GIS AND REMOTE SENSING–BASED ANALYSIS OF ARCHAEOLOGICAL SITES MALINITHAN LOWER SIANG, ARUNACHAL PRADESH

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Keywords	Abstract
Arunachal Pradesh, Gis, Malinithan, Archaeological Sites, Gai Nadi.	Arunachal Pradesh, previously referred to as the North East Frontier Agency (NEFA), is a northeastern Indian state possessing a profound historical and archaeological legacy. Esteemed for its varied ethnic populations and distinctive geography, it encompasses significant locations like the archaeological site at Malinithan, established in the 13th–14th centuries CE. This location showcases a mediaeval temple adorned with sculptures of deities like Indra and Ganesh and is harmoniously situated within the local topography, particularly its closeness to the Brahmaputra plains and other waterways. Geographic Information Systems (GIS) enable the investigation of site distribution and environmental contexts, emphasising the impacts of terrain and

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	resources on ancient communities. The research highlights the significance of GIS in archaeological methodologies, underscoring its contribution to heritage preservation and planning, along with its capacity to clarify the cultural landscapes of Arunachal Pradesh.

1. INTRODUCTION

Arunachal Pradesh, once known as the North East Frontier Agency (NEFA), is a northeastern state of India that possesses a complex historical and archaeological history, reflecting centuries of cultural exchanges among indigenous communities, ancient kingdoms, and other Indian cultures (Bath & Babin, 2021; Sunwani, 2007). It is sometimes referred to by various names, including "the land of the rising sun" and "the land of dawn-lit mountains" (Mondal & Thungon, 2024). Positioned in the eastern Himalaya region, it features a varied topography of hills, plains, and river valleys, and contains notable architectural masterpieces like mediaeval temples, ancient forts, and archaeological sites (Yumi Nyori, 2026). It is the largest state in northeastern India, covering an area of 83,743 square kilometres. It shares its northern and northeastern boundaries with China, its eastern boundary with Myanmar, its western boundary with Bhutan, and its southern boundaries with the Indian states of Assam and Nagaland (Toku T Tada, 2025). The state hosts around 25 primary ethnic tribal groups and subgroups, each utilising their distinct languages and dialects.

This study analyses the historical site of Malinithan, exploring its history, material culture, and spatial dynamics through the application of Geographic Information Systems (GIS). Malinithan is a prominent archaeological site in the state. Malinithan is located in the Likabali town of the Lower Siang district of Arunachal Pradesh, comprising the remnants of a medieval temple complex believed to have been founded in the 13th–14th centuries CE by the Chutia monarchs (Balasubramanian, 2013; Behera; Thakur, 2008). The temple's sculpture programs feature characters like Indra, Surya, and Ganesh. The regional mythological connection to the legend of Krishna and Rukmini enhances its cultural narrative (Chetia, 2017; Oruganty, 2007). Malinithan's position in the foothills, overlooking the Brahmaputra plains, indicates a purposeful integration with significant natural corridors and regional networks.

Geographic Information Systems (GIS) help researchers delineate site distributions, evaluate environmental contexts, and understand spatial patterns, thereby offering perspectives on site selection, regional interdependence, and heritage conservation requirements. Remote sensing and GIS have unveiled new opportunities and potential for archaeology, as researchers can record these locations in a geographic database, which facilitates comparison studies across spatial and temporal dimensions and supports informed preservation planning (Argyrou & Agapiou, 2022; Lasaponara & Masini, 2011; Opitz & Herrmann, 2018). The application of satellites in archaeology is an emerging discipline where remotely sensed data have emerged as a prevalent instrument for the study, mapping, prediction, and forecasting of archaeological sites. The integration of spatial data with historical analysis yields enhanced understanding of archaeological sites (Forte & Campana, 2016).\

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2. LITERATURE REVIEW

2.1. M.C. Behera (2024)

Studying the folklore of our nation's communities highlights its essential function in linking, familiarising, and syncretising diverse cultural traditions in the establishment of a pluralistic India. In Arunachal Pradesh, he studies historical places and pilgrimage centres like Malinithan and their links with local communities through folklore. This study examines the legends linking the locations to the populations of Arunachal Pradesh and, consequently, to pan-Indian tradition, against a backdrop of empirical and theoretical postulates (Behera).

2.2. Maila Lama (2016)

The article investigated and analysed the integration of economic growth and environmental protection through tourism advancement in Arunachal Pradesh, a Himalayan state with significant tourism potential due to its location in the Eastern Himalayan ranges. The increasing influx of tourists in recent years clearly indicates its tourism potential. Archaeological locations are the main attraction for tourists. The study also analyses tourists' willingness to pay and the drivers of environmental conservation in the Himalayan state of Arunachal Pradesh (LAMA, 2016).

2.3. Rashmi Rekha Bhuyan and Nisha Rani Das (2023)

They found that the temple in Assam originated in the Gupta era; however, only a limited number of artefacts from that time remain. The ruins of Bamuni Hills are attributed to the Salastambha period, while the temple remains of Madan Kamdev originate from the Pala dynasty. They examine the recently uncovered temple plinth at Moiramora, adjacent to the Jokai Reserve Forest near Dibrugarh town, Assam, situated along the banks of the Dihing River. They used to visit the field and use multiple secondary sources and approaches (Bhuyan & Das).

2.4. Aled Rowlands, and Apostolos Sarris (2007)

They use GIS and remote sensing in the Itanos region of eastern Crete to evaluate their capacity for identifying both exposed and buried archaeological artefacts, as well as to delineate subsurface remains beyond the existing boundaries of ground geophysical data. This approach facilitates future targeted geophysical surveys and archaeological excavations. The study found that acquiring multi- or hyperspectral data at elevated spatial resolution is significant (Rowlands & Sarris, 2007).

2.5. Siart, C., et al. (2008)

They found that spatial analysis in geoarchaeological applications can be enhanced by using a broader array of geoecological characteristics to yield more accurate results. The study is trying to demonstrate how geoscientific ground truth and methodologies can be utilised for in-depth archaeological investigations by employing a thorough array of environmental variables that may have impacted ancient settlement patterns. They examine the spatial distribution of archaeological sites and Bronze Age communication routes in Central Crete using a multi-method approach, including surveying, remote sensing, DEM analysis, least-cost analysis, candidate site detection, and predictive modelling (Siart et al., 2008).

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2.6.   Nsanziyera, A.F., et al. (2018)

They study in a region renowned for being one of the most archaeologically affluent, featuring numerous monuments, which is Morocco. Several of the locations have been designated as UNESCO World Heritage sites. They discovered that modern technologies, particularly GIS and remote sensing, are becoming more widely accepted as tools for forecasting at archaeological sites. They try to find and evaluate the use of GIS and remote sensing to create a predictive model for identifying regions with significant archaeological potential in the Awsard area of southern Morocco (Nsanziyera et al., 2018).

3. METHODOLOGY

3.1.   Study area

The study area, Malinithan Temple, is located at Likabali in the Lower Siang area of Arunachal Pradesh, India (Figure 1). It is a significant archaeological, historical, and cultural heritage site located near the foothill zone of the Eastern Himalayas. The research area serves as a transitional landscape between the hilly region of Arunachal Pradesh and the alluvial plains of Assam, with its southern boundary next to Assam. The region is mostly populated by the Galo tribe, a significant indigenous community of Arunachal Pradesh, whose traditional livelihoods, belief systems, and cultural expressions are intricately connected to the surrounding natural environment. The region boasts undulating terrain, extensive forestation, fertile valleys, and a humid subtropical climate with substantial precipitation, all of which contribute to its biodiversity and ecological significance.
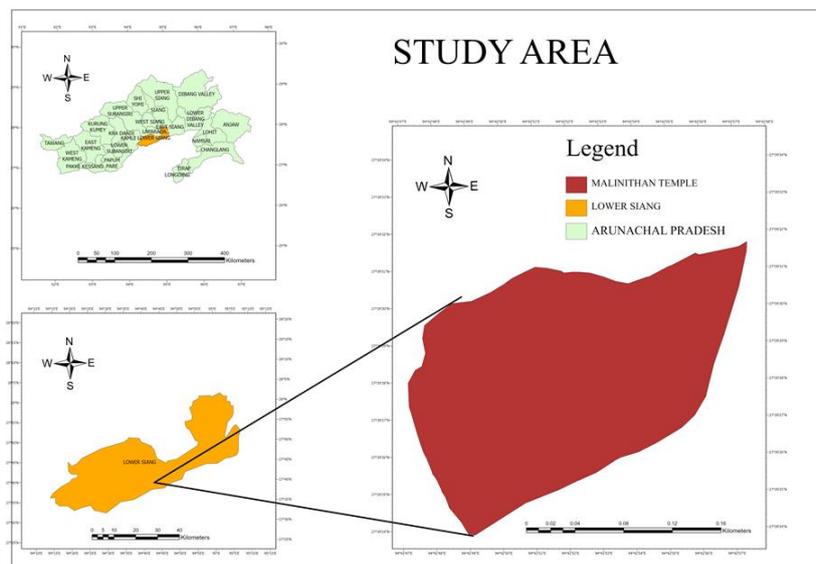
Figure 1: Map and location of the study area.

3.2.   Data collection

Historical and Archaeological Data: Gather published literature, governmental records, and archaeological reports to understand the history of sites.

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Geographic Coordinates and Spatial Data: Retrieve location coordinates and attributes from trusted sources, satellite photos, and published datasets.

Environmental Layers: Incorporate digital elevation models (DEMs), and land cover data from open GIS repositories. A 1 arc-second SRTM DEM image with a spatial resolution of 30 meters was obtained from the United States Geological Survey (USGS) website at http://earthexplorer.usgs.gov/.

3.3. GIS database creation

Establish a GIS database in ArcGIS by importing coordinates and attribute tables for each site. Integrate environmental layers (elevation, water networks) to assess terrain influence on site locations.

3.4. Spatial and Thematic Analysis

Topographic Analysis: Evaluate elevation relationships to understand site placement relative to strategic terrain features.

4. RESULT AND DISCUSSION

Using GIS, we analysed these historical sites, which reveals how terrain and regional connectivity influenced ancient settlement decisions. The study area is tiny, as some parts of it are encroached upon by the people living around it due to a lack of proper studies and demarcation. The investigation reveals that the Malinithan temple covers only a tiny portion of the study area. It is situated at the foothills, as shown in Figure 1. The study area is also located in between two small rivers, which are the Gai Nadi and Goghar rivers, as shown in Figure 2 and 3. This evidence indicates that the rivers also play an important role in the establishment of this temple.

The DEM map is illustrated in Figure 4. The town where the temple is located does not have a particularly high elevation. Because it is closest to Assam, this area has a significant number of devotees from Assam. Spatial analysis elucidates common features, such as elevated platforms for defence and visibility, accessibility to resource networks, and proximity to river systems that provide water for agriculture and domestic consumption.
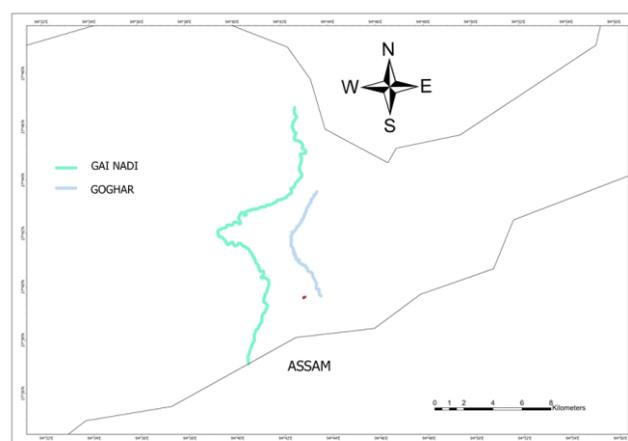
Figure 2: Gai Nadi and Goghar rivers basin map.

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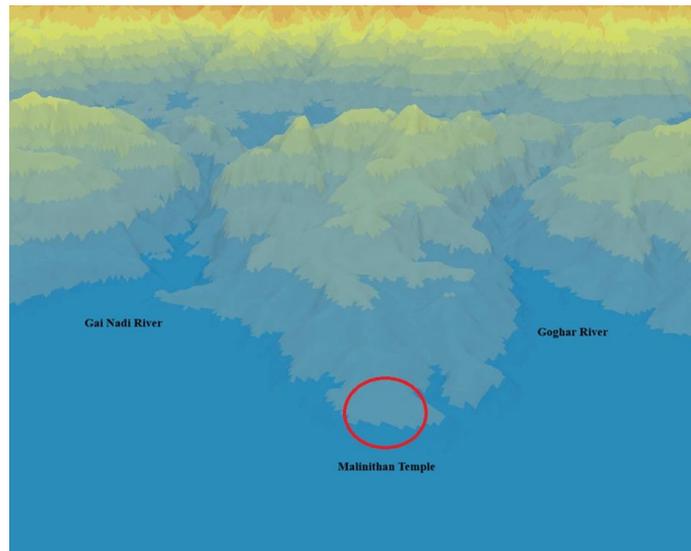

Figure 3: Map of Malinithan Temple, Gai Nadi and Goghar rivers in 3D.

GIS also aids in identifying spatial vulnerabilities and conservation concerns because these sites face pressures from urban expansion, agricultural use, and environmental change. This fusion enhances scholarly understanding and supports heritage practitioners in planning preservation measures and inclusive storytelling.

5. CONCLUSION

The historical site of Malinithan exemplifies the intricate heritage of Arunachal Pradesh, encompassing temple complexes and walled urban towns. GIS provides a robust analytical framework for documenting, analysing, and understanding these sites within their spatial and environmental contexts. The amalgamation of spatial data with historical analysis yields profound insights into cultural landscapes and furnishes practical instruments for heritage conservation, delineation of historical locations, and sustainable site management.
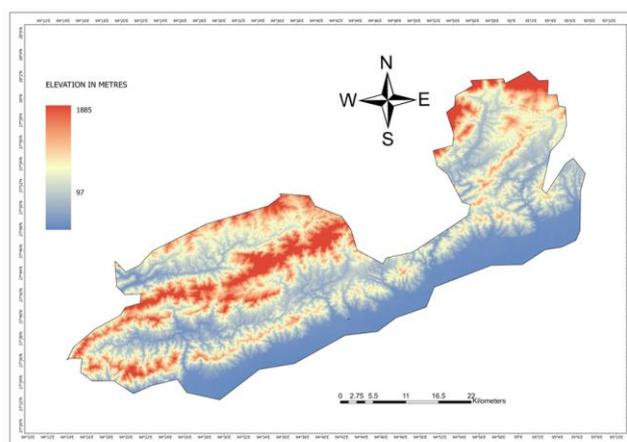
Figure 4: Digital elevation map of the Lower Siang District.

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6. AUTHOR(S) CONTRIBUTION

The writers affirm that they have no connections to, or engagement with, any group or body that provides financial or non-financial assistance for the topics or resources covered in this manuscript.

7. CONFLICTS OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

8. PLAGIARISM POLICY

All authors declare that any kind of violation of plagiarism, copyright and ethical matters will take care by all authors. Journal and editors are not liable for aforesaid matters.

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