Tangible Heritage at Risk: Climate Change and Cultural Heritage in Iran

Synopsis of Monograph and Research Interests

*Postdoctoral Proposal for the Elahé Omidyar Mir-Djalali Institute of Iranian Studies*  
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Iran's tangible cultural heritage—including historic cities, ancient structures, water systems, religious monuments, and archaeological sites—represents a profound legacy of human creativity and resilience. Yet today, many of these irreplaceable assets face increasing threats not only from urban development and neglect, but from a far more insidious force: climate change.

This postdoctoral research proposes a systematic, data-driven investigation into how climate change is affecting tangible cultural heritage in Iran. Combining remote sensing, geospatial analysis, and climatological data, the study aims to develop a comprehensive vulnerability assessment of selected heritage sites across Iran, mapping both existing damage and future risk. The ultimate goal is to support policy, planning, and adaptive strategies for heritage protection in the face of accelerating environmental instability.

Research Objectives

This study is guided by four key objectives:

1. Identify and map major heritage sites in Iran vulnerable to climate-related risks (e.g., drought, flood, erosion, land subsidence, rising temperatures).
2. Analyze temporal-spatial patterns of environmental degradation around these sites using satellite imagery and climate data from 2000 to 2025.
3. Develop a Heritage Vulnerability Index (HVI) by integrating environmental, structural, and geographical indicators.
4. Provide data-driven recommendations for site management, prioritization of conservation efforts, and sustainable heritage policy design.

Background and Significance

Iran's diverse topography and climate have long shaped the development of unique architectural and infrastructural solutions: qanats in arid zones, mudbrick cities adapted to desert environments, and hydraulic engineering systems in the southwest. These features, while ingenious, are also highly sensitive to environmental shifts.

For example:

* Land subsidence due to overextraction of groundwater is damaging foundations in cities like Tehran, Isfahan, and Yazd.
* Desertification and wind erosion threaten historic structures in arid zones, especially in southeastern provinces.
* Flooding and erratic rainfall have increasingly damaged ancient bridges, bathhouses, and castles.

Despite mounting evidence of these threats, few comprehensive, data-driven assessments of climate risk to Iranian cultural heritage exist. Most conservation strategies remain reactive rather than preventive, and national heritage policies often lack integration with climate adaptation frameworks.

This project seeks to fill this critical gap by producing the first geospatial and quantitative model of climate-induced heritage vulnerability in Iran—situating Iran's challenges within broader global conversations on sustainability, cultural continuity, and environmental justice.

Theoretical and Conceptual Framework

The project draws on an interdisciplinary framework that integrates:

* Climate Risk and Resilience Theory: Focusing on vulnerability, exposure, and adaptive capacity of heritage assets.
* Geospatial Heritage Studies: Applying spatial technologies to analyze and manage heritage risk.
* Critical Heritage Theory: Understanding how environmental degradation intersects with social, cultural, and political narratives of loss, memory, and responsibility.

Concepts such as endangered heritage, resilient landscapes, and climate justice will be central to the analysis, offering not only technical insights but also ethical reflections on the cultural cost of environmental change.

Methodology (Quantitative and Geospatial)

This research employs a quantitative, GIS-based methodology divided into five phases:

1. Site Selection

A sample of 10–12 heritage sites will be chosen based on UNESCO registration, national significance, and ecological vulnerability. Likely sites include:

* Persepolis and Pasargadae
* Historic city of Yazd
* Hydraulic structures of Shushtar
* Isfahan’s bridges and riverfront
* Bam Citadel
* Ancient qanats in Kerman and Semnan provinces

2. Data Collection

* Satellite Imagery: Landsat 7/8, Sentinel-2, MODIS (2000–2025)
* Climate Data: Temperature, precipitation, soil moisture (from WorldClim, ERA5)
* Topographic and hydrological maps (SRTM, DEM)
* Land use/land cover (LULC) changes around heritage zones
* Subsidence and ground deformation via InSAR analysis

3. Spatial Analysis

* Time-series analysis to detect trends in vegetation loss (NDVI), urban encroachment (NDBI), water stress (NDWI), and surface temperature (LST).
* Overlay and buffer analysis to map risk zones surrounding heritage sites.
* Hotspot analysis to identify clusters of rapid environmental degradation.

4. Heritage Vulnerability Index (HVI)

A composite index will be created by assigning weights to each vulnerability factor (e.g., proximity to fault lines, erosion rate, frequency of temperature anomalies). Methods such as Analytic Hierarchy Process (AHP) or Principal Component Analysis (PCA) will be used to ensure rigorous weighting and validation.

5. Mapping and Visualization

GIS-based risk maps and dashboards will be produced for each site, illustrating:

* Levels of physical threat
* Change over time
* Priority zones for intervention

Relevance to the Elahé Omidyar Mir-Djalali Institute

This project aligns with the Elahé Omidyar Mir-Djalali Institute’s commitment to innovative, interdisciplinary, and globally engaged Iranian Studies. It brings together history, technology, environmental studies, and cultural policy, offering a rare fusion of tradition and modernity. As climate change continues to reshape global cultural landscapes, this project positions Iranian heritage as a crucial case study in the international dialogue on sustainability and memory.

Being in residence at the University of Toronto would enable access to advanced GIS labs, interdisciplinary expertise, and valuable mentorship, while providing a supportive environment to complete and publish this research. Additionally, it opens space for collaborative work on comparative heritage risks across West and Central Asia—a field in need of further scholarly attention.