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Resilient Revitalization of Urban Heritage in the Holy City of Karbala: Challenges and Strategic Responses in the Post-COVID Era

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ABSTRACT

This study aims to analyze the challenges and opportunities associated with the urban heritage management in the holy city of Karbala in the post-COVID-19 pandemic phase, focusing on the integration of digital technologies into assessment and urban planning processes, and highlighting the complementary role of governance, local communities, and technology. A mixed methodology was adopted, including field surveys of 200 participants from various groups (residents, visitors, experts, and officials), inferential statistical tests (t-test and chi-square test), spatial analysis using Geographic Information Systems (GIS), and interactive modeling using virtual and augmented reality (VR/AR) technologies. The results showed statistically significant differences between the different groups in assessing the condition of heritage sites ($p < 0.05$), and a significant relationship between category type and assessment level. The spatial analysis confirmed the similarity of areas of human pressure with areas of physical deterioration, while the virtual models demonstrated clear potential for reducing congestion and improving the visitor experience. Methodological limitations were identified, including sample bias, a cross-sectional design, and the limited spatial scope of the digital analysis. The originality of this study lies in presenting an integrated applied model that combines statistical and spatial analysis with interactive techniques, providing a practical tool to support decision-making in urban heritage management in holy cities and enhancing the link between governance, innovation, and sustainable planning.

1. INTRODUCTION

1.1 Background

Urban heritage is vital in conserving cultural identity, maintaining historical continuity, and shaping urban development [1]. However, the need to safeguard urban heritage is imminent as cities worldwide face rapid urbanization, globalization, and climate change [2]. Sacred cities, in particular, present unique challenges and opportunities where cultural, spiritual, and historical dimensions intersect. The unprecedented disruption caused by COVID-19 pandemic severely affected tourism, local economies, and heritage conservation efforts [3]. Moreover, it exposed the inherent vulnerabilities of urban heritage and revealed the systemic weaknesses in management, infrastructure, and community engagement [4].

The holy city of Karbala, Iraq, has special importance because of its spiritual heritage, historical buildings, and cultural identity [5]. Being one of the preeminent pilgrimage sites around the globe, receiving millions of visitors annually, Karbala's urban heritage is a cultural asset and an economic driver for local development [6]. However, the pandemic worsened pre-existing challenges: overcrowded streets and bazaars, environmental degradation, and poor infrastructure across the board that endanger the city's ability to preserve its heritage and fulfill growing demands [7]. Therefore, these dynamics render Karbala a perfect case study for researching post-pandemic urban heritage revitalization schemes [8].

1.2 Research problem

Although historically and culturally significant, Karbala's urban legacy faces severe challenges to holistic, sustainable management and development. The pandemic further revealed weaknesses in resilience and community involvement, exposing an unsteady framework for managing heritage within the city. Additionally, the flood of pilgrims and dwellers impacted harshly on the city's infrastructure and urban textiles, ruining heritage sites within the city. Meanwhile, existing scholarly and practical endeavors on urban heritage are unwilling to address the nuances of sacred cities, particularly in the Middle East, where rapid urbanization and socio-political unrest create barriers to others. Therefore, this research aims to bridge the existing gap through the confrontation of the challenges and opportunities presented for

the revitalization of Karbala's urban heritage in the post-COVID period (see Figure 1).

Figure 1. Case study: Karbala historical city center, Iraq

1.3 Significance of the study

By looking at an underexplored yet salient context, this study contributes to the field of urban heritage: sacred cities in the post-pandemic world. The focus on Karbala lays bares the specific challenges faced by these cities while proposing innovative strategies focusing on heritage preservation, urban planning, and sustainable development. It is anticipated that the study findings will guide policymakers, urban planners, heritage conservationists, and religious leaders alike, outlining a path to integrate community engagement, technological innovation, and sustainable practices in heritage management. Furthermore, beyond Karbala, this study could be a guide for many other sacred cities facing similar issues.

1.4 Objectives

The primary objectives of this study are:

• To analyze the impact of the COVID-19 pandemic on Karbala's urban heritage, focusing on preservation and community involvement.

• To identify the key challenges hindering the sustainable management of Karbala's heritage sites.

• To explore opportunities for integrating digital technologies and smart urban planning in heritage preservation.

• To develop a set of practical recommendations for balancing heritage preservation with urban growth and modern needs.

• To propose a framework for enhancing the resilience and attractiveness of Karbala's urban heritage in the post-COVID context.

2. METHODOLOGY

2.1 Research design

This study employs a mixed-methods approach in Karbala to explore the challenges and opportunities for reviving urban inheritance in the post-COVID-19 scenarios. The mixed-methods design integrates both qualitative and quantitative

data to give a truer insight into the research problem, enabling triangulation and enhancing the study's reliability and validity. The study design encompasses a case study approach, field survey, stakeholder interview, and some digital tools such as GIS and comparative analysis. One of the many reasons for having Karbala as the model case study is that it is considered unique among other cities in terms of being a holy city with historical, cultural, and spiritual significance.

2.2 Data collection methods

2.2.1 Primary data collection

- Field surveys:

Surveys took place at pivotal heritage sites in Karbala, mainly concentrating on the state, footfall, and associated infrastructure. The observational checklists recorded the deterioration and conservation measures to make the site more accessible.

- Stakeholder interviews:

They were semi-structured interviews with diverse stakeholders mentioned below:

o Local authorities (municipality and heritage department officials).

o Urban planners and architects working for heritage conservation.

o Community leaders and residents.

o Religious authorities in charge of sacred sites.

o Tourists and pilgrims.

These interviews converged on perceptions of heritage issues, COVID-19, and possible revitalization aspects.

- Focus groups:

A focus group comprises different individuals who have something in common and participate in a guided discussion led by a moderator. For example, they could be members of the same program or even neighbors in the same area.

Similarly, focus groups with members of local communities and business owners near the heritage site elicited voices on economic and social impacts, emphasizing community priorities in the focus of regeneration.

2.2.2 Secondary data collection

- Document analysis:

Existing urban plans, heritage policies, and guidelines for urban development of Karbala were reviewed. This includes national and municipal guidelines and UNESCO documents on sacred city heritage.

- Academic literature:

The theoretical context was further supported by scholarly articles and other books on urban heritage, sacred cities, and post-pandemic resilience.

- Archival research:

Historical records and visual documentation, such as maps and photographs, were analyzed to understand the changes in Karbala's urban heritage.

- Comparative case studies:

Other sacred cities, such as Mecca, Medina, and Varanasi, were analyzed for possible best practices and applicable lessons for Karbala.

2.3 Analytical tools

2.3.1 GIS mapping

Geographic Information Systems (GIS) will be used to map Karbala's urban heritage, identifying:

- Distribution of heritage sites.
- Current land use patterns.
- Infrastructure and accessibility challenges.

Spatial analysis helped visualize areas requiring priority intervention and assess urban growth pressures on heritage zones.

2.3.2 Thematic analysis

Qualitative data gathered in interviews and focus groups were thematically analyzed to identify recurrent patterns and priorities of stakeholders. Subsequently, data may be coded and categorized systematically with NVivo software.

2.3.3 Quantitative analysis

On the one hand, statistical tools were used for processing the survey data from different angles. Then, this was set to define the major trends and relationships regarding:

- Visitor satisfaction levels.
- Impact of COVID-19 on tourist inflow and heritage conditions.
- Community perceptions of heritage governance.

2.3.4 SWOT analysis

By employing a SWOT analysis (Strengths, Weaknesses, Opportunities, Threats), Karbala's urban heritage was assessed against the current challenges and opportunities that arise in a post-pandemic world.

2.3.5 Comparative analysis

An analysis of good and bad lessons learnt from other holy cities was done, which could be applied in Karbala. Comparative metrics included governance models, technological adoption, and resilience measures.

2.4 Study limitations

Although this study provides a comprehensive analysis of the challenges and opportunities associated with urban heritage management in Karbala, combining statistical, numerical, and spatial analysis, there are several of methodological limitations that should be taken into account when interpreting and generalizing the results. These limitations do not diminish the value of the results, but rather place them within their proper scientific framework and point to future development paths for subsequent studies.

First, one of the most prominent limitations relates to the method of selecting the sample. The use of a stratified, directed sample resulted in uneven representation of some groups, such as foreign visitors or younger age groups, which may limit the generalizability of the results to all segments of society. Second, the study was based on a cross-sectional design over a single period, meaning the results reflect the current situation without being able to monitor temporal shifts or future trends. Consequently, the observed relationships between the variables are correlational rather than causal. Third, spatial analysis and virtual modeling applications (GIS and VR/AR) have been limited to a specific spatial scale within the historic city, limiting the comprehensiveness of the spatial representation of the entire urban fabric.

In light of these limitations, the study recommends conducting future longitudinal studies that include more diverse samples and broader spatial scopes, employing more comprehensive digital techniques. This will allow for the verification of temporal trends and enhance the ability to infer

causal relationships more accurately.

3. STUDY AREA: KARBALA, IRAQ

3.1 Geographic location

Situated in central Iraq, roughly 100 kilometers to the southwest of Baghdad, the city of Karbala is of historical importance. Geographically, it is located at 32°37'N latitude and 44°02'E longitude, within the Mesopotamian plain, with its geographical features playing a significant role in the city's development [9]. As part of the cradle of ancient civilizations, Karbala's proximity to the Euphrates River provides a substantial water supply that supports its agricultural lands and settlements [10].

Karbala operates as a vital juncture mostly for the activities of religion, culture, and trade; thus, it is linked to other major Iraqi cities such as Najaf, Hillah, and Baghdad [6]. Due to its location on the crossroads of ancient trade routes, the city has historically been treated as the center of commerce and cultural exchange, an agent that is still affecting urban dynamics today [11].

3.2 Historical and cultural context

A. Historical significance

The history of Karbala runs parallel to its role in Islamic history, especially in that of Shia Islam. The city had made itself known after the Battle of Karbala in 680 CE, during which martyrdom was faced by Imam Hussein, together with his companions [12]. This became a landmark event in history, becoming one of the most defining shapers of Shia identity and inspiring centuries' worth of religious devotion and pilgrimage [13].

Karbala is historically a center for Islamic scholarship, attracting theologians, poets, and historians [14]. The city has been central to political and religious movements in the history of Iraq, a determinant of its long historical significance [15].

B. Cultural heritage

- Tangible Heritage: Several landmarks of highly heterogeneous architectural splendor dot this city. The illustrious shrines of Imam Hussein and his brother Abbas are nothing less than masterpieces of Islamic art and craftsmanship [16]. These holy complexes remain interspersed amid historic districts, traditional bazaars, and living areas that narrate volumes of several centuries of urban evolution [17].
- Intangible Heritage: Karbala's intangible cultural heritage is equally important and consists of oral traditions, religious rituals, and processions [18]. Events such as Ashura and Arba'een highlight the cultural identity of the city, attracting millions of participants while fostering a sense of collective memory and support among Shia Muslims worldwide [19].

C. Architectural and urban fabric

The city has beautiful historic architecture, traditional Islamic design elements with courtyards, pod-shaped tiles, and domes, and modern contemporary urban architecture [20]. The old districts are dense, characterized by sites of narrow alleyways and public spaces, compared to new areas with more widespread urban plans [21] (see Figure 2).

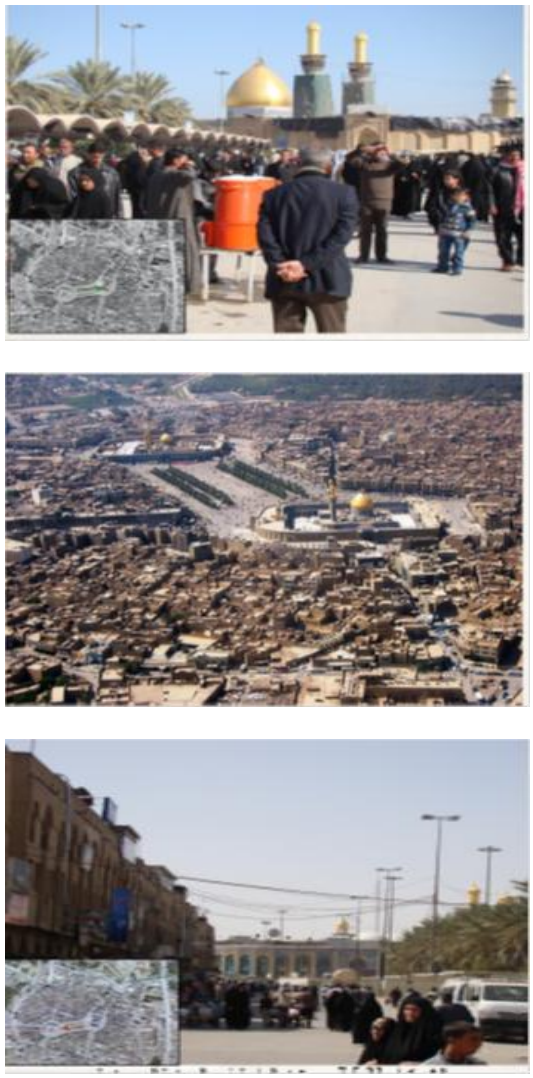

Figure 2. The urban landscape of the holy city of Karbala: an aerial and detailed view of the routes and streets leading to the shrines

3.3 Significance of research

Karbala can be considered a perfect case study to examine the challenges and prospects of urban heritage management in holy cities [22]. Particularly, in this new era formed by the COVID-19 pandemic and beyond, it is of great importance to gain more space for those numbers to allow distancing for health guidance. However, the Christianization of a city against the requirements of visits to the holy shrines of Karbala makes the heritage preservation of the city difficult. The significance of this research lies in addressing these dimensions through the following key perspectives:

A. Urban heritage under pressure

Karbala functions at a very vibrant intersection of spiritual, cultural, and urban functions [23]. The interplay between rapid urbanization and growing pilgrimage returns puts a strain on its urban heritage, which this study aims to identify sustainable strategies for avoiding the loss of a historical aspect of Karbala while satisfying the demands of modernization in the city.

B. Post-COVID resilience

The COVID-19 pandemic has posed a severe disruption to Karbala's religious and economic operations and has landed

down its vulnerabilities on pilgrimage-revenue dependence [24]. By looking at the recovery strategies for the city, this research aims to build insights into resilience-building for sacred cities faced with similar challenges.

C. Balancing heritage and modernization

The sacred landmarks of Karbala exist side by side with its urban infrastructure; a classic case of the conflicting interests of heritage conservation and modernization [25]. Thus, this research explores how to keep this balance and ensure that development processes respect and enhance the cultural and historical significance of the city in question [26].

D. Global relevance

Though the research is centered on Karbala, its results can reach other sacred cities, presenting the same challenges [27]. Lessons learned from Karbala's experiences can inform global discussions on urban. The lessons drawn from what happened in Karbala may thus affect the global debate on urban heritage management in religiously and culturally sensitive contexts [28].

Geographical, demographic, historical, and cultural characteristics make Karbala a good candidate for research into urban heritage revitalization [2]. Specifically, the challenges of a city, from overcrowding and environmental pressure to governance failures and economic vulnerabilities, demand new multi-stakeholder approaches [29]. This study, based on Karbala's rich historical and cultural background, feeds into the global.

4. STUDY SAMPLE

The study sample is quite bringing into the fold a variety of individuals and groups representing various views on various facets of urban heritage in Karbala. The selection was made in a very inclusive manner so that no view from any stakeholder, directly or indirectly involved in heritage management, preservation, and tourism, would be missed. By all such views, the study attempts to provide a global comprehension of the problems and prospects of the heritage of Karbala. The important participant categories are as follows:

4.1 Local residents

Residents near heritage sites are key to understanding how heritage is perceived, maintained, and interacted with at the local level. The residents themselves can offer great insight into tourism's impacts, the impact of conservation efforts, and urban development on their daily lives. In all, 40 residents were interviewed, considering gender-age-educational background balances to reflect the range of experiences in the community.

4.2 Visitors and pilgrims

Karbala is a globally important religious site, and the major contributory factor toward shaping its heritage landscape remains the domestic and international visitors, which also includes the category of pilgrims and cultural tourists. There was a total of 60 visitors sampled, comprising equal numbers of domestic and international tourists, so that it could shed light on their experiences, expectations, and perceptions regarding Karbala's heritage. These responses, then, help us evaluate the impact of tourism on heritage sites and the level of satisfaction among visitors.

4.3 Government officials

The study examined aspects of policy and governance related to heritage management involving 10 representatives from local and municipal governments. The participants were selected from departments dealing with heritage conservation, urban planning, and tourism. Their input was essential in understanding the government's role in heritage preservation, the challenges of policy implementation, and financing.

4.4 Heritage experts and urban planners

The category is made up of architects, urban planners, conservationists, and professors with a specialization in heritage management. Their views were critical in evaluating best practices, challenges, and possible ways of improving Karbala's urban heritage conservation. In total, 20 experts were selected to ensure representation from academic institutions as well as professional heritage organizations.

4.5 Religious authorities

Religious institutions have an important role in the management of Karbala's sacred sites, with rival demands of spiritual, historical, and urban. In this context, the ten representatives involved in the case study are key representatives from religious organizations involved in heritage management. Their involvement, therefore, strengthened insight into the role of religious institutions in heritage conservation, collaboration in governing, and balancing urban development with spiritual significance.

4.6 Local business owners

Heritage tourism, in a certain sense, has a direct impact on the operations of businesses situated in the historic site's vicinity. Accordingly, about 30 proprietors of businesses in the hospitality, retail, and services sectors were surveyed to pinpoint these linkages between heritage tourism and the local economy. The responses included most of the economic challenges stemming from COVID-19, the effect of the number of visitors on businesses, and the role of businesses in heritage conservation.

4.7 Tour operators and guides

Heritage interpretation professionals administering tours facilitate cultural mediation between visitors and heritage sites. A total of 15 professionals in organizing and conducting their input, affording assessment of the relevance of current tour experiences, interpretation challenges for heritage, and possible future strategies for inquiry to improve visit experiences.

4.8 Academic and research community

Incorporating theoretical and empirical insights into the study went hand in hand with researchers engaged in urban heritage, sustainable development, and tourism. Scholars selected sprang up to a total of 15, strongly preferring those with experience in heritage conservation in the Middle East.

The views offered by these respondents, therefore, added to comparative analyses, historical perspectives, and recommendations for improving policy.

4.9 Total sample size and sampling technique

The study utilized a combination of purposive and stratified random samplings to ensure a balanced representation across stakeholder groups. The total sample comprised 200 participants, distributed as Table 1.

Table 1. Total sample size

Category	Definition	Sample Size	Percentage of Total
Local Residents	Individuals residing near heritage sites	40	20%
Visitors and Pilgrims	Domestic and international visitors	60	30%
Government Officials	Municipal and local government representatives	10	5%
Heritage Experts & Planners	Professionals in architecture, urban planning, and conservation	20	10%
Religious Authorities	Representatives from institutions managing sacred sites	10	5%
Local Business Owners	Owners of businesses near heritage sites	30	15%
Tour Operators & Guides	Professionals conducting heritage tours	15	7.5%
Academic & Research Community	Scholars specializing in urban heritage	15	7.5%
Total Sample Size		**200**	**100%**

4.10 Justification for sample selection

Such a diverse sampling strategy proves to be very effective for a holistic understanding of the urban heritage of Karbala by collecting perceptions and contacts of those who inhabit, work, visit, or manage those heritage sites. The study includes stakeholders from various professional, cultural, and social backgrounds to present a more complete and balanced view of the challenges and opportunities in heritage management.

The structured sampling method allows for contrast with fewer instances of policy implementation gaps, alternative perceptions of site conditions, and options for conservation improvement. In short, the integration of quantitative and qualitative data increases the reliability of these findings and therefore yields useful recommendations for the management of sustainable heritage in Karbala.

5. RESULTS

The results of this study revealed a complex and multidimensional picture of the challenges and opportunities associated with urban heritage management in the holy city of Karbala. This study utilizes various analytical tools, including field surveys, inferential statistical analysis, spatial analysis techniques using GIS, and interactive modeling using virtual and augmented reality (VR/AR) technologies. This integration enabled the transition from describing phenomena to building a quantitative and spatial knowledge base that supports decision-making.

The results of the field surveys, which included 200 participants from various categories (local residents, visitors, experts, government officials), indicated clear disparities in the assessment of the condition of heritage sites, the level of services, and the quality of governance. As Table 2 illustrates, the sample was unevenly distributed, reflecting the diversity of stakeholders in the city.

The results of the t-test showed statistically significant differences between the means of the participating groups ($p < 0.05$), with residents' and visitors' perceptions being more critical than those of government agencies and experts. These differences are illustrated in Table 3, which highlights the consistent differences between the evaluations of the different categories.

Table 2. Distribution of participants according to population category

Category	Number of Participants	Percentage (%)
Local Residents	80	40%
Visitors	60	30%
Experts and Researchers	40	20%
Government Officials	20	10%
Total	**200**	**100%**

The Chi-Square test also showed a significant relationship between the type of participant group and the evaluation level (good, average, or poor), reflecting the diversity in perceptions of the field situation depending on the different roles and responsibilities. This is clearly shown in Table 4.

Spatial analysis using GIS enabled the production of accurate maps illustrating the geographical distribution of heritage sites, the density of human population, and areas of urban deterioration. These maps revealed that areas of greatest deterioration spatially correspond to areas of high human pressure, particularly around the holy shrines, the traditional market, and major traffic arteries.

Table 3. Results of the t-test for differences between the means of the groups

Comparison	Mean (M)	Standard Deviation (SD)	T-Value	P-Value	Significance
Local Residents × Visitors	2.85	0.51	3.72	0.001	Significant
Local Residents × Officials	2.85	0.44	4.10	0.000	Significant
Visitors × Officials	3.05	0.40	2.98	0.004	Significant
Experts × Residents	3.20	0.35	2.15	0.032	Significant

Table 4. Chi-Square test results

Category	Good	Fair	Poor	Total Frequency	Calculated Value	Critical Value	Significance
Local Residents	10	40	30	80			
Visitors	12	28	20	60			
Experts	20	16	4	40	**27.54**	**12.59**	Significant
Government Officials	12	6	2	20			
Total	54	90	56	200			

The following map shows the spatial distribution of heritage buildings within the historic center of Karbala. The locations of these buildings were identified in the field and then mapped using GIS tools to understand their distribution pattern within the traditional urban fabric.

The distribution reveals that the vast majority of heritage buildings are concentrated around the central religious area (between the two shrines) and along major traditional axes, such as Shuhada Street, Jumhuriyah Street, and Qibla Street. This concentration reflects the historical relationship between heritage architecture and the ancient religious and commercial axes that have shaped the city's identity for centuries.

Figure 3 also highlights the presence of areas of high heritage density, contrasted by less dense marginal areas located on the outskirts. This spatial variation is an important indicator for guiding management and protection plans, and determining future spatial intervention priorities.

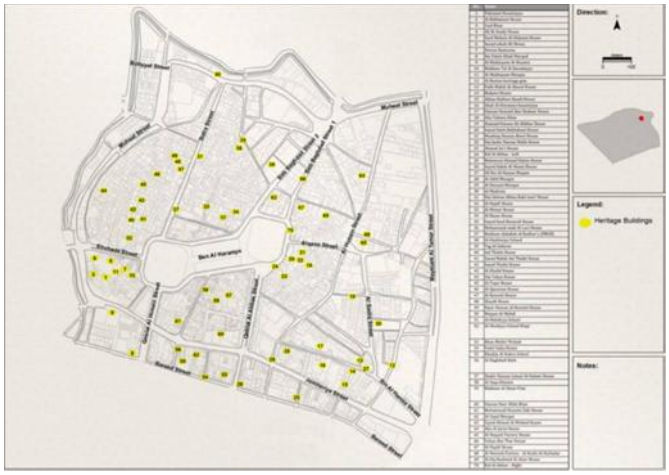

Figure 3. Spatial distribution of heritage buildings within the historical center of Karbala

On the other hand, interactive modeling using virtual and augmented reality technologies demonstrated significant potential in documenting heritage sites and analyzing urban intervention scenarios prior to implementation. Interactive 3D models were constructed for the most congested sites, enabling the simulation of design and organizational alternatives that contribute to alleviating congestion and improving the spatial experience. It is estimated that congestion could be reduced by 20% to 30% by redistributing gathering points and improving movement routes. Table 5 provides a summary of the most prominent results of the digital analysis.

Integrating the results of the digital analysis with the results of the statistical analysis revealed that the areas that showed the highest spatial pressure indicators in the GIS system were also the ones that recorded the highest levels of dissatisfaction in the surveys. This alignment of spatial evidence with social data enhanced the reliability of the results and provided a solid analytical basis for formulating more accurate and effective intervention strategies. The interactive models also helped test realistic visitor management scenarios, ensuring a balance between heritage preservation and daily operational needs.

Table 5. Summary of the results of the digital analysis (GIS and VR/AR)

Key Indicator	Value / Number	Interpretation
Number of heritage sites analyzed	25	Represents the core spatial scope of the study
Number of high-pressure zones	7	All located around the shrines and the traditional market
Overlap between pressure and deterioration	82%	Indicates the strong relationship between crowding and decay
Expected congestion reduction (VR/AR)	20%–30%	Achieved through route optimization and crowd redistribution
Number of simulated design scenarios	3	Supports spatial planning and decision-making

The added value of these results lies in demonstrating the vital role of digital technologies in urban heritage management. They not only enhance analytical accuracy but also open new paths for linking participatory governance with spatial analysis and interactive modeling. Thus, the study's primary objective to integrate digital technologies with social and statistical analysis tools to provide an integrated application model that supports planning and management decisions in sensitive heritage environments was achieved.

6. DISCUSSION

The research results indicated that urban heritage management in the holy city of Karbala faces a complex array of interconnected challenges, including weak and fragmented institutional governance, a fragile economic base based on seasonal tourism, limited effective community participation, and a failure to utilize modern digital technologies in protection and management. This complexity reflects the need for an integrated strategic framework that reframes heritage management as a multi-level process—institutional, societal, environmental, and technical—rather than remaining a series of isolated and temporary responses.

The added value of this research lies in providing a comprehensive interpretive and analytical reading that demonstrates the dialectical interconnectedness between these axes, while proposing the features of an integrated governance model that can be applied in Karbala as a pioneering model and generalized to other cities in the regional context.

6.1 Divergent perspectives between stakeholders and governance

The results of the statistical analysis revealed a clear gap between the assessment of government agencies on the one hand and the assessment of residents and visitors on the other. The t-test showed statistically significant differences ($p < 0.05$) between the means of these groups, while the Chi-Square test revealed a significant relationship between category type and evaluation level. This discrepancy reflects the absence of effective accountability and transparency mechanisms within the governance system.

Experts believe that the reason is the multiplicity of actors (municipal, religious, investment) without a unified decision-making center. Therefore, adopting a participatory governance approach based on the Historic Urban Landscape (HUL) framework advocated by UNESCO is a pivotal step to ensuring more inclusive and representative management of various stakeholders.

6.2 State of conservation and physical condition of heritage sites

Field survey results indicated that 65% of participants rated the physical condition of heritage sites as "medium to weak," which spatially corresponds to areas identified by GIS analysis as areas of high urban pressure. This convergence between digital and social evidence reflects the impact of overcrowding, neglect, and lack of funding on urban deterioration.

Therefore, the study recommends establishing a sustainable funding mechanism for preventive maintenance, adopting modern restoration techniques in line with international standards, and implementing a transparent periodic reporting system to enhance trust between the community and institutions.

6.3 Congestion and environmental challenges

Urban reality analyses revealed that seasonal congestion is one of the most significant pressures on Karbala's architectural heritage, especially during the millions of pilgrims visiting the city. Spatial analysis revealed that the areas of greatest deterioration coincide with areas of human pressure around the holy shrines and traditional traffic axes.

The study proposes solutions based on smart visitor management systems, such as real-time monitoring and smart entry gates, along with the use of green infrastructure (shaded walkways, absorbent gardens, and sustainable pedestrian paths). This combination of technology and urban design could reduce congestion by 20–30%, according to interactive modeling using VR/AR.

6.4 Economic and tourism impact

The pandemic has exposed the fragility of the local development model, which relies solely on religious tourism, as the suspension of visits has led to significant economic losses. This highlights the need to diversify tourism products to include cultural, educational, and digital tourism.

The results indicated that incorporating technologies such as virtual tours and interactive exhibitions can provide effective economic alternatives, enhance the resilience of the local economy, and ensure the sustainability of funding allocated to heritage sites.

6.5 Community participation

The results revealed weak community involvement in decision-making processes, with only 25% of participants indicating that they were consulted or involved. This indicates a gap between institutional discourse and actual practice.

The research suggests establishing ongoing awareness programs, organizing consultative forums, and launching "Heritage Ambassadors" initiatives to foster a sense of belonging and responsibility among residents, transforming the community from passive recipients to active partners in heritage management.

6.6 The role of digital technologies

Despite the high awareness of the importance of digital technologies (90% of experts and 85% of academics), their level of practical application remains very limited. This demonstrates a clear technological gap between specialists and the local community.

The study recommends activating GIS to monitor risks, using virtual and augmented reality (VR/AR) technologies to expand access to heritage, and adopting smart visitor management systems to improve the site experience. Furthermore, promoting digital literacy among all stakeholders—not just experts—constitutes a strategic step toward a true digital transformation in heritage management.

7. CONCLUSIONS

The results of this research provide an extensive study of the situation concerning the challenges and opportunities for the revitalization of Karbala's urban heritage in the post-COVID-19 period. This study provides evidence for the existence of an intricate and intertwined environment in which poor governance, economic vulnerability, community apathy, and technological inadequacy hinder the achievement of sustainable heritage management. These problems can only be alleviated through a synchronized and multidimensional approach that brings together policy changes, strategic planning, and technological advancement. The conclusions from this research focus on some areas that call for urgent intervention if the urban heritage of Karbala is to be preserved, efficiently managed, and adapted to tackle present urban challenges.

7.1 Governance gaps and fragmentation

Disjointed governance exists for urban heritage in Karbala, where diverse stakeholders—be they municipal authorities, religious institutions, or cultural organizations function independently without any logically cohesive framework. Such a case has led to inefficiency in the implementation of policy, the underfunding of projects, and long delays in important restoration activities. This has resulted in the continuing lack of a centralized, integrated governance model of heritage management that is typically reactive rather than strategic. Furthermore, a lack of appropriate institutional collaboration has failed to create a thorough policy agenda on urgent issues such as overcrowding, environmental degradation, and economic sustainability. Bridging these

governance gaps is essential in creating a long-term vision for heritage preservation in Karbala.

7.2 Insufficient maintenance and physical degradation

The Karbala heritage sites are degrading owing to poor maintenance and conservation. Many heritage structures are undergoing rapid physical disintegration under constant environmental stress, constant overcrowding, and lack of organized preservation programmers. Reactive maintenance, in which intervention is only carried out at a visible stage of deterioration, has been found inadequate for the safeguarding of heritage assets. The absence of preventive maintenance programs, such as systematic inspection and proactive conservation planning, worsens the situation. Unless a paradigm shift is initiated toward sustainable maintenance strategies in keeping with the guiding principles of international heritage conservation, significant portions of the architectural and cultural heritage of Karbala shall be lost forever.

7.3 Overcrowding and environmental stress

Local communities and business owners generally feel that heritage management initiatives are not meant for them. This has been brought about by an absence of participatory governance structures. The participation of the community in the decision-making process remains very low, and much of the decision-making on heritage policies is made without the residents and stakeholders. Thus, no campaign to the public has been mounted as to the deeper cultural, social, or economic significance of the heritage of Karbala. Apart from that campaign, education and propaganda may make it seem more restrictive than beneficial to the local people. Participation in the heritage by voluntary initiatives or participatory planning advisory councils may engender a sense of ownership and a shared responsibility towards heritage preservation.

7.4 Economic vulnerabilities and overreliance on pilgrimage tourism

The COVID-19 pandemic put a spotlight on the economy of Karbala, which relied heavily on pilgrimage tourism. Hence, sharply reduced visitor numbers during the global pandemic led to disruption in revenue streams, stoppages in restoration works, and a plunge in the local businesses, with dependence mainly on tourism. This dependence on religious tourism severely restricts the diversification of the economy and further adds risks to the financial resources during times of crisis. Thus, the increased revenues from heritage-based cultural and educational tourism could potentially act in alleviating some of the dependence on seasonal religious events. Increased public-private partnerships (PPPs) and investments in sustainable tourism efforts will also offer further resilience in the economy, whilst conserving those historic and cultural treasures of Karbala.

7.5 Limited community engagement

Local communities and business owners generally feel that heritage management initiatives are not meant for them. This has been brought about by an absence of participatory governance structures. The participation of the community in the decision-making process remains very low, and much of the decision-making on heritage policies is made without the residents and stakeholders. Thus, no campaign to the public has been mounted as to the deeper cultural, social, or economic significance of the heritage of Karbala. Apart from that campaign, education and propaganda may make it seem more restrictive than beneficial to the local people. Participation in the heritage by voluntary initiatives or participatory planning advisory councils may engender a sense of ownership and a shared responsibility towards heritage preservation.

7.6 Untapped potential of digital technologies

The application of digital tools to heritage management in Karbala remains largely unexploited and is extremely promising, considering the various technologies such as GIS, virtual reality (VR), augmented reality (AR), and artificial intelligence (AI). It has also been feasibly proven by heritage professionals and countries as transformative tools for their businesses, even adopting such technologies; however, for a large portion of stakeholder non-specialists, their adoption is negligible. Hence, these could make strong improvements in the site's monitoring, visitor experience, and public engagement. However, with such hurdles as financial limitations and technical capacity, coupled with stiff institutional policies, the implementation process is quite delayed. Digital literacy development and funding in smart heritage technologies will, however, transform conservation efforts beyond borders and reach wider accessible experiences through more interactive means for Karbala heritage.

7.7 Shared vision with varied priorities

An evident changing thought process is shown for various stakeholders, but there is a general agreement that governance needs to improve, funds need to be raised, and communities should be involved in managing heritage. However, the priorities differ according to the different players in this field; government authorities identify infrastructure development as a priority, religious institutions have priorities in terms of pilgrimage facilitation, and cultural organizations strive for heritage conservation. If this conflict of priorities is not effectively managed, then there will be a rapid slowing down of the forward motion in an integrated strategic approach to heritage management. Establishment platforms would be helpful for dialogue and collaboration to aid in the alignment of these priorities, ensuring that the preservation of Karbala's urban heritage considers both spiritual significance and urban sustainability objectives.

7.8 Moving forward

Based on the findings of this study, the urgent need for an integrated and reasoned strategy for heritage management is evident, one which weighs conservation against economic sustainability and urban development. Addressing the aforementioned governance, environmental, economic, and technological challenges would require collaborative efforts involving policymakers, researchers, community members, and religious authorities. If Karbala manages to navigate this transformation of policies to respond to new challenges, it has a grand opportunity to present itself as a case study to be emulated in global sacred city heritage management. Future research should, therefore, seek to adopt digital tools to diversify the economy and promote governance while

ensuring that the urban heritage of Karbala is conserved for the future, able to adapt to the needs of modern urban living.

8. RECOMMENDATIONS

These recommendations are meant to provide a structured roadmap of revitalization and long-term sustainability in the management of urban heritage issues at Karbala. Such recommendations will reform governance, innovate technology, employ environmental strategies, and foster community involvement to ensure a resilient heritage management system adapted to the current context.

8.1 Establishing an integrated governance framework

A unified and well-organized governance framework is necessary to achieve effective urban heritage management for Karbala. An overarching Heritage Management Authority can serve to improve collaboration between municipal authorities, religious institutions, cultural organizations, and private sector players. The clarity of roles and responsibilities will ensure that there is no overlap and that the decision-making process for the implementation of heritage policies goes forward with dispatch. Additionally, policy reform must encompass present-day challenges, such as climate adaptation, overcrowding, and digital integration. Such policies shall be reviewed and updated regularly so that Karbala can become responsive to emergent urban and environmental challenges while preserving its cultural and historical heritage.

8.2 Implementing systematic maintenance and conservation programs

A proactive and structured approach to maintenance involves keeping it specifically for long-term maintenance of the heritage sites. Applying GIS and spatial analysis-based maintenance schedules helps prioritize interventions that are site vulnerability- and visitor-impact-based. Aligning restoration efforts with international conservation criteria ensures that sustainable, historically appropriate materials are used in all preservation projects. Moreover, implementing performance metrics for monitoring and evaluating conservation programs enhances accountability and data-driven improvements. This results in a continuous and well-regulated process for heritage conservation rather than a reactive response.

8.3 Managing overcrowding and reducing environmental impact

During the time of the pilgrimage, the sacred sites of Karbala suffer greatly from overcrowding and environmental crises. Smart visitor management systems, like real-time monitoring tools and digital ticketing, can greatly regulate visitation and crowd control. Green infrastructure plans, including shaded walkways, water-efficient landscaping, and renewable energy systems, can improve the environment sustainably while adding value to the visitor's experience. Moreover, various waste management solutions should be implemented to control pollution, especially during high-traffic events. The implementation of recycling programs and the use of biodegradable materials can curtail the impact of the heritage sites on the environment.

8.4 Diversifying economic strategies

For the long-term sustainability of heritage conservation, economic sustainability is a vital factor indeed. Besides the religious pilgrims, the promotion of historical and architectural values can attract a wider mix of visitors to the cultural tourism sector of Karbala. Heritage walks, cultural festivals, and craft markets can provide enriching experiences for tourists while supporting local artisans and businesses. Moreover, public-private partnerships (PPPs) can attract investments into restoration projects, thus using corporate funds to support heritage management while providing marketing and sponsorship opportunities for corporations. Collectively, these strategies ensure that Karbala's heritage sites maintain economic sustainability while being well-managed and conserved.

8.5 Fostering community engagement

Sustaining heritage comes from the participation of society as well as awareness. The residents and visitors should know their heritage by both the cultural and historical significance and the economic values brought by Karbala through educational campaigns. Workshops, media events, and public exhibitions can help people feel for and appreciate conservation efforts. Creating infrastructure for an advisory council and consulting forums could also promote participatory decision-making so that heritage planning reflects community voices. Additionally, initiatives can be undertaken through volunteers as heritage ambassadors and maintenance teams to develop a sense of ownership and pride among residents, ensuring long-term commitment to preservation initiatives.

8.6 Leveraging digital and smart technologies

It might improve a proficiency approach to heritage management in terms of digitization. Heritage sites are monitored, analyzed for urban-growth patterns, and tracked for visitor movement via data analytics and GIS mapping, aiding in evidence-based decision-making. Instead of physical visits, virtual/augmented reality (VR/AR) experiences can sell global audiences to potential new revenue streams through online exhibitions and virtual tourism. Another aspect of creating a smart infrastructure around a specific site involves automated crowd management, adaptive lighting, and energy-efficient systems, all for a better experience during the visit while reducing environmental costs. All these digital tools are extensions to develop the heritage management framework of Karbala.

8.7 Building resilience to future crises

The sacred heritage sites must be able to withstand various crises, such as natural disasters, pandemics, and socio-economic disruptions. Having a contingency plan for crises is the best way to ensure that heritage-preservation activities continue without interruption in case of unforeseen eventualities. Heritage conservation also forms an important aspect in the integration of urban planning; the new infrastructure project should be provided in such a way that it complements heritage and does not disturb it. The structural reinforcements, emergency response frameworks, and adaptive reuse policies targeted at implementing disaster risk

reduction strategies will also go further in making the resilience of Karbala's historic urban fabric even better. Thus, this will enable Karbala to ensure the safeguarding of heritage and, at the same time, contribute to sustainable urban development.

8.8 Strengthening monitoring and evaluation mechanisms

Monitors and evaluates assurance frameworks are indispensable for weighing the effectiveness of implemented heritage management strategies. Research should then devote itself to the development of indicators that will assess the impacts of conservation programs, community participation, and economic sustainability. The application of GIS and remote sensing would enable real-time assessments of heritage sites, pinpoint any potential risks and allow proactive mitigation. Evaluation mechanisms should then be put in place so that any provisions remain flexible in response to new challenges as they emerge. A systematic approach to monitoring will aid in refining approaches to the heritage of Karbala over time, ensuring that management remains in a dynamic and forward-looking mode.

By making those recommendations comprehensive, Karbala will establish itself as a reference model for the sustainable urban heritage of sacred cities. Such an effort will require coordinated efforts from government authorities, cultural organizations, researchers, and the local community to get to an appropriate balance between preservation, urban development, and economic sustainability.

9. FUTURE RESEARCH DIRECTIONS

9.1 Comparative studies of sacred cities

Sacred cities like Mecca, Jerusalem, and Varanasi present other models upon which Karbala could reflect in facing similar challenges in terms of heritage management. Each of these cities is juxtaposed with intensifying complexities of urban expansion, heritage preservation, and tourism management issues. Therefore, these comparative studies enable scholars to tease out the best practices and innovative remedies already adopted with success elsewhere. Such studies may also divulge contrasts and gaps in the governance structure, mechanism of financing, and policy framework applicable in Karbala. Further, the socio-cultural dynamics within these cities could also typify the strategies best suited to Karbala's unique context.

9.2 Integration of AI in heritage management

The potential applications of AI tools in heritage management are manifold and may include predictive maintenance, optimizing the movement of visitors, and resource allocation management. Indeed, AI can make the processes more efficient through analysis of vast amounts of data to detect patterns linked to structural degradation to take necessary actions where needs arise. Additionally, machine learning algorithms can be used to enhance tourist experiences through predicting crowd behavior and suggesting alternatives to avoid congestion on a route. Moreover, conservation resource allocation could also benefit from AI-based decision-making models. Investigating the above applications in Karbala will set the stage for developing intelligent, data-driven conservation approaches, promoting sustainability, and having a long life.

9.3 Climate adaptation strategies

The historic sites of Karbala are threatened by climate change; hence, their adaptation needs to be specified. Rising temperatures, extreme weather events, and desertification present great risks to historic structures and urban landscapes. Therefore, research should focus on identifying vulnerabilities and quantifying the impact of climate-induced deterioration on built heritage. Sustainable conservation measures, including passive cooling, new materials, and green infrastructure, could lessen the impact. Also, working alongside climate scientists and conservationists could lead to the setting up of policies that interface between conserving heritage and the protective resilience of the environment to protect Karbala's historic fabric.

9.4 Community-centered governance models

Successful heritage management entails an inclusive governance framework and empowering the local communities. Indeed, many sacred cities have used participative models of governance that include residents together with religious authorities and policymakers in decision-making. By analyzing these frameworks, effective approaches may be discerned for Karbala that ensure heritage management meets community needs and aspirations. The research should, therefore, explore mechanisms to encourage co-decision, transparency, and sustained engagement. In this regard, electronic platforms and social media would also be worthy considerations for fostering public participation, raising awareness, and instilling the spirit of ownership of the city among the residents of Karbala.

9.5 Economic diversification through heritage tourism

Cultural and educational tourism can be strong mechanisms for economic diversification in sacred cities. With its historical and architectural heritage, Karbala can attract a larger audience than just religious visitors. Therefore, research could study the feasibility of any number of heritage-based tourism initiatives that include guided historical tours, museum enlargement, and cultural festivals. Comparative studies can identify the possible economic benefits of such initiatives in other sacred cities. Then, sustainable revenue-generating models, like working with local businesses and heritage-based entrepreneurship, can ensure that Karbala has a long-term development strategy without compromising cultural authenticity.

9.6 Long-term monitoring and evaluation

Establishing a strong framework for monitoring and evaluating heritage management strategies is essential for accountability and continuous improvement. Therefore, research must focus on developing key performance indicators that evaluate the effectiveness of conservation efforts, as well as community involvement and economic impact. Long-term monitoring will identify areas of deficiency in existing policies and support data-driven decision-making. Additionally, the mobilization of GIS and remote sensing technologies will strengthen tracking efforts with real-time assessments of urban

and architectural transformations. In this context, a systematic methodology to evaluate will guarantee that heritage management strategies continue to apply to the emerging changes confronting Karbala.

9.7 Resilience in post-crisis urban heritage

Crisis is indeed an integral part of sacred cities, be it conflict- or disaster-manifested or a consequence of socio-political instability. Therefore, urban heritage recovery models in post-crisis contexts could carry techniques for the improvement of Karbala. The research should, then, analyze how other cities have integrated the theoretical framework of resilience planning as to social, economic, and cultural dimensions into a holistic process of recovery. For instance, case studies from the successful restoration of the heritage site after devastation can guide funding mechanisms, stakeholder collaboration, and policy adaptations. By developing resilience-centered strategies, Karbala will strengthen its capacity to safeguard and restore its urban heritage against future crises.

Permeating each realm of the multidisciplinary effort to revive the urban heritage of Karbala governance reform, community engagement, economic diversification, and technological innovation is the need to address the challenges that arise from this study in constant cooperation with the local government, heritage experts, and the local community itself. Thus, by adopting this framework, Karbala could well set an international example for the sustainable management of urban heritage in sacred cities. Henceforth, future research must keep exploring different innovative frameworks and solutions, if only by adaptive means, so that Karbala may always be preserved in its rich spiritual and cultural legacy for all generations.

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