



INFLUENCE OF CLIMATE ON COASTAL KARNATAKA TEMPLE ARCHITECTURE

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ABSTRACT :

This study explores the impact of the coastal climate of Karnataka on the architectural design and construction of temples in the region. Coastal Karnataka, characterized by its humid tropical climate, heavy monsoon rains, and high humidity levels, has shaped the structural features, materials, and artistic elements of its temple architecture. The research examines how temple builders adapted to these environmental conditions through innovative use of locally available materials, design techniques for rainwater management, ventilation, and durability against coastal weathering. By analyzing specific temples along the coast, this study highlights the interplay between climate and cultural expression, offering insights into the sustainable architectural practices developed by ancient craftsmen. Understanding this relationship enhances appreciation of the region's heritage and informs contemporary conservation efforts.



KEYWORDS : *Climate impact, coastal Karnataka, temple architecture, design adaptation, monsoon resilience.*

INTRODUCTION:

The coastal region of Karnataka, located along the Arabian Sea, is known for its distinctive temple architecture that reflects a harmonious blend of cultural heritage and environmental adaptation. The region experiences a tropical monsoon climate characterized by heavy rainfall, high humidity, and moderate to high temperatures throughout the year. These climatic conditions have played a crucial role in shaping the architectural style, materials, and construction techniques of temples in coastal Karnataka. Ancient builders and artisans demonstrated remarkable ingenuity by designing temples that could withstand the challenges posed by the coastal climate, such as water erosion, moisture damage, and salt-laden winds. Features such as sloping roofs, elevated plinths, intricate drainage systems, and the use of locally sourced durable materials are some examples of how climate influenced architectural decisions. This study aims to explore the ways in which the coastal climate affected temple architecture in this region, highlighting the sustainable practices embedded in these ancient structures and their significance in the preservation of cultural heritage. By examining key temples and architectural elements, this research sheds light on the interrelationship between environment and architecture and offers valuable lessons for modern conservation and sustainable design in similar climatic zones.

AIMS AND OBJECTIVES

Aim:

To investigate how the coastal climate of Karnataka has influenced the architectural design, construction techniques, and material selection of temples in the region.

Objectives:

1. To analyze the climatic characteristics of coastal Karnataka, including rainfall patterns, humidity, temperature, and coastal environmental factors.
2. To identify the architectural features in coastal Karnataka temples that reflect adaptation to the local climate.
3. To study the use of local materials and construction methods that enhance durability and resilience against coastal weather conditions.
4. To examine specific temples in coastal Karnataka as case studies demonstrating climate-responsive architecture.
5. To assess how these traditional architectural practices contribute to sustainable building and cultural preservation.
6. To provide recommendations for the conservation and restoration of coastal temples considering climatic challenges.

REVIEW OF LITERATURE

The relationship between climate and architecture has been widely studied across various regions, emphasizing how environmental factors shape building design and material use to enhance durability and comfort. In the context of coastal architecture, several scholars highlight the importance of adapting construction techniques to mitigate the effects of high humidity, heavy rainfall, and saline environments (Singh & Kumar, 2018; Rao, 2015). Specific to temple architecture, research has underscored the role of climate in influencing structural forms, roofing patterns, and ventilation methods. For instance, Hardy (2007) notes that sloping roofs and raised platforms are common features in temple constructions in high-rainfall regions, facilitating efficient water drainage and reducing moisture damage. Similarly, Michell (1995) discusses the use of local stone and wood in South Indian temples, selected for their availability and resistance to weathering. Studies focusing on the coastal Karnataka region have highlighted its unique climatic challenges and the corresponding architectural responses. According to Kulkarni (2013), temples along the Karnataka coast exhibit distinct features such as tiled roofs instead of stone slabs, open pillared halls for better airflow, and elaborate drainage systems. These adaptations reflect a conscious effort by ancient builders to harmonize temple design with environmental conditions.

Furthermore, research by Shetty (2019) emphasizes the cultural significance of temple architecture as a repository of traditional knowledge, including sustainable practices that have ensured the longevity of these structures despite harsh climatic conditions. Conservation studies (Nair & Bhat, 2020) advocate for integrating this indigenous wisdom with modern restoration techniques to preserve coastal temples effectively. While considerable work exists on South Indian temple architecture broadly, there remains a gap in comprehensive studies focusing exclusively on how coastal Karnataka's climate has shaped temple construction. This research aims to fill that gap by synthesizing climatic data with architectural analysis to deepen understanding of this interrelationship.

RESEARCH METHODOLOGY

1. Research Design

This study adopts a descriptive and exploratory research design to investigate how the coastal climate influences temple architecture in Karnataka. The approach combines both qualitative and quantitative methods to analyze architectural features and environmental data.

2. Data Collection Methods

Literature Review: Comprehensive analysis of existing scholarly articles, books, and reports on temple architecture, climatic conditions, and traditional construction techniques in coastal Karnataka. **Field Surveys:** On-site visits to selected coastal temples to observe and document architectural features, materials used, and structural adaptations to climate. **Interviews:** Semi-structured interviews with local historians, architects, temple authorities, and conservation experts to gain insights into traditional knowledge and climatic considerations in temple construction. **Climatic Data Collection:** Gathering meteorological data from official sources such as the Indian Meteorological Department (IMD) on rainfall, humidity, temperature, and coastal weather patterns for the region.

3. Sampling

Selection of Temples: Purposeful sampling of representative temples along the coastal Karnataka belt, based on historical significance, architectural diversity, and accessibility. **Participants for Interviews:** Selected experts and stakeholders with knowledge about temple architecture and local climate adaptations.

4. Data Analysis

Qualitative Analysis: Thematic analysis of interview transcripts and architectural observations to identify patterns of climate adaptation in temple design. **Statistical evaluation:** Statistical evaluation of climatic data to understand environmental pressures and their correlation with architectural features.

5. Tools and Techniques

Use of architectural photography, sketches, and measurement tools during field surveys. Software for data organization and thematic coding (e.g., NVivo for qualitative data). Meteorological data analysis using charts and graphs to interpret climatic trends.

STATEMENT OF THE PROBLEM

The temples of coastal Karnataka represent a rich cultural and architectural heritage that has evolved over centuries in response to the region's unique climatic conditions. However, despite the apparent influence of the coastal tropical climate—characterized by heavy monsoon rains, high humidity, and saline air—there is limited systematic research exploring how these environmental factors have shaped the design, materials, and construction techniques of these temples. This gap in understanding poses challenges for the effective conservation and restoration of coastal temples, many of which are increasingly vulnerable to weathering, structural damage, and material degradation. Without a clear comprehension of how climate historically influenced temple architecture, preservation efforts may overlook crucial adaptive features, potentially leading to inappropriate interventions that could further harm these heritage structures. Therefore, this study seeks to address the problem of insufficient knowledge regarding the specific ways in which climate has impacted coastal Karnataka temple architecture, with the goal of informing more sustainable conservation practices and deepening appreciation of the interplay between environment and cultural expression.

NEED OF THE STUDY

Coastal Karnataka's temple architecture is a vital part of India's cultural and historical legacy. These temples not only serve as places of worship but also as monuments showcasing ancient craftsmanship and sustainable architectural practices. However, the coastal climate—marked by heavy rainfall, humidity, and saline winds—poses significant challenges to the durability and preservation of these structures. There is a critical need to understand how ancient builders adapted temple design and construction techniques to withstand these climatic conditions. Such knowledge is essential for several reasons:

- 1. Preservation and Conservation:** Insight into climate-responsive architectural features can guide effective restoration and conservation efforts, ensuring the longevity of these heritage sites.
- 2. Sustainable Architecture:** Studying traditional climate adaptations provides valuable lessons for modern sustainable building practices, especially in regions facing similar environmental challenges.
- 3. Cultural Awareness:** Understanding the influence of climate on temple architecture deepens appreciation of the interplay between environment, culture, and technology in historical contexts.
- 4. Policy and Planning:** The study can inform policymakers and heritage authorities in formulating climate-sensitive preservation policies and resource allocation.

Given the increasing threats from climate change and environmental degradation, this research is timely and necessary to safeguard coastal Karnataka's temple heritage for future generations. Here are some ideas & directions for further research on how climate has influenced temple architecture in Coastal Karnataka. You can frame them as research questions, comparative case studies, or thematic investigations. If you want, I can also suggest sources / methods.

FURTHER RESEARCH DIRECTIONS

1. Detailed Comparative Case Studies by Temple Type and Material

Compare wooden-roofed temples ones in Coastal Karnataka with respect to damage over years
Chronological comparison: older temples vs restorations how have materials and techniques shifted (e.g. from timber and clay tile to concrete, steel)? Study temples in different coastal districts to see micro-climatic variation and corresponding architectural responses.

2. Quantitative-Architectural Analysis

Measure overhang depth, roof pitch, spacing and size of pillars/columns, thickness of walls, type/size of openings slope of flooring, drainage gradient, etc. Correlate these with local rainfall intensity, humidity, wind exposure. Thermal performance measurements: temperature inside vs outside, dampness, moisture ingress, drying times, etc., in different seasons .

3. Material-Science / Conservation Studies

Wood species used: types, durability, decay rate under humid monsoon conditions. Stone / laterite porosity, weathering under salty air, microbial/lichen/moss/fungal growth, influence of salt spray. Testing coatings that are traditional vs modern for weather resistance.

4. Rainwater Management & Drainage Systems

Mapping of rainwater harvesting features in temple complexes (tanks, step-wells, channelling of runoff). Examination of foundation design vis-à-vis runoff water, drainage around base of structures, and erosion control.

5. Orientation, Spatial Layout, and Ventilation

Study orientations of temple plans relative to prevailing monsoon winds, sun paths. Are there predictable patterns of orientation which minimize wind/rain exposure? Examine placement of mandapas, corridors, open halls for airflow to reduce humidity inside, especially during monsoon.

6. Mapping Changes Over Time

Use old photographs, drawings, inscriptions, colonial or pre-colonial records to see how architecture responded to past climatic extremes, versus what is happening now with more intense monsoons or changing patterns. GIS / remote sensing: land cover changes in hinterland affecting availability of timber and moisture regimes.

7. Climatic Data Correlation

Acquire site-specific climatic data: rainfall wind speed/direction, humidity, temperature, salt spray exposure (for temples very close to shoreline). Correlate with observed damage, structural changes, maintenance intervals.

8. Cultural / Artisanal Practices & Local Knowledge

Interview traditional architects / sthapathis / carpenters: what folk knowledge exists about choosing sites, materials, and detailing to cope with monsoon / wind / humidity. Ritual aspects: temple festivals during monsoon, maintenance practices, re-roofing or renewal cycles; how those are timed and what techniques are used.

9. Effects of climate change

Study whether there's an increase in maintenance demands, damage or wear, due to intensification of monsoon rain, sea level rise (for temples near coast), increased humidity, storm events. Projections: how might future climatic scenarios require changes in temple conservation, restoration and new temple design.

RESEARCH STATEMENT:

The temple architecture of Coastal Karnataka presents a unique synthesis of religious, cultural, and environmental responses shaped over centuries. This research investigates the extent to which climatic factors—particularly high monsoonal rainfall, humidity, coastal winds, and seasonal temperature variations—have influenced the design, material choice, construction techniques, and spatial organization of temples in this region. By examining architectural elements such as roof forms, overhangs, material weathering, drainage systems, and orientation, this study aims to identify climate-responsive features that distinguish coastal temple architecture from its inland counterparts. Furthermore, it explores how traditional building knowledge, local materials, and adaptive practices have evolved in response to environmental challenges, and how these strategies may inform sustainable architectural practices in the face of contemporary climate change. Through a combination of fieldwork, climatic data analysis, and comparative architectural study, this research contributes to a deeper understanding of the interplay between climate and sacred architecture in coastal South India.

SCOPE

This study focuses on examining how climatic conditions—particularly heavy rainfall, high humidity, coastal winds, and seasonal temperature variations—have influenced the architectural features of temples in the Coastal Karnataka region, which includes the districts of Uttara Kannada, Udupi, and Dakshina Kannada. The research will explore: Climate-responsive architectural elements such as roof forms, materials, drainage systems, spatial planning, and orientation. The use of local materials (timber, laterite, clay tiles, stone) and how their selection reflects climatic adaptation. A comparative analysis between selected temples in Coastal Karnataka and those in non-coastal regions (as control/reference).

The role of traditional knowledge systems and construction practices in managing the effects of the coastal climate. The impact of climate change and increasing weather extremes on the preservation and resilience of temple structures. The methodology includes field surveys, photographic documentation, architectural analysis, interviews with artisans and scholars, and the integration of historical climatic and conservation data.

LIMITATIONS

Geographical Focus: The research is limited to the coastal belt of Karnataka and does not cover the architectural responses in inland or plateau regions in detail. The study primarily focuses on

historical and early-modern temples. Contemporary temple construction may only be discussed for contrast or projection. Limited access to climatic and maintenance records specific to individual temple sites may restrict the depth of correlation between weather data and architectural degradation. Due to preservation regulations, temple activity, or logistical constraints, not all relevant temples may be surveyed on-site. While local craftsmanship and traditional knowledge will be included where possible, scientific testing of materials (e.g., decay rates, porosity) may be beyond the scope due to resource constraints. The study focuses primarily on climatic influences and does not deeply explore religious, symbolic, or ritualistic architectural determinants, though these may intersect with functional climate responses.

SCOPE OF STUDY

This study explores the relationship between the climatic conditions of Coastal Karnataka and the architectural features of temples located in this region, specifically within the districts of Uttara Kannada, Udupi, and Dakshina Kannada. The research aims to identify how environmental factors such as high rainfall, humidity, coastal winds, salt-laden air, and temperature variations have influenced structural design elements including roof forms, overhangs, plinth height, and orientation. Material choices such as timber, laterite stone, and clay roof tiles, and their suitability in a humid, monsoon-driven climate. Drainage and water management systems within temple precincts. Ventilation and spatial organization of sacred spaces in response to climatic comfort and durability. Traditional construction techniques and vernacular adaptations developed by local artisans and temple builders. The study involves field-based documentation, architectural analysis, climatic data review, and, where available, the oral histories and practices of temple architects and caretakers. It may also include a comparative framework with temples in inland Karnataka to highlight the distinctive adaptations to coastal climate.

DISCUSSION:

The temple architecture of Coastal Karnataka demonstrates a nuanced and adaptive response to the region's distinct climatic conditions, particularly its heavy monsoonal rainfall, high humidity, warm temperatures, and coastal winds. These environmental forces have played a defining role in shaping not just the aesthetic, but also the functional and structural aspects of temple design in this region. One of the most visible architectural adaptations is the steeply sloped, tiered roof forms often made with timber frameworks and covered with clay tiles, a feature designed to rapidly shed rainwater and reduce water stagnation. These sloped roofs frequently extend beyond the temple walls as projecting eaves or overhangs, offering protection to the walls, entrances, and devotees during heavy rainfall. Such features are particularly pronounced in comparison to temples in drier, inland parts of Karnataka, where flatter roof forms and more exposed layouts are common. Another climatic influence is observed in material selection. The abundance of laterite stone—a porous but locally available material—along with timber from nearby forests, has encouraged the use of both in temple construction. While laterite is easy to quarry and work with, it requires careful maintenance in high-moisture environments. The frequent use of lime plaster and slaked lime coatings serves both as a protective layer against dampness and as a traditional method of preventing fungal and moss growth due to persistent humidity. Ventilation and spatial planning are also closely tied to the climate. Open mandapas (pillared halls), wide verandahs, and perforated wooden or stone screens allow for natural cross-ventilation, which helps regulate interior humidity and temperature. The orientation of temples—often adjusted to minimize direct exposure to rain-bearing winds—reflects a deep integration of environmental understanding into spatial planning. Drainage systems within temple compounds further demonstrate climate adaptation. Elevated plinths, stone-paved courtyards with subtle gradients, and integrated water outlets are designed to divert rainwater and prevent waterlogging. Many temple complexes also include temple

tanks or ponds, which not only serve ritual purposes but also function as rainwater catchments and microclimatic stabilizers.

Over time, climate has also influenced maintenance cycles and conservation practices. Wooden components require regular treatment or replacement due to decay, and structures are often repainted or re-plastered at regular intervals to counteract moisture-related deterioration. Oral traditions and artisanal knowledge systems have preserved climate-adaptive techniques, such as specific wood joinery that resists swelling or cracking due to humidity. In recent decades, climate change has introduced new pressures. Increased rainfall intensity, saline intrusion from rising sea levels (in temples close to the coast), and changes in local ecosystems may challenge the long-term resilience of traditional materials and techniques. Modern restoration often introduces cement and synthetic materials, which may not always be compatible with the original climate-responsive logic of temple design. In conclusion, the architectural vocabulary of temples in Coastal Karnataka is a product of centuries of cultural ingenuity shaped by environmental necessity. Recognizing these climate-responsive strategies is critical not only for heritage conservation but also for inspiring sustainable architectural approaches in contemporary coastal development.

CONCLUSION:

The temple architecture of Coastal Karnataka offers compelling evidence of how built heritage can evolve in harmony with environmental conditions. The region's distinct climate—marked by heavy monsoon rains, high humidity, coastal winds, and warm temperatures—has significantly influenced the structural, material, and spatial characteristics of its temples.

Architectural features such as steeply sloped tiled roofs, projecting eaves, elevated plinths, and natural ventilation systems demonstrate an intentional and well-developed response to climatic challenges. The use of locally available materials like timber and laterite, along with protective treatments such as lime plastering, reflects a deep understanding of the climate's long-term impact on durability and maintenance. Traditional knowledge systems, embedded in both construction and upkeep, have played a vital role in ensuring the resilience of these temples over centuries. However, modern developments, environmental degradation, and the effects of climate change now pose new threats to their integrity. The increasing use of incompatible materials and the loss of indigenous building practices highlight the urgency for sustainable conservation approaches that respect the original climatic logic of these structures.

Ultimately, the architectural legacy of Coastal Karnataka temples stands as a testament to the potential of climate-adaptive design rooted in local context. Recognizing and preserving this relationship between climate and architecture is not only essential for cultural heritage, but also provides valuable insights for future architecture in similar environmental settings.

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