combining modern day with traditional values, and instigating the necessary cultural shifts required for the community to play an integral part in local services commissioning. There is the political aspect of inefficiencies in governance institutions and policy frameworks egregiously inadequate to underpin sustainability. Security issues and regional instability deter investment and stall projects. Aging infrastructure and unplanned sprawl intensify pressures, making a shift in service delivery urgent. Education and public awareness are needed to close sustainability knowledge gaps. Balancing tourism income with environmental impacts, especially during peak pilgrimages, remains challenging. A citywide strategy engaging government, communities, international partners, and private actors, focused on policy reform, infrastructure investment, outreach, and education while protecting environmental services, is essential for Najaf's sustainability.

Najaf's historic core can reconcile preservation with progress when actions match its compact fabric and institutional realities. Priorities include adaptive reuse, craft-based conservation, tightly managed eco-tourism, and targeted upgrades to water, waste, and mobility, with modest greening where feasible. The aim is durable local benefit rather than showcase projects, with rules that steer investment, participation that filters choices through local values, and monitoring that tracks impacts. We frame adaptive sustainability as three coordinated tracks: Heritage, Urban Development, and Integrative tools, covering conservation and maintenance, basic services and human-scale mobility, and governance, permits, digital documentation, and participation. Table 1 operationalizes these through concise indicators for sequencing and review.

7. Conclusions

7.1. Adaptive sustainability means aligning heritage preservation with infrastructure and mobility through measurable actions that can be iteratively adjusted to local conditions.

7.2. Najaf's spatial and institutional specifics matter, with a compact fabric, pilgrimage-driven peaks, and service deficits that require context-designed solutions rather than imported models.

7.3. A practice gap persists between standards and on-the-ground delivery; closing it requires stronger institutional capacity, clear inter-agency coordination, and implementation oversight.

7.4. Spiritual heritage is a lever for social cohesion, not a constraint; acknowledging intangible values improves acceptance and the durability of interventions.

7.5. The indicator framework in Table X, supported by expert evidence in Table Y, provides a practical basis for monitoring, prioritization, and course correction.

7.6. Adaptive reuse functions as the urban-design integrator, repurposing heritage buildings through reversible, low-impact retrofits to host needed services and small enterprises while conserving the historic fabric.

8. Recommendations

8.1. Deliver rapid upgrades to transport, waste, and sanitation within the historic core to stabilize basic service conditions.

8.2. Launch a phased restoration program for priority assets, paired with clear design and permitting rules so that new works remain compatible with the historic environment.

8.3. Strengthen governance and monitoring with three actions: issue concise guidelines, simplify permit pathways, and create baseline digital files for priority assets. Track a small set of indicators from Refer to Table 1 and review Table 2.

8.4. Embed community participation and recognition of intangible heritage in project design and evaluation to strengthen social cohesion and acceptance.

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This appendix lists expert prompts that directly support the adaptive sustainability strategies discussed in Sections 4.1 to 4.4. No scores or calculations are reported.

A.1 Heritage and Adaptive Reuse

- To what extent should priority heritage buildings be adaptively reused for education, culture, or small-scale hospitality while safeguarding character-defining elements.

- What incentives or controls can steer owners toward adaptive reuse rather than demolition or incongruent alteration.

- Which building types are most suitable for low-impact retrofits that improve comfort and energy performance without harming heritage value

A.2 Mobility and Walkability in the Shrine Perimeter

- What is an appropriate pedestrian-priority zone around the shrine, and which street segments should be traffic calmed first.

- Which last-mile public transport options are feasible for peak pilgrimage periods while maintaining access for residents and businesses.

- What design elements are critical to improve walkability and thermal comfort along key axes.

A.3 Public Space Shading and Greening

- Which public spaces within the historic fabric should be prioritized for shading structures and micro-greening to reduce heat stress.

- What plant palettes and soil solutions are compatible with conservation constraints and limited maintenance capacity.

- How should vendors and temporary uses be organized to keep shaded routes continuous and unobstructed.

A.4 Digital Documentation and Asset Management

- Which heritage assets require immediate digital documentation to support maintenance, risk assessment, and approvals.

- What minimum data standards and update cycles should be adopted for drawings, photos, and 3D records.

- What training or institutional support is needed to embed digital workflows in routine conservation practice.

A.5 Infrastructure Upgrades Compatible with Heritage

- Which utility corridors or methods minimize disruption to historic fabric during water, sewer, and power upgrades.

- What facade or roof interventions are acceptable for energy efficiency without visual harm in protected streetscapes.

- How should waste collection and servicing be scheduled and routed to reduce congestion in narrow streets.

A.6 Governance, Policy, and Community Participation

- What decision pathways and permitting steps best balance conservation objectives with small-business needs.

- Which community engagement practices align resident priorities with visitor management and conservation rules.

- What simple performance checkpoints should authorities track to keep projects accountable over time.

Note. Items used Likert-type responses; details are provided in methodology and expert questionnaire.

Appendix

Appendix A. Expert Prompts Supporting Adaptive Sustainability Strategies